Digital Imaging: its current and future influence upon the creative practice of textile and surface pattern designers

by

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Declaration

This work has not previously been accepted in substance for any degree and is not being concurrently submitted in candidature for any degree.

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Statement 1

This thesis is the result of my own investigation, except where otherwise stated. Other sources are acknowledged by footnotes giving explicit references.

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To my Dad, Dennis O'Donnell,
who taught me to have an enquiring mind and to value communicating with others

and to my Mum, Jean O'Donnell,
who always believed in me
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Abstract

This thesis describes research into the impact of digital imaging technology on the creative practice of artists and designers in the field of printed surface pattern for textiles. It examines how digital tools support creative thinking and enhance innovation through the visualisation, manipulation and communication of imagery, and assesses the role and importance of memory and physical experience in creative digital practice. Recent developments in digital ink-jet printing technology now enable practitioners to translate digital imagery directly onto textiles. The research provides evidence to assist future technological development, and effective design strategies are identified for implementation within creative textile practice.

A contextual review, informed by visits to practitioners, industry and education, and a critical review of published literature, identifies key issues examined in the research. These include the ways in which digital technology supports creative thinking and how communication of visual data facilitates collaborative practice. The rationale for the use of qualitative research methods in the project is explained. A case study, documented using video and audio recordings of interviews, and photography and research journals to gather data on site, is described. Practical investigations, emanating from the field study visits, and an independent experimental body of work created by the researcher, provide additional data to elucidate how digital tools support creative practice. The findings are informed by feedback and evaluation from telephone conversations and personal correspondence from the participants, along with analysis of the research data.

Digital tools are shown to support creative thinking, providing a means of stimulating, manipulating, and outputting printed digital imagery. The collaborative investigations demonstrate how communication of visual imagery, via the Internet and portable digital memory storage media, is able to enhance creative practice. Recommendations are also made for future research in areas including colour communication, 3D printing and flexible textile displays.
1. Introduction

1.1 Digital imaging and printed textile practice

'This is a significant moment in the study of textiles. Radically new technologies are emerging that change both our notions of textile production and our ways of understanding textiles'

(Jeffries and Zimmer 2000, p.1)

Digital imaging technology is widely used for product development by the printed textile industry and increasingly amongst practitioners who produce freelance design and textile art¹ (Braddock and O'Mahony 2005). It impacts upon both the textile practitioners' working process and creative output² (Stevens 2002). The Internet enables rapid communication of visual design data, reducing product development time and speeding up the time to market cycle (Crawford 2003). Recent developments in textile ink-jet printing have accelerated the implementation and integration of digital imaging technology within textile practice and are providing effective methods of translating pattern and image onto cloth (Campbell 2005). Although computers have been used in industry for several decades to prepare artwork⁴ for printed textile manufacture, it has not been possible to print digital images directly onto fabric without substantial modification to accommodate the analogue process⁵. None of these production constraints exist in the digital ink-jet print process: the full width of the cloth can be printed in millions of colours; there is no imperative for repeat (Briggs and Bunce 1995).

These developments in technology, affecting the process of design origination through to the final production of printed textiles, can be expected to impact upon practitioners' working methods and the tools they use. The ways in which digital tools affect the creation and subsequent rendition of pattern and image on cloth, and their influence on the practitioners' working process are issues to be investigated through this research. Polvynen contends that 'digital printing has expanded the

¹ 'As reductions in the cost of computers and Internet services continue to trickle down, they are becoming more widely used, supplementing and even replacing the paintbrush as the designers main tool'. Braddock, S. and O'Mahony, M. (2005, p.34). Techno Textiles 2: revolutionary fabrics for fashion and design. London, Thames & Hudson.

² In the context of this thesis the term 'textile practitioner' is used to describe artists and designers working in the medium of textiles.


⁴ This includes colour reduction, modification of pattern into repeating units and subsequent colour separations.

⁵ See Chapter 2 section 2.2.2 and 2.3.1.
parameters for design limitations' (Polvinen 2005, p.50). Designs can now be translated onto printed products that exhibit increased colour range, flexibility in scale, image making and repeat. Stevens asserts that 'digital technologies not only make new design possible, the equipment itself stimulates the artists' creative thinking' (Stevens 2002 p.2). This raises questions about the ways in which practice may be influenced and at what stages in the creative process; whether the technology affects the initial stage of idea generation or is confined to the production process, and how the digital practitioners' creative motivation and practice is affected by technology.

Braddock and O'Mahony state that digital technology has greatly changed the look of textiles (Braddock and O'Mahony 2005) but to date, there has been little research to explain what change may result in terms of the visual characteristics of the printed output or the role of the technology in this process. Computer aided design systems and software have made redundant many of the hand rendering skills required in the traditional production of printed textiles; this poses new questions concerning the effect of physical tool use on creative thought and the ways digital tools compare with traditional implements and media in this process. Many practitioners find that making by hand stimulates their creative thinking and physical manipulation enhances imaginative thought (Harris 2005).

The ease with which digital images can now be communicated has implications for collaborative working methods. Fischer states that 'much of our intelligence and creativity results from interaction and collaboration with other individuals' (Fischer 2005 p.71). Therefore, the use of the Internet, and the facility to share imagery using portable digital storage media, has the potential to enhance creative practice through collaboration, in ways not previously available. Research into how this may be achieved using digital technology as an integral part of the creative process, is likely to yield insight into both digital tool use and creative practice (Edmonds, Weakley et al. 2005).

1.2 Rationale and scope of the research

To date there has been relatively little published research, within the domain, to explain the ways in which digital practice impacts on the creative process. Campbell contends that these changes in textile 'design and production methods, and in future products, need to be addressed by both design researchers and practicing designers' (Campbell 2005 p.1). Although there has been significant research concerning digital ink-jet printing and textile production methods, there has been little detailed investigation into how technology impacts on design innovation. Resnick, 6 CD, DVD, flash storage etc.

6 CD, DVD, flash storage etc.

Chapter 1

Introduction

Myers et al. (2005) state that human computer interaction research indicates the importance of empirical investigations into creative computer use, to illuminate the nature of creativity and develop computer tools that are able to support it. Further understanding of creative digital textile processes will add to this body of knowledge and inform the development of design software, interface design and computer hardware.

Briggs and Bunce (2001) contend that the advent of digital ink-jet printing poses a number of challenges for designers of the future. Designers are now able to create concepts that capitalise on the expanded parameters available using the technology (Bunce 2005). Industry will require designers with expertise, trained and educated to exploit the possibilities. Research that reveals the current potential of digital imaging in printed textile practice will help to identify possible future developments, challenging existing thinking about how textiles of the future may be designed, and suggesting new paradigms for practice and production.

Polvinen (2005 p.38) argues that collaborative working methods, using the Internet, 'is where the technology driven global industry of apparel/textiles is rapidly moving today.' Examination of the impact of digital collaboration on the creative process, facilitates insight into the ways in which digital tools and communications systems, may support and enhance distributed creative practice.

This project focuses upon the use of digital imaging to develop concepts for printed textiles. Although digital technology is used in a wide range of textile practices, including jacquard weaving, computer-assisted knitting, and machine embroidery, this study has been confined to an investigation into the ways in which it is able to support the development of concepts for printed surface. The creative process is examined from idea generation to printed output, focusing on the impact of the technology on the creative elements of practice rather than methods of industrial printed textile production. It also examines how digital tools support creative cognition and therefore is informed by recent studies of creativity in psychology, including research work described by Amabile (1996), Csikszentmihalyi (1996), Gardner (1985, 1993), Smith, Ward et al. (1995), Sternberg (1988) and Candy and Edmonds (2002).

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8 'While it is difficult to study 'creativity' itself, we can study the process by which creative people and teams work, and embody their best practices in tools that can aid others in emulating those processes.' Resnick, M., B. Myers, et al. (2005). Design principles for tools to support creative thinking. Washington, D.C., National Science Foundation p.2.


10 Bunce states that textile ink-jet printing 'has removed the practical necessity of using traditional forms of repeat to cover a fabric length.' Bunce, G. (2005). Digital Print: to repeat or not to repeat. Creativity: Designer meets technology 2, KRIDT Denmark, KRIDT, p.1.

Chapter 1 Introduction

1.3 Aim

The aim of this investigation is to examine the ways in which digital imaging is impacting upon the creative practice of artists and designers, working in the field of surface pattern for printed textiles. Analysis of the findings from this study is intended to inform the development of effective strategies for the innovative exploitation of this technology.

1.4 Objectives

To critically review and analyse recent work within the field of inquiry, undertaken by other researchers, practitioners and industry, to gain an understanding of the field and contextually situate the study.

To identify key textile practitioners, reflecting some of the diversity in practice within the field, and document and analyse the creative strategies used in their textile practice.

To examine the impact of digital imaging within these creative strategies and to interrogate the findings through a series of practical collaborative investigations.

To use the insights revealed in all strands of the project to inform the researcher’s own creative practice, enabling the exploration and development of effective strategies for the digital generation, manipulation and output of surface imagery for printed textiles.

To identify and evaluate the effectiveness of these strategies in peer review following conference presentations and publication of papers12 as well as the exhibition of artefacts, resulting from practical investigations.

To set out in this thesis a full account of the project, including findings and proposals for future research.

1.5 Approach

Edmonds et al. contend that research methodologies for studying the creative process should be able to combine the rigour of the laboratory study with the realism of a residency experience (Edmonds, Weakley et al. 2005). Their recent research findings advocate the concept of ‘the studio as laboratory’ (Ibid p.454) in which a combination of research and practice can be successful in generating both research results and creative artefacts13. This practice-based approach to research

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12 These can be found in Appendix C

provides the opportunity to examine, qualitatively, the complex variables inherent in human centred action in which experience, and the product of that experience, can be analysed (Candy and Edmonds 2002).

Thus this investigation examines and theorises practice within the field of inquiry, through contextual review and case study, and uses the researcher's own practice as a vehicle to explore, analyse and evaluate new ways of working.

1.6 Presentation of the research

This thesis describes the research in seven chapters. Chapter 2 presents a contextual review, to situate the project within the field of inquiry, informed by visits to industry, academia and individual practitioners using digital imaging in their creative practice. The chapter also includes a critical review of published literature within the domain and an overview of recent research into the psychology of creativity, providing the theoretical framework for the subsequent investigation.

Chapter 3 presents the research methodology used to gather and analyse data in the case study and investigations. The case study is described in detail in Chapter 4, presenting three field study reports used to inform it, describing observations of the practice of two textile artists and an industry based textile designer.

The investigations described in Chapter 5, are informed by the field study experience, drawing on visual data gathered during the visits and collaborative work with the practitioners from the case study. The final section in this chapter describes a body of experimental work pursued independently by the researcher. Additional investigations, which are not included in this chapter, can be found in Appendix B sections B5-B8.

The analysis of data from the case study and investigations is synthesised in Chapter 6, which discusses the findings, making an interpretation guided by creativity theory outlined in Chapter 2.

Chapter 7 sets out implications of the findings and makes recommendations for further research. It also discusses areas of current related research likely to impact upon the field and proposes effective strategies for implementing the findings in professional practice.

Appendix A contains the case study protocol and related information including interview questions.

Appendix B contains questionnaires providing evaluation of the collaborative investigations and material describing additional practical investigations, which broadly inform the research findings but which were not selected for inclusion in Chapter 5.
Appendix C contains four published papers, which were informed by findings at various stages of this research and are cited in the thesis.
Chapter 2

2. Literature and Contextual Review

2.1 Introduction

This chapter provides a contextual review of the use by the textile industry, individual practitioners, and academia, of digital imaging technology for the development of printed surface design. Review of relevant published material in the English language and recent field visits to countries in Europe, China and the USA have informed this chapter.

2.1.1 Methodology of literature review

The literature review focused specifically on published material directly related to the field of digital design for printed textiles, along with any papers that referenced research into design for textile digital ink-jet printing and digital working methods for textile designers\textsuperscript{14}. Related textile fields, such as weave, knit, and non-woven design were excluded from the search, to enable the study to focus specifically on the issues directly related to designing pattern and images for printed textile surface. Texts related to digital design for textiles and digital ink-jet printing published prior to 1994 were not considered as being recent enough for inclusion, due to rapid technological development in the field. Literature published prior to this was considered useful only in related areas, such as design development and use of computers as a tool in the design process.

Much of the published literature on digital ink-jet printing is of a technical nature and is concerned with the issues of print head development, dye chemistry, fibre technology and textile processing. It was considered outside the scope of this project to include these areas of current research, except where developments were likely to impact on creative practice or digital design working processes. Publications relating to computer science and digital processing were also deemed beyond the scope of this project, particularly since the field is vast and rapidly changing. Literature concerning digital tool use and human computer interaction has been sought, where there is a direct relationship to creativity or manipulation of visual data.

The review of literature was extended to seek texts able to provide insights into current discourses concerning the psychology of creativity, to illuminate the phenomenon of the creative digital process.

\textsuperscript{14} Guidance for the methodology used in this literature review was found in Murray (2002) and Webster and Watson (2002).
Chapter 2 Literature and Contextual Review

Some of the most useful information gathered for this review has been gained from attending conferences, visiting practitioners and industry. Networking and discussion forums\(^{15}\) have provided useful avenues for exploration and have extended understanding of the research subject and related disciplines. Exhibitions, trade fairs and exhibition catalogues have also been useful sources of visual and written information, as have conferences and publications from societies and professional associations\(^ {16} \).

2.2 Context — a review of the field

2.2.1 Scope of the review

Three key areas were identified for investigation from a range of situations in which digital imaging technology is being used in creative textile practice. These included industry, individual practitioners and education. Companies producing textile designs and digitally printed fabric were visited as were practitioners working as designers for industry and artists making textile artefacts for commission and exhibition.

Visits were made to industry, practitioners and Higher Education institutions in the USA, Hong Kong, China, Belgium, France, Germany and the UK in the course of this review, providing a global perspective of the field.

2.2.2 Industry

Textile digital print technology has begun to be embraced by industry for its economic advantages in pre-print production, sampling and prototyping (Byrne 2004). Digital ink-jet printers have not yet displaced rotary engraved screen-printing for manufacture due to their relative slow printing speeds, lack of speciality colours, and care properties\(^ {17} \) (Ibid), (Dehghani 2004). Nevertheless, recent technological developments in ink-jet printers, indicate that mass-production print speeds can now be matched in the most advanced models\(^ {18} \) and it is expected that both the economic and environmental\(^ {19} \) benefits of digital printing will encourage greater investment in the technology\(^ {20} \).

\(^{15}\) The Joint Information Systems Committee (JISC) PhD Design JISC List and Digital Textile JISC List http://www.jiscmail.ac.uk/lists/phd-design.html (acc.05.03.06)

\(^{16}\) Society of Dyers and Colourists, Textile Institute, Computer Integrated Textile Design Association, Surface Design Association

\(^{17}\) These include light fastness, wear and laundering properties. Byrne (2004) writes, "digital textiles have met with much slower acceptance in the textile decoration market. This is partly for technical and cost reasons—inks/preparation/finishing processes that will stand up to the full rigours of wear and laundering, whilst leaving the handle of the fabric essentially unaffected." Byrne, C. (2004). "Segmenting the digital textile market." Digital Textile 1(3).

\(^{18}\) For example the DuPont Artistri http://www.dupont.com/inkjet/en/artistri/index.html (acc.05.03.06)

\(^{19}\) Digital ink jet printing is environmentally friendly since there is very little waste colour produced.
(Potz 2002). Some companies have begun to use completely digital printed textile manufacturing processes. Elanbach21, a Welsh based printed textile company, has a manufacturing process that is digital in most stages, from pre-production pattern and colour preparation, to the final printed product (Swengely 2002). In Belgium, S.print NV, Color-Web GmbH in Germany and First to Print (based in New York and Los Angeles, USA) offer a similar digital manufacturing process. Many companies in China are also investing heavily in production speed digital ink-jet print technology and, in 2004, was the largest market for potential sales of digital print machinery in the world22 (Treadaway 2004b).

Many bureau facilities, offering digitally printed textile solutions on a short print run 'pay as you go' basis, are beginning to emerge. In the UK some of these are located within universities23 and others have been established as businesses that can offer specialised printing on a variety of substrates for industry, retail and individual consumers24.

Despite advances in digital ink-jet technology, much of the printed textile industry, worldwide, continues to use analogue print manufacture methods25 (Byrne 2004). Design development and pre-print preparation however, has become increasingly digitally based (Crawford 2000). Many companies develop artwork, either in-house or via design agencies, using computer-aided design, putting designs into repeat and producing digital colour separations for conventional rotary engraved screen-printing. The advantage of the digital working method is the speed with which colours can be altered, sizes changed and separations made for stencils (Griffin 1999). During visits to companies in New York26, in-house designers were observed working closely with garment design and marketing teams, creating production ready artwork to be manufactured in factory sites in the Far East. The ease with which digital design files can be communicated using the Internet, along with economic factors involving the reduction of production costs, has led to the growth of outsourcing and collaborative manufacturing. Businesses in Hong Kong frequently operate as a

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20 The International Textile Machinery Association (ITMA) 2003 trade fair in Birmingham provided a platform for a number of companies that manufacture and distribute textile digital ink-jet printers to trade globally. Most machines are manufactured under licence from Japanese companies who have been at the forefront of technical developments in the field; the most widely used of these are Mimaki, Epson, DuPont, Stork and Encad printers.

21 http://elanbach.com visited March 2003

22 Information provided by Anita Leung, IATC Shanghai, visited July 2004

23 Centre for Advanced Textiles at Glasgow School of Art and the University of East London offer bureau facilities for digitally printed textiles.

24 Example of commercial fabric digital printing bureaus in the U.K.: http://www.quantumclothing.com (acc.05.03.06) www.rasmart.co.uk (acc.05.03.06)

25 Digital methods accounted for less than 0.5% of the market in 2004

26 Liz Claiborne Inc., the Gap Inc. and Banana Republic Inc. visited May 2004
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bridge between textile and fashion companies in the west and manufacturing sites based in China (Treadaway 2004b). Intermediary companies in Hong Kong receive CAD files, via the Internet, from design studios in the USA and Europe, and digitally printed garment prototypes are produced for marketing and sales teams from the retail industry around the world27. Once orders are placed, the printed designs are then mass manufactured in factories in China, using rotary engraved screen-printing processes; advances in production speed digital ink-jet print manufacturing technology suggest that it may soon supersede analogue methods28.

The capacity to communicate accurate colour in design data is imperative and has become a major focus of commercial and academic research29. The variables in sending colour information between computers and printers are many and complex and are discussed in detail in section 2.3.1.3. Sharing of design data between designers, workstations, printers, and the use of a variety of substrates, dyes, fabric pre-treatment and finishing processes, increase the range and complexity of these colour issues (Dawson 2001). Research is currently underway to engage with these issues through the provision of a global digital colour communication standard. The aim is to provide accuracy of spectral data that can be used in software to provide a universal language of colour30. A number of companies offer colour management solutions to business. These include software applications that enable colour calibration of colour data from spectrophotometer input, monitor and printer calibration, colour libraries, spectral and colorimetric displays and accurate colour communication.

The growth in the number of companies now using digital imaging for design development and pre-print production32 has led to an increase in dedicated textile software providers33. Many of the commercial software packages include fashion design, lay planning, garment construction management, merchandise visualisation, and textile design, in an integrated suite (Townsend

27 Orient Forest, Kowloon, is an example of a company, visited in Hong Kong, operating as a bridge between Gap in USA and a printed textile manufacturing site in China

28 Information from Lectra, Hong Kong and Orient Forest, Kowloon, Hong Kong, visited July 2004

29 The implication of colour management and transfer of digital data was the subject of the Society of Dyers and Colourists 'Colour Communication Conference'. Birmingham, UK. September 2003. http://www.sdc.org.uk/members/conferences.htm (acc.05.03.06)

30 Research is being undertaken by the Society of Dyers and Colourists in conjunction with the American Textile Chemists and Colourists Committee C2C (Communications Subcommittee-Electronic Standards Sub Committee)

31Pantone  www.pantone.com  Datacolor www.datacolor.com eWarna  www.ewarna.com Digieye Plc www.digieyeplc.com (acc.05.03.06)

32 Colour reduction and manipulation of designs into repeat structures to accommodate production constraints.

33 Companies include Lectra www.lectra.com (Kalido Style, U-4ia); Options Systems Ltd. www.styleman.com (Styleit Texpro); and Blue Fox NedGraphics www.nedgraphics.com (acc.05.03.06)
Software solutions of this kind enable companies to integrate design, manufacture and marketing personnel in the development of new products, even when they work in different geographic locations. Using the Internet and secure websites, design data can be communicated to suppliers, retail outlets and dye houses, ensuring consistency across the product range and reducing the *time to market* cycle. The expansion of Internet shopping is likely to lead to greater consumer involvement in product design (Atkinson 2004) and the production of mass customised textile products34 (Campbell 2005). The digital communication of design imagery is vital in these developing markets.

The increasing use of digital ink-jet printing and digital imaging technology has already begun to influence the type of design work industry requires. Some textile designers are using digitally printed fabric swatches, and patterns engineered into product shape, to display their surface pattern designs35. Those companies who digitally manufacture printed textiles are demanding designs that will exploit the potential of digital design, stating a preference for employing younger designers whose work appears less constrained by the conventions of analogue printing, such as reduced flattened colours and repeat36.

### 2.2.3 Individual textile practitioners

Freelance textile designers, producing artwork for the printed textile industry, are increasingly using digital imaging at some stage in their creative work. The integration of digital skills into textile design courses in Higher Education in the UK has resulted in many recent graduates who are able to incorporate new technologies in their working method (Kavanagh 2004)37. Although computer use by freelance textile designers at the beginning of the century was mainly limited to administration, business and communication (Jenkyn Jones and Parish 1999), visits to recent UK graduate exhibitions and international trade events38 suggests that the technology is increasingly being used as a creative tool.

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34 See section 7.4.3
35 Those exhibiting textile designers interviewed at Indigo, Premiere Vision, Paris in March 2005 stated that manufacturers expressed a preference to seeing work on cloth rather than paper.
36 Information supplied by Color-Web GmbH, at Flanders Textile Valley Xpo, Kortrijk, Belgium, September 2005
2.2.3.1 Fashion textiles

Access to commercial digital print bureaus has enabled independent designers to create fabric samples of their designs and produce short run bespoke products for sale or commission. Textile artists and craft practitioners are now able to incorporate digitally printed textiles in their work and use digital imaging technology to extend their visual language and narrative (Isaacs 2003). Issey Miyake, Julian Roberts and Hussein Chalayan\(^{39}\) are among a growing number of fashion designers who have explored the potential of digital imaging and ink-jet printing in the development of their work (Quinn 2002). Frequently working collaboratively with textile designers\(^{40}\), they create garments that integrate surface pattern into the shape of their designs (O'Mahony and Braddock 2000-2001).

Rebecca Earley, who has designed fabrics for Chalayan, has developed a digital working method that combines the use of digital collage with dye sublimation as well as ink-jet printing. Her concern for environmental issues has fuelled her interest in exhaustive printing techniques, and sustainable fashion. In her ‘Top 100’ project she used recycled polyester garments (Fig. 2.1), creating surface pattern using dye sublimation and photogram resist processes\(^{41}\). Earley uses ‘technology for motivation and inspiration over and above materials and techniques’\(^{42}\) (Greenhalgh 2002, p.44), describing her use of the computer as ‘a massive scrapbook’, facilitating collation of new imagery and ideas\(^{43}\). Using a digital camera and scanner to input visual data, she layers and manipulates imagery within garment shapes to build concepts prior to printing.

\(^{39}\) Pixel Print Dress 1997 designed in collaboration with Eley Kishimoto


\(^{43}\) Interviewed by the researcher at Chelsea College of Art, October 2003
Fashion designer Hamish Morrow is extending the boundaries of digital imaging for apparel surface pattern. Working with Philip Delamore, Warren Du Preez and Nick Thornton Jones, his Spring/Summer collection 2004 contained clothes that were presented as a blank canvas onto which a pattern was projected creating ‘the print as a virtual print which existed only in the moment’ (Delamore 2005). Designs were created by capturing the models on the catwalk, using a motion sensor and software filter to process the visual information; the abstracted patterns were then projected back onto the garment surface. Customers selected from a series of stills of the projected images, which were subsequently ‘printed onto fabric and assembled as an unique numbered piece’ (Ibid). In a second project, for Autumn/Winter 2004, Morrow worked collaboratively with Philip Delamore and Clive Ford, to create printed textiles derived from images created by visually expressing forces and stresses inherent in the material produced through the garment construction. On a computer system used for FEA (finite element analysis) the strength of the stress across the fabric surface was visualised using a spectral colour map. Images created by the software were re-coloured to fit the design collection and then digitally printed and assembled into garments. Images generated by the Abaqus software for the mapping, were very low-
resolution\textsuperscript{44} however, the resulting textiles did not exhibit the pixelation, as had been anticipated, but became softened and refined in the digital print process\textsuperscript{45}.

2.2.3.2 Textile art

A number of continental European textile artists are exploring the potential of digital processes in the development of artefacts for exhibition. In the Netherlands, Wilma Kuil has used Photoshop\textsuperscript{®} to create digitally manipulated photographic images, subsequently ink-jet printed onto fabric. In work exhibited in Prato, Italy in 2003, layers of translucent printed fabric were used over another printed rendition of the image to create a 'soft atmosphere', echoing the layering method used in the software (Museo del Tessuto a 2003). Hil Driessen, another Dutch textile practitioner, used a range of digital technologies to create artefacts for exhibition, including carpets, ceramics, wall coverings, printed and woven furnishing fabrics, printed apparel, and laminates. Vibeke Riisberg\textsuperscript{46} has explored the potential of digital printed imagery to intrigue the viewer with trompe d'oeil, colour and layered effects in her textile installations (Fig. 2.2) (Braddock and O'Mahony 2005). Danish digital textile practitioner, Hele Abild has produced digitally printed works that challenge the necessity of repeating pattern, giving the impression of repetition, but with the use of subtly evolving non-repeating motifs\textsuperscript{47} (Fig. 2.3). In the USA, Hitoshi Ujiie's work has reflected the same theme, and has made use of large-scale single flower motifs and imagery that evolves along the length of the printed cloth (Fig. 2.4) (Stevens 2002).

\textsuperscript{44} The resolution of the images was 32dpi.

\textsuperscript{45} 'The nature of the low-res was transformed quite beautifully and unexpectedly by the interpolation of the digital printers, so that what had appeared quite pixelated became softened and refined in reality.' Delamore, P. (2005). Personal email. C. Treadaway.

\textsuperscript{46} Working in Denmark

\textsuperscript{47} Hele Abild presented a paper about her work at the 'Creativity: Designer meets technology' conference, Philadelphia University, USA, May 2004.
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Fig. 2.2 Vibeke Riisberg - digital print onto chiffon
Photo © V. Riisberg

Fig. 2.3 Hele Abild – 'Transatlantic Transformation' – digital ink jet print
Approx 90cmx90cm
Photo © H. Abild
A growing number of textile artists are exploring the development and elaboration of digitally printed surface through the use of embroidered, painted, metallic and beaded effects. In the UK, Norma Starszakowna, produces textile art pieces in which digital and hand printing processes are combined with metallic patination, bonding and heat reactive dyes to create textiles in which 'the printed image and process are integral to the structure of the cloth' (Museo del Tessuto a 2003, p. 74). Scottish textile artist, Alison Bell, applies layers of hand rendered colour on top of her printed digital images with the addition of stitch and appliqué, in order to interact by hand with the product of the machine (Treadaway 2004d). A similar desire for dialogue with the cloth motivates Susan Brandeis. Based in North Carolina, USA, Brandeis’ digitally printed and embroidered work has featured in a number of major digital textile art exhibitions in the USA (Stevens 2002; Brandeis 2004)\textsuperscript{48}. The work of Bell and Brandeis is discussed in greater detail in Chapter 4, Case Study.

\textsuperscript{48} Including: 'Technology as a Catalyst: Textile Artists at the Cutting Edge'. Washington D.C., The Textile Museum and 'Recursions: Material expressions of zeros and ones'. Museum of Design, Atlanta, USA
A number of artists are incorporating digitally printed images within their work as an expressive means of communicating their narrative. Michael James uses his own digitally generated and printed imagery in the art quilts he creates, rather than the hand crafted fabrics he previously used. The digital print is constructed and embellished with machine embroidery and quilting, providing a more precise communication of his narrative and theme (James 2003) (Fig. 2.5). The artist Amy C. Clarke uses digital imaging to manipulate the photographic imagery that is used to generate the narrative in her work. Her pieces, which explore story telling, myth and legend, are narrated through the imagery and influenced by the ancient Native American spiral-embroidered bead craft technique. The image to be beaded is photographed, scanned and manipulated in Photoshop®. Once digitally printed, the beads are applied to the fabric by hand stitching. The choice and positioning of the beads relates to their light reflecting qualities, referencing the digital pixelation on the computer screen (Fig. 2.6). For James and Clarke, digital printing provides the means of producing individual art fabrics, each unique and available for further elaboration.

49 [http://www.unl.edu/mjames_quilts/Biography.htm](http://www.unl.edu/mjames_quilts/Biography.htm) (acc. 05.03.06)

50 Spiral beading is symbolic of eternity, continuity and the thread of life.
The textile installation artist, Joan Truckenbrod, has been working with computers since 1975 and is described as being one of the pioneers of digital art (Ullrich 2005). Her recent installation work combines sound, video and sculpture along with digital imagery to ‘interweave the intensity of physical reality with the resonance of invisible worlds’\(^{51}\). In her early work, Truckenbrod created her own computer software programs that ‘described natural forces, such as wind currents and how light reflects off curved and irregular surfaces’ (Ullrich 2003, p.25). These were printed on plotters used for drafting maps on paper. During the 1980’s Truckenbrod abandoned writing her own software, and began using commercial software design packages, to create printed textile artworks that exploited the emerging dye sublimation\(^{52}\) digital print processes. The result was a series of artworks, printed onto polyester voile and charmeuse, at Editextile in Montreal (Mensing 1999). Her current narratives describe the ‘vast invisible fields of energy, with turbulence and flow, which form the substructure of the tangible world’ (Ullrich 2003, p.25). The work that she creates

\(^{51}\) Exhibition: ‘Against The Current’, Society for Contemporary Photography, Kansas City, USA May-June 2005

\(^{52}\) Sublimation is ‘the transference of printed images to a synthetic substrate by the application of heat’ http://en.wikipedia.org
has become increasingly concerned with projection of moving images onto textile surface and her aim is ultimately to have the video imagery ‘embedded’ in the textile surface.

2.2.4 Research in Higher Education Institutions

The following sections identify and outline some of the research currently underway or recently completed in Higher Education institutions.

2.2.4.1 Textile digital imaging for ink-jet printing technology

Digital textile printing is the focus of research at a number of universities. At Glasgow School of Art, Centre for Advanced Textiles (C.A.T.) Helena Britt is currently investigating the use of inkjet printing technology to develop innovative textiles for interiors (Britt 2004) (Fig. 2.7). Her study is also examining the implications of digital textile design on teaching practice in Higher Education.

J.R. Campbell, Research Fellow and Director of C.A.T. has explored digital printing in his collaborative research work with fashion designer Jean Parsons, from Iowa State University, USA. Their digital art to wear has been exhibited internationally and documented in a number of academic papers on digital textile printing and mass customisation (Campbell 2005) (Fig 2.12).

Fig. 2.7 Helena Britt – digital ink-jet printed furnishing fabric and cushions

Photo © Helena Britt


The use of the computer as a design tool for digital printing has been the focus of several recently completed research projects at Nottingham Trent University. Gillian Bunce explored the early development of the technology and its impact on surface pattern design (Bunce 1994). Like Bunce, Amanda Briggs' study involved surface pattern and the potential of digital ink-jet printing to produce photographic imagery on fabric (Briggs 1997). Hilary Carlisle's research concerned the generation of non-repeating pattern (Carlisle 2001) and Adrian Leak the use of colour in digitally printed textiles (Leak 1998). Research into the potential of the technology for simultaneously integrating surface pattern with garment design, was recently completed by Katherine Townsend (Townsend 2004).

University of Manchester Institute of Science and Technology (UMIST) and Leeds University have continuing research into many aspects of digital colour and ink jet-printing technology. The work has addressed the difficulties in accurately rendering digital colour on textiles and industrial requirements of digital ink-jet printing, including speed and print accuracy. A wealth of published material on digital technical processes and manufacturing technologies have resulted from a EPSRC funded project at Leeds University, concerning digital ink-jet printing, that commenced in 2000 (Dehghani 2004). Much of the work is highly specialised and is used to inform the textile industry. A similar approach has been taken by North Carolina State University (NCSU), where researchers at the NCSU College of Textiles have produced an extensive body of work concerning industrial applications of textile digital ink-jet technology, design visualisation, merchandising and mass customisation. This includes research by Traci May-Plumlee on digital visualisation of garments and textile properties (Kenkare and May-Plumlee 2005); and Lisa Perillo Chapman, director of the NCSU Digital Design Lab, whose research involves digital apparel design for ink-jet printing (Perillo Chapman and Istook 2002). Work at NCSU has focused on the development of digital processes to enhance manufacturing efficiency, suggesting new strategies for marketing products that take advantage of digital communication. Design research concerning elaboration of digitally printed textile surface by Susan Brandeis, in the College of Design, NCSU, builds on the technical expertise within the College of Textiles and explores the expressive potential of digital printing within the creative process (Brandeis 2004).

The Centre for Industrial Collaboration (CIC) in digital printing at the University of Leeds has been established as a centre to advise industry on digital print technology. 2005 "Digital Printing CIC: Innovation in the digital print sector". The Colourist: 7.


Presentation at ‘Creativity: Designer meets technology’ conference, Philadelphia University, May 2004.

Interviewed by the researcher during a visit to NCSU College of Textiles, May 2004.
In Europe, the KriDT\textsuperscript{59} European research centre in Denmark investigates and develops new methods of digital textile design and production. Designer Hele Abild directs the centre\textsuperscript{60}; her research concerns manipulation of digital images for ink-jet printing and industrial implementation of digital technologies\textsuperscript{61}.

2.2.4.2 Colour management

At Philadelphia University, USA, Hitoshi Ujiie directs the Center for Excellence of Digital Inkjet Printing for Textiles. His research has focused on digital ink-jet printing process, colour management and the implications of ink-jet printing on design development (Ujiie 2001) (see also section 2.2.3.2). Like Ujiie, research by John Xin at the Hong Kong Polytechnic University (HKPU), has focused on colour management and ink-jet printing colouration (Xin 2005). Other current research projects at the HKPU include processes for printing on metallic fibres and pre-treatments for ink-jet printable substrates\textsuperscript{62}.

Other major centres working on digital textile ink-jet printing colour management research include UMIST (Dawson 2001) and Leeds University School of Colour Chemistry (Dehghani 2004).

2.2.4.3 Three-dimensional visualisation, body scanning and mass customisation

Research at NCSU into the use of three-dimensional body scanning has informed projects concerning digital visualisation and mass customisation (Simmons, C.L et al. 2004). The SizeUK project completed in 2002 involved UK based researchers from University College London and the London College of Fashion, in a UK wide, three-dimensional body scanning research project. This work has contributed to the on-going research in a number of other universities\textsuperscript{63} concerning garment design, mass customisation and digital printing\textsuperscript{64}. Body scanning research was observed in a visit to the Clothing Industry Training Authority in Hong Kong during a visit in July 2004\textsuperscript{65} (Fig. 2.8).

\textsuperscript{59} KriDT is the Creative Institute for Design and Technology, Denmark. www.kridt.dk (acc. 05.03.06)

\textsuperscript{60} Abild presented a paper on her research at ‘Creativity: Designer meets technology’ conference, Philadelphia University May 2004

\textsuperscript{61} The centre hosted the ‘Creativity: designer meets technology 2’ conference in Copenhagen in September 2005.

\textsuperscript{62} Information from visit to HKPU in July 2005

\textsuperscript{63} Cornell University, USA, Iowa State University, USA, Auburn University USA, Hong Kong Polytechnic University, Nottingham Trent University, London College of Fashion.

\textsuperscript{64} www.sizeuk.org (acc. 05.03.06)

\textsuperscript{65} The Hong Kong Clothing Industry Training Authority was established to support the textile and apparel industry; it provides training for management and technical professionals, promoting good business practice and supporting the integration of new technology into the textile and apparel manufacturing process.
At the London College of Fashion (LCF), research by Philip Delamore is exploring the new paradigm that now exists for garment design and manufacture using digital technologies that integrate body scanning, digital design, ink-jet printing and garment manufacture, including rapid prototyping (Delamore 2004). This is part of Interrogating Fashion, a research project, currently in progress at the LCF, which aims to challenge existing practices and processes in textiles and fashion.

2.2.4.4 Digital imaging and interface design

Research by Jane Harris, at Central St Martins College, University of the Arts London, has examined visualisation of textile surface, drape and movement through three-dimensional computer graphics. Her concerns also include the value of material skills and handcrafting in relation to


66 http://www.fashion.arts.ac.uk/17414.htm (acc.05.03.06)
digital imaging and computer graphics (Harris 2005). The Tacitus haptics research project at Edinburgh University also investigates crafting processes and the role of the hand in digital interface design (Shillito 2002).

2.2.5 Summary

This review identifies that the key players in the field concerned with deployment of digital imaging technology for printed textile and surface pattern are: industry, individual art and design practitioners and academia. A significant proportion of the on-going research in the field involves the development of all aspects of digital ink-jet printing systems capable of replicating the production speeds of existing rotary print manufacture, and investigation of design processes that exploit ink-jet printing technology; this includes co-design, mass customisation and rapid prototyping. Research into interface design is examining the importance of handcrafting within the creative process.

Areas in which little evidence was found of research activity within the field include the use of digital imaging technology in the early generative stages of creative design development for printed textile design and research into the implication of communication technologies on the generative stages in design concept formulation. There was also little evidence of research into collaborative creative working strategies for surface pattern and textile practitioners, supported by digital technology.

The following section 2.3 reviews the published material, expanding on this summary and providing the rationale for the propositions that shape this project.

2.3 Literature review

2.3.1 The production tool

The review of the field indicates that digital processes are becoming integral to the manufacture of printed surface pattern and textiles and that they are utilised for design visualisation, communication and various stages in production. Much of the published material reflects this concern with the computer as a production tool.

2.3.1.1 Analogue print production

Doctoral research by Leak (1998) narrates the evolution of digital imaging from early computer programs and Computer Aided Design (CAD) systems in the nineteen sixties and seventies, through to the dedicated textile design applications programs and digital textile ink-jet printing of the late twentieth century. He contends that computers at the end of millennium were regarded as a production tool, purchased by companies to reduce lead-time in product development rather than
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for use in creative design practice (Leak 1998). At this time, few companies were employing designers to innovate design concepts, preferring to buy in work from freelance designers, agents or design studios; the task of design manipulation, colour reduction and pre-print preparation was undertaken by in-house studio design technicians. Bunce (1999, p.1) states that computers were being used in industry 'predominantly for converting artwork, but rarely for direct creative design'. Research conducted by the London Institute in 1999 found that only a minority of those textile practitioners questioned were using computers as a tool to innovate work. It also indicated that designers frequently did not know 'to what use designs are put, or their success, viability and longevity as products' but regarded their practice as being isolated from the manufacturing process and 'not part of a lengthy process in product creation' (Jenkyn Jones and Parish 1999, p.4). Bunce (1999) explains how designs were bought by industry as design ideas and, once digitally manipulated and printed, were likely to be unrecognisable from the initial artwork. The major use of digital imaging by industry involved the replicating of analogue methods of pre-print preparation, including the creation of colour separations for printing, and design alterations to fit patterns to specific sizes of rollers used in the process. Most developments in CAD for the textile design industry have been 'to replicate existing techniques' (Bunce 1999, p.1).

2.3.1.2 Ink jet printing

Bunce (1999) states that the introduction of digital ink jet printing in printed textile manufacture will free the designer from the constraints of analogue print process. Campbell (2002) contends that this will impact on the style of surface pattern designs that are produced for industry. Recent developments in ink jet printing have resulted in the production of machines that are beginning to compete with analogue manufacturing on speed, flexibility, and economy, and are likely to supersede them 'in the medium term' (Dehghani 2004 p.262). Dehghani considers that, even in the short term, digital print processes, will replace some short-run traditional screen-printing markets. Potz (2002), Xudong and Yenmai (2002), identify the specific advantages of textile digital ink jet print technology as: the increased flexibility and economy due to the elimination of costly tooling (such as screen engraving); speed with which patterns can be changed and the elimination of stockholding, as potentially work could be printed to order (Potz 2002; Xudong and Yenmai 2002).

67 Bunce, G. (1999). CAD and the role of the printed textile design. CADE 99, University of Teesside, CADE.


69 These include repeat sizes and numbers of colours.

Fryberg (2005) also notes that environmental issues are likely to encourage adoption of the technology, as little chemical waste is produced in the process. There are however, several disadvantages that remain to be overcome before digital printing is accepted widely as a viable alternative to analogue manufacturing processes. These concern colour management, printing speed, reliability and cost. Dehghani (2004) proposes solutions to print speed and reliability difficulties, through development of digital quality assessment tools, which automatically scan printed textiles in production and make compensatory adjustments in the print head operation. Problems concerning colour management are more complex, as has been described in section 2.2.2

2.3.1.3 Colour management in digital ink-jet printing

Campbell (in Xin 2005) describes the many variables that occur in digital ink-jet printing. He states that "Factors such as environmental conditions, ink properties and print head construction can cause results to vary from day to day using the exact same printer and inks." (Xin 2005 p.160). In conjunction with these issues are the added variables of pre-treatment and finishing processes. Hees, Freche et al. (2003) have identified the importance of pre-treatments in digital ink-jet printed colours and found that colour intensity can be increased substantially using products which are able to control the absorption of colour on the fabric surface. Yang and Naarani (2004) describe research that has shown that both steaming time and temperature in the post processing of printed textiles can also greatly affect the colours produced. Gordon (2001) advocates the management of colour through dedicated software and Raster Image Processing (RIP) and contends that 'colour matching accuracy and reproducibility is an operator controlled process' (Gordon 2001, p.1). Campbell (in Xin 2005) supports this approach and contends that colour management is a service issue that can be accommodated by skilled operators who have expertise in the entire print process.

72 Fryberg states that: 'In order to be accepted as a viable alternative technology, ink-jet textile printing needs to match in all respects, the results obtained by conventional screen printing.' Ibid.
76 Campbell in 'Controlling digital colour printing on textiles' states that operators should have 'knowledge of fiber and fabric structure, preparatory and finishing processes and the appropriate application of ink/dye stuff in addition to a solid understanding of the printing technology' Xin, J., Ed. (2005). Total Colour Management, Woodhead Publishing Ltd.
Colour management problems are not however, confined to the print procedure alone. The entire process from digital design origination, through manufacture to marketing and sales, requires that colour should be managed and communicated effectively (Gordon 2001), (Chapman 2000).

2.3.1.4 Colour perception

Leak (1998) investigated colour issues in CAD and digital ink-jet printing in his doctoral research at Nottingham Trent University. His practical investigations revealed the difficulties that exist between colours viewed on a computer monitor compared with the digitally printed product. This disparity results from the different ways in which colour is generated; the screen colours are a product of light, in an additive process, where as printed colour results from perception of the reflected light through subtraction, employing a model using four basic colours: cyan, magenta, yellow and black (Laing 2005). Computer monitors however, are capable of producing up to 16.4 million colours; far more than the human eye can distinguish (Leak 1998). This vast colour range motivates practitioners to achieve the same results in the printed product and this has become the source of great frustration since the colour gamut of colour printers does not match that of the monitor nor the range the human eye can see.

The perception of a printed colour is also modified by the substrate onto which it is applied, due to its reflective properties, and the ambient light source in which it is viewed.

Lotto and Purves (2004, p.12) state that the perception of colour 'is made especially challenging by the peculiar phenomenology of colour contrast and constancy effects'. They contend that the colours we see are not a direct consequence of the spectral composition of light stimuli 'but rather...'

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77 Laing describes the RGB colour model on which monitors, scanners and digital camera sensors are based, stating that: 'the common RGB colour model, for example, adds varying degrees of red, green and blue light to generate any colour'. This is contrasted with the model used in printing which is based on the reflective properties of ink. 'As light is reflected from paper, the inks absorb various colours and reflect others. A model employing Cyan, Magenta and Yellow ink can be used to absorb a range of light, thereby reflecting specific colours. CMY is thus known as a subtractive colour model.' Laing, G. (2005). Colour Management. PC Pro: 152-152.
78 'The number of colours the human eye can differentiate is unknown. Scholars believe between one and ten million colours can be differentiated' Leak, A. (1998). A Practical Investigation of Colour and CAD in Printed Textile Design. Nottingham, Nottingham Trent University.
80 Leak (1998) writes: 'Printers create colour by subtractive optical mixing, the majority using a mixture of cyan, yellow and magenta inks...The printer is unable to reproduce all the colours that the average human eye can see. While some colours are common to both devices, there are printer colours not covered by the monitor and vice versa.' Leak, A. (1998). A Practical Investigation of Colour and CAD in Printed Textile Design. Nottingham, Nottingham Trent University p.30.
the result of past experience of the individual and the species’ (Lotto and Purves 2004, p.24). The work of Land, the colour scientist and inventor of the Polaroid camera, revealed that the appearance of a colour depends on its context, not just the wavelengths reflected from the sample. He contended that all colours perceived in a scene supply the brain with information about a given object, which is used to reinterpret this data (Leak 1998). Our perceptions are also shaped by our experiences (Merleau-Ponty and Edie James 1964). Sight alone is not vision, but what we perceive is moulded, changed and adapted by the brain (McCullough 1996). Colour is, therefore, dependent on perception and interpretation.

For the digital practitioner, the interpretation of additive primary (light) colour information from the computer monitor simultaneously with that of subtractive primary (pigment) colour of printed product is an additional difficulty. A growing number of software solutions and calibration devices are being developed to help address this issue.

2.3.1.5 Digital colour strategies

Designers who work digitally must contend with the difficulties of colour communication from multiple electronic devices such as cameras and scanners, to the computer monitor and possibly other users on a network (Laing 2005). Digital colour artwork may also be communicated via the Internet or copied to other electronic media. Methods of managing accurate communication of electronic colour data are available and involve the use of spectrophotometers, monitor calibration tools, and colour profile software (Gordon 2001). Although electronic devices may employ the same RGB colour model, products from different manufacturers will have a slightly varying colour gamut. Information concerning colour reproduction, and its colour gamut, is stored in a profile using a standard developed by the International Colour Consortium (ICC). It is possible to calibrate devices with software using this data (Dawson 2001)\(^81\). Alternatively, for greater accuracy, colorimetric devices can be used to measure specific colours and generate an exact profile for that product\(^82\).

Colour management and RIP software is available that enables printed colours to be managed by creating profiles specific to the printer, ink, fabric and post processing. This is achieved by printing sample colour chips, in degrees of colour saturation of the inks in the printer. Once these have been processed, they are calibrated using a spectrophotometer and the colour space is calculated from

\(^81\) Dawson (2001, p.187) writes: ‘The adoption of a widely accepted standard form of the ICC Color Profile ensures that colour consistency can be achieved and communicated from the colour space of one device to another, irrespective of the computer operating system’.

\(^82\) For example Pantone’s ColorVision Spyder2
the data to produce the profile (Gordon 2001). Dawson (2001) describes a range of commercial
colour management systems and their use in the textile industry for creating colour standards.

The literature reviewed above does not however, address the needs of the digital practitioner
working outside industry, who has limited resources to purchase expensive colour management and
calibration tools. Polvinen (2005) advocates a more empirical approach to solving colour
communication problems. Her research has found that by developing a 'general colour setting
method involving the saturation, contrast and brightness levels' in Photoshop® she was able to
save considerable time in matching colours on the monitor to those printed (Polvinen 2005, p.53).
The experimental stage involved printing small fabric samples, which were then digitally 'tweaked'
and compared by eye. The adjustments were noted and then applied systematically in future
printing. Like Polvinen, Campbell (2005) suggests that colour modifications can be made
empirically through rapid and economic sampling; digital ink-jet printing therefore, enables greater
experimentation with colour (Xin 2005).

Leak (1998) contends that the attitude of the practitioner towards colour issues shapes whether they
are regarded as problems within the design process or creative stimulation83. His view is that 'what
are termed colour mistakes, when looking at a CAD system as a production tool, can be seen as
catalysts for change if they are approached from a different perspective' (Leak 1998 p.35). The
key consideration is whether the system is considered a production tool or a creative medium.

2.3.2 The digital medium

Developments of textile CAD systems have reflected their use in industry as a production tool.
Software applications have been developed that work within the constraints of analogue
production, providing facilities for developing repeat structures and to flatten and reduce colours84.
For those practitioners working outside industry or who produce designs for digital ink-jet printing,
new approaches to creating imagery and patterns are appropriate for originating artwork. Bunce
(1999) suggests that developments in digital ink-jet printing provide greater opportunities for
practitioners to express their ideas on the computer and translate them directly onto fabric 'creating
a method of working which has parallels with craft printing' (Bunce 1999, p.4). The intermediate
production processes85, involving translation and manipulation of original artwork, that had

83 'Designers using systems, soon realise that there are restrictions in terms of colour and, therefore, they
work with and around them, dependent on the specific working context. When a CAD system is treated as a
medium, these restrictions become characteristics of the system. From this perspective poor colour fidelity
may not necessarily be so problematic.' Leak, A. (1998). A Practical Investigation of Colour and CAD in
Printed Textile Design. Nottingham, Nottingham Trent University p.35.

84 For example Lectra's U4-ia www.lectra.com (acc.05.03.06)

85 For example colour reduction, separation and screen engraving.
distanced the designer from the printed product, are made unnecessary with digital print technology (Briggs and Bunce 1995). The practitioner is freed from production constraints to craft with the digital medium86 (Ibid).

The etymology of the word ‘medium’, (from the Latin meaning middle), conveys not only a position between but also a means of effecting or conveying something87. This is useful to describe the role of the computer in the process of digital creation. In ‘Abstracting Craft’, McCullough describes the relationship between digital practices and ‘traditional handicrafts, where a master continuously coaxes a material’ (McCullough 1996 p.x); however, in the digital process the material is virtual rather than physical. He defines the experience of a digital medium as being ‘mediation between physical devices and symbolic contexts’ (Ibid p.115). Marshall (1999), in his doctoral research, describes the role of the computer as being the ‘media-ting’ between the virtual digital environment and the real world (Marshall 1999 p.307). It is the software that provides this function since ‘digital information or symbolic forms cannot be directly, either mentally or physically, manipulated without the mediation of the computer’ (Ibid). Twenty years ago Alan Kay cited by Laurel (1991 p.32) defined software as ‘a medium that can dynamically simulate the details of any other medium, including media that cannot exist physically’ (Kay 1984)88. He denied that the computer is a tool although it is capable of acting like many tools, preferring to describe it as ‘the first meta medium’ (Ibid)89.

Software applications used for digital imaging can therefore, be described as providing meta media. Gale (1994 p.173) describes the production knowledge90 embedded in software, as being knowledge beyond replication since it holds a quantity of information beyond the likely mental capacity of any single individual. Dormer, in ‘The Art of the Maker,’ similarly describes software as ‘a means of making available the effects of other people’s skills to an individual without that individual having to acquire them’ (Dormer 1994 p.102).

There is an inherent danger in working within the structure of embedded knowledge. Marshall (1999 p.309) warns of being ‘enframed’ in a particular way of thinking and Dormer (1994) notes that by using acquired embedded knowledge rather than acquiring skills for oneself, ‘it is possible

86 This is contended in Briggs, A. and Bunce, G. E (1995). "Breaking the rules: Innovatory uses of CAD in printed textiles." Ars Textrina 24: 185 – 203. See also section 2.3.2.1

87 From Merriam-Webster online dictionary www.m-w.com/ (acc.05.03.06)


89 Meta in this sense can be defined as change or transformation www.m-w.com (acc.05.03.06)

90 Gale describes production knowledge as ‘the presence of material knowledge which affects knowledge exercised in action. In terms of art and design practice it is the cognitive state which attends work in hand at the time of work.’ Gale, C. (1994). Modelling Creative Practice. Birmingham, Birmingham University.
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to be trapped by other peoples thinking’ (Dormer 1994 p.102). Candy and Edmonds (2002) note that visual styles are often evident as a result of the use of a particular software package, notably filters in Photoshop® (Candy and Edmonds 2002). The objective of any successful creative exploitation of digital imaging ought to be the determination to achieve the artists’ aesthetic objective rather than to conform to the software engineer’s logic (Braddock and O'Mahony 1998). Harris (1999) contends that computer software ‘provides a medium with its own aesthetic, open to the influence of ‘crafting’ vocabularies as is any other material’ and that one of the greatest challenges in working with the medium ‘will be to impose a unique identity on the results of digital imaging, that could be associated with the maker’ (Harris 1999 p.6).

2.3.2.1 Crafting the medium

The crafting process is driven by the practitioners’ desire to interact with a medium, often by hand and using tools; the usual approach is one of ‘playful experimentation of ideas and processes’ (Wallace and Press 2004 p.48). When working digitally, the computer works as both medium and tool in this process enabling creative ideas to be realised. McCullough (1996) describes how, using the digital medium ‘concepts become things. We can’t touch them yet, but already we can look at them, point at them and work on them as though with hand held tools’ (McCullough 1996 p.81). The ability to innovate artwork in any medium necessitates the acquisition of a range of skills requiring practice and engagement before they can become tacit. The desire to play and the need for spontaneity are essential ingredients in the production of a creative outcome. Dormer (1994) states that it is ‘informed spontaneity’ on which the artist or studio craftsperson depends and that ‘spontaneity depends on fluency, knowledge and economy’ (Dormer 1994 p.85).

Fluency with digital tools and knowledge of the properties of the medium requires the digital practitioner to ‘seek opportunities for transparency of software tools, work around psychological-technical barriers, manage sensory imbalance, and handle perceptual and cognitive loads’ (McCullough 1996 p.142). Such considerable demands on the practitioner's cognition, indicates the importance of interface design that facilitates easy access to embedded knowledge, and enables the locus of attention to remain the development of creative ideas rather than operation of software.

Raskin (2000), in the ‘Humane Interface’, states that many computer software tools are


92 According to Dormer ‘Tacit knowledge refers to a body of knowledge which we have gained through experience- both through the experience of our senses and through the experience of doing work of various kinds,’ Dormer, P. (1994). The art of the maker: [skill and its meaning in art, craft and design]. London, Thames & Hudson, p14.

unnecessarily complicated and peripheral input devices have room for improvement in their usability. He cites problems with navigation tools, unreasonable demands on memory to learn icons and sequences of action, frustration with delays and difficulties in mentally modelling software, as all contributing to a lack of fluency with digital tools (Raskin 2000). When crafting the digital medium, two tasks are being undertaken simultaneously: the development of the creative idea and the operation of the software. Research in psychology has shown, that in such circumstances, performance in both tasks is degraded. Once a task has become automatic however, the less it competes with other tasks and the more performance is enhanced94(Ibid). Habituation is developed through practice, and fluency through experimentation with the system; both take time to achieve. Briggs and Bunce (1995 p.189), stress the importance of time to experiment and play when using CAD systems, in order to get through the ‘learning curve’. Harris (2005) contends that digital skills ‘do in time, become more intuitive and contribute to a potentially broader range of practice’ (Harris 2005 p.31).

For many practitioners, the difficulties in mentally modelling software, have led them to develop a method of working that specialises in a particular set of software functions or digital processes. This enables virtuosity to be achieved in a limited range of tools and so greater freedom to negotiate the medium. In a paper ‘Collage and the digital print’ presented at the Tate Britain in 200395, Hodes (2003) describes her practice in which copy, cut and paste, in both physical material and digital media, have become highly developed skills in the creation of her digital wallpapers (Fig. 2.9). She does not regard herself as being expert in any of the software packages that she employs, but rather uses them appropriately for what they are able to provide, in order to communicate her narrative. Hodes sees the digital extension of her technique as another tool in the repertoire that drives her artistic vision, and does not permit herself to become diverted, or seduced, by the distractions that the other features of the software may offer. The digital cut and paste facility enables her to explore the nature of physical surface and how cut edges impact upon it.


Other practitioners use software specifically to collect and adjust photographic imagery to produce digital ink-jet printed fabrics, to be integrated within their artworks. The doctoral research of Amanda Briggs focused specifically on the use of photographic imagery in the development of design work for ink-jet printing (Briggs 1997). Other practitioners who incorporate photographic imagery in their work include Michael James, who uses photography in the creation of digitally printed art quilts (James 2003); Susan Brandeis ink-jet prints photographic layered imagery, which is subsequently incorporated into her embroidered textiles (Fig. 2.10) and Alison Bell collects and combines photographic and scanned imagery, focusing her work on digital layering effects (Fig. 2.11) (Treadaway 2004d).

Hilary Carlisle, whose work is concerned with repeating and non-repeating motif, has found that existing commercial software does not provide her with the flexibility to explore her themes. She has developed her own computer-aided randomisation programs, applying variations to small-scale motifs, to create non-repeating ink-jet textile prints (Carlisle 2004). It is unusual however, for textile practitioners to have the interest or the level of computer programming expertise required to develop their own software in this way. Carlisle’s approach however, indicates that there are occasions where practitioners may sometimes decide to work outside the boundaries of commercial off the shelf software in order to achieve their individual creative expression.

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Fig. 2.10 Susan Brandeis - 'Rainglade'
Digital ink-jet print and embroidery
Size: 48" x 51"
Photo ©Marc Brandeis

Fig. 2.11 Alison Bell - 'Berneray Bird'
Digital ink-jet print on silk
Size: 48" x 36"
Photo © Alison Bell

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2.3.2.2 Visual language

Digital media are able to emulate, in two-dimensional images, a variety of physical media. The facility to combine and layer these illusionary effects, obtained from disparate sources (digital photographs and video, Internet sourced material, scanned images, photographs, drawings, and physical objects), has been described as producing a 'digital soup' (Treadaway 2004d). Briggs (1997) argues that the integration of photography and digital imaging in designs for printed textiles is producing a new visual language. Briggs and Bunce (1995) contend that throughout history, the legacy of technological change has been the adoption of stylistic variation in the textile design practitioners’ visual vocabulary. They claim that each change creates 'a visual language that contains a wide range of dialects and which expands as new developments occur' (Briggs and Bunce 1995, p.186).

The existence of visual language is contentious. Lester (1995) explains that linguistic theorists categorically assert that since pictures are presentational and not discursive, they have no formal grammar and 'without a grammar, images cannot be considered a language. Without a language, pictures cannot be read' (Lester 1995 p.4). He expresses the view however, that unlike words, which must follow a linear, horizontal order between two points, or verbal language, which is sequential, the visual structure of an image 'is taken in all at once by the viewer without any specific rules of order' (Ibid). Cohen (2003) suggests that visual language is a shared communicative system with an organised linguistic structure and features conceptually produced images (Cohen 2003). He contends that a visual language is an innate human capacity and involves sequential picture making. Dissanayake (2000) develops the concept of innate predisposition to communicate visually, citing the work of Naom Chomsky, who argues the existence of a deep structure of language that all humans possess, which forms the basis of all communication systems (Dissanayake 2000). Rose (2005) questions Chomsky’s proposition that language depends on an innate universal grammar, and argues that language is inseparable from culture.

Nevertheless, visual language is widely accepted as a description of communication of images. Research into drawing at Loughborough University has led to the contention that 'there is such a thing as a visual language, and that a drawing can be considered a unique expression of it' (Saorsa 2002). Saorsa also states that visual language has to 'be translated and interpreted in order to

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97 Professor Paul Coldwell, Digital Surface within Fine Art Practice conference, 26-27 June 2003 London Tate Britain
100 Tracy Drawing Research Group at Loughborough University
http://www.lboro.ac.uk/departments/ac/tracey/index.html (acc.05.03.06)
achieve understanding' (Ibid). In the domain of printed textiles, for example, the dialect of repeat and rhythm may be read or experienced visually by all, but its complexity not fully comprehended by those lacking fluency in its visual modalities. Digitally created textile artefacts can be considered therefore, to embody a visual language that can be perceived, by those within the domain, as being manifest in the complexity and increased colour range of the printed product (Treadaway 2004d).

2.3.3 The role of the hand

The visual language, expressed through the digital medium, can now be reproduced accurately using digital ink-jet printing technology. Nevertheless, some practitioners regard the visual qualities of the printed fabric as being flat and lifeless. The reasons for this dissatisfaction arise from both the way the printed colour is perceived and the lack of hands-on crafting in physical space. Brandeis (2003) advocates the need to 're-establish a relationship with the materials, to reclaim the images from the machine, and to convert the monologue of the machine printed product to a dialogue between artist and cloth' (Brandeis 2003 p. 17). For Brandeis, this dialogue is re-established through the embellishment of the textile surface by a variety of textile crafting techniques. She refers to the need for elaboration that is 'more gestural and expressive, in order to keep the surface rich and tactile' (Brandeis 2003 p. 11). Her view is that physical experience of hands-on crafting motivates her desire to physically intervene in the printed textile surface, investing time and craft skill to enhance it with the qualities that contribute to its visual and emotional power (Brandeis 2003).

In his essay 'The Work of Art in the Age of Mechanical Reproduction,' Walter Benjamin uses the term 'aura' to describe the emotive element that is lacking in the machine manufactured product. The aura of a crafted product is a unique accumulation of responses to a material and is derived from the hands-on workmanship of risk involved in human manufacture (Pye 1964). The digitally printed fabric is perceived by some practitioners to lack aura, to have been made without risk and therefore, to lack emotional human connection. This has led to the development of hybrid craft practices in which the digitally printed cloth is regarded as a transitional stage in the creation of the artefact. Surfaces are embellished with embroidery, beadwork, laser cutting or hand applied

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101 The concept of a good repeating structure within a textile design is regarded as one whose structure is not apparent to casual observation although, as any textile designer will have experienced, once an understanding of repeat pattern construction has been acquired it is difficult not to be aware of structures and rhythms in repeated motif in any context.
102 Information from interviews with Susan Brandeis, Alison Bell and Rebecca Earley during fieldwork 2003-4

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colour, metallic effects and craft printing techniques (Treadaway 2004d). The additional handcrafted element re-introduces the element of risk to restore the desired aura of the piece.

The emotional connection that results from a handcrafted artefact, is both physically satisfying to the maker, and is perceived and valued by its audience. The increased commercial value, of the one of a kind work of art, reflects the importance of this widely perceived added value of the hand in its creation. Wilson (1998) contends that work made by hand is endowed with a powerful emotional charge (Wilson 1998 p.5), due to the physical and neurological connection between the hand and brain. He contends that many aspects of cognitive architecture, including language, have evolved as a result of hand use and crafting skills. Hands are useful for gaining knowledge as well as producing work; they reach out from the body, simultaneously drawing sensory experience back in. These experiences are used to inform the body, and they shape perception of the world through cognition. The hand making process is able therefore, to express this mediated human experience in the crafted product.

The importance of making by hand and knowledge of textile crafting skills, has informed the research work of Jane Harris. Like Wilson (1998) she regards making as essentially a sensory experience that informs the end result. Hands provide an intuitive touch for material during the crafting process (Harris 2005 p.28). Her work, in creating computer graphic 3D textile simulations, has provided insight into the relationship between textile handcrafting and digital crafting processes. She contends that those who have had experience of textile crafting skills are more wary and questioning of the potential of digital media than users beguiled by gimmickry (Ibid p.21) and that traditional hand making provides skills, such as patience and reflective practice, that are useful when working digitally. The appreciation of time related to process gained through the slowness of textile making, is at odds with the digital working process that creates more time to execute more work related tasks and enables many new ideas and concepts to be explored, and at greater depth, than would usually be possible (Harris 2002 p.1-2).

Myerson, in 'Tornados, T Squares and Technology: can computing be a craft?' (Dormer 1997), argues that traditional design knowledge, drawing skills and practice rooted in a tactile or physical encounter with materials informs computer tool use. For practitioners who value kinaesthetic and tactile sensitivity in their working process, its absence in digital tools results in frustration and

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105 Wilson writes: 'The brain does not live inside the head, even though that is its formal habitat. It reaches out to the body, and with the body it reaches out to the world.' Wilson, F. R. (1998). The Hand. New York, Pantheon Books p.307.
demotivation. Myerson states that computers should ‘become less of a machine and more a biological extension of its user’\(^{106}\) (Dormer 1997 p.180).

2.3.4 Development of creative support systems

Digital tools rarely provide sensory feedback to the hands in the same way that is cherished by practitioners using traditional crafting processes. Transparency of tool use can be achieved through practice and habituation (Harris 1999) however, accessibility to the medium can be restricted as a result of poor interface design (Raskin 2000) (McCullough 1996). Research that is focusing on the development of haptic interface devices providing sensory feedback is described in a number of papers produced by the Tacitus project at Edinburgh University. Shillito (2002) suggests that artists and designers find computers ‘deeply alienating’ as a result of ‘impoverished yet complex interfaces and steep learning curves’ (Shillito 2002 p.2). This research is investigating the use of haptic feedback devices that enable practitioners to touch, feel, and manipulate virtual environments and so enable them to work on a computer in a more intuitive manner.

Resnick, Myers et al. (2005) describe human computer interaction (HCI) research into the development of digital systems that will enhance creativity. They propose that environments need to be developed to support the user ‘to generate, modify, interact and play with and/or share both logical and/or physical representations’ (Resnick, Myers et al. 2005 p.1). They regard support of the creative process as important requirement of software, claiming that it should provide the potential to try out ideas easily and to backtrack when these are unsuccessful. Both Hewson\(^{107}\) (1994), Resnick, Myers et al. (2005) stress the importance of providing electronic tools that support sketching and the process of drawing, which ‘helps designers engaging in reflection-in-action’\(^{108}\) (Resnick, Myers et al. 2005 p.12). In evaluating the usefulness of digital tools to support creativity, Hewett, Czerwinski et al. stress that since creativity can be both individual and social, the tools required for support must reflect this (Hewett, Czerwinski et al. 2005). Resnick, Myers et al. propose that tools should support collaboration and ‘foster a community of users to share their creations, and the tricks and techniques they have discovered for using the tools’ (Resnick, Myers et al. 2005 p.5). It is evident from this recent literature, that computers are now considered as tools that are able to support creative practice.


2.3.5 Collaboration and communication

Braddock and O’Mahony (1998) note that, digital technology is resulting in ‘a more interdisciplinary approach to the ways designers work. It is becoming more common for designers to work in teams, bringing in experts from other disciplines.’ (Braddock and O’Mahony 1998 p.130). Resnick Myers et al. assert that in the ‘real world’ most creative work is done in teams (Resnick, Myers et al. 2005 p.5) and Fischer (2005) describes how digital tools need to support ‘the interaction and synthesis of several separate knowledge systems’ which practitioners with different expertise may need to share (Fischer 2005 p.71). Malins and Press (2004), in describing the value of craft and proposing new models of professional practice, assert the need for practitioners to have a ‘connexive’ attitude which is described as ‘a technological opportunism that is furthered through networking, looking out with the specialism and engaging in dialogue with specialists from other fields’ (Malins and Press 2004 p.3).

Although collaborative design processes are commonplace in industry for product development, there are a limited number of examples in the reviewed literature that describe creative collaborative partnerships using digital technology for printed textile design. The textile designer, J.R. Campbell and fashion designer, Jean Parsons have worked collaboratively to produce bespoke printed garments in which the textile design is engineered into the garment form (Campbell, Parsons et al. 2002). Work created in 2002 included collaboration of a third designer, whose contribution of a knitted section to the garment used the printed imagery (created by Campbell) in the garment pattern (designed by Parsons) (Strawn 2003) (Fig.2.12). This collaboration made use of several software packages that enabled images to be manipulated, translated into garment shapes, visualised, adjusted, printed and prototyped. Campbell (2005) claims that the collaborative process has resulted in ‘more complex design thinking and analysis than possible with only one designer’ (Campbell 2005 p.2). Philip Delamore, at the London College of Fashion (see section 2.2.3.1), is collaborating with scientists and fashion designers. Working with rapid prototyping technology, their objective is to engineer three-dimensional printed textiles and develop mass customisation garment production109 (Delamore 2004). Without the shared expert knowledge involved in this project, the development of this work would not be possible.

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109 www.freedomofcreation.com (acc.05.03.06)
The Internet is facilitating new types of collaboration. The customer could be described as co-designer in the development of mass customised products described by Campbell in the *Digi Kids* project (Campbell 2005). In this research, the selection of imagery, garment shape and style is given to the customer. The surface design is then engineered into the garment pattern shape and digitally printed to produce customised apparel. Polvinen (2005) describes a collaborative textile design process in which the Internet and email was used to facilitate the development of a design collection. Designers worked independently to innovate and develop their designs but used common visual imagery, displayed on a website, to stimulate their independent generative ideas. The project highlighted the importance of communication between collaborators and the advantages of digital design and ink-jet printing.
2.3.6 Summary of the literature review

The review of literature identifies that digital technology is being used within the domain of printed textiles as a production tool in industry, for pre-print preparation of imagery for analogue printing processes, and for manipulating imagery and printed designs for digital ink-jet printing. Most of the literature is concerned with technical developments in digital ink-jet printing including pre-print treatments, colorants, post-treatments, and print head development. Issues concerning colour management and design development for production are also discussed, as are distributed working methods and communication of design data.

The use of digital imaging technology as a creative medium to support the generation of design concepts, digital crafting, and the importance of the hand in the creative process, is also identified.

The review indicates that there is only a limited amount of literature concerning use of digital tools to support creative practice and collaboration, in the digital textile design process.

Further investigation into the use of digital tools to support creative practice, requires consideration of human cognitive processes resulting in creative thought and action (Hewett, Czerwinski et al. 2005). The following section contains a limited review of literature in this field, providing a brief interpretation of current thinking on creativity and the role of memory in cognition. This presents the context for examination of the creative digital process within this research.

2.4 Creativity and cognition

Creativity is an essential human attribute\textsuperscript{110}. It is fundamental to survival of the species and is implicit in every restructured thought process that produces a novel solution in the mind. All healthy human brains have the potential for creative thought, which is produced through the same cognitive processes used in non-creative thinking\textsuperscript{111} (Smith, Ward et al. 1995 p.1). Research in neuroscience and cognitive psychology has been able to illuminate how these processes occur in the brain and how they might be enhanced to facilitate creative thinking and innovation (Rose 2005).

Research findings, from studies in psychology, indicate that playful, non-constrained activities are conducive to creative thought and that extrinsic factors such as reluctance to take risks, fear of

\textsuperscript{110} 'Understanding the Phenomena' Designing for the 21\textsuperscript{st} Century: Understanding and supporting group creativity in design 24.01.05 Bath University AHRC cluster workshop.

judgement, preoccupation with order and tradition can be detrimental (Amabile 1996). Amabile states that whatever an individual’s capacity may be for creative thought ‘the social environment – the conditions under which he or she works – can significantly increase or decrease the level of creativity produced’ (Ibid p17). Gardener stresses that individual creativity can only be considered within the context of a domain and the society within which it resides112 (Gardner 1993). He asserts that whether an action is defined as creative is dependent on the judgment of history, society, as well as the individual. For creative ideas to be accepted within society, there must be an implicit permission to think beyond what is held as accepted or normal. There must also be permission within the individual to think the unthinkable and to suspend rational, logical thought.

Study of cognitive processes has provided theoretical insights into how creative thought occurs in the individual. Helmholtz113 (1896) and Wallace114 (1926) highlighted stages in the development of creative thinking; these include preparation, incubation and illumination. The initial germinal stage involves gathering information and framing of the problem to be solved. At this point, diverse types of knowledge and sensory stimulus activate connections in the brain. Martindale115 (1995) describes how creative thinking consists of the activation of neural networks in the brain. Where network connections are strong, thinking is routine and unsurprising. Sensory arousal enhances the bonds of specific nodes, providing awareness of conscious experience and the encoding of relevant ideas. In the next stage, incubation, nodes in the creative mind remain primed and able to develop new connections, leading to full activation when insight occurs. This illumination phase strengthens new bonds within the network so that novel concepts are developed. Problems with ‘fixation’ or an inability to ‘break set’ occur when attention is focused and highly activated nodes inhibit others from being stimulated. During the incubation phase, the creative mind is able to simmer, with nodes activated ready to create new connections. During this process of free associative thinking, memories of multiple sensory experiences become co-related, often subconsciously.


114 Cited in Smith, Ward et al. 1995 Pp 135

115 ‘Creativity and Connectionism’ Martindale, C. in Smith, Ward et al. 1995 Chapter 11
A requirement of productive creative thinking is that the idea should be appropriate or useful for its context. The solution is verified or evaluated at the final stage before either being discarded or honed and refined. This requires comparisons to be made with the original problem definition, past experience and tacit knowledge. Memory is key to the whole process and is fundamental to each stage of the developing creative thought.

2.4.1 Memory

Findings from research in experimental neuroscience have revealed the importance of memory in the human ability to make sense of lived experience, and in the development of thought processes (Rose 2003). Ward describes the value of prior knowledge in creative thinking and states that 'we
must always rely on some type of stored information when we develop any new idea\textsuperscript{116} (Ward, B. in Smith, Ward et al. 1995 p.158). He describes creative ideas as being a mix between the old and the new. Smith, Ward et al. (1995) contend that knowledge is restructured when memories are recalled and Rose (2003) claims that our memories are re-created each time we remember, since they do not exist in the brain as information but as meaning\textsuperscript{117}.

The ability to remember is directly linked to the fundamental need to forget some of our lived experience. The brain is continuously bombarded with multi sensory stimulation and it is its capacity for habituation\textsuperscript{118} (Rose 2005) or redundancy (Gombrich 1984) that enables selective sensations to be stored. Habituation enables the body to become desensitised to perpetual stimulation and to notice only changes in degree. An example of this is the way in which the haptic sensation of clothes on our body is not experienced consciously, except as a result of increased pressure, temperature changes, movement etc. The complexity of lived experience is filtered so that the brain is able to make use of sufficient information to form a memory that encapsulates those attributes of experience personal to the individual. Memory is, therefore, filtered perceived experience.

Studies in neuroscience indicate that memory is constructed physiologically through the building of proteins in the brain, extending the synapses to enable rerouting of maps of stimulation around the neural system (Rose 2005). Rose argues that memories are not located in isolated areas but rather exist as systems of interlinked stimulations in a constant state of flux, revealing the plasticity of the brain and its adaptive nature. A memory is constructed from past experience and held fleetingly in temporary short-term memory until the refining process can change it from episodic snapshots of experience into focused sensory maps. These maps are able to store tactile, visual, spatial and olfactory phenomena in such a way that they can be recalled at an instant from a multitude of related stimuli.

Emotional response to experience has been found to enhance the strength of memories due to the release of hormones in the brain\textsuperscript{119} (Ibid). Thus an emotional response to lived experience influences both the mapping of memory and the probability of future recall. Since creative thoughts


\textsuperscript{117} ‘The act of recall remakes a memory, so that the next time one remembers it one is not remembering the initial event but the remade memory from the last time it was invoked. Hence memories become transformed over time..., Biological memories are living meaning, not dead information.’ Pp. 145 Rose, S. P. R. (2005). The 21st-century brain: explaining, mending and manipulating the mind. London, Jonathan Cape.

\textsuperscript{118} Rose describes habituation as ‘a universal property of nervous systems’ and ‘is a way of adapting based on experience’ pp32-33 Ibid.

\textsuperscript{119} Research by Cahill and McGaugh at the University of California, Irvine, USA
are built from selected memories of knowledge and experience, emotion is also likely to play a key role in the stimulation of creative thought.

Rose (2003) explains that memory is composed of ‘knowing that’ (declarative memory) and ‘knowing how’ (procedural memory) processes. Both are remembered differently. Knowing how to do something is learnt through repeated action and is remembered tacitly. Kinaesthetic connections are formed between brain and muscles, limbs and organs in actions such as riding a bike or getting dressed. Once learnt, these activities are performed without a conscious act of remembering. By comparison declarative memory comprises memories of events of lived personal experience (episodic memory) and objective knowledge (semantic memory), which has to be stimulated or consciously recalled. These various types of memory are useful in the development of creative thought and require different prompts to stimulate their activation. Declarative memory benefits from sensory and linguistic stimulation whereas procedural memory is prompted through action.

The act of remembering involves assimilation of stored multi-sensory cues. Some memories are abstracted into symbolic form as numbers, words or shapes and require interpretation as well as recall. To consciously access semantic memories can sometimes be difficult; a name or list of words may require further prompts or strategies for remembering, such as sequences or associations. Recognition is the preconscious recall of declarative memory. When a face is recognised in a crowd it may not replicate the exact likeness previously encountered yet a resonance with past experience provides identification. Gombrich (1982) describes this as the plasticity of vision, and contends that what we see is the product of past experience and future expectation. Sensory past experience is frequently more easily recognised than consciously remembered (Rose 2003); smells, tastes and tactile qualities are more difficult to rekindle than visual ones.

2.4.2 Imagination and creativity

According to Collingwood (1958) it is necessary to be able to visualise and imagine in a domain outside the physical world if one is to create a new idea, description or artefact (Collingwood 1958). Imagination enables memories and knowledge to be remodelled and sensory stimulation simulated, without having physically occurred. Research, using electronic brain imaging techniques, indicates that those processes used in recall of past experience are the same as those used when imagining a similar experience. According to Rose (2005) ‘mental activity in the absence of non mental stimuli can result in similar if not identical neural activity as that generated

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120 Imagination is defined as: the act or power of forming a mental image of something not present to the senses or never before wholly perceived in reality. Merriam Webster Dictionary [www.m-w.com/](http://www.m-w.com/) (acc.05.03.06)
by the material stimuli' (Rose 2005 p.198). This is the basis of creative thought; enabling the multiple connections of sensory lived and learnt experience to be activated in the mind. Fauconnier and Turner (1999) state that daily cognition requires compression of experience and this is achieved through a process described as conceptual blending\textsuperscript{121}. The brain uses techniques including perceptual redundancy to cluster visual cues (Gombrich 1984), and conceptual blending to compress and store experience in order to make sense of a complex world. Dreams and reveries are the ultimate form of imagination in which memory is recalled without plan or conscious intent. Kris (1952) cited in Smith, Ward et al. (1995) describes this as primary process thinking which can be responsible for generating creative thought through the formation of associative ideas. Secondary process thinking occurs when ideas become refined, logical and structured. Creative cognition requires the movement from primary towards secondary process thinking.

Visualisation plays an essential role in this process. Recent research by Slotnick, Thompson and Kosslyn (2005), into perception and neural activity has revealed that visual mental imagery relies on depictive or picture-like representations rather than symbolic language like representations\textsuperscript{122}. Verbalisation at this stage has been found to be inhibiting to the development of representations and associative thought (Schooler 1993). Non-verbal processing involving visualisation, enhances the generation of ideas and further structuring of thought, which might then include the use of symbols, diagrams and sketches\textsuperscript{123} (Hewson 1994) (Lawson 1997)\textsuperscript{124}. The process of innovation flows from this generative stage of creative thinking and involves the convergence of ideas, reflection, iterative refinement and re-conceptualisation until a proposal is produced. This can be recognised in the iterative process of design thinking preceding the production of both problem solutions and artefact creation (Fig. 6.1 Iterative stages in creative cognition). Nevertheless, the process is dynamic, multi-layered, and frequently non-sequential and any schematic representation cannot fully or accurately explain the complexity of the process.


\textsuperscript{123} Hewson states: 'These ideas are often only partially formed whilst still in mind, and the externalisation enables the designer both to see an instantiation of the idea, and hence to develop it.' Hewson, R. (1994). Making and marking. Milton Keynes, Open University.

\textsuperscript{124} Lawson describes the purpose of doodles, sketches and models as acting as a kind of 'additional memory to freeze and store spatial ideas which can then be evaluated and manipulated' Lawson, B. (1997). How designers think: the design process demystified. Oxford, Architectural Press.
Chapter 2 Literature and Contextual Review

2.4.3 Creativity in a social context

It is suggested, by research in anthropology, that artistic creativity has developed as a result of an innate human need to communicate mutuality in order to make meaning of the world (Dissanayake 2000). It is embedded in, and arises from, communication that may be preverbal, visual and subconscious, and is a result of visceral experience and interaction with the world. The collation of sensory data that feeds creativity starts from birth and psychologists have noted the importance of the experiences of childhood in the development of a creative mind (Gardner 1982).

Dissanayake (2000) contends that perception of the world is affected by the different systems of knowledge that exist; these are crucial in non-literate societies where analytical thought is not exhibited (Dissanayake 2000). To be analytical requires an objectivity that can be achieved only through the use of written language. For this reason, western societies whose writing has evolved from Latin and Greek alphabets, have developed a culture of analytic thought and logic which pervades the whole of society; it is the basis of the logical thought on which computers operate and communications technology has been developed (Seelig 2003).

Gardner (1982) dismisses this view of analytical and intuitive thought as being separate activities in his essay 'What we know (and do not know) about the two halves of the brain' preferring the premise that there exists a set of intelligences (Gardner 1982). Coyne and Snodgrass explore the philosophical argument against the theory that logic and reasoning reside in separate areas of the brain, in their challenge to the dual knowledge thesis (Coyne & Snodgrass 1991). They contend that 'understanding is accomplished through interpretation' and that we are 'replete with expectations distilled from our background of experiences' (Ibid p.125). Dormer (1994) describes the creative process as 'the interplay between what we see now and how we have interpreted what we have seen in the past' (Dormer 1994 p.102). The creative design process is not isolated in the mind of the individual but is affected by temporal and cultural influences125 (Csikszentmihalyi 1996).

The impact of interaction and collaboration with other individuals in a social context cannot be underestimated in the creative process (Fischer 2005)126. Not only does cultural background influence the cognitive development of an individual, but daily social interactions also dynamically modify thought processes impacting on creative thinking. Fischer (2005) states that 'much of our

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125 Csikszentmihalyi claims that 'an idea or product that deserves the label 'creative' arises from the synergy of many sources and not only from the mind of a single person' Csikszentmihalyi, M. (1996). Creativity: flow and the psychology of discovery and invention. New York, HarperCollins Publishers c1996.

126 Fisher states that 'Much human creativity arises from activities that take place in a social context in which interactions with other people and the shared artefacts are important contributors in the process' Fischer, G. (2005). Creativity and distributed intelligence. Washington DC, National Science Foundation, p.71.
intelligence and creativity results from interaction and collaboration with other individuals, with their tools and with their artefacts’ (Fischer 2005 p.71).

2.5 Discussion

The field study and literature review suggests that to date, digital imaging technology has been used in industry predominantly for pre-print production, visualization and marketing of surface pattern designs to be printed via rotary and flat bed screen based methods. The constraints of the manufacturing processes have dictated the development of textile specific software and are evident in the visual language of the printed product127. Where design work has been generated using digital software tools, such as Photoshop®, the limitations of the print manufacturing process have required images to be reworked for production128. However, the recent developments in textile digital ink-jet printing now enable practitioners to accurately reproduce imagery developed using digital tools. The review of literature indicates that the use of production speed textile digital printers is likely to impact on the visual characteristics of design work required by industry in the future. Access to textile digital ink-jet printers is providing independent practitioners with the opportunity to realize their digital imagery directly onto fabric as samples, printed artworks and short run lengths. Review of the field and published literature suggests that advances in printing technologies will increasingly impact upon practitioners’ creative processes and the generation of visual concepts.

The review of the field indicates that technological advancements in hard and software, graphic input devices such as digital cameras, scanners, video as well as digital communications technology, are making a rapidly increasing impact on creative practice. Imagery can be collected, reviewed, stored, manipulated, combined and communicated with ease using digital tools and the resulting artifact expresses new visual characteristics, including complexity of colour and line. For some practitioners the lack of physical hand crafting skills in the digital process has resulted in the development of hybrid practice in which the digital process is combined with handcrafting. The review has highlighted the importance of hand use in the creative process.

Much of the recent and on-going research reviewed, is concerned with manufacture and production of design solutions. There is little evidence of research into how digital tools support the germinal stage of design development, in which visual concepts are generated and explored. Review of literature on creativity indicates the importance of memory in the imaginative process, and its impact on conceptual development. It suggests that individual creative solutions are affected by

127 This includes reduced colour and tonal range, use of repeat and limited linear detail.

128 This involves colour reduction and development of patterns into repeating structures that will fit within the dimensions of the screen or roller.
social interaction; however, there is little research that interrogates the ways in which digital tools may support the collaborative creative process in the generation of design concepts for printed textile surface.

The contextual review poses a number of questions concerning the impact of digital imaging technology on the generative stage of creative textile practice. Synthesis of reviewed information indicates that practitioners are using technology to originate design concepts but does not provide insight into how digital tools support or interrupt the creative flow of ideas. The material reveals that digital communications technology is providing practitioners access to distributed knowledge and expertise but does not indicate how the creative process is enhanced by collaboration or what support digital imaging provides in this type of practice; nor is there any analysis of how this may impact on the visual qualities of the resulting printed artifact.

Recent HCI\textsuperscript{129} research, into the development of digital tools to support creative practice, suggests that qualitative methods (such as ethnography and field studies) are the most appropriate means of gaining useful data and help to reveal user needs and not just practices: why they do what they do, not just what they do (Hewett, Czerwinski et al. 2005)\textsuperscript{130}. Hewett, Czerwinski et al. (2005) stress the importance of understanding the cognitive processes, which take place in the generation of creative ideas, before an assessment of digital tool use can be made. This approach has been instrumental in the choice of research methodologies used to collect data for this body of research and is discussed in greater depth in the following section: Chapter 3 Research Methodology.

\textsuperscript{129} Human Computer Interaction

\textsuperscript{130} Hewett, Czerwinski et al. state that qualitative research is 'particularly well suited to gaining a deep understanding of the needs and methods of a community of practice' Hewett, T., M. Czerwinski, et al. (2005). Creativity support tool evaluation methods and metrics. Washington DC, National Science Foundation p.17.
3. Research Methodology

3.1 Introduction

Findings arising out of the contextual and literature review in Chapter 2, suggests that digital imaging is affecting creative textile practice, changing working processes and impacting upon the visual characteristics of the artefacts produced. Chapter 3 explains the rationale for the selection of the chosen research methodologies used to gather data for subsequent analysis to inform the findings of the project.

The selection of appropriate methodologies for the investigation of human centred action is discussed and strategies for the use of qualitative methods are described. Use of research techniques and methods of data collection, for example disciplined noticing, audio and video recording, and reflection on practice are proposed. Case study, interviews, the use of research journals, and practical collaborative investigations are identified as methods for gathering valid research data.

The chapter concludes with a discussion concerning the validity and effectiveness of video recorded research data and practice as research. The application of the research methods is explained more specifically in Chapter 4 Case Study and Chapter 5 Investigations.

3.2 Methodological approach

Investigation into mental processes resulting from human centred action is difficult to interrogate. Research in neuroscience continues to reveal the variations in brain structure and mind processes that build physical experience of the world (Rose, S, 2005). Nature and nurture, DNA and life experience, contribute to the workings of the mind, establishing memory and knowledge structures. Every individual is unique. The problem of how to explore hypotheses about the nature of creative thought and subsequent artefact production must, therefore, be approached using a methodology that can have validity when complex variables are inherent. This kind of research area may benefit from a qualitative phenomenological model in which an analytical description can be made of conscious experience. Through disciplined noticing\textsuperscript{131} and recording methods, it is possible to build research data that yields useful information concerning the complex multi faceted cognitive structures that ultimately result in human action.

Researchers in the social sciences frequently use action research, case study and other descriptive ethnographic techniques to study human experience and interaction. A phenomenological approach

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to this process requires a critical analysis of human action and the product of that action. It is based in the premise that unconscious thought, memory and human attributes that are descriptively elusive 'can be shown to unfold from our condition as beings physically immersed in the world' (Cazeaux 2000 p.74). Candy and Edmonds (2002 p.39) contend that if the knowledge acquired through this kind research is to be useful 'it must be deeply rooted in the actual context and experiences of participants'\(^{132}\). Their research into human computer interaction in art and design practice at Loughborough University made use of practice-based action research and case study methodology.

When provided with the opportunity to reflect, a practitioner's experience becomes a valuable source of research data. In 'Educating The Reflective Practitioner' (1991), Schön advocates the use of processes of reflection to inform and build new knowledge about practice as it occurs. He describes how experience provides acquisition of tacit knowledge or 'knowing in action' (Schön 1991 p25), which cannot always be described verbally as it occurs. However, if cognition occurs simultaneously with the action, it can be described as 'reflection in action' (Schön 1991 p31), and this may or may not be articulated. The product of reflection in action is the iterative exploratory process that lies at the heart of creative practice\(^{133}\). Retrospective description of this experience can be used to inform future actions and is described as reflection on practice (Schön 1991p.31).

Through this reflective process in which the researcher reports detailed self-analysis of practice, it is possible to gain fresh insight from the familiar and new understanding from the routine. The artefacts produced as a result of this will express the knowledge gained in the reflective process and exist as valid research data\(^{134}\).

3.3 Research strategies

3.3.1 Concurrent verbalisation and retrospective reports

Qualitative research methods used in the social sciences rely heavily upon the verbal report of subjects' experience as well as observations of behaviour and context. Verbal reports and introspection were relied upon by psychologists as the only valid form of data available in early psychology research (Ericsson and Simon 1993). However, behavioural psychologists later disputed that verbal accounts could be relied upon as accurately reflecting the information that was

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\(^{134}\) See section 3.5.2
Chapter 3 Research Methodology

retrieved at the time the action occurred\textsuperscript{135} (Nisbett and Wilson, 1977 cited in Ericsson 1993). Ericsson and Simon argue, however, that their research indicates that verbal reports are a 'rich source of data, combinable with other data, that can be of the greatest value in providing an integrated and full account of cognitive processes and structures' (Ericsson and Simon 1993 p.373). The validity of this type of data relies on the verbal report being either concurrent with the action through 'talking aloud' or as a retrospective verbal report on tasks of very short duration (Ibid).

The dangers inherent in the use of verbal reports as hard data concern the types of thought processes that vocalisation of the inner cognitive experiences requires. According to Rose, neuroscience has revealed that cognitive processes are not linear but multi layered, receiving simultaneous stimulus from various parts of the brain (Rose 2003). When a subject is asked to talk aloud, the cognitive process deployed involves encoding experience, sensation and perception into language. If however the verbal report provides explanation and analysis of action, different mental processes are involved using complex synthesis of past sensory experience, memory and knowledge\textsuperscript{136} (Ericsson and Simon 1993). The vocalisation no longer specifically relates to the current situation but draws from other past experiences which may be biased or contain false memory, having been honed by time and influenced by others. The danger of retrospective verbal reports is that subjects tend to 'elaborate the information at the time of the report as well as include rationalisations and justifications, generated after completion of the cognitive process'\textsuperscript{137} (Eriksson and Simon 1993 p.xiv). Retrospective reports given less than a few seconds after the experience however, do provide more complete evidence. In this instance the information is contained in short term memory, not yet having been processed by the brain into retrievable and ordered data and made subject to change through synthesis and analysis in this procedure.

Eriksson and Simon's findings indicate that verbal reports are valid in research involving human centred investigation but that integrity remains intact only when the reports are made concurrently with the action or immediately after and do not contain rationalisation or justifications. This approach can be extended to include non-verbal visual reporting through action described as disciplined noticing.


\textsuperscript{136} '...however if subjects are also instructed to describe or explain their thoughts, additional thoughts and information have to be accessed to produce these auxiliary descriptions and explanations. As a result the sequence of thought is changed, because the subject must attend to information not normally needed to perform the task.' Ibid, p.xii.

\textsuperscript{137} xvi Protocol Analysis Ibid.
3.3.2 Disciplined noticing

Mason (2002) claims that the discipline of noticing constitutes 'a research method which is particularly suited to practitioners researching their own practice' (Mason 2002 p.182). He describes the method as a sharpening of awareness reported through brief but vivid accounts in which details that might divert from the locus of attention are omitted and behaviour is described in such a way that 'others, had they been present, would have readily agreed to having seen, heard or felt'\(^{138}\) (Ibid p.57). As with concurrent verbalisation techniques, disciplined noticing requires that unnecessary interpretation, explanation and value judgements be avoided when making reports; technical terms and jargon are also avoided as is personal opinion and deduction. The aim is to convey with clarity and brevity the nature of the experience.

Observation however, is based on past experience. Attention is likely to focus on those aspects of the situation to which the researcher is sensitised through past experience or prior thought. Any description of what has been noticed is encoded in language and this has to be interpreted; at each level of noticing there is a subjective element. The demands of disciplined noticing to yield brief but vivid reports, however, enable others to 'experience something of what the researcher claims to notice and then test it out in their own experience'\(^{139}\) (Mason 2002 p.182). The subjective nature of the process becomes a shared experience in which commonalities can be noted.

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\(^{139}\) Pp. 182 Ibid.
3.3.3 Video as data

Visual and audio recording techniques can enhance observation and written transcripts can provide distilled observations of the recorded situation. Video and audio recordings themselves are able to provide even richer information; video can reveal gesture, facial expressions and body language, which may compliment or even contradict the verbal discourse. Like photographs, video can act as a memory trigger and provide information that could have easily been forgotten. It must be noted however that visual cues also bring subjective perception\(^{140}\), what one researcher perceives might not be the same as that perceived by another.

There are considerable advantages in the use of video in the collection of research data. Shrum, Duque et al. propose that digital video is 'an innovation in research practice rather than simply a new medium for recording social behaviour' (Shrum, Duque et al. 2005 p.21). Their research findings indicate that the advantages of digital video over traditional ethnographic methods include the ease with which data can be stored, retrieved and communicated by and amongst researchers. The ubiquity of video surveillance, home video and web cam equipment has relaxed the way in which subjects interact with the technology to the extent that 'the researcher-subject boundary is blurred and visual artefacts and behaviours become as prominent as the words the subject utters' (Ibid p.21). Video provides opportunity for the subject to show artefacts and documentary evidence. It also enables the demonstration of actions, gestures, techniques and tools without the mediation and possible misinterpretation of language.

Ethical issues concerning what can be videoed and to whom the video may be shown are of considerable importance and trust and relationship building play a crucial role in the collection of video data. The ease with which digital video can be edited non sequentially and then communicated, makes this a particularly important concern for the researcher who must be aware of possible bias and distortion of the data as it is processed.

Digital video is particularly useful in documenting the researcher’s own practice since the camera can be operated without assistance and with the viewfinder tilted towards the action\(^{141}\). As a documentary diary of practice, digital video is able to provide data for systematic and rigorous reflection on practice. Buur, Binder et al. (2000) have found that video can be used as a design

\(^{140}\) E.g. a family holiday photograph will be perceived as a very different image by a friend who has not seen the place for herself; experience and memories add to the visual experience providing a rebuilding of that past memory in the present.

\(^{141}\) This enables the researcher to monitor the recording of practice as it occurs.
material in the research process. They contend that it is able to inform the design of an artefact by providing a means of continuous reflection on the design process\(^{142}\) (Buur, Binder et al. 2000).

### 3.4 Research methods

The techniques of disciplined noticing, recording and reflection described in section 3.3 have guided the collection of research data in this body of work. This has been accumulated using digital video, audio recording, reflective journals, photography and personal correspondence generated in the process of conducting the case study, semi structured interviews and collaborative investigations.

\[\text{Diagram 3.2 Collection of research data}\]

The digital video data has been stored as a collection of raw unedited high-resolution mini DV tapes providing a permanent record of the captured research. The tapes have also been digitised,

Chapter 3 Research Methodology

edited and saved as Mpeg 1 files, small enough to store on CD and access from a computer using standard media viewing software such as Windows Media Player®. This has enabled the data files to be accessed with ease during analysis and has facilitated communication. The camera used for the filming was a Sony Digital Handycam DCR-PC8E with 120x digital zoom selected for its very small size and ease of operation. The majority of the filming was carried out with the camera mounted on a tripod and operated by the researcher.

Other equipment used in data collection included a small analogue dictaphone with external microphone which was used to boost the audio input for some of the interviews where the inbuilt camera microphone was likely to lack clarity. Still photographic documentation during the research was made using a Canon Powershot G5 digital camera. An RM tablet PC was used on location to download video files as backup to the DV tape and to share and store digital photographs.

3.4.1 Semi structured interviews

A series of questions was devised, honed and refined through use with a number of people interviewed during the initial field study stage of the project. This series of questions formed the core of those used later during the semi-structured interviews with the case study participants. The questions sought to explore some of the issues that had become apparent as a result of the literature search and review of the field; these concern conceptual framework, design process and tool use. Use of a structured set of questions enabled the researcher to provide consistency between studies in the kind of information sought and later to make comparisons between the answers given. The informality of the initial field study interviews enabled conversations to extend beyond the boundaries of the core questions, providing insights into issues that could be incorporated into later sets of questions. These opportunities also enabled rephrasing of questions that were ambiguous and elimination of those that were deemed inappropriate or of little value.

3.4.2 Process maps

The first question posed to the interviewee involved drawing a schematic representation of how they viewed their creative process. It was hoped that involvement in a task requiring sketching

143 Although the image resolution is low using Mpeg 1 file format, the advantages of small file size and ease of sharing files was deemed more important due to the quantity of recorded data especially since the high resolution video can be accessed if required from the mini DV tapes.

144 Size and weight are important considerations when equipment is to be transported around the world.

145 Particularly in situations where artists talk and show their work and so move away from the camera.

146 www.rm.com (acc.05.03.06)

147 This set of questions can be found in the appendix 3.7

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would be likely to help the participant to relax and provide an opportunity to explain visually, concepts that might have been difficult to express in words. The resulting process maps proved to be an invaluable aid in the interview process providing documentation of how the interviewee perceived her own practice. The maps also enabled interrogation of the practitioners' described working method during the interview and provided documentary evidence to be included in the case study database.

3.4.3 Case study

Case study was selected as a key research method since it provided an opportunity to gain in-depth understanding concerning specific working practices used by individual textile practitioners (Gillham 2000). This provided a contrast to previous quantitative research undertaken by four fashion and textile lecturers from Central Saint Martins, London University of the Arts, between 1995-1997, in which questionnaires had been used to establish the use of technology in the field (Jenkyn Jones 1999).

In contrast, this research has sought to study qualitatively, how technology is being used and its impact upon creative practice. To achieve this, case study methodology was employed to facilitate 'studies of events within their real life context' (Yin 1994 p.72). The study was designed to cover contextual conditions: location, working environment, production of artefacts, as well as the collection of verbal data, since these factors might be found to influence creative cognition and practice.

Yin (1994) states the importance of case study design, stressing the requirement for validity comparable with that possible using other research methods. He emphasises the need for the development of tactics to increase construct validity, internal and external validity, and reliability (Yin 1994)150. To achieve construct validity in the design of this case study, multiple sources of evidence were collected including video and audio recordings, interviews, map drawing, and still photography of artefacts. Three separate studies of individual practice were used to build the case providing a chain of evidence that could be compared at the analysis stage. The key informants in the field studies were given the opportunity to review the section of the case study report to which they had contributed.

148 Gillham states that 'surveys give you large-scale data that are relatively superficial; case studies give you in-depth data with limited claims to representedness.' Gillham, B. (2000). The Research Interview. London, Continuum, p.16.

149 Textiles, Techniques and Technology (T3) research project

The internal validity of the data emerged through the identification of patterns within the three studies. External validity was provided through analytical generalisation or generation of theory that was then tested in the second and third studies. The theoretical basis for the study had been informed by the literature search and review of the field earlier in the project. The first case was able to illuminate the propositions (identified in Appendix A.1.1) and subsequent studies reinforced their validity. Reliability of the research design was provided through the use of a protocol to guide each study. This enabled the possibility of future replication of the data collection procedures.

Preparations were made for the design of the case study protocol during the early stages of the research and included identification of appropriate individual practitioners and informal pre-interview meetings. It was decided that three practitioners would be sought that reflected the diversity of the field: a textile artist, a textile craft maker and a textile designer. The criteria for selection included being recognised for their contribution to the digital textile field by academia, industry or professional association. Each of the chosen candidates was met informally before being approached to participate in the study and further communication via email and telephone enabled a working relationship to be established prior to the research visit.

The literature search and review of the field had enabled theoretical issues to be identified for investigation and research questions to be formalised. Interviews with two practitioners were documented to pilot the data collection methods and refine the interview questions. Both were practitioners, researchers and educators, sympathetic to the research procedure and within convenient travelling distance. Data collection tools were tested and systems of archiving the data were developed in preparation for the case study. This included the search for video editing and image filing software.

The three studies took place over a period of ten months towards the end of the first and during the second year of the project. They each included a visit to the artists’ place of work, a semi structured interview, opportunity to observe and video record working practice and view, document and discuss examples of existing artwork. Each followed a slightly different format in which the

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151 Analytic generalisation is defined by Yin as a mode of generalization in which ‘a previous developed theory is used as a template with which to compare the empirical results of the case study. If two or more cases are shown to support the same theory, replication can be claimed.’ Ibid p.32.

152 These included the role of the hand in creative process, the development of digital language and impact of technology on artefact production and visual concept communication.

153 The protocol can be found in the Appendix 3.

154 Charlotte Hodes and Rebecca Earley

155 Video camera, audio recorder and digital camera
researcher aspired to be sensitive to the demands on the practitioners’ time whilst adhering to the content of the case study protocol. The first day on each occasion was informal; the bulk of the video recording and formal interviewing took place on the second and third days with opportunity to photograph and discuss work at the end. The studies took place over a period of 4-5 days and a descriptive account of each can be found in detail in Chapter 4. The format of the case study report was devised to enable comparison between the studies and relate the findings to the theoretical propositions outlined in the case study protocol. For this reason the sections in each report cover the background and introduction to the practitioner and their creative environment (Context), the method of working process (Rhythm), modalities within that process such as colour, pattern, imagery (Mode) and the role of digital technology within creative practice (Digital Tool Use).

The follow up procedure for the case study included formal letters of thanks to each participant as well as informal communication\textsuperscript{156} to build relationships in preparation for the next stage of the research, which involved creative collaboration.

3.4.4 Investigation and collaboration

Following each of the studies, a task exercise in which both the practitioner and researcher could engage collaboratively was devised\textsuperscript{157}. It was intended that this investigation would enable a shared experience of some of the issues raised during the case study and enable a reflective dialogue to take place. De Freitas (2005 p.1), in her paper ‘The role of the evolving artefact in creative collaboration’\textsuperscript{158} cites Morse (1994):

\textit{`Creative practice can benefit in particular ways through the unique sensitivity of collaborating artists to the materials and processes in progress and through the triggering of new insights for one person as a result of differing insights and differing perspectives of another.'} (Morse 1994)\textsuperscript{159}

Video was used to document the researcher’s experience and email and telephone calls provided opportunity for the reflective dialogue to take place. A body of collaborative textile artwork was produced as a result of the investigations and the production of this work is described in depth in Chapter 5.

\textsuperscript{156} Email correspondence, telephone conversations and meetings

\textsuperscript{157} Mason writes: ‘the construction of a task exercise is the most fruitful form of research report, because it enables others to experience something of what the researcher claims to notice and then to test it out in their own experience.’ Mason, J. (2002). Researching your own practice: the discipline of noticing. London, Routledge Falmer 2002.


\textsuperscript{159} Morse, J.M (1994) Designing funded qualitative research. In Handbook of Qualitative Research. Sage, Denzin, NK and Lincoln, Y.S. (Eds.), Thousand Oaks, California, pp220-235
3.4.5 Reflective journal

The development of the collaborative artwork during the investigations has been documented through the use of reflective journals. These books contain both visual and written reflections on the practice as it occurred, exploring thoughts and processes and providing visual exploration of ideas that cannot always be expressed verbally. Photographic images, sketches, collage aide-memoires, fabric samples and colour swatches are collated in a series of books relating to each of the case studies and investigations, documenting the thought processes of the researcher. The creation of each book has enabled reflection on practice to occur at every stage in the process and exist as documentary evidence of the research journey. The video documentation of the investigations provides additional data concerning cognitive process and physical tool use.

3.5 Discussion

3.5.1 Validity: video as method of recording data

Although digital video has proved to be a useful aid in the collection of data enabling material to be stored and retrieved efficiently for analysis, a number of concerns have become apparent concerning the validity of the data along with a number of practical issues.

As a method of action capture, video enabled detailed description and analysis of practice to occur in both the case studies and observations of work in progress. The infiltration of the camera as observer, in what is normally a private creative process, provides moments of frustration and inhibition as documented in the material itself. The creative process requires a relaxed attitude in which the practitioner is uninhibited and freed from extrinsic constraints including judgement and assessment (Amabile 1996). At times video recording had to be suspended due to the impossible constraint of the camera on the creative process felt by the practitioner.

Video recording could not occur throughout the entire period of practice due to practical considerations of time, quantity of DV tape and time required to process the data. Moments of insight occurred frequently off camera, either because there was no longer a sense of inhibition or simply as a result of the fact that the creative process is not constrained to the average working day or restricted to the studio environment.

Once the process of reflection on camera had become familiar to the practitioner and the techniques of digitisation and editing routine to the researcher, there was a temptation to be selective about what was video recorded. The understanding of what and when to film, and what to comment upon, formed a tacit knowledge that resulted in subconscious pre-editing of material as it was delivered.

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Although the researcher’s intention was to avoid this, it became inevitable with a research team in which the researcher was also camera crew, editor, and analyst; especially so when the researcher was also the subject.

Technical difficulties involving use of the equipment and software inevitably impacted on the video recording process. Tapes ran out at inconvenient moments and microphones sometimes did not pickup auditory data with clarity. The use of a single camera also restricted the viewpoint to either the subject or the computer screen; use of several simultaneous viewpoints might have enhanced the information provided.

During periods of intense creative thought the camera was forgotten, as was the necessity to reflect on the practice. Long stretches of video were produced with very little physical evidence of cognition taking place and no concurrent verbalisation. These sections of practice have been illuminated through retrospective verbal reports that summarise the practitioners’ thoughts as the work progressed; the artefacts produced providing the evidence of what had occurred.

3.5.2 Practice as research

The artworks produced in the investigations have been used to document the practice as research and this is described in detail in Chapter 5. Schön describes such artefacts as the embodiment of ‘knowledge in action’ (Schön 1987) providing a more visceral communication of the creative process than can be achieved by verbal report alone. Scrivener and Chapman (2005 p.9) contend that the artwork itself does not simply contain knowledge but ‘the artwork itself is knowledge; and existence or proof that something is possible.’ They argue that the ‘proper goal of visual arts research is visual art’ and that the concern of the researcher should be ‘with endowing novel insights through the apprehension of and discourse surrounding artefacts’ (Ibid p.2).

The juried selection of the artworks for international exhibitions161 and subsequent critique at conferences162 indicates that the work produced is regarded as descriptive data and embodies knowledge of the research experience.

3.5.3 Further investigation of research methods

Use of the qualitative research methods described in this body of work has yielded data on the broad issues of how digital technology is being used by textile practitioners. Tool use, communication techniques and the collaborative working process could be interrogated more

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162 Surface Design Association Conference, Kansas City Art Institute, June 2005 and Digital Perceptions Conference to accompany exhibition, Collins Gallery, Glasgow, February 2006
rigorously using quantitative analysis, questionnaires and statistics. Any future research of this nature may require technical expertise in areas such as computer hard and software design, statistics and psychology of human computer interaction; this was deemed beyond the scope of this body of work. Verbal reports could receive further detailed interrogation using techniques to reduce the data numerically for computer analysis (Ericsson and Simon 1993).

The research experience has had considerable value in sharpening the researcher’s and practitioners’ awareness of creative practice and the reflective process will inevitably impact upon the future working method.

The case study and subsequent investigations, described in the following two chapters, have proved useful in producing qualitative insight into the way in which digital imaging technology is influencing practitioners, their creative process and the interaction between them. The research outcomes will be described in more detail in Chapter 6, Discussion.
4. Case Study

4.1 Introduction

The rationale for the selection of specific research methodologies is described in Chapter 3 Research Methodology. Hewett, Czerwinski et al. (2005) suggest that qualitative research methods (ethnography and field study) are appropriate when studying human computer interaction and creative processes. Yin (1994) suggests that case study provides the opportunity to observe and document 'real life' contexts in depth and is able to yield qualitative data for subsequent analysis.

This chapter describes the conduct of the case study and the selection of candidates, their working processes and the artefacts they produce. The field study reports are presented sequentially, in the order in which they occurred within the project; the initial section of each providing an introduction to the practitioner and context for their work. Issues, emerging from the recorded video data of interviews and documentary evidence acquired during the field visits, have been categorised into two headings: Rhythm and Mode. These terms are used to differentiate between those factors that relate directly to the method of practice, including the creative process deployed, described as rhythm and those in which colour, pattern, layering, composition are implicit; these are presented as mode. The key issues concerning digital tool use are examined in a section at the end of each report.

Hewett, Czerwinski et al. (2005) stress the importance of understanding the cognitive process before any evaluation of creative digital tool use can occur. The literature review has indicated the significance of memory, of physical experience and learnt knowledge in this process, as well as the influence of cultural factors. For this reason, the following accounts also document the context in which the practitioners work, in order to gain insights into their creative process, facilitating the subsequent appraisal of the impact of digital technologies on their practice.

The chapter concludes with a synthesis of issues arising from the three studies. These findings contribute to those presented in Chapter 6, Findings: Interpretation and discussion, which result

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163 See Chapter 2 section 2.5


165 The word ‘mode’ (from the Late Latin modus) implies a form or manner of expression and a rhythmical scheme; it is used in this context to describe the manner of expression: colour, pattern, and layering that result from the rhythmic process of making work.

166 See Chapter 2 section 2.5
from a synthesis of case study data (comprising the three field studies described in this chapter),
with four practical investigations described in detail in Chapter 5 Investigations.
Chapter 4  

Case Study

4.2 Field study 1: Alison Bell

This field study took place during a five-day period in August 2003, at the artist's studio on the Isle of Arran, Scotland. Data was collected using digital video, photography, and audio recordings of interviews, demonstrations and explanations of work. A reflective journal including sketches, photographs and notes was also started at this time and provided information used later in the collaborative investigation with Bell. The procedure used followed that outlined in the Case Study Protocol\(^\text{167}\) described in Chapter 3 section 3.4.3. The subsequent sections contain information collated from the recordings made during the field study.

4.2.1 Context

Bell trained initially as a commercial textile and surface pattern designer at Glasgow School of Art and later at Duncan of Jordanstone College of Art; she now works as a textile artist and craft practitioner in her studio in Lagg, Kilmory on the Isle of Arran. After receiving her Diploma in Art and Design and Post Graduate Diploma in printed textile design, she trained as a teacher at Dundee College of Education and has continued to teach, both in schools and adult education classes, since 1977. She has a significant standing as a digital textile artist and her work is held in numerous collections around the world.

Bell was selected as a case study candidate to represent, in the research, the textile artist/craft practitioners' approach to using digital technology for the creation of textile artefacts. Contact was initially made through the European Textile Network\(^\text{168}\), which led to a meeting at the 2003 Surface Design Association\(^\text{169}\) conference in Kansas City, USA. Bell is an active member of both professional associations and is recognised by them as being one of the leading craft practitioners currently working in the digital textile domain. Her digital textile work was selected for exhibition sponsorship by the SDA in 2005\(^\text{170}\) and was supported by the Scottish Arts Council.

Bell's work has developed over the years from decorative and illustrative surface pattern into more abstracted forms. Her textiles reflect her geographic location though subtlety of colour and thematic content. She is both physically and emotionally immersed in the landscape of Arran and this is a continued source of inspiration. She states that:

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\(^{167}\) This can be found in the Appendix A

\(^{168}\) www.etn-net.org (acc. 05.03.06)

\(^{169}\) www.surfacedesign.org (acc. 05.03.06)

\(^{170}\) Exhibited in 'Digital Perceptions' a concurrent exhibition with the SDA 'Uncovering the Surface' international conference, Kansas City Art Institute June 2005
Living on the Isle of Arran has influenced me, in that I am more conscious of the metaphysical qualities of the land and sea, and how this affects the transient way we view the world (Bell 2003).

The technique of hand painting on to silk that Bell has mastered, provides her with freedom and spontaneity\textsuperscript{171} essential to her creative process. Working mainly on silk habotai with both reactive dyes and pigments, she uses direct painting methods with discharge techniques to develop the surface of the cloth. Over the last five years, Bell has begun to work digitally combining digital print methods with direct hand painting. This fusion is now stimulating her to explore and extend her craft through the integration of stitch, three-dimensional relief and a desire to experiment onto new substrates and hard surfaces.

In 2002 Bell received a Scottish Arts Council Training Award for Digital Imaging and, as a result of this, travelled to the Netherlands where she visited the Dutch digital textile artist Wilma Kuhl and the Dutch Textile Museum. It was as a result of this visit that Bell saw the potential for using large format digital printers to develop her work. Using the bureau facility for textile digital ink-jet printing at the Centre for Advanced Textiles at the Glasgow School of Art, Bell was able to explore the technology through the production of a number of large-scale silk printed images.

Other experimental work has been produced using her home computer, standard A4 ink jet paper printer and heat transfer paper that is widely used for producing T-shirt designs. The dense surface quality that this technique produces on fabric and the distortion of the structure of the cloth was explored in her early digital textiles. Further experiments using a pre-treatment chemical enabled her to print on small samples of silk and her current work continues to explore the process of integration of hand silk painting with digital printing; colour being applied at various stages in the production of the printed cloth to create a variety of visual effects.

Bell's creative process is stimulated and influenced by her environment\textsuperscript{172}. The remoteness of the island, its northerly geographical situation and resulting purity of light, its history, nature and culture all have influenced the visual outcomes of the textile art that Bell creates.

\textsuperscript{171} Spontaneous is defined as: 1: proceeding from natural feeling or native tendency without external constraint 2: arising from a momentary impulse 3: controlled and directed internally (Merriam Webster online dictionary)

\textsuperscript{172} Bell states that: 'I draw my inspiration from that great pool which is here....it never runs dry.....I would like to give something back, not to the people but to the place.'
4.2.2 Rhythm

4.2.2.1 Process map

During the field study interview Bell was asked to create a visual description on paper as a means of describing the methodology used in the creative practice (Fig. 4.2). This process map was used as a starting point for a discussion about the influences, practice and outcomes of her creative journey. The diagram produced contains few words, but those that have been used are of paramount importance. They include colour, which is written along the central core of the diagram and curiosity, which has been placed inside a box to highlight its importance. The central strand is branched, each ending with a question mark, indicating the many questions that interrupt, distract and enhance the creative flow. Bell states that it is not these branches that are important to her but rather the rhythm that they punctuate. This is described using a flowing curved line, indicating that the process is not inherently linear or direct; rather it is contemplative, winding and sometimes

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173 It was thought that it might be easier for an artist or designer to make a description of abstract issues via a visual representation rather than using words alone.
Chapter 4 Case Study

slow. The branches are questions provoked by discoveries, which Bell describes as surprises; these are moments of insight that punctuate the rhythm as it develops. The whole creative process is described by Bell as 'being driven by curiosity.' It is the element of discovery in the process that drives her creative energy, causing her to explore numerous iterations of an idea.

Fabric painting process is unpredictable, due to the physical movement of the cloth as it is worked and the bleeding of the colours once they are applied. The resulting pattern is not complete until it has been left overnight to dry, during which time the colours continue to change and move on the fabric. Bell is stimulated by the unpredictability of the process and is driven by a desire for new discoveries.

4.2.2.2 Motivation

'The initial spark is usually based on the natural environment... Arran is such a timeless place.'

Bell's visual concepts are stimulated by her environment and the imprint that man has on it. During the video recording of work in progress during the field visit, she returned to a familiar theme of Assyrian art and stone relief, which is evident in many of her pieces. She sees a link between this

Fig. 4.2 Alison Bell: Process map: a diagrammatic representation of methodology © A. Bell

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174 This is due to the wicking process of the textile fibres.
and her interest in the Neolithic standing stones for which Arran is renowned. Bell regards the Neolithic standing stones on Arran as a physical connection with society of the past and has made use of their shapes in a number of her silk paintings (Fig. 4.3 Machrie Standing Stones). The physical presence of the stone circle in a remote field on Machrie moor is dramatic; it serves as an important reminder, to Bell, of the human occupation of the island since pre-Christian times and is a physical historical imprint of mankind upon the landscape of Arran.

Bell regards her work as being linked with map-making since some of her images comprise linear progressions of marks on paper or textile, which she feels leave ‘timeless directions’ (Fig. 4.4 Map drawing). The engagement with map-making appears to reflect a desire to communicate and

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175 During the interview she describes touching a stele patterned with Oghm script in the British Museum and how it felt warm to touch, as if pulsating with the inscribed life of the society who had fashioned it.
participate in the timeless imprinting of human existence in artefacts and surface. Bell records and collates reference material from her surroundings using a sketchbook and camera. Her recent digital work contains images, derived from photographs taken on the Arran shoreline, depicting seabirds, feathers and pebbles.

4.2.2.3 Generative ideas and concept development

'Usually my starting point will be a surface texture of some description, then I move on to the computer and then I would start to play.'

Bell describes the visual starting point for her work as frequently being a found object or surface that elicits a strong emotive reaction. The diagram produced during the interview indicates that the computer plays a key role in the very early development of idea and has been placed almost at the starting point of the journey. Its role is described by Bell as 'being a sort of doodle pad'. She also explains that her original purpose in purchasing the computer was to use it as an electronic sketchbook. Information, in the form of photographs, sketches and pieces of painted fabrics, are

\[176\] In the case study video she describes a journey she made to the remote island of North Uist, in the Western Isles, Scotland, where she made a series of map drawings 'I found myself doing drawings that looked like maps.' The map making came from 'being away somewhere else' and reflecting back on Arran.
scanned into the computer and act as a catalyst at the germinal stage of conceptual development. The computer becomes an electronic melting pot for each stimulant to the emergent embryonic concept, providing a freedom to explore and merge different media, materials and surfaces in a common visual format.

Once the visual data has been input into the computer, the rhythm of conceptual development continues through numerous iterations. Discoveries interrupt the process and prompt new ideas; during the video recording of Bell developing an idea for the Cuneiform image (Fig. 4.5), the eraser tool was used to reveal a vibrant 'electric' red; this has provided impetus for an additional inquiry into substrates and materials in order to reproduce the colour. This illustrates the branches on the diagram that culminate in question marks; moments of insight that provoke questioning and lateral thinking within the overall conceptual framework.

4.2.2.4 Making and materials

Bell describes materials as becoming important in the creative process once the concept has been developed into a visual format on the computer. On the process map (Fig. 4.2) these were placed at

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177 Germinal stage in the creative process: the point at which initial concepts begin to be generated. See Chapter 2 section 2.4
about the halfway point. Materials also interrupt the creative process providing new qualities to be explored and creative opportunities to be exploited.

To date, Bell has worked mainly on silk fabric, which she describes as being ‘almost alive’ since it physically moves during the application of colour by hand. It is evident from the video recorded data that she derives considerable sensory pleasure from the haptic process involved in handcrafting. Several times during the interview, Bell described herself as being a ‘physical’ person who enjoys tactile experience. The kinaesthetic skills she uses in painting silk provide her work with a freedom of expression in line and colour. This process contrasts sharply with the digital practice in which the image is submitted to a digital print bureau in electronic format and returned as a finished printed textile. For Bell, absence of physical interaction in the process of patterning the cloth was initially inhibiting; she states that she was ‘transfixed by the quality and it stopped me looking beyond it’. When she received her first digitally printed fabrics she described them as being impersonal and lacking the creator’s touch. Her desire to regain a more direct interaction with the fabric surface caused her to explore a method in which silk painting is combined with digital printing.

Fig. 4.6 ‘Berneray Bird’ silk digitally printed silk
Size: 48”x36”
Photo ©CT

She states on the recording: ‘I want to feel the surface react to my touch.’
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She is now exploring additional elaboration of the surface of the image through the use of stitch and appliqué. The image Berneray Bird (Fig. 4.6) was developed digitally from a scanned photograph of a sea bird that had been washed up on the shore and is part of a series of works that explore the photographic image, using a combination of print and hand painting techniques. Bell decided to turn the image on its side and appliqué the red diagonal fabric strips to 'put a surface on top of a surface, providing her with an opportunity to physically interact with the cloth by hand. The resulting image is menacing, dark and confrontational and provokes a quite different visual response compared to other outcomes developed from the same original digital image, for example Bird 3 (Fig. 4.7).

![Image of Berneray Bird](image)

**Fig. 4.7 'Bird 3'- Digitally printed silk**
_Size: approx 50cmx30cm Photo ©CT_

4.2.3 Mode

4.2.3.1 Colour

The unpolluted northerly light on Arran is likely to be responsible for the vibrancy of the observable colour in the landscape. Bell’s own use of colour is striking. She comments on colours used in her work as being ‘Scottish colours’ and ‘heathery.’ These are the intense blues and rich purple hues associated with the mountain landscape and stormy skies, where light is restricted above the horizon but the intensity of colour of the flora is strengthened. Light reflected from the surface of the sea provides an intensity and luminosity to the blues and greens of the coastline and, in summer, the vibrancy of the acid green seaweed is intensified by its contrast with the tonal
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strength of the black volcanic rock. Pebbles, in a vast array of tonal and colour variations, line the shores, as do subtly patterned shells, fauna and bird life.

Crispness, clarity and luminosity of colour are major concerns within Bell’s work. Achieving this colour sensitivity and impact on cloth is one of the compelling motivations that drive her creative practice. Bell regards colour as being of primary importance in her work and it is placed as the central strand in the diagrammatic representation of her creative process. Video documentation from the field study provides evidence that colour stimulates a strong emotive response from the artist, verbally, visually and in her body language. It is the desire to communicate this excitement that drives her exploration of print and painting techniques on fabric.

In work produced prior to working digitally, colour plays a key role in the development of the surface or image. The silk fabric holds the intensity of the colours chosen to convey a particular concept, as the surface of the cloth is smooth and reflective. The dyes\textsuperscript{179} used can be applied to give subtlety of hue and tone in a dynamic way. They are not deliberately controlled in the painting technique, but move while wet, blending and creating new subtleties of hue and saturation as they merge together. Her ability to barely control the colour effect has been developed from her tacit knowledge of how colours interact, developed over a number of years experience of working with the process. The resulting colour effects contrast sharply with the use of digital colour. Bell often combines hand painted sources\textsuperscript{180} with electronic, when working digitally, to provide the unpredictability the electronic medium lacks.

4.2.3.2 Digital colour

Bell enthuses about the luminous quality of the colour she sees on the computer screen but is also aware of the difficulties in translating the digital light emitted colour into a printed colour on fabric. The complications of colour communication, without access to colour calibration equipment, are overcome by allowing the digital colour to stimulate the creative process rather than inhibit it.

Bell’s answer to these issues is to ‘work with it,’ by fine-tuning the image first on the system that is to print the fabric or else through development of the colour by over painting by hand. She appreciates that it may be difficult to produce a specific colour, in order to communicate a desired concept, when working digitally. Analysis of the video documentation reveals how, even at a very early stage in design development, Bell addresses this difficulty, suggesting that colour accuracy might have to be achieved by working back into the surface of the cloth by hand, using dyes.

\textsuperscript{179} Bell uses reactive dyes and pigments.

\textsuperscript{180} This is achieved through scanning hand painted samples into the computer.
An advantage of using digital, compared with hand painted colour is that it is possible to apply light tones on top of darker areas. Light on dark colours can only be produced, in Bell’s silk painting process, using discharge techniques as can be seen in the bleached line around edge in Arran (Fig. 4.8) However, by manipulating the digital image to provide areas of lighter tone that can have colour painted back into them, the two techniques may be combined giving detail and flexibility in the application of colour. Bell uses this technique to extend the way in which colour is used in the images she creates.

Fig. 4.8 ‘Aran’ – silk painting
Size: approx 48”x20”

Fig. 4.9 Digitally printed silk
Size: 60” x12”

The hand rendered technique (Left) does not permit light on dark colour except through the use of discharge technique as in the bleached line around edge in Fig.4.8. Digital printing in Fig.4.9 reveals the amount of detail possible in a ‘light on dark’ digital image. Photos ©CT
4.2.3.3 Colour on cloth

Bell sends her digital images on CD to the Centre for Advanced Textiles (CAT)\(^{181}\) in Glasgow where they are printed onto silk using the Stork\(^{182}\) digital ink-jet textile printer. Test samples provide a limited opportunity to refine the digital colour prior to printing. However, the final result may differ substantially from the original computer image and frequently evolves into a new image through further post-printing application of colour by hand.

Early experimentation with digital fabric printing was confined, through choice, to the use of black and white; colour was applied tentatively over the top. The first examples of this work were produced on Bell’s home printer using heat transfer paper. The tactile quality and distortion that this technique produced was of particular interest to the artist as it moved the surface into relief and three dimensions. The application of the pre-treatment Bubble Jet Set®\(^{183}\) to the fabric, prior to direct printing through the home computer printer, produced a detailed image with better handling properties and provided a means of printing in colour. However, these colours were light fugitive and therefore not practical for producing saleable artwork.

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181 Centre for Advanced Textiles, Glasgow School of Art.

182 Information can be found on: http://www2.stork.com (acc. 05.03.06)

183 Bubble Jet Set® is a product that is applied in solution to the surface of the textile substrate prior to ink jet printing using conventional inks. The product provides adhesion of the dye product to the substrate so that it can be washed. The colours however, are light fugitive.
Bell’s first experience with the large format digital inkjet printer at Glasgow CAT was in the production of a four-foot silk digital print of a black and white photographic image of a dead seabird. The result was a detailed image that she felt was ‘too perfect’ and incapable of further development. She attempted to reassert her authorship by flooding a red dye over the whole surface, describing this process as ‘contamination’. Bell’s digitally printed fabrics produced immediately after this, comprised tonal images into which colour was subsequently applied by hand. This enabled the artist to focus on the creation of digital line-work and detail that she was unable to achieve via other textile print processes.

Colour was re-introduced into later digital printed work through the use of the artists’ own scanned textiles, as in OK Silk Reels18 (Fig. 4.10). The synthesis of processes used in the Berneray Bird pieces (Fig. 4.6 & 4.7) are perceived by Bell as being pivotal, revealing the successful amalgamation of hand and digital colour.

4.2.3.4 Layers and illusion

Bell’s digital images reveal the development of themes and imagery through the integration of layers of line, pattern and colour. This involves physical layering of fabric or paper images that are scanned into the computer and combined with virtual layers of pattern, line and colour. These physical and virtual layers echo those of thought and meaning which are simultaneously embedded into the image. An example of this was recorded during the development of the Cuneiform image (Fig. 4.5). This image incorporates a layer of scanned hand painted fabric, included for the colours that evoke the Scottish landscape, beneath a section containing a piece of cuneiform writing taken from an image found on the Internet. The two layers combined communicate the evolving link in the artist’s mind concerning the imprint of humanity on the landscape: colours evoking landscape and line-work, human history. The inclusion of the scanned imagery in the top layer evokes a different geographic location, providing a sense of personal history, a trapped memory within the virtual layers.

The use of layering within the creation of this image also provides greater freedom in the marks that build it. The scanned image is described as being ‘painterly’ and is in contrast to the sharp line work created using the graphics tablet and pen a few minutes later. Also documented on the field study video, is the creation of an image that combines Assyrian imagery with a photographic texture of grasses on the beach. The poor resolution of the image captured from the Internet causes irritation to Bell when it is compared with the stark, detailed, linear texture of the grasses. These

184 In describing these textiles, Bell comments: ‘I feel I am starting to bring together painting and printing and make them mine.’
exist on two different virtual layers but their lack of similarity in resolution creates tension within the combined image.

Bell is interested in the illusion of surface and has created a number of pieces of digital work that explore this theme, including *Catknit* (Fig. 4.11) which was an early digital piece, produced by scanning a piece of knitted textile. The enlarged scale of the final print produced an image that suggested that it had been knitted rather than printed; the illusion of the surface evokes a different material - wool rather than silk.

![Fig. 4.11 'Catknit'- digital print onto silk from scanned knitting](image)

Size: 60"x72"

*Photo ©CT*

4.2.4 Digital tool use

4.2.4.1 Drawing and lines

Bell originally purchased her computer with a mouse and scanner as the means of inputting visual and hand rendered data. Finding that she could not make the marks she needed using the mouse,
she acquired a Wacom® graphics tablet and pen for drawing. Although she considers that this lacks the friction of pencil on paper, it does provide greater freedom and flexibility in the physical movements required in creating line work on screen. Bell frequently commented, during the case study, on the importance of lines in her work and their role in building images and surface. Using Photoshop® software, images are developed from scanned painted surfaces or photographs integrated with line work. The software enables linear marks to be developed quickly into brushes, which can be used to create painterly areas of colour.

The video recording highlights how, by developing the image using digital tools, discovery gives rise to moments of epiphany that interrupt the rhythm of the creative process. These moments inspire new directions and ideas concerning the development of the whole piece, causing Bell to reconsider the printed image and its physical development. These interruptions in conceptual flow suggest that the computer enhances lateral thought within the design process. Bell makes a comparison with pre-computer use when both the making and decision-making process was slower and there was less opportunity for lateral thinking. The computer does not therefore make the whole process quicker for Bell, but provides new directions to be explored within the rhythmic creative process.

4.2.4.2 Virtual layering

The Photoshop® software provides a history of digital activities as a series of virtual layers; it is possible to interact with earlier renderings at any stage in the process of making. This interactivity within the image building process, contrasts sharply with the hand silk painting technique that is difficult to change or erase once the colour has been applied. Once several layers have been built up in Photoshop®, the use of some of the digital tools, such as the eraser or clone device can provide a degree of spontaneity in creating the digital image. Bell craves the unplanned effect in her work and uses the software to contrive the moments of unpredictability she needs.

4.2.4.3 Visual language

Bell describes the computer as enabling her concepts to become ‘instantaneously visual’ providing her with stimulation that enables her to begin to ‘trigger the next possible potential steps, instead of

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185 Bell comments: “See this thing I have about doing lines, I don’t know why I just can’t stop it.”

186 Merriam Webster dictionary defines epiphany as: a usually sudden manifestation or perception of the essential nature or meaning of something; an intuitive grasp of reality through something (as an event) usually simple and striking; an illuminating discovery. www.m-w.com (acc.05.03.06)
drawing and painting it'. She claims that it has extended her visual language with regard to ‘colours, textures, surfaces, and subtleties’.

The perceived perfection and anonymity of her early large format digital printed fabrics, has encouraged Bell to try to integrate the digital process so that it appears almost indistinguishable from the hand painting. The new type of imagery that is possible with digital printing is providing new direction in her working method. The detailed tonal and photographic representations that characterised her early digital work are being developed into more complex images consisting of new qualities of line work, texture and subtlety of colour that would be difficult to achieve without the integration of digital technology with textile craft skill.

187 In the field study video, Bell describes how the computer has provided her with a 'totally new visual language' which is 'full of words that I didn’t know existed'.

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4.3 Field study 2: Debra Bernath

This field study was carried out in May 2004 and followed the Case Study Protocol\textsuperscript{188} described in Chapter 3 section 3.4.3. Video, audio and photographic recordings were made at the designer’s studio in Brooklyn, New York, and visits were also made to several Manhattan fashion textile design studios where Bernath works as a freelance designer\textsuperscript{189}. It was not possible to document these visits with video or photography due to confidentiality and intellectual property issues, which are of particular concern to the fashion industry where the originality in design concept is of high economic value. Employees were, however, happy to discuss the use of technology within the design process. Brief notes were made on site and retrospective accounts were produced as soon as possible after the meetings. This data has been incorporated into the field study report.

A research journal containing photographs, sketches and notes was also developed during the field study and formed the basis for the collaborative development of textile art pieces made during the investigation. This is documented in Chapter 5 sections 5.2.4 and 5.2.5

4.3.1 Context

Debra Bernath is a textile designer based in New York, USA. She was selected as a case study candidate to represent the approach taken by a designer for industry, using digital imaging technology within the textile design process. Contact was first made with Bernath following recommendation from Craig Crawford, Director of Technologies at Liz Claiborne Inc., New York, at the Surface Design Association Conference in Kansas City in 2003. An initial informal meeting took place with Bernath during this conference and plans were made for the field study visit through correspondence over the following ten months.

Bernath divides her time between freelance practice, based in her Brooklyn studio, and digital design consultancy work for a number of leading fashion textile studios in New York, including Liz Claiborne Inc., Gap Inc. and Danskin Inc. After gaining considerable experience working as a full-time studio designer for the fashion industry, Bernath chose to work as an independent freelance designer. This provides her with the flexibility and freedom to now work innovatively on her own design concepts. The studio design work affords her access to the technology and trend information available only to those working within larger companies. She also creates ‘free expression’ textile art pieces that are complementary to the commercial design work that takes up the majority of her time. These provide her with opportunity to explore new concepts, materials

\textsuperscript{188} The protocol can be found in Appendix 3.1

\textsuperscript{189} These included design studios at Liz Claiborne Inc., Gap Inc., Banana Republic (a subsidiary of Gap Inc.) and Danskin Inc.
and forms, which expand the visual language that she is able to use in commercial design work. This is explained further in section 4.3.3.3.

Bernath graduated in 1988 with a Bachelor of Fine Arts degree from East Carolina University, focusing on textiles, surface pattern design and weaving. Following her graduation, she was employed as an apprentice textile designer in The Fabric Workshop in Philadelphia, Pennsylvania, where she gained experience in textile printing and expertise in the archiving of fabrics and artwork. Following this she moved to New York where she worked as a studio designer for a number of companies producing designs for the fashion industry. In 1993 she was employed as a senior designer at Liz Claiborne Inc. where she worked full-time for five years and continues to be employed on a part-time basis. Her senior design position involved the production of traditionally hand rendered artwork, development of coordinate prints, knits, yarn-dyes as well as research and communication in-house\(^{190}\) of current textile and fashion trends. Her role also required liaison with manufacturing suppliers and supervision of other designers. In 1995 Liz Claiborne Inc. began to invest heavily in Computer Aided Design\(^{191}\) and Bernath was given the opportunity to be trained in the use of U4-ia\(^{\text{®}}\) textile design software\(^{192}\). During her period of full-time employment, Bernath continued to use both hand rendered and digital design processes, but by the time her full-time contract terminated in June 1998, design working methods had become totally electronic\(^{193}\).

Acquisition of digital textile design skills, at this early stage in her career, may account for Bernath's self-assurance in using digital tools. She is one of the few practitioners interviewed for the project that has expressed confidence in their use, and regards computer aided design as an integral part of her creative process for both commercial design and textile art. Bernath first acquired her own personal computer when she moved to a one-room apartment in New York. The lack of physical space for working with wet media influenced this decision and she purchased an Apple Macintosh\(^{\text{®}}\) computer (Mac) running Photoshop\(^{\text{®}}\) and Illustrator\(^{\text{®}}\) software. She attended evening classes in Photoshop\(^{\text{®}}\), Illustrator\(^{\text{®}}\), Painter\(^{\text{®}}\) and Quark\(^{\text{®}}\) at the New School of Social Research in New York whilst working as a studio designer at Liz Claiborne Inc. during the day. She states in the field study interview, that she did this out of her 'own personal interest in

\(^{190}\) Within the Liz Claiborne Inc. company

\(^{191}\) When Craig Crawford joined Liz Claiborne Inc. from Gap as Director of Technologies in 1995, his remit and vision was to integrate the design and manufacturing process through computer technology. By 1998 Liz Claiborne was cited as one of the most innovative users of CAD technology with a team of forty-five CAD textile and graphic designers, one of whom was Debra Bernath. Griffin, T. (1999). "Fitting today's new form: computer aided design at Liz Claiborne and Parsons School of Design." Artbyte 1(6): 68-71.

\(^{192}\) U4-ia\(^{\text{®}}\) is one of the most widely used textile design software packages used currently in the textile and fashion industry.

\(^{193}\) "I still continued to paint up to the very time that I left the company. I believe that when I left they took the very last drawing table." Bernath, D. (2003). Email interview about CAD. C. Treadaway. New York.
computer design'. At this stage in her career, the only design work that she was able to produce on an independent freelance basis was digital, due to the size limitations of her workspace.

Bernath was unable to purchase the expensive U-4ia® design software she had used at Liz Claiborne Inc. and so adapted her use of Photoshop® for creating textile designs. At the same time she took classes in Pointcarre®, another textile specific software that was originated for knit design. The advantage, to Bernath, of these software applications is that they run on a Mac based platform, unlike the Windows® based U4-ia®, which she regards as less intuitive to use. Between 1999 and 2000 she was able to consolidate her expertise with the Pointcarre® software whilst working at J Crew Inc., in New York, as an apparel textile designer.

Bernath continues to make use of a combination of hand rendering techniques, computer aided design, scanning and digital photography to generate artwork. Her studio is designed so that she is able to move freely between electronic and non-electronic techniques (Fig. 4.12). Her Mac based computer system runs Photoshop®, Illustrator® and Painter® software and has scanner, digitising tablet and pen for data input. Paper hardcopy is produced from two high quality Epson printers that have been calibrated to translate colour accurately from her computer screen.

The studio space, equipment and materials which fill it, are indicative of the importance Bernath ascribes to the process of making by hand, and the way in which ‘free expression’ informs her digital craft.

Fig. 4.12 Debra Bernath in her Brooklyn studio
Photo ©CT
4.3.2 Rhythm

During the field study interview, Bernath described three different approaches to her design method: the studio design brief, the freelance commission, and free expression to create art pieces or speculative freelance work. The approaches differ in the way in which concepts are generated and the type of work that is created, nevertheless, it is evident that both the use of technology and making by hand has reciprocal influence.

4.3.2.1 Studio design brief

‘For industry you have to let go of perfection.’

Bernath is employed three or four days each week by one of a number of commercial fashion textile design studios in Manhattan. During the field study period she was working at Liz Claiborne Inc. where she has a regular contract for studio design work.

Although it was not possible to document the work in progress, it was evident from observation during the visit that the studio design brief was restrictive, specific in nature and the work algorithmic and largely uncreative. Much of the innovative visual concepts are not created within the studio but are purchased from agencies who sell work for freelance designers. The CAD studio designer’s role is to clean up artwork, make repeats, colour reductions, colourways and coordinates. Sometimes the work involves the creation of mood boards and visualisation schemes using mini bodies for marketing and in-house decision-making. The work that was observed in progress within the studio was largely concerned with the latter.

The Liz Claiborne Inc. design studios are equipped with PC’s running U4-ia® software and are networked throughout the company. Several large format Iris paper printers are available for output as well as a number of ink-jet fabric printers for sampling. Technical help is at hand at all times and the CAD Technologies Department is constantly undertaking trials of new software and developing and supporting the CAD expertise within the company.

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194 Algorithmic processes involve well-defined instructions for accomplishing some task and are in contrast to heuristic or creative processes. Amabile draws a distinction between the two types of thinking in Amabile, T. M. (1996). Creativity in context: update to the social psychology of creativity. Boulder, Colo.; Oxford, Westview Press.

195 This involves the elimination of stray pixels as a result of scanning, colour reduction etc.

196 Mini bodies are outline shapes of garments that are filled with rescaled surface pattern in order to visualise a textile design on a garment. Sometimes this also involves pattern placement or the creation of engineered prints.
Bernath also works regularly for the Banana Republic design studio, which like Liz Claiborne Inc., is based in the Garment District of Manhattan. This company was also visited during the field study and the use of photography was again prohibited. The design studio space at Banana Republic is compact with five PC workstations running U4-ia® software and an adjoining room containing a single Iris printer. The company also works with out-sourced design concepts purchased from agencies and studio designers work to very rigid direction and time deadlines. The dissatisfaction with the working method was evident from those interviewed; they expressed concerns about the lack of creativity afforded studio designers. The design methods used were similar to those observed at Liz Claiborne Inc. and consisted of refining scanned artwork, colour reduction, making repeating patterns, and colourways.

4.3.2.2 Freelance commission

Bernath works with a number of companies who commission her to create apparel designs on a regular basis. This freelance work is completed in her studio in Brooklyn between the periods of employed studio work in Manhattan. Over the last three years she has worked on a number of commissions for H. Greenblatt in New York, producing textile designs mainly for swim and leisurewear (Fig 4.13).

![Fig. 4.13 Digital design for children’s swimwear](image)

Photo ©CT

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197 Banana Republic is part of the company that also includes Gap and Old Navy.
Generative stage

When asked to explain the generative stage in her design process, Bernath described the design method used, citing work produced for H. Greenblatt as an example. She is clear that her process of originating design concepts, when working on a freelance commission, differs from that used when creating freelance work to sell speculatively or when she is involved in free expression\textsuperscript{198}. Freelance commissioned work involves verbal briefing from a client, including suggested themes, but without specific direction or guidelines. The computer plays an important part at the generative germinal stage to explore the themes, often via images on the Internet or on CD clip art. Although the freelance commission brief is described as being ‘open’ it is evident that even at this early stage of concept development the constraints of product, manufacturing process and client are filtering the choice of visual information.

Bernath believes that the definition of the parameters of a commission should not be the sole concern of the client but that it is a designer’s responsibility to ask the right questions so they can be clearly outlined before research begins\textsuperscript{199}. The early definition of parameters saves time and provides the criteria for the selection of appropriate visual material with which to work.

Organisation of visual material

The sifting of generative visual material in electronic format is aided by the designer’s tacit knowledge of product and client. The computer facilitates rapid groupings and storage of these visual stimuli and Bernath makes use of iPhoto to organise her images\textsuperscript{200}. She views organisation, rationalisation and storage of imagery as a vital component of the early stage of conceptual development; using work on CD and ‘trashing’ irrelevant or obsolete material to provide clarity of thought as well as keeping vital image processing space free on the computer. The virtual library of selected images found on the Internet is enriched with clip art, digital photographs, and scanned imagery including reference material in the form of antique fabrics forming a virtual sketchbook. Many of these images are printed onto paper as well as filed on the computer at an early stage in the design process.

Design development

Bernath carries out all the design development work on the computer. She finds that it speeds up the process of manipulation of imagery and facilitates rapid experimentation with repeat structure

\textsuperscript{198} Free expression is a term that Bernath uses frequently to describe the artwork she creates which is not directly connected to her design practice.

\textsuperscript{199} Bernath states, ‘my job is to pose the questions...my job is to find out what the restrictions are’.

\textsuperscript{200} iPhoto is software that comes as standard on the Mac OS10 operating system.
and colour changes. Time is a major factor in the design development process and she comments: ‘...it’s an economic thing...I have to think about time and I have to have some structure’. One of the most time intensive parts of the process is the cleaning up of scanned artwork and Bernath states that she is ‘always trying to find a faster way to execute it’. This can take up to eight hours to complete, but once finished, the potential for producing numerous iterations, changing repeat and colour, can be swift. Colourways and coordinates are also frequently required to accompany design work and are produced much more quickly digitally than previously possible by hand.

The parameters of the project shape each stage of the design development process. The knowledge of customer requirements, as well as the tacit knowledge of pattern positioning on a garment, scale, and type of repeat structure, affect the experimentation with ideas. Bernath often works on several different design concepts at the same time, building each one in turn and saving it on the computer in layers. This she finds is very useful in helping to avoid over working a concept and provides reflection in the process without wasting time. Bernath describes herself as ‘one of those designers who likes to give options,’ providing the client with several alternative design concepts which may comprise a selection of layers that build the design. She believes that this helps the client to visualise and articulate their requirements more clearly and they are usually satisfied with making a choice from what is provided (Figs. 4.14 & 4.15). Decisions made by the client at this stage are often quite subjective and are unlikely to be anticipated by the designer.

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*Fig. 4.14 (left) & Fig. 4.15 (right) Digital designs – alternative concepts on the same theme*
*Photo ©CT*
For commissioned projects, working digitally has obvious benefits for both the designer and client; it provides clear visualisation and rapid proliferation of design concepts.

4.3.2.3 Speculative freelance work and free expression

When working on speculative freelance textile design work, a less restrictive approach is taken to the design process\(^{201}\). Although there is a sense of liberation from industrial and trend constraints, the tacit knowledge formulated during the other design work influences decisions and processes. The nature of the generative idea is described by Bernath as being 'poetic,' and emanates from source material that is not necessarily visual, but may comprise music or words; film, photographs, doodles or the process of physically making with the hands may stimulate ideas.

Bernath regards the sense of touch as being vital in the creative process, but difficult for her to embrace in digital work. Her previous experience in fine art and weaving is evident in the three-dimensional sculptural work that she is currently making (Fig. 4.16). She feels that it is important for her 'to be creative inside and outside the box' and, after spending many hours on the computer, she finds she relishes the physicality of creating with her hands in three dimensions. Sometimes the forms she builds act as inspiration for design work and are photographed and explored using her digital design process. Periods of play or doodling using software, notably Painter\(^{®}\), can also be productive sources for generating new design concepts.

\(^{201}\) Trends and production constraints are not made a priority as they are in commercial studio practice.
Although clearly regarded as two separate working methods, Bernath is able to move between digital and physical crafts with ease and exploits and combines both to innovate and develop design concepts. When working digitally she is able to explore ideas rapidly, including those that may have been neglected in pre-digital work, due to the time required to execute them. The computer is described as being 'additional to,' and 'an extension' of her sketchbook.

Bernath explains the major difference between her various working methods as being 'a relationship thing'. The studio and commissioned work evolves from well-communicated guidelines that act as a framework for the creative inquiry and generative thought. In speculative design work and the 'free expression' three-dimensional artwork there is no building of relationships involved, only the communication by the artist of the sensuous response to her 'inspiration' and materials.

4.3.2.4 Process map

When Bernath was asked to draw diagrammatic representation of her design process she produced instead two lists of short sentences, defining the stages that she regarded as important and in their likely order of occurrence (Fig. 4.17). The two columns are headed Commercial Originals and Individual. Between these two, but adjoining Commercial Originals, is the word Speculative. These two columns relate to the production of freelance commission work described in section 4.3.3.2 and speculative freelance work (section 4.3.3.3) that is produced with no particular client in mind. Both of these approaches contain creative limitations due to the print process used in manufacture of the designs. The column headed Individual contains words and short phrases that describe how this creative approach is influenced. The clear separation of the two columns indicates the important difference, in Bernath's perception, of the creative processes involved.

The process map does not emphasise the use of technology but is implicit in the process described. In the Commercial Originals column, the idea generation stage includes using the Internet and images on CDs to gather visual ideas and the final stage includes scanning of hand rendered artwork but this is qualified by 'sometimes'; the work is predominantly carried out digitally. The list concludes with the statement: 'has boundaries, have to consider trends and colours - customer'. This is in contrast to the Individual column, which contains the words 'what I like', the process is subjective and involves personal expression evident in the choice of words: 'see, seeing, sense, feeling, tactile'. Bernath describes the use of technology within this process as being 'more of a camera' and is used to compose images. The word colour is underlined twice to emphasise its importance; shape is also noted and underlined. An important aspect of the Individual column is
Bernath’s reference to the need to express ‘feeling’ and ‘a sense of my body’. Technology is used to capture hand use in other media within the evolving design concept.

### Commercial Speculation
- Gather trends for ideas
  - Client will suggest trends
  - Movies, mag, news, foreground
  - Internet, online, gossip

- Gather material research
  - Mag, cos, internet, library

- Start doing it

- Make little stories - a collage

- Sometimes draw, sometimes trace, sometimes scan, paint

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### Individual
- More loose - what I like more poetic
  - Reading, words, tactual

- Color, shapes, material

- Sub need to express
  - The feeling I see

- Sense of my body

- Technology is more
  - Camera - which I

- Compose my image

- Write a lot about ideas

- Seeing art will inspire me

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Has boundaries, have to consider trends of colors *customer*

---

**Fig. 4.17 Debra Bernath: Process map**

©D. Bernath

### 4.3.3 Mode

#### 4.3.3.1 Colour

Textile design work produced for the fashion industry is generally expected to adhere to the predicted market trends\(^\text{202}\). Bernath’s understanding of colour predictions is developed through her commercial studio work and informed by those customers for whom she undertakes commissioned projects. Her tacit knowledge of the evolving seasonal trends inevitably filters into all aspects of her work. She describes herself as being inherently good with colour and regards this as being an important personal characteristic of a successful textile designer. Tacit knowledge of materials, products and manufacturing techniques also modify the way in which colours are used in building design concepts. Colour reduction techniques play a large part in studio design work (Fig. 4.18).

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\(^{202}\) An example of these can be found on [www.wgsn.com](http://www.wgsn.com) (acc. 05.03.06)
An understanding of the rationale for this, and a sensibility to the way in which reduced colours work together visually, has no doubt provided Bernath with confidence in selecting and arranging colours in her work.

Communication of digital colour does not pose a particular problem to Bernath. The computer screen she uses is not colour calibrated, however, she has established a good colour relationship between it and output from her two Epson 1280 printers, using software profiles. Rather than relying on the perceived on-screen colour however, she has a pre-printed colour atlas\footnote{A colour atlas is compiled from colour chips printed from a particular system and used as a reference manual for further colour selection and correction.} from which she selects the colours she wishes to use. The atlas comprises colour chips containing 100% hue saturation of the printer’s complete gamut as well as additional shades and tints. These colour chips

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**Fig. 4.18 Colour reduced artwork with pantone colour chips**

*Size: approx 24cm x 36cm*

*Photo ©CT*
can be used in conjunction with Pantone\(^{204}\) colour identification (Fig. 4.18). All artwork is supplied to clients in both printed-paper and digital format so that colours can be modified further in-house if required.

Bernath is pragmatic when commenting on the colour restrictions she faces when working on studio and commissioned work. She describes how ‘sometimes the aesthetic gets sacrificed’ when images have to be colour reduced to meet production demands.

4.3.3.2 Pattern and repeat

Studio and commissioned design work is largely concerned with the development of imagery into appropriate repeat structures or the engineering of pattern or image into garment shapes. Bernath’s tacit skill in making repeat structures has developed through her years of experience in developing artwork for industry and she recognises this ability as one of her key strengths as a designer. The computer is a useful tool to speed up this process but requires the designer to have a developed sensitivity to recognise a flaw in a repeat structure and a tacit understanding of how to create flow and balance within the design.

Repeat structures are also important to Bernath when exploring design ideas that result from free expression. Doodles, paintings and scanned hand rendered artwork are frequently explored digitally in different repeat structures. This exploration of ideas was inhibited in pre- digital work due to the time involved in testing and rendering suitable repeat structures by hand.

4.3.3.3 Motifs and techniques

The majority of textile designs produced by Bernath for the apparel industry are floral reflecting the predominance of this type of design in the market. Having focused on hand rendering of floral subject matter at the beginning of her career, she has developed considerable skill in the execution of colour reduced\(^{205}\) painted floral artwork (Fig 4.19).

\(^{204}\) www.pantone.com (acc.05.03.06)  
\(^{205}\) Colour reduced artwork is produced to eliminate colours in a design to be manufactured via screen based textile printing methods. Skill is required to maintain the integrity of the image whilst reducing the number of colours needed to reproduce it.
Her work as a studio designer, concerned with scanning and cleaning up other designers’ artwork, has no doubt enhanced her vocabulary of rendering techniques and given her competence in the use of floral imagery within repeating pattern structures. The use of digital techniques has enabled her to combine painted and photographic floral imagery and the layering of these within a single design.

4.3.3.4 Layers

One of the advantages of working digitally is the ability to use layers design development. The opportunity to save work at various stages, in layers, enables intervention into the format, structure and colour within a design so that multiple solutions can be developed from a single generative idea (Fig. 4.20) Layering of motifs also enables rapid colourways to be produced with ease.

At the research stage, images from multiple sources: the Internet, scanned artwork, photographs, electronic doodles etc. are layered together to form storyboards to stimulate visual concepts. Once
designs begin to be developed, these images are often layered and blended together enabling a single image to emerge from numerous visual starting points.

Fig. 4.20 Use of layers: providing multiple design solutions  
(Left) scanned tied dyed fabric background (Right) addition of floral motifs to background  
Photo ©CT

4.3.4 Digital tool use

4.3.4.1 Hand use

Bernath comments on how important hand painted work is to her on a number of occasions during the case study interview. Although having invested heavily in computer technology, she states that she has ‘never gotten rid of my paint boxes...I feel like that’s my soul’. She often refers to herself as being ‘a painter’ and has expressed regret at the demise of the use of paint and hand rendered work when digital technology was introduced into the design studio at Liz Claiborne Inc. (Bernath 2003). Hand painted croquis and backgrounds are often scanned in to the computer and integrated into digital work. Fig. 4.20 shows development of a design idea from a scanned background and the later addition of floral motif; Fig. 4.21 contains scanned hand coloured fabric. This technique is used to inspire new creative directions or break out of fixed ideas in design construction.
Bernath makes use of both hands when working digitally, using her right hand to draw with the digital pen and left to operate ‘hot keys’\textsuperscript{206}. She occasionally uses her left hand to operate the pen as this gives freer expression to the marks she is able to produce. She also works this way when her hands get tired from over use.

4.3.4.2 Digital tools

A clear preference for drawing with a digitising pen and tablet rather than a mouse is expressed; she states ‘I have to have that feeling of drawing’. The mouse is used exclusively for ‘more automatic things...for when I only have to click’. Bernath comments that from her experience, digital artists who prefer using a mouse tend to be those who have not drawn with traditional tools before working on the computer.

The size of the digitising tablet is also regarded as being vital in providing a fluid means of drawing digitally. Bernath initially purchased a larger one, thinking that she would require physical space in which to move her hand and arm. This did not prove to be the case and it has now been replaced with a smaller version. Bernath’s explanation is that the physical movement is awkward and the space required needs to be small due to the limited movement on the computer screen, ‘it’s a

\textsuperscript{206} These are combinations of keys which shortcut menu selections.
disconnect and its uncomfortable'. It is suggested that the disparity is also linked to hand eye coordination\textsuperscript{207}.

Advances in the design of both peripheral drawing tools and software were commented on during the interview. The pressure sensitivity of the digital pen and corresponding software additions has made its use more responsive as a drawing tool. She expressed optimism that technology would continue to develop, emulating more closely conventional art tools, which are able to provide sensory feedback. The importance of making by hand, physical tool use and hand-eye coordination were mentioned throughout the interview and video recording of work in progress. It is evident that, for Bernath, handcrafting skills provide an important source of stimulation within her creative process and are particularly important at the generative stage.

4.3.4.3 Software
Bernath develops most of her commissioned and freelance design work on Photoshop® although she finds that is not ideal software for textile design. She has developed her own personal working process with the software and is confident in its use as a tool within her practice. Bernath is the most adept and competent in the use of Photoshop® of all those practitioners interviewed to date for the project. She is constantly updating her skills and makes use of short courses and seminars available, at no cost, at institutions in New York.\textsuperscript{208}

Most of the design studio-based work is done on U4-ia® working on PCs and Bernath describes this software as being 'the big one'. Although she was trained on U4-ia® and uses it extensively in her employed work, she admits to finding the PC platform difficult. Criticism is also expressed concerning the visual layout of the software and inability to minimise menus and maximize working area on the screen. She believes that the ubiquity of U4-ia® in the industry is due more to marketing than to any particular advantage within the software. When questioned about repeat functions she did acknowledge that the software is advantageous when being used by CAD operators who had not been trained as textile designers due to the embedded knowledge of repeat structures that it contains.

The complexity and number of software packages Bernath is able to use, necessitates constant refamiliarisation, so that fluidity of use is maintained. For this reason, she is eager to maintain her

\textsuperscript{207} In physical drawing the eye watches the movement of the hand and arm, the movements are connected and information is transmitted both ways by the brain. In digital tablet use the eye is gazing at the monitor in a different location. The feedback loop of eye, hand arm and brain becomes interrupted and therefore feels uncomfortable. McCullough, M. (1996). Abstracting craft: the practiced digital hand. Cambridge, Mass.; London, MIT Press.

Manhattan studio-based work within fashion houses that are able to supply access to the latest technology.
4.4 Field study 3: Susan Brandeis

The final field study took place in May 2004 in Raleigh, North Carolina, USA and followed the structure outlined in the Case Study Protocol\textsuperscript{209} described in Chapter 3 section 3.4.3. The interviews and video documentation of work in progress took place in two locations: the artist’s studio in Carey, near Raleigh and at the North Carolina State University, College of Design and College of Textiles.

During the five days of the field study research, photographs, sketches and notes were made in a research journal and these have been used to develop artwork in the collaborative investigation with Susan Brandeis described in detail in Chapter 5 section 5.3

4.4.1 Context

Susan Brandeis is an experienced and highly respected educator and textile artist, who is recognised for the integration of digital technology in her practice. She was one of six artists featured in the ‘Technology as a Catalyst’ exhibition, held in the Textile Museum in Washington in 2002\textsuperscript{210}. Her digital textiles and contributions to the debate on the place of computer technology within textile art practice have featured in both journal articles and conference presentations\textsuperscript{211}.

Brandeis’ selection as a case study candidate followed several months of correspondence culminating in a meeting at the 2003 Surface Design Association conference where she made a presentation on digital technology and textile design. Correspondence continued over the following months in preparation for the field study visit in May 2004.

In 1971, Brandeis graduated from Indiana University with a Bachelor of Arts degree, which was followed by a Master of Science in Art Education from the same university in 1979. In 1982 she received a Master of Fine Arts degree in textile design and fibre art from the University of Kansas where she later taught for just over a year as a teaching assistant. She moved to North Carolina in 1982 when she was appointed to teach textiles at the College of Design at North Carolina State University. She currently lectures at numerous Schools of Arts and Crafts across the USA as well as being a very active and influential member of academic staff at North Carolina State University.

The university recognises Brandeis' high profile within the field and is very supportive of her textile making, both in the acquisition of her work for the NCSU art collection and in the access

\textsuperscript{209} The protocol can be found in Appendix 3.1


that is provided to materials, technology and technical support staff. Although based in the College of Design, she has free access to the industrial facilities within the College of Textiles at NCSU, including materials, textile processing equipment, digital printers and computer access with technical staff support. It could be argued that the access to both technology and technical expertise has influenced the way in which digital imaging has been readily incorporated into her work.

Recent surgery on her hands has been a major influence in the inclusion of digital imaging in her working process. The opportunity to digitally print fabrics has enabled her to continue to work through a period in her life when the physical demands of silkscreen printing would have made this textile process impossible. In the recorded field study interview she comments on how the ‘physical trauma of screen printing large pieces of fabric which is very damaging to the arms, shoulders and hands’ led to the substitution of silk screen by digital print process in 2000.

The computers are networked internally within NCSU. They provide access to a number of software packages including Photoshop® and are linked to the workstations running the RIP software for the Stork Mimakel textile digital ink jet printers. Access is also provided for the processing and finishing of fabrics within the textile department.

![Image of Susan Brandeis at her computer.](https://example.com/susan-brandeis.png)

*Fig. 4.22 Susan Brandeis, College of Textiles, North Carolina State University  
Photo © CT*

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212 Her work on the computer is currently assisted by Lisa Perrillo-Chapman who is a PhD student working on a digital printing research project within the department.
Brandeis’ passion for materials and making lies at the heart of her creative process, she states that ‘the work is not all in my head it is in my heart and hands as well’. She has no desire to intellectualise her work, which she perceives as being poetic and romantic in its visual qualities, and describes herself as straddling the disciplines of art and craft. It is the material and the textile processes she uses that are her source of inspiration; her aim is to respond to specific visual and physical properties of a material, perceive what it is capable of communicating and then enter a dialogue with it. She sees textile-crafting skills as being key to this process and her aspiration is always to create an object of beauty.

Nature is the main theme in her work and her intention is to describe it through the textile medium. Much of the work involves the expression of multiple simultaneous sensuous responses to a given geographic location and is based on fieldwork carried out in various locations in the USA. Colour and texture are particularly important in this respect.

Music plays an important part in supporting Brandeis’ creative process by stimulating a mood for the pieces that she is working on and maintains focus on the communication of her concepts. During the creation of Discovered Secrets (Fig. 4.23) and Messages from the Past (Fig. 4.24), based on visits to petroglyph sites and ancient cliff dwellings, she played Native American music while she worked.

\[\text{215 Brandeis states that her creative stimulation emanates from ‘intense visual experiences of the Earth and its natural phenomena- everyday experiences elevated and intensified’ Brandeis, S. (2004). Tyndall Galleries Personal Profile.}\]

\[\text{214 She states: ‘I am more often moved by music than I am visual art...I suspect the rhythms and nuances of music do influence me, but I can’t always say just how’ (Brandeis 2003).}\]
Brandeis describes her working method as often being intuitive, 'it is driven from within and is highly irrational and illogical' (Brandeis 2003)\textsuperscript{215}. However, her teaching experience has contributed to the development of a reflective and cognitive approach to her own practice. Although she uses a variety of methods, her creative process is ordered, logical and well defined. It is evident that the reflective approach required for analysing and describing processes in her teaching has been instrumental in the development of her methodology. She is able to define clearly these stages as can be seen in her process maps (Figs. 4.25 & 4.26).

Hand use and the sense of touch are of paramount importance to Brandeis. She believes that tactility is essential in the initiation of her design development process, including the activity of sketching on paper and the movement of fabric samples in her physical working space. She believes that the haptic feedback enables connections to be made between ideas in her brain that shape the conception of the work. She also maintains that textiles that are designed without first hand knowledge of touching fabric are deficient, 'they have a stiff quality, a lack of knowledge of

\textsuperscript{215} On the recorded interview she states that her aim is to create work that 'all adds up to greater than the sum of the parts. I want that magic, I want that magic in the process and in the final object'.

100
what fabric is about' and she is critical of those who produce textile designs digitally without any physical experience of cloth.

Brandeis’ intention is that the digital process should be invisible in her finished artefact so it is ironic that she has gained recognition internationally for the integration of digital technology in her work. Although she acknowledges that the computer is a very useful tool, and has taken the drudgery out of many disciplines, she is highly critical of computer use that does not balance aesthetic, purpose, and cultural and personal identity. The following sections describe her creative process and the role of digital technology within it.

Fig. 4.24 'Messages from the Past'
Size: 38”x76” Digital print, felted, reverse appliqué, embroidery
Photo: Marc Brandeis

4.4.2 Rhythm

4.4.2.1 Analysis of process maps

Prior to the field study visit and following an early preparatory meeting, Brandies produced two process maps of her creative process. These set out the various approaches to her design methodology and indicate how digital imaging is incorporated into it. In both the pre and post digital processes, the initial steps are the same and involve fieldwork, photography and note making. By comparing the maps it can be seen that the production of printed fabrics is described as happening at a much earlier stage in the digital process\(^{216}\), and that digital imaging is being used for the production of printed fabrics as a resource to be used later, rather than being integrated closely

\(^{216}\) It occurs prior to the stage noted as imagining within the Generating Alternatives boxes 3 and 4.
within the development of any particular design idea. During the field study, however, this was not the case. Design ideas had been sketched first and considerable prior imaginative thought was drawn upon during the digital manipulation of the photographs.

The physical depiction of the map reveals Brandeis’ logical and systematic approach to the development of her work. The ideas are ordered, clearly defined and neatly set out on the page. She comments that she was unable to draw the map on the computer, ‘I had to draw the boxes and handwrite the maps’. The reason for this in her view was that ‘it is too much a part of the connection between my hand and brain to let the computer intervene’ (Brandeis 2003)\(^{217}\). In the video recorded field study interview she comments on the way in which the slowness of making by hand gives opportunity for natural pauses, which provide clarity of thought; the drawing and planning stages in design development are, therefore, essential. It is evident that the production by hand of the process maps provides this opportunity for logical analytical reflective thought to occur.

Chapter 4: Case Study

Fig. 4.25 Susan Brandeis: Process Map (Pre-Digital)
© S. Brandeis
Chapter 4 Case Study

Fig. 4.26 Susan Brandeis: Process Map (Post-Digital)
© S. Brandeis

**MAP OF DESIGN PROCESS: SUSAN BRANDEIS**

**A**

1. **Steps 1-2 the Same**
   - Choose Interchangeable Photo Images to Scan
   - Enhance & Manipulate Within on Computer

2. **Print Fabric Digital**
   - Choose Fabrics Which Best Convey Idea
   - Sketch Idea Final Piece
   - Choose Other Fabrics and Techniques
   - Steps 7-10 are the Same

**B**

3. **Steps 1-9 the Same**
   - Produce Instant Painted Fabrics from a "Painted" on Hand
   - Steps 11-19 are the Same

4. **A More Intuitive Way...**

**C**

1. **Come Across a Digitally Painted Fabric Already Produced That Serves as a "Skein"**
   - Be Inspired to Build on it to Make a Piece
   - Make the Piece

   Note: This also happens in the Pre-Digital Process.

Creative process finding happens different ways. The spark of the idea always has its roots in the visual to place but can be found spanned by materials or techniques that connect powerful finding.

Making the work is always about internal balance finding, and those have many ways to balance!
4.4.2.2 Generative stage

"The experience and the record of the experience and being in a place are the things that are the initial inspiration"

Much of Brandeis' textile art is based on landscape and nature and is developed from fieldwork in various locations in the USA. This fieldwork is important for building and reliving memories, and she strives to gather sufficient information so that sensuous responses can be rekindled at a later date. Her intention is to gather a sense of unique characteristics of the place through photography, capturing its visual textures and colours and 'to bring back visual cues that elicit smells and sounds and the feeling of air and temperature'. The information about the place is noted as written lists of words including specific objects that have been drawn to her attention and these provide inspiration for the concepts for the art pieces. Sketches made on-site include diagrams indicating how the work may develop as a textile, including its composition and the ways in which the photographs may be juxtaposed to convey a 'simultaneous multiple glimpse' of the place. She also considers the technical methods she can use to convey her concepts, including specific materials and processes, and tries, at this early stage, to develop connections between what she is experiencing on site and the textiles that can be developed later in the studio. Notes are also made to describe formal compositional issues that may be used to convey information about the place, including subtle colour relationships and contrasts. Photographs are taken purposefully so that the framing and composition of image happens with the camera rather than later on the computer. She is particularly concerned with capturing the subtlety of colour and texture, in detail and close-up.

This initial research, in the form of drawn images, sketchbook notes, and photographs may be 'mined for years' to develop new pieces of work. Her intention in gathering the information is that it should feed a series of works, each piece building a cumulative evocative and sensuous response to the place. Brandeis emphasises the importance of the artist as a visitor to the location in the fieldwork. Her desire is to see the place afresh with an uncluttered mind and without preconceptions. The sketchbooks and photographs produced during her fieldwork are rich, focused and essential to the development stage in the design process.

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218 The passage of time in the revisiting of this data can be key in the development of concepts, she notes that 'when you come back to it you come back a different person, you've brought some more experience with you and it means different things and you can make new connections'.

219 Characteristic is defined as: 'a distinguishing trait, quality, or property' Merriam Webster on-line dictionary

220 For example: perishable versus enduring, the mark of man on his environment etc.

221 Brandeis comments in the interview that she thinks 'of the whole series as something that will tell the whole story about being in a place, no single piece can tell the whole story'.
4.4.2.3 Design development

After the fieldwork, the development of sketches and design ideas from the photographs happens quite quickly in the studio; Brandeis does not often sketch on site. If there has been a period away from studio work, the initial step is to review the photographs and notes, and try to 'recapture the experience'. During this period of reflection, it is the connections between the images that evoke the sense of the place, that are pinpointed for design development. Planning sketches are made which convey information concerning construction and composition, mentioning potential materials and sampling techniques (Fig. 4.27).

Throughout the design development process, Brandeis constantly reviews the photographs, looking for ways she can translate the visual information within them directly onto cloth, as a starting point for further embellishment, or to include them as elements within the composition of a piece. Sometimes they inspire her to produce a sample using a textile craft technique as in the woven raffia piece (Fig. 4.28). Occasionally she will return from a field trip and make a textile piece intuitively without any planning and development work. The textile pieces Messages from the Past (Fig. 4.24) and Discovered Secrets (Fig. 4.23), produced for the 'Technology as a Catalyst' exhibition were created in this way. Brandeis found it difficult to explain how this intuitive process happens, but describes it as a combined physical and emotional response.

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222 Brandeis comments: 'The sketches usually happen when I come back to the studio: I am looking at the lists and my photographs ...the physical act of moving my hand and drawing, using colour and thinking about proportions and the way composition can be a tool to communicate something, happens back in the studio.'

223 Brandeis states on the recorded interview: 'I know there is something physically in my eye and in my gut when that happens...there is just a feeling that it is right.'
Several design ideas are in the process of development at any one time. Brandeis realised, even before she began working digitally, that if she did one particular task for too long she would suffer body pain\(^\text{224}\). A variety of work at different stages is developed so that no one task is undertaken all day. This also enables her to avoid the mental difficulty of starting a new piece of work\(^\text{225}\).

4.4.2.4 Sampling and reflective process

Throughout the making process, Brandeis creates numerous samples testing out techniques and colours, providing her with an opportunity to reflect on whether the fabric expresses her intentions (Fig. 4.28). Sometimes the development process is slow. The period of reflection can take many weeks during which time samples are pinned up on the studio wall; from time to time pieces are added and considered juxtaposed together. This process of review and reflection enables new connections to be made both cognitively and physically between fabric surfaces, stimulating the development of new ideas.

\(^{224}\) From repetitive strain injury

\(^{225}\) Brandeis explains ‘you never come to that place where you are at a dead stop, it keeps the brain constantly engaged...continuity for me is really important.’
4.4.3 Mode

4.4.3.1 Colour

Brandeis uses colour to evoke a multi sensuous response to a particular location. Her sketchbook notes describe both tactile and visual qualities such as the feeling on the skin of the environment she is describing; she comments ‘I try to get at those kinds of things in the work through colour.’ In the piece ‘Messages from the Past’ (Fig. 4.24) she uses colour to evoke ‘the dry sandy smell in your nose.’

The colours captured through the photographic images taken on site, are now translatable directly onto digitally printed fabric, although this is not without its difficulties. Frequently the scanned photographs must be colour adjusted in Photoshop® to produce images on fabric as close as possible to the original. Brandeis’ previous work with screen printing reactive dyes means that she is aware of how the colours are likely to change after processing and is able to work intuitively with the image. She is aware that the printed colour will be more intense by about 15% so she adjusts the screen image to de-intensify it and lightens the whole colour palette. As with pre digital

226 Brandeis explains: ‘I know that the printers we are using are going to emphasise the colour, make it more intense, it’s darker, it gets brighter, I am looking for something that is as close to the original photograph as possible, so I have to de-intensify the colour I see on the screen to make it close to what I have in the photograph when it prints, of course that changes with the type of fibre that I print on as well.’
printed colour she is ‘willing to accept it within a range anyway and continue to work with it, ... when it is goes in context with something else, that is also going to change the way it is perceived.’ Sometimes unpredictable colour effects inspire further work. Mistakes in the printing process or wrinkles when the substrate is printed also provide serendipitous opportunities for creative exploitation.

![Image](quintessence_detail_2001.jpg)

**Fig. 4.29 'Quintessence' detail (2001)**

Digital print, machine and hand embroidery; size: 52” x 56”

Photo ©Marc Brandeis

4.4.3.2 Composition: pattern, repeat, texture and layers

The composition of the finished pieces is designed to convey the multi-sensory information of the visited location; the arrangements of the constituent parts are developed in the planning sketches. The intention is to bring various aspects of research material together, selecting appropriate images and making decisions about scale, colour and alignment. The sketches are hand rendered in the sketchbook using coloured pencil crayon and pen (Fig. 4.30). Small panels, that Brandeis describes as ‘bridge bands’, are used to link and differentiate between areas of pattern and texture within a piece and also to enable the viewer to make connections between the different areas of visual information. These bands are often layered on top of printed or textured fabric, building relief in the surface to the work.
Some images are layered digitally before being printed. Working in Photoshop®, photographs are manipulated in layers to create a complexity of texture or to build shapes within the planned composition of a piece. An example of this can be seen in 'Discovered Secrets' (Fig. 4.23), which incorporates a panel containing three different layered images, which were combined digitally before printing on to fabric. At the digital manipulation stage of the design process, Brandeis considers how the fabric might be manipulated and embellished after digital printing. Her prime consideration is the textile surface she is creating and the materials she will use.

4.4.3.3 Embellishment
Brandeis uses a variety of textile processes to embellish the digitally printed surfaces that she creates. These include appliqué; reverse appliqué, beading, hand and machine stitching as well as the inclusion of hand woven fabrics and those made using off-loom such as plaiting and felting. These techniques enhance the printed motifs and contribute to the structure of the piece. Machine embroidery is frequently used to ‘draw’ back into the surface of the digitally printed fabric. The process helps to define areas of interest and may introduce or emphasise colour. Embroidered detail also provides links between various parts of the composition and facilitates the physical layering of printed fabrics.

227 Brandeis states ‘There is a real connection for me between materiality and my visual and physical experiences of the world’.

228 During the video recording of work in progress, a Bernina 930 machine was used for this purpose. Using a darning foot, and dropping the feed dogs, she used a zig zag stitch to respond to the printed shapes, enhancing them and making them appear more three dimensional by varying the weight of the stitched line.
4.4.4 Digital tool use

4.4.4.1 Digital image making

'I want the fact that I am using digital imaging to be invisible in the final work. I am using it to get at a kind of complexity of colour and pattern and image that I can't get any other way.'

The translation of photographs onto fabric, using digital ink-jet printing, has considerably altered the visual character of Brandeis's work. In her pre-digital work, dyed fabrics were used to suggest the visual content of her photographs; the digital process now enables her to create a more literal interpretation of her subject (Figs. 4.31 and 4.32). Working with Photoshop®, photographs are scanned and manipulated in a number of ways. Usually the images are cropped, layered, resized and colour adjusted so that the resulting digital print is as close as possible to the original. Occasionally, when it is difficult to make a selection from the photographic images, a large number of digitally printed fabrics are produced without any digital manipulation. This enables fabrics to be chosen that have the potential to convey the intended information. Sometimes images are stretched or resized digitally to fit within the structure of the planned piece and occasionally they are developed into repeating pattern. The photographs and sketchbook containing the fieldwork is kept close at hand and referred to continually during the digital development process.

Fig. 4.31 Left: 'Dancing with Horsetails' (Pre-digital) and
Fig. 4.32 Right: 'Rainglade' (woven digital print, print and embroidery) a more literal interpretation
Photo ©Marc Brandeis
4.4.4.2 Digital printing

Once the photographs have been digitally manipulated, they are saved and printed immediately onto prepared substrates using one of the Stork Mimaki TX1 ink-jet digital printers (Fig. 4.33). Brandeis expresses ambivalence to working digitally. She is delighted by the resulting images on cloth but frustrated by the process required to achieve them and the lack of hands on involvement. One of the aspects of digitally printed cloth which excites Brandeis is the way the structure of the fabric and the size of the threads distort the image; the flat, paper-like quality of digitally printed cloth is enhanced, in her opinion, when the textile surface interferes with the image as it passes through the printer. She is also unperturbed by stray marks made by the printer but is content to incorporate them into the piece exploiting the serendipitous effects.

Fig. 4.33 Digital ink jet printing fabric
Fig. 4.34 Steaming process

4.4.4.3 Digital tools

Brandeis does not claim to be confident in using software and says that she finds drawing with a mouse ‘not as eloquent or precise’ as pencil and paper. Consequently much of her digital work involves photographic manipulation and the rewards for struggling with the digital process are the fabrics that stimulate her ideas. Her pre-digital work involved a translation of photography, mimicking the structures in the photographs with different kinds of fabrics, through a variety of textile techniques.

229 Fabrics are pre-treated in the textile department.

230 Brandeis comments during the video recording of the print process: ‘it is all part of being one with the materials, with the printers you’re not, you’re not touching it at all, you have manipulated something in the box and you’ve come to this piece of fabric which is very flat...its lost its real textileness so I am always anxious to get it back to the studio and manipulate it in some way.’
The need to mentally map software, and remember icons and menus, is described by Brandeis as being particularly difficult. She makes the comparison with learning tactile skills such as knitting or weaving that are not easily forgotten, even though long periods elapse when the skill is not practiced. It is the abstract nature of the memory recall and a lack of personal motivation that she feels has inhibited the development of her digital skills. In the field study interview she questions whether her inability to recall the symbols in Photoshop® is linked to a lack of sensory feedback. Her primary concern is with the materials and textile crafting and she does not regard the time required to develop digital skills a priority.

Brandeis contrasts digital imaging with the process of making textiles by hand, which she feels has very different psychological demands. She contends that there is a sensory satisfaction obtained through the inherent slowness of hand crafting which is lacking in digital work. When asked to describe the ways in which digital tools might be enhanced to become more engaging, she suggested drawing tools, physically independent of the computer, with different sized tips that could be used on surfaces offering a variety of force and friction feedback. Brandeis sees drawing as an essential skill; she regards it as a filtering of visual information providing a clearer perception of the world. She also feels that it is important for developing hand-eye coordination and is critical of the way in which digital skills appear to be displacing drawing and manipulative skills amongst the students she teaches. This, she believes, is affecting not only the way the work is physically produced but also how visual concepts are being constructed in the mind.

The speed of operation of the networked system used at NCSU contributes to Brandeis' frustration in working digitally. Nevertheless, Brandeis commented that she was even more frustrated by doing the operation in the software than I am by waiting for it to do something, although I do sometimes lose my train of thought. Although the production of digitally printed fabrics is considerably faster than previous hand printing techniques, Brandeis describes the time waiting for the digital prints to be produced as being very frustrating.

Although Brandeis owns a digital camera she does not currently use it in her work preferring the analogue SLR camera she has used throughout her working life. She is aware that the use of a digital camera would eliminate the need to scan photographs in to the computer; however, she is reluctant to give up a tool she is confident with.

Brandeis explains in the field study interview ‘I think it is just not an appealing tool for me; there is no real warmth about using it, no real attachment. I am not really interested in the way software works.'
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4.4.4.4 Visual language

Brandeis' conceptual themes, the use of photography in the development of ideas and integration of textile processes to embellish printed surface, have not changed substantially since she began using digital technology. What has changed, however, is the amount of detail that can be included in the work that she makes. The ability to directly translate photographic detail into printed fabric has increased the range and complexity of colour and motif. This has not led to a simplification of the embellishment. Rather, the lack of physical crafting of the printed cloth has motivated a desire to 're-establish contact with the materials...and to convert the monologue of the machine-printed product to a dialogue between artist and cloth' (Brandeis 2003 p.17). This is achieved through the textile processes that trap, layer and enhance the imagery; moulding and crafting the machine product into the artist's expressive response to her theme.

Brandeis is aware of the problems of increased visual complexity possible with digital imaging. Her view of contemporary digital graphic design is that many images created are 'viewer hostile' and rather than communicating with the audience, have become 'unreadable'. She stresses the importance of clarity of vision and sense of purpose in composition, learning when to stop with an image and 'remembering what your goal is.' Her view is that digital technology should not be a means to an end but rather an aid to artistic expression. She uses the technology as a tool to enable her to develop and print imagery that would otherwise be difficult to achieve by analogue processes. It has also enabled her to continue working when the physical demands of the printed craft methods she had been using may have brought her career to a premature end.
4.5 Case study findings

In reviewing the data provided by the three field study visits together, it has been possible to build the validity of the case study, providing a chain of evidence for comparison and analysis\(^{222}\).

There are several recurring issues that emerge from this analysis; these include the ways in which digital imaging is able to stimulate the generative stage of concept development, through the review, organisation, storage and compositing of visual data.

Digital imaging tools are also able to support playful, risk free, exploration of generative ideas. The technology also supports insight and illumination in the creative process, through the facility to visualise ideas rapidly.

Hand use and haptic sensory feedback are useful in stimulating creative thought and are regarded as being vital in creative practice. The opportunity to combine hand skills with digital process results in hybrid practice that is able to extend the practitioners creative processes.

4.5.1 Rhythm

The generative stage in conceptual development, within the creative process, includes the gaining of experience and knowledge, research, associative thinking and play (Smith, Ward et al. 1995). The case study findings indicate that digital tools are able to support idea generation through the facility to gather and review visual data from a wide variety sources including photographs, video, images from the Internet, and scanned material. Digital tools provide the freedom to explore and merge imagery. The computer acts as a catalyst at this stage providing a method for associative thinking, through the use of digital layering and compositing. Bernath stresses the importance of the computer to research and then generate visual ideas at the early stage of commercial design development.

Both Bell and Bernath comment on how the computer supports the process of playing with ideas in a risk free environment. Bell calls the computer a ‘doodle pad’ on which she is able to play; Bernath describes using software to ‘doodle’ and also stresses the importance of play in the early stages of her ‘free expression’ method of practice. The facility to easily step backwards, undo and save eliminates the risk of ruining the developing work. This provides opportunity to generate and explore a greater number of ideas, which might not otherwise have been considered.

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All three practitioners consider that memory of personal experience plays an important role in the development of their visual concepts. Sometimes memories are recorded as written notes, sometimes stimulated by music but predominantly through the use of photographic imagery and colour. Bell and Brandeis both make use of this type of imagery to recall past experience and integrate personal memory into their work.

Insight and illumination occurs in the creative process once ideas have been generated; concepts begin to be narrowed and organised, production constraints are considered and ideas are visualised (Smith, Ward et al. 1995). Digital tools support this stage of the creative process by enabling embryonic ideas to rapidly become visual. Bell describes how thoughts become ‘instantaneously visual’ and all three practitioners note that multiple visual ideas can be explored quickly. The rapid review of collected data enhances the reflective process and insight can occur through the association of visual ideas. Both Bell and Bernath describe the computer as being an extension of the physical sketchbook in which visual concepts are explored, developed and stored.

All three practitioners agree that the digital process enables development and visualisation of concepts that would be difficult and time consuming using traditional rendering techniques. Rapid visualisation of imagery in different repeat structures saves Bernath time in developing design ideas and also encourages greater experimentation. Bell describes how her creative process is frequently interrupted by ‘new discoveries’, which digital tools provide opportunity for her to explore rapidly while they remain fresh; lateral thinking is supported and novel lines of inquiry can be pursued. The production of multiple images, each with potential for further development, increases the number of possible creative outcomes and results in the intensification of the decision making process. As a consequence of this, each of the practitioners stressed the importance of time to reflect on the work being developed.

4.5.2 Mode

Colour is of paramount importance to all three practitioners and the facility to easily adjust and replace colours in an image is considered a major advantage. Both Bell and Brandeis consider the disparity between colours on screen and printed fabric as being opportunities for creative exploitation. Anomalies are used to generate new ideas through the application of stitch or further colour applied by hand. Bernath, however, has devised a method of managing digital colour, without sophisticated calibration tools, through the use of an atlas and digital colour profiling software. Bell has integrated silk painting techniques with the digital image making process, providing space on the printed textile for subsequent additional hand applied colour. The digital imaging process also enables the simulation of light tonal colours, layered over darker tones and so negates the need for printed discharge techniques.
The use of layers enables all three practitioners to experiment with colour. For Brandeis and Bell this is important in communicating personal memory of location and experience. It facilitates the inclusion of multiple sources within a single image and intensifies the artists’ communication of the visual characteristics of the memory. The use of layers can result in complexity within a representation. All three practitioners note the importance of knowing when an image is becoming visually confusing and overworked; the need for reflection was again stressed with regard to this.

Bell and Brandeis have used digital imaging to increase the amount of detail and line work that can be achieved in their printed textiles. Inclusion of photographic imagery provides a more literal interpretation of experience, which can be blended, merged and layered with material that is more gestured and expressive. For Bell this happens during the digital development and again after the image is printed; Brandeis is more concerned with post printing elaboration.

4.5.3 Digital tools

The importance of hand use, tactile skills and making by hand were central themes expressed by all three practitioners. The importance of drawing skills, processes involving physical manipulation and hand-eye coordination, was stressed throughout each field study visit. All three practitioners regard the spontaneity provided by hand making as being important at the generative stage of idea development and it is regarded as being an essential ingredient in each of their creative processes. Bernath described how her free expression work, involving handcrafting and physical manipulation of materials, was also important in informing commercial digital design work. Both Bell and Brandeis emphasised the importance of physical interaction with the printed fabric and the desire to embellish it by hand.

This conviction shaped the attitudes expressed towards the use of digital tools in the creative process. There was agreement that digital input devices, when used as drawing tools, did not provide the sensory feedback and creative stimulation comparable with conventional media. Bell and Brandeis both expressed their desire for input devices that are able to provide greater freedom to incorporate gestured line work within the digital image. All three practitioners commented on the importance of pressure sensitivity of drawing devices, and frustration with the ‘disconnect’ between hand and eye when working on the computer.

The use of scanning devices, to input imagery, was considered unanimously to be of considerable advantage in the digital process. For Bell and Bernath this enables the integration of hand rendered imagery within the developing image. This was described as providing a means of breaking out of
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fixation\textsuperscript{233} with an unproductive idea. Bell describes the use of scanned fabric and artwork as providing images with spontaneity and freedom, lacking in the electronic medium. Bernath uses a similar approach to capture the qualities of hand making within the digital image.

Fluency in the use of software provides greater opportunity to explore the creative potential of digital imaging. The data suggests that Bernath’s proficiency with software is proportional to both practice and motivation. Brandeis’ lack of confidence in the use of digital tools is compensated for in her creative manipulation of imagery post-printing. The three practitioners recognize that tacit knowledge of textile crafting and design development is influential in their use of software. Bernath describes her identification of successful repeat structures, during digital experimentation, as being based on previous experience of developing repeats by hand. Brandeis’ digital adjustment of colour prior to printing is also based on a tacit understanding of how dyes react in the post-printing processes.

Both Bell and Brandeis comment, on the recorded data, on their frustration at the lack of physical interaction with the cloth in the digital print process. Bell regarded the product as being inhibiting, and ‘too perfect’; Brandeis longed to regain the ‘dialogue with the cloth’. Both practitioners describe feeling compelled to embellish the digitally printed fabric surface through hand painting, stitch and appliqué. In both cases the amount of embellishment to the fabric surface has increased, following the integration of digital imaging into their creative process.

The use of digital tools enabled Bernath to continue working creatively when physical space was limited and Brandeis when health issues prohibited the use of other textile print techniques. It has helped Bell to develop her craft practice in an isolated island location and provided vital communication links with other practitioners through email and Internet.

The impact of digital communication on the creative process has been explored through the collaborative investigations resulting from this case study. These are described in detail in the following chapter.

5. Investigations

5.1 Introduction.

The findings arising from the contextual and literature review (Chapter 2) and case study (Chapter 4) indicate that digital imaging technology can enhance and support the creative process, stimulating concepts through the review, storage and compositing of visual data, leading to the development and production of printed textile artefacts. The studio-based practical investigations that inform this chapter, examine the ways in which digital tools support and facilitate the creative process. This includes an assessment of the practical issues regarding the use of digital technology, as well as the implications for creative cognition and distributed practice.

The visual components that stimulate ideas can be communicated, adapted and modified using digital imaging technology; imagination can be shared in a virtual environment\(^{234}\) (Treadaway 2004c). The theoretical importance of external stimulus in the creative process is well acknowledged and documented in cognitive psychology research (Amabile 1996); (Smith, Ward et al. 1995). These studies indicate that combinations of past and current visual experiences provide artists and designers with fertile imagery for conceptual development in their practice. Digital manipulation of ideas resulting from memory of personal and shared experience, stimulated by digital photography and video, is explored in the practical investigations documented in this chapter.

The investigations are presented in two parts: first is a series of collaborative \textit{task exercises}\(^{235}\) undertaken with the three case study practitioners, each involving the shared generation of printed textile artefacts. The second part presents a studio-based investigation by the researcher that examines the ways in which digital tools may support independent creative practice. The data was collected during the investigations using recording techniques which included video and audio recording, still photography and research journals. There was no intention to video record every moment in the making of the work; the creative process cannot be confined to specific moments spent in the studio\(^{236}\) nor can it be inviolate to the inhibiting effect of the \textit{third eye} of the video camera even when operated by the practitioner. For this reason, the video evidence provides snapshots of the creative process at various stages and has yielded information that is able to stir the memory, clarify thoughts and synthesise experiences. The reflective journals provide further


\(^{235}\) See Chapter 3 section 3.4.4

\(^{236}\) See Chapter 2 section 2.4 creative thinking is stimulated by human experience and memory of that experience.
visual information indicating the nature of the cognitive processes involved in the development of
the work.

The collaborators provided evaluation and feedback on the collaborative task exercises, formally,
through the use of questionnaires and informally, via email and telephone conversations.

Analysis of the recorded data enables issues to be identified and evidence to be corroborated
between the exercises. This synthesis of data provides a chain of evidence that informs the research
findings. The theoretical basis for the analysis of the creative process is outlined in Chapter 2
section 2.4. Further evaluation of the work has been provided through peer review following the
presentation and publication of conference papers and exhibition of the digitally printed artefacts.

The initial work for the collaborative investigations was carried out on location during the field
studies in the first and second year of the project and completed during the second and third year.
The distributed nature of the collaborations necessitated the use of a variety of computer systems
with Bernath and Brandeis using an Apple Mac platform, while Bell and the researcher both
worked with PC’s. All the investigations involved the use of Photoshop software. In addition, the
researcher also made limited use of Corel Draw®, Photopaint® and Painter® software. Digital
artwork was generated using both a PC and a Tablet PC in the researcher’s studio. Peripheral
deVICES such as Wacom graphics tablet, scanner and digital cameras were also used for the input
of imagery. A textile digital print bureau facility was used initially to output the digital artwork
and towards the end of the project a Mimaki TX2 digital textile ink-jet printer based at the
University of Wales Institute Cardiff was used.

The collaborative investigations are presented sequentially in this chapter, in the order in which
they occurred within the project. The researcher’s independent studio based work is described in
the final section. The investigation is informed by the experience of undertaking the contextual and

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237 See Appendix B sections B.2; B.3; B.4
238 ‘Creativity: Designer meets technology’, Philadelphia University, May 2004 and SDA conference
Uncovering the Surface’, Kansas City Art Institute, May 2005.
239 ‘Recursions: Material expressions of zeroes and ones’, Museum of Design, Atlanta, USA, January – April
Perceptions’, Collins Gallery, Glasgow, January-February 2006
240 350 Gigabyte (Gb) hard drive and 1Gb RAM
241 There were upgrades to the equipment used throughout the project, to accommodate the need for
additional processing speed, memory, reliability and enhanced visual display.
242 http://www.quantumclothing.com/quantumDsgProfile.php (acc.05.03.06)
243 http://www.mimaki.co.jp/english/tx/inkjet/tx2-1600/index.php (acc.05.03.06)
244 The university acquired this machine during the final year of the project.

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literature reviews as well as the collaborative investigations, and makes use of visual research
gathered throughout the duration of the project. Each section concludes with a discussion
concerning the use of digital tools in the creative printed textile process, drawing from analysis of a
series of video diary entries as well as written, visual notes and photographs. The findings arising
from the investigations form the final section of the chapter and are a synthesis of the information
from each of these previous sections. General descriptions of the task exercises are found in each
section however, due to the volume of information produced, it has been necessary to limit the
detailed presentation of each exercise to one or two examples in each investigation\textsuperscript{245}. Additional
investigations are described and illustrated in Appendix B, sections B.5 - B.8. The examples
presented in full in this chapter have been selected for the ways the creative stages can be identified
and to provide a means of explaining the cognitive, digital and practical processes deployed in the
exercise. Illustrations and diagrams have been used to describe the investigations and explain and
communicate the complex factors that are inherent in the creative process\textsuperscript{246}.

\textsuperscript{245} The remainder of the detailed information can be accessed in Appendix B.

\textsuperscript{246} Any linear or sequential presentation is likely to be inadequate to fully explain the complexity of the
creative process, nevertheless it provides some insight into both cognition and tool use.
5.2 Part One: Collaborative investigation with Alison Bell

5.2.1 Rationale and framework for the project

The collaborative investigation with Alison Bell was first discussed during a meeting with the artist three months after the field study had taken place. The researcher proposed that a series of images could be made collaboratively to explore the potential of digital imaging technology to support a shared creative process. It was proposed that these images should be derived from shared memory, interpreting a sensuous response to a particular geographic location. The field study indicated the importance of Arran in the development of Bell’s visual concepts and so it was agreed that the collaborative images would be stimulated by memories of specific locations and time on the shoreline of Arran.

The aim of the project was to produce the collaborative images as digital prints on silk\textsuperscript{247}. The proposed plan for developing the work included the construction of three digital images containing three layers each. It was thought, at this stage, that three layers would provide sufficient opportunity to collaboratively explore a given theme to create a shared image. The intention was to develop and save each layer of the image onto a CD, and send it to the collaborator for a response; this would subsequently be developed as a further layer and returned. This iterative process would result in six layers in total for each image. The idea of transferring the files via the Internet was discussed and dismissed due to the likely file size and slow speed of the connection available for use at that time\textsuperscript{248}.

A number of practical issues were also discussed at this stage, including file format, the communication of files as layers rather than flattened images and ultimate production of the printed imagery. The intention was to produce a series of images suitable for exhibition. It was proposed that the researcher would video document the development of her layers for subsequent analysis while the artist would provide brief commentary on her contribution via email. The images themselves would provide physical evidence of the creative process.

\textsuperscript{247} This substrate was selected, from the outset, as Bell’s digital practice is specifically concerned with developing imagery that can be digitally printed and combined with hand painting on silk. However, it was not proposed that the resulting textile would be hand painted following ink-jet printing, since the focus of the investigation was digital image development.

\textsuperscript{248} Neither collaborator had access to broadband Internet connections.
Three images were developed during the project; two initiated by the researcher and one by the artist\textsuperscript{249}.

5.2.2 Creative process

Initial ideas, based on digital photographs and watercolour sketches made on site, were explored in Photoshop® and sent to Alison Bell as separate JPEG images written on a CD (Fig. 5.3 Layer 1). The artist reviewed the images, made a selection (Fig. 5.3 layer 2) and added her thoughts, images and colours. Once her layer had been completed and written to CD, it was returned to the researcher for an additional layer. This cycle was continued until it was mutually agreed that the image, \textquoteleft Kilmory, \textquoteright was complete. The artist initiated a second image, \textquoteleft Dawn, \textquoteright and the same iterative process took place. The final image, \textquoteleft Pladda, \textquoteright was begun by the researcher and completed by the artist in the same way. The three completed images were digitally printed onto silk using a commercial bureau facility\textsuperscript{250}.

\textbf{Fig. 5.1 \textquoteleft Kilmory', \textquoteleft Pladda' and \textquoteleft Dawn'}

\textit{(Left to right)}

Exhibited in \textquoteleft Recursions: Material expressions of zeros and ones\textquoteright Museum of Design, Atlanta, USA. January - March 2005

Photo © Museum of Design, Atlanta

\textsuperscript{249} The printed artefacts were selected for inclusion in an international exhibition of digital textile art \textquoteleft Recursions: Material expressions of zeros and ones\textquoteright, Museum of Design, Atlanta, USA January – April 2005.

\textsuperscript{250} The choice of substrate was determined by the artist's silk painting practice.
5.2.3 Kilmory

(Figs. 5.2, 5.3, 5.4, 5.5, 5.6)

5.2.3.1 Process:

The image was developed from an initial sketch of the shoreline at Kilmory, on the southern coast of Arran. Photographs and sketches were made on site and it was noted that the watercolour sketch provided a better expression of the ‘atmosphere’ that had been experienced than the photographic record of the location. The researcher decided to use this as a starting point for an image to express a memory of the location (Fig. 5.3).

The research journal and digital photographs were reviewed and a watercolour sketch of Kilmory beach was selected and scanned at 300dpi and saved (Fig. 5.3 Layer 1). This image was later manipulated in Photoshop® and then dropped onto a blue background. The layers were flattened and the image saved onto a CD and mailed to Alison Bell. The subsequent layers involved the addition of textural photographic elements such as details from flotsam and jetsam on the beach (Fig. 5.3 Layer 2). Both participants added hand rendered electronic line work, including the lower section of the piece, which is intended to be evocative of the impressions of seabird feet in the sand.
(Fig. 5.4 Layer 3). This section was made using a tablet PC and enabled comparisons to be made between graphical input devices (GID).  

5.2.3.2 Format:  
Composition of the piece relates closely to the original watercolour sketch and photographs on which the first layer of the concept was based. The colour of the blue ground was selected from the scanned watercolour sketch, with the intention of providing open space for the subsequent layers of imagery (Fig. 5.3). After the addition of the third layer (Fig. 5.4), Bell introduced a new daffodil motif. This related to her experience of the location at that point in time, and she noted in correspondence that the beaches were fringed with wild daffodils. This new association did not concur with the memory of the researcher and the subsequent layers were more difficult to complete. Three layers each were added, but the complexity of the final image resulted in the decision, by both artist and researcher, to print it before the inclusion of the daffodil motif (Fig. 5.4). The first three layers were saved to CD and printed onto silk satin by a digital print bureau.

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251 GID: graphical input devices include mouse, tablet and pen, light pen, joystick etc.

252 Personal correspondence March 10 2004 'the image does continue to speak of Arran, but spring is very much on my mind as I walk along that part of the shoreline. Light changes and new colours appear here, it is a lovely time of year on an island. That's maybe why I kept wanting to put daffodils in so I did.'

253 Printed by Quantum Design Group www.quantumclothing.com (acc. 05.03.06)
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Fig. 5.3 'Kilmory' - Layers 1 and 2

Layer 1 (Step 1)

Review of visual data in research journal, including sketches and photographs made on site. The photographic record of the location did not express the atmosphere experienced as accurately as the watercolour sketch of the same vista (above). It was decided to use this as a starting point for an image to express a memory of the location.

Layer 1 (Step 2)

The scanned image was colour reduced and layered onto the blue background. It was then digitally manipulated and combined with a second image of the scanned watercolour (above). The file was saved on to CD, along with additional digital photographs of the location, and mailed to Alison Bell.

Layer 2

Above: addition (by Bell) of photographic elements: flotsam and jetsam, textures on the sand etc. and hand rendered electronic line work. Detail (above right) showing digital layering of photographic elements and line work.
Fig. 5.4 'Kilmory' – Layers 3 and 4

Layer 3

Addition of hand rendered electronic line work. Background modified with gradated colour. Detail (above right): marks were drawn (using tablet PC and pen) to evoke the imprint of seabird feet in the sand.

Layer 4

Introduction of daffodil motif. Bell decided to incorporate the flowers after noticing them growing along the shore. This image was saved to CD and returned to researcher.
Fig. 5.5 ‘Kilmory’ – Layers 5 and 6

Layer 5

Introduction of a green textural element from a photograph of paint peeling on a beach hut (above right) and the addition of yellow shapes and lines. This image was saved onto a CD and mailed to Alison Bell.

Layer 6

Introduction of a shape to suggest the island Ailsa Craig (detail above right). This image was saved onto a CD and returned to researcher.
Both the artist and researcher were in agreement that the image had become overly complex at layer 6. The introduction of the daffodil motif and subsequent addition of colour had moved the image away from the original concept: a shared memory theme involving a specific location on the Arran shoreline.

It was decided by both collaborators that layer 3 represented the most satisfactory expression of the theme and successfully portrayed, to both parties, a shared memory.

A final adjustment to the background colour was made involving the gradation of tone to provide greater contrast in the lower section. The image was saved onto a CD and sent to a specialist bureau to be digitally ink-jet printed onto a silk satin substrate.

"Kilmory" was one of the three artworks selected for inclusion in the digital textile art exhibition, "Recursions: Material expressions of zeros and ones" at the Museum of Design, Atlanta USA in 2005.
5.2.4 Discussion

5.2.4.1 Creative framework

The analysis and evaluation of collected data suggests that the technology is able to enhance the creative process, by enabling images to be reviewed, manipulated and shared. The creative collaborative partnership that evolved through the project was based on willingness of the participants to share the evolving creative process and the emotional ownership of the images that developed. At the outset of the project, limitations were mutually agreed including: the theme, a shared memory of a geographic location at a specific moment in time, the number of layers to be produced on each rendition and the output of the images as digitally printed silk artefacts (described in section 5.2.1). These constraints provided a framework to structure the creative process.

5.2.4.2 Digital tool use to stimulate memory

Memory of the location is a key element in the development of the work; digital photography and on site sketches played a key role in rekindling visual and emotional constituents. During the development of digital imagery for ‘Kilmory’, memories were reconstructed in the researcher’s mind. Photographs of the impressions made by sea bird feet, in the sand, stimulated the electronic rendition of marks in the lower section of the image (Fig. 5.4 Layer 3). The video documentation of the development of this section also records the sound of sea gulls outside the studio. This may have acted as an auditory prompt or an additional preconscious element, in the cognitive blending of the idea. The words ‘seagull feet’ are uttered numerous times as the work progresses, as an aid to focus on recapturing the visual memory.

The introduction of the daffodil motif by Bell, on the third layer of ‘Kilmory’ (Fig. 5.4 Layer 4), introduced a new memory into the piece, one that could not be shared. This element drove the work in a different direction and, for the researcher, away from the agreed framework of exploring shared memory. This resulted in the researcher’s stated intention, recorded on the video, to change the image dramatically. However, in reality, the only changes that were made were an attempt to reconcile the artist’s image with the researcher’s memory, through the addition of photographic and hand rendered electronic imagery (Fig. 5.5). The result was confusion; it was agreed by the collaborators that the image had become overworked.

Problems encountered developing the ‘Kilmory’ image, resulted in sharpened focus on the shared memory theme, in the production of the second image, ‘Dawn’, (described and illustrated in detail in Appendix B section 5.5.1). The colour and format of the initial layer of the image was able to

254 The researcher had experienced the location only in August. The daffodils were in flower in March.
communicate a sense of the location, and this was quickly combined with photographs, using
layers in Photoshop®. The resulting image stimulated additional memories that expanded the
imagery used within the piece.

In the third piece, 'Pladda' (described and illustrated in detail in Appendix B section 5.5.2), colour
and shapes work collectively to communicate memory of the place. The triangular motif
representing an island, added by the researcher to the image, was both anticipated and understood
by the artist. The same island symbol is also used by Bell in the final layer of 'Kilmory' (Fig. 5.3
Layer 6). The colours used in 'Pladda' were described as 'Arran blues'. They are characteristic
of the intense light on the island and are able to convey the memory of the location at a particular
season. In all three works the 'atmosphere' of the landscape has been communicated through the
use of colour: deep stormy blue in 'Kilmory', early morning mauves in 'Dawn' and Arran blue in
'Pladda'. The data collected throughout the investigation, indicates that the creative process of
collaboration is enhanced through the facility to communicate imagery at ease. The works arising
from the collaboration suggest that memory can be shared using digital technology.

5.2.4.3 Digital tool use to support creative thinking

The data reveals moments of insight, reflection and closure within the digital design process. The
facility to combine visual information from different sources, through the use of layering in
Photoshop®, encourages experimentation and enables new associations to be made very rapidly.
The ease with which images can be modified in opacity, position and scale enables rapid generation
of ideas and the opportunity for serendipitous solutions to occur providing moments of creative
insight. Rapidity of the image modification process, however, highlights the importance of periods
of reflection in the development process. The data reveals incidents when the researcher becomes
saturated with the decision-making process and displays a lack of confidence. These periods can be
seen to be overcome through the collaborative process, which provides both times for reflection, as
well as input of fresh imagery; building new associations and enabling renewed focus on the
creative task.

The decision making process is revealed as being particularly daunting for the digital designer at
the closure stage, prior to printing. The 'Kilmory' investigation highlights how images can rapidly
become over complex. The framework, outlined between collaborators at the outset of the project,
had defined the number of layers that would be produced. The data suggests that closure in the

255 This was discussed in email correspondence from Bell
256 Description used in correspondence between practitioners and in information provided for the
'Recursions: material expressions of zeros and ones' exhibition.
257 See Chapter 2 section 2.4.
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design development process needs to be negotiated at intervals rather than pre-defined when working collaboratively.

5.2.4.4 Digital tool use in creative practice

Data from the video of the investigations records the ways in which a variety of digital tools both enhance and inhibit the creative process. Cameras and scanners proved invaluable in the collection of visual data, some of which was combined with hand rendered sketches and notes in the research journal. The original intention of the researcher was to explore the notion of a virtual digital sketchbook but practicalities demanded that a physical book was developed. This enabled ideas to be presented to others with ease and allowed for images to be viewed in parallel by ‘flicking through’ or ‘at a glance’ rather than sequentially in a computer visualisation program such as PowerPoint®. The desire to physically handle and touch images and pages, to feel the gritty sand trapped in the watercolour sketches made on the beach, all contributed to the process of recapturing memory. Nevertheless, being able to visualise the images digitally and manipulate them with ease, enabled rapid review of a vast number of collected images and assisted in the initial phase of concept generation.

The use of digital tools enables detailed images to be developed for printing at almost any size, the only limitations being the dimensions of the substrate and printer. Scale and position of imagery can be manipulated on the computer screen at small size with the facility to zoom in and out enabling the image on screen to be perceived as it would be printed, large scale but viewed from a distance. Using the scale and zoom facilities in software, it is possible to view enlarged areas, and add detail that may not be apparent when the digital image is viewed on screen. Not every practitioner is comfortable with the physical demands of working on a large scale, but the digital tools provide considerable flexibility in the size of the finished printed work. Nevertheless, the visualisation of large-scale work on a computer screen is not without some difficulties. Practitioners must use their imagination in order to re-conceptualise the whole image when viewing detailed sections; the alternative is to print out, to scale, on paper at considerable expense.

It is evident, from the data, that the use of layers in Photoshop® was one of the most important features of the software, particularly for the integration of photographic information into the image. Use of the ‘clone’ and ‘pattern stamp’ tools enabled photographic details to be abstracted and blended with the image (Appendix B section 5.5.1). Changing layer opacity provided subtlety in
this integration and the facility to remove layers enhanced creative flow\textsuperscript{258} by providing freedom to try out ideas within a developing image without risk of destroying it.

The digital hardware proved at times to be detrimental to creative flow during the video recording of data. The frustration of working with large graphics files with a slow processor was noted on numerous occasions. The gaps between physical action and virtual rendering created pauses in which the momentum of the developing idea was lost. Digital tool use is optimised when it is reduced to background cognition and the locus of attention remains \textit{the content of the operation}\textsuperscript{259} (Raskin 2000 p.17). Attention was diverted away from the creative process and onto the operation of the hardware, resulting in distraction and loss of motivation to complete the idea.

Other frustrations involved the lack of sensitivity of the GID as a drawing tool. To overcome this, a tablet PC was used to complete various sections of the image in which line work, rather than image manipulation, was involved. Use of the pen and tablet is described as being \textit{more fun} compared to the mouse, as it permitted greater sensitivity and freedom of gesture in the marks created. The tablet however, was unreliable due to a technical problem and caused considerable frustration\textsuperscript{260}.

Email communication provided a key function in assisting the collaborative process and providing feedback. Knowledge that the image was developing successfully as a shared memory encouraged the participants providing intrinsic task motivation essential for creative thought \textsuperscript{261}(Amabile 1996).


\textsuperscript{259} Locus of attention (Raskin, J. 2000) pp17

\textsuperscript{260} The tablet PC was replaced by the manufacturer during the investigations with Alison Bell, the second device proving much more reliable.

\textsuperscript{261} Amabile 1996 pp107
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5.3 Part Two: Collaborative investigation with Debra Bernath

5.3.1 Rationale and framework for the project
The collaborative task exercise\(^{262}\) with Debra Bernath was conducted to investigate the ways digital technology may support the shared creation and development of design concepts for printed textiles using the Internet to communicate design data. Through the use of websites to transfer image files, it was possible to accelerate the process of sharing imagery and facilitate a collaborative creative process of innovating and developing design concepts. Email and telephone conversations were used for gaining feedback during the project and the researcher documented stages in the development of her contribution in the design process using digital video and a reflective journal. Analysis of the recorded data, feedback from the designer and the work created, provide information concerning the ways in which digital imaging is able to support the creative process and enhance collaborative printed textile design practice.

The proposal for the development of a collaborative body of digital design work was first discussed during the field study visit to New York in May 2004. It was decided at this stage that a series of digital images would be created that were able to express a shared memory of a particular location, New York, equivalent to the work previously developed with Bell described in Part One, section 5.2. The development of a small collection of commercial textile designs was also discussed. The proposal for this work was finalised during a meeting with the designer in Wales three months later; visual data recorded during the visit became the stimulus for the development of imagery used in the design collection.

5.3.2 Creative Process
The three panels that comprise the work ‘New York Skyline’ (Fig. 5.7) were developed from digital photographs of the view from the designer’s apartment in Brooklyn. The first layer of this image was selected from a variety of printed options provided by the designer during her visit to Wales (Fig. 5.9). This enabled initial visual ideas to be reviewed and discussed and a joint decision was made about how to progress\(^{263}\). Subsequent layers were added resulting in three digitally printed cotton velvet panels printed by the researcher (Fig. 5.7).

A shared memory of a visit to the top of the Empire State building provided the theme for the second work that was developed. This is described in detail in Appendix B section 5.6. Sketches and digital photographs were made on site and ideas developed in a reflective journal. The

\(^{262}\) See Chapter 3 section 3.4.4

\(^{263}\) This included the working method, file format, printed output etc.
researcher initiated the first part of this image and subsequent layers were added iteratively. The final output was a digital print onto cotton velvet (Fig. 5.8).

The Wales design collection was initiated by the researcher using a number of scanned images of wild flowers collected during Bernath’s visit to Wales. An initial idea, based on ferns, was posted on the website, but this concept was not developed as it was considered, by both parties, to be ‘too resolved’, leaving little creative space for additional layers. Following a second visit to New York by the researcher in May 2005, development of a collection of commercial floral designs suitable for apparel, was discussed and a framework for progress outlined264. Scanned flowers and photographs were digitally manipulated and layered in Photoshop® to create repeating design croquis265 (Fig. 5.18). A small collection of these was developed further into repeating patterns and a collection of six silk digital prints produced.

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264 This included the floral theme, market sector for the product, file format and method of data transfer.

265 A design croqui refers to the unit of pattern containing elements that build the repeating section.
Fig. 5.7 'New York Skyline'
Digital print onto cotton velvet
Photo © CT

Fig. 5.8 'Empire State' (detail)
Digital print onto cotton velvet
Photo © CT
5.3.3 *New York Skyline*

(*Figs. 5.7; 5.9; 5.10; 5.11; 5.12*)

5.3.3.1 Process

The work produced for the *New York Skyline* textile comprised three panels. The first image was produced from a combination of photographs taken from the designer’s roof garden overlooking Manhattan. These were printed onto paper to provide a number of options\(^{266}\) and one was selected that was considered to clearly express the memory of the location. This image was colour reduced and flattened in Photoshop® (*Fig. 5.9 Layer1*). The second layer combined sections of photographs of buildings, windows and reflections, photographed by the researcher in Manhattan, and combined elements of close up detail with the distant urban sky-scape (*Fig. 5.9 Layer2*). Subsequent layers included the addition of coloured shapes and a floral pattern element that referenced a laser-cut light sculpture, seen in a Manhattan gallery, during the visit (*Fig. 5.10 Layer 3*).

Following the inclusion of the floral element it was thought that the image was in danger of becoming over complex, so two new ideas based on the first were developed (*Fig. 5.12*). Sections of the first image were copied and pasted into new documents and areas of solid colour were added to the composition (*Fig. 5.11*). Having reviewed the photographs, it was noted that the colours being used in the piece had a strong relationship with Bernath’s apartment, particularly the kitchen. As a result of this association (*Fig. 5.11 Layer 4*) a texture was taken from a photograph of a section of kitchen wall and included in one of the images, and an area of pattern was developed, based on a series of photographs of the ceiling of the Guggenheim Museum (*Fig. 5.11 Layer 4*). This pattern was created in Corel Draw® as a vector file before being imported into Photoshop® and combined with the background.

The designs were digitally printed on a Mimaki TX2 ink jet printer by the researcher, onto a cotton velvet substrate using reactive dyes.

5.3.3.2 Format

The three *New York Skyline* panels work as a series: the first as the key pattern, and the others as coordinates. Design layout was influenced by screens seen in an exhibition of Japanese art at the Asia Society in New York, visited by the collaborators together. Sections of the panels have been divided geometrically to provide spaces for the pattern motifs to reside on top of a coloured ground. Elements, such as the floral shapes, overlap and break into these areas and are intended to create flow within the composition of each piece.

\(^{266}\) In the case study Debra Bernath comments on how she always likes to provide her clients with options.
In the final layer (Fig. 5.12 Layer 5), a photograph of the designer and researcher taken together in New York has been used as a pattern motif. In one, as a subtle layer under a section of stripes, and in the second as a tiny repeating motif that reads as textural pattern. In both cases the photograph has been colour reduced and reads as an area of tonal pattern.
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Fig. 5.9 'New York Skyline' - Layers 1 and 2

Layer 1 (Step 1)

Left: Collection of visual data: a number of photographs were taken from the designer's rooftop garden as stimulation for the concept. These were manipulated digitally into a vertical format, printed onto paper and saved on CD.

A number of options were created and the image (left) selected for development during a face-to-face meeting of researcher and designer.

Layer 2

Left: Introduction of areas of flat colour and photographic elements derived from images of architectural details in Manhattan.

Colour relationships with the image (in step one) were combined with memory of colours observed of reflected sky in the glass of the buildings. Memory was enhanced through the review and selection of digital photographs taken during visit.

Image was saved to CD at 300 dpi and mailed to the designer.

Layer 1 (Step 2)

Left: The image was simplified through digital colour reduction and saved at high resolution (300dpi) onto CD.

The image was mailed to researcher.

Left: An example of one of the photographs used in the image. This image was digitally manipulated to change shape and scale and integrated into the diagonal striped sections within the developing image.
Introduction of a motif derived from a photograph of a laser cut lampshade (below). The researcher and designer observed this object during a visit to a New York gallery. The photograph has been digitally manipulated to reduce colours and enhance the stencil pattern qualities in the original photograph. This motif was layered onto the developing image.

Layer 3 (Step 1)
Introduction of background colour

Layer 3 (Step 2)
Introduction of floral stencil element. The flowing lines were intended to break up the rigidity of the geometric format of the developing image.

The choice of subject matter refers to the concept of shared memory.

The image was ink-jet printed, at this stage, onto cotton velvet.

Detail (below) of the stencil motif combined with image.
Fig. 5.11 'New York Skyline' - Layer 4

Step 1

A section from layer 3 was copied and pasted into a new image by the researcher.

Sections at the top and bottom were filled with colour from the central part of the image.

Pattern imagery was created from architectural details using digital techniques with Photoshop® and Corel Draw® software. The selection of imagery was intended to reinforce the concept of shared memory.

The image was saved onto a CD and sent to the designer.

Step 2

A section from layer 3 was copied and pasted into a second new image by the researcher.

Sections at top and bottom were filled with colour from the central part of the image.

The overall colour scheme used in the developing series of images reminded the researcher of the designer's apartment. This led to a review of digital photographs and the selection of the kitchen image (right).

A section was copied and pasted from the kitchen photograph and included as a textural pattern in the developing image.
It was agreed by both designer and researcher that the images were complete at this stage since they were perceived to express the shared memory of the original concept discussed at the outset of the project. Any further addition to the images was considered likely to make them overly complex and difficult to read visually.

The three New York Skyline images were digitally printed onto cotton velvet using a Mimaki TX2 ink-jet printer.
5.3.4 Design Collection

(Figs. 5.13; 5.14; 5.15; 5.16, 5.17; 5.18)

5.3.4.1 Process

A collection of six co-ordinating designs was produced for the Wales design collection (Fig. 5.18). Initial design ideas were based on memories and photographs of Llancarfan village church combined with local wild flowers (Fig. 5.15). A selection of photographs taken during the designer's visit to Wales in August 2004 were posted on the website. These included the stained glass windows from inside the church, architectural details and the church pipe organ. From these images visual concepts were developed; initially the stained glass window image was manipulated into a stripe and later into a repeating unit forming a simple grid. This was combined with scanned pressed Welsh poppies to create 'Poppies and Church Window' (Fig. 5.15 Layer 3). The design was developed sequentially uploading to the research website and downloading amended versions from the designers website. The speed with which it was possible to transfer ideas made numerous changes and additions possible. A number of variations in the scale and strength of the grid pattern were explored and a sample digitally printed to test out resolution and colour. At this point it was decided to work large scale to exploit the possibilities of digital printing with non-repeating pattern.

The test print indicated that image needed to be cleaned up, to eliminate small marks that only became apparent with the increase in scale.

A second design, 'Viola and Organ Pipes' (Fig. 5.16) was developed using additional photographs of the church. The initial concept was posted by the researcher on the website. This comprised a colour reduced and repeating section of the organ pipes (Fig. 5.16 Layer 1). Bernath added to this, layers of scanned flowers including violas, buttercups and ferns collected from a Welsh garden. The background was colour adjusted and simplified (Fig. 5.16 Layer 3). The croqui was developed into repeat and a scanned daisy motif added by the researcher. From this repeating unit, Bernath developed a series of variations including 'Viola with dark background' (Fig. 5.18) in which a blue floral motif was added.

The fourth concept was developed from a photograph of grass blowing in the wind, taken by the researcher. The process used to create the background for this design, originated in a technique discovered while trying to isolate a floral motif from its background in an earlier image (Fig. 5.17). Using the colour range tool and working with low opacity on the eraser, an interesting texture had been created that reduced the photographic image into pattern. The grass photograph was stored in the same folder as the floral image and led to the technique being subsequently explored on this image. The resulting texture was developed into a repeating element using the offset filter, clone, pattern and fill tools in Photoshop® (Fig. 5.17 Layer 1). When Bernath downloaded it from the
website she expressed excitement to work with this particular image. The result was a number of variations on the viola design in which the organ pipe texture was exchanged for the grass layer.

In addition to the grass layer, two motifs of Welsh cornflowers, photographed at the same location, were posted on the website for possible integration into the concept. There followed several email communications discussing the difference between native Welsh and North American cornflowers (Fig. 5.17 Layer 2). Bernath visited Missouri shortly after this and was eager to include North American cornflowers and thistles with the grass and Welsh cornflowers. The result was ‘Cornflowers and Thistles’ (Fig. 5.17 Layer 3).

The final design, ‘Poppies and Cornflowers’ (Fig. 5.18), was developed specifically to integrate the five designs together as a collection and utilises motifs, colours and techniques used in all the designs. The work was not completed sequentially and most concepts evolved in parallel, influencing the development of each other.

5.3.4.2 Format

Two of the designs, ‘Poppies and Church Window’ (Fig. 5.18) and ‘Cornflowers and Thistles’ (Fig. 5.18), have been created to exploit the potential of digital printing to produce large scale imagery, without the necessity for repeat between the selvedges. In ‘Cornflowers and Thistles’ repeating elements have been incorporated into the format of the piece without an exact structure. This provides rhythm and flow of the motifs across the fabric surface.

The other four designs produced make use of the digital facility to copy, cut and paste with accuracy, to produce repeating designs with complex, multi-tonal, coloured design elements. Both approaches would have been difficult to achieve without the digital technology.

The colours used in the work relate directly to the source material used, either photographic or scanned. Some experimentation with saturation was explored to create vibrant digital colour combinations but it was not felt, by either collaborator, that these kept the work within the parameters of the shared memory theme in which colour plays an important role. As a creative tool, experimentation with colour could have provided new directions and a fresh approach to the work that was produced.
Fig. 5.13 ‘Poppies with Cornflowers’ detail
Digital print on silk crepe de chine
Photo ©CT

Fig. 5.14 Detail of ‘Viola with dark background’
Digital print on silk crepe de chine
Photo ©CT
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Fig. 5.15 Wales design collection: Poppies

Photographs taken during the designer’s visit to Wales were reviewed and the image of a church window (above left) was selected for development of ideas. A number of motifs were generated including the repeating grid pattern (above right).

Layer 2

Pressed flowers from the researcher’s garden were scanned and developed by Bernath into repeating imagery. The Welsh poppy flower was scanned at 300 dpi, colour adjusted and cleaned to remove stray pixels and background. The croqui (non-repeating) was posted on the designer’s website.

Layer 3

The croqui was downloaded by the researcher and developed into a repeating unit. Colours were adjusted and centres redrawn using digital brushes. The grid pattern developed from the window motif was layered behind the repeating unit. Designer and researcher worked on a number of iterations to find the most appropriate scale of grid pattern to work with the floral motif. It was agreed that the scale of the printed design would be large, full width of the fabric, repeating only top to bottom. The design was digitally ink-jet printed onto silk chiffon and silk crepe de chine using reactive dyes.
Fig. 5.16 Wales design collection: Viola and organ pipes

A photograph of the church organ (above left) was selected from several posted on website. The image was digitally manipulated to reduce colours (above centre) and adapted into a repeating pattern using copy and paste and uploaded onto the website (above right).

Pressed flowers and ferns were scanned (above), digitally colour adjusted, arranged and repeated, then combined with repeating organ pipe pattern. The file was uploaded to the website.

The pattern was put into repeat structure suitable for a commercial apparel print design using copy, cut and paste and the offset filter (above).

The colours were digitally readjusted and an additional scanned flower motif included, enabling the design to co-ordinate with the collection (above). Although this process is described in 4 stages, there were numerous small adjustments made at each stage, the design being up and down loaded from the website by the collaborators.
**Fig. 5.17 Wales design collection: Grass**

**Layer 1**

From a review of digital photographs, the grass (a.) and cornflower (b.) images were selected. Using the *colour range* tool and the *eraser* a new effect (c.) was discovered during experimentation.

![a.](image1) ![b.](image2) ![c.](image3)

**Layer 1 (Step 2)**

The same digital technique was used to modify the grass photograph (a.). The motif was put into repeat using *copy, cut and paste* and the *offset filter* (above).

![Layer 1](image4)

**Layer 2**

Two cornflower heads were layered onto the grass background (above) and uploaded onto the website. There followed an email conversation about whether these flowers were *cornflowers or thistles* which led to Bernath posting a photograph of a new flower, a native US thistle, on to the website.

![Layer 2](image5)

A combination of cornflowers, thistles and butterflies were layered to create *Cornflowers and Thistles* (above). Bernath developed the croqui into a repeating unit.

![A combination of cornflowers, thistles and butterflies](image6)

A second US flower was integrated into the grass layer by Bernath, this was posted on the website. The researcher included scanned buttercups and daisies to develop the concept further and provide colour coordination with the other designs in the collection.
All the design concepts depicted (below) are digital repeat units and can be digitally ink-jet printed at any size. Test prints were made on a variety of apparel fabrics including cotton lawn, silk crepe de chine and silk chiffon. The detail obtained on the silk crepe de chine was particularly notable and since the files are high resolution (300 dpi), can be printed to the full width of fabric 140cms without obvious pixelation.

1. Poppies and church window (above).

2. Cornflowers and Thistles (above).

3. Viola and organ pipes (above).

4. Viola dark background (above).

Viola and organ pipes (above) led to the development of 4. Viola with dark background (above right) in which the scale of some of the flowers have been digitally enlarged, the background re-coloured and the blue and yellow flowers incorporated from 5. Grass (below left).

5. Grass (above).

6. Poppies and cornflowers (above).

This design concept combines elements from all the others linking colours and shapes in the collection.
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5.3.5 Discussion

5.3.5.1 Creative Framework

This investigation provided the opportunity to explore two different creative approaches. The textile pieces ‘New York Skyline’ and ‘Empire State’ were produced without commercial constraints and with the sole purpose of exploring the use of digital technology to create textiles that express a shared memory of New York. The second part of the investigation focused on creating a commercial design collection of apparel prints. The implicit constraints in designing printed apparel textiles shaped the ways in which concepts were developed and drew on tacit knowledge of designing for the analogue printing process, garment pattern cutting, market influence and cultural factors. These issues set parameters for the creative exploration of generative ideas and framed the structuring of the visual concepts.

5.3.5.2 Digital tool use to stimulate memory

The shared memory theme guided the development of ‘Empire State’ and ‘New York Skyline’. Colour was considered a crucial component in the construction of the pieces and linked memories of previous locations visited with artefacts\(^\text{267}\). Colour memories were also important in the development of the ‘New York Skyline’ image: the soft blues and greens of Manhattan in the late spring and reflections of the blue sky in the grey architecture. Each digital layer contains specific memories of places and people\(^\text{268}\). The use of digital technology to review photographs, stimulated colour memories and enabled new associations between images to be formed. Colours were collected from digital reference material using colour selection tools and integrated within the developing image.

Memory played an equally important role in the development of the Wales design collection although it is less visually apparent. The floral elements represent a variety of locations visited by Bernath during her visit to Wales. The inclusion of elements such as the church window and organ pipes, also enable repeating pattern to be used to layer memory of physical experience within the design concepts. The digital tools facilitated collection, editing and manipulation of these visual elements so they could be combined within an image.

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\(\text{267}\) The earthy quality of light and colour in New York was compared with that experienced in Venice this was associated with a pre-Columbian object from the Metropolitan Museum of Art in New York.

\(\text{268}\) The composition of New York Skyline was stimulated by the shared memory of a visit to an exhibition of antique Japanese screens in the Asia Society in Manhattan, and the laser cut Tjord Boontje lamp seen in a gallery inspired the stencilled floral element in the work.
5.3.5.3 Digital tool use to support creative thinking

Photographs and sketches stimulated associative thought, the computer providing a means of visualising the blended connections. When working collaboratively, the data reveals how insightful moments occur when both practitioners experienced shared motivation resulting from the visual influences. This occurred at the stage when the pressed flowers were introduced in the Wales design project. Both the researcher and designer had initiated earlier design concepts however, only when the floral element was included as the major visual element, did the momentum of the collaborative creative process begin. The freshness of colour and appropriateness of imagery for the solution required, were key factors in this change.

Insight can also occur non-sequentially in design development. The inclusion of the texture from the cheese-grater in 'Empire State' (Fig. 5.8) occurred as a result of earlier experimentation with the pattern during the development of 'New York Skyline'. It had been assumed that the 'Empire State' image was complete at this point. The memory association and suitability of the colour, provided the insight that led to its inclusion within this piece and initiated the final layer.

In the Wales design project, most of the work was developed in parallel, with layering providing alternative design options. The collaborative nature of the process provided time to reflect on ideas and forced appraisal of the work in progress at each point of communication via the website. The result of this reflective process was the rapid development of non-sequential concepts in which layers were interchanged and new insights occurred. Designs were developed and refined in numerous stages without the need for substantial investment in time that is usually required in non-digital hand rendered work. It was possible to create design concepts freely, considering co-ordination of the collection as a whole only as the project reached a climax. Use of layers and rapid manipulation of colours, backgrounds and motifs made the co-ordination of individual designs straightforward, resulting in numerous design options. The processes of reflection and selection became key elements, within the creative practice, requiring constant evaluation and decision-making.

Layers were added sequentially and with little alteration in the development of 'Empire State' and 'New York Skyline'. The depiction of personal memory provided the individual layers with inviolability and the image became a fusion of joint imagination. Images were regarded as complete when sufficient layers had been added to convey the memory without destroying the visual balance contained in the composition. The Wales design solutions were more difficult to conclude. External considerations, for example the print process and end use, were combined with both practitioners' expectations and understanding of what pertains a printed apparel textile design. This influenced the refinement process within which numerous adjustments were made to the
designs. Had there not been a time constraint and requirement for sampling, the process of adjustment was likely to have continued.

5.3.5.4 Digital tool use in creative practice

Ease of transfer of design data between designer and researcher, using websites and high speed Internet connections provided an enhanced environment for collaboration. This was particularly evident in the development of the design collection, providing rapid feedback on ideas and the opportunity to continually modify layers of each design. Bernath’s non-secure Mac website provided an uncomplicated method of viewing and sharing work in progress. The disadvantage of this site was the limitation on file size, which meant that designs had to be posted either at a lower resolution, smaller size or in separate layers. The secure website used by the researcher lacked the simple interface and viewing facility but enabled huge files to be successfully up and downloaded. Access via Broadband provided download times in a matter of minutes from Bernath’s site and uploads of very large files in several hours. The same day delivery of design data kept ideas fresh and interest sustained in the project. Email communication and telephone conversations enabled discussion and reflection on the process to take place as the work progressed.

File sizes became almost unworkable when working at 300dpi and 9000² pixels on some of the non-repeating designs, due to the amount of RAM²⁶⁹ required by the software for image manipulation. This caused frustration at the final design development stage, however, it was also noted that memory capacity was insatiable; as soon as more was available increasingly complex tasks were attempted. Storage of large files also became a problem and additional hard drive capacity was required with back up of files onto DVD rather than CD.

Files were kept as layers and communicated at 300dpi to ensure consistency in design development and no loss of detail in the images. The final designs were ink-jet printed onto paper to check for inconsistencies prior to being digitally printed on fabric.

The use of digital tools: video, scanner and photographs provided efficient and rapid review of visual material prior to design development. Electronic drawing tools, including Wacom® tablet and pen and tablet PC, were used to create hand rendered electronic marks, the mouse being used predominantly for selection from menus and tools. The inclusion of a large amount of photographic and scanned imagery posed a problem when integrating hand rendered electronic line work, which appeared clumsy and crude by comparison. This was achieved most successfully in ‘Empire State’ where the image was simplified, less photographic and contained fewer colours. The colour complexity and tonal differences in the Wales design collection demanded a similar quality in

²⁶⁹ A machine with 1Gigabytes (Gb) of RAM was used during the project.
electronic hand rendered work; this was achieved using the *clone* tool to emulate the detail of adjacent areas.

The data suggests that a large proportion of time was spent digitally refining imagery prior to its inclusion within an image\(^{270}\). Several hours were spent in cleaning up stray pixels in a scanned image of two small flower heads. It was noted, however, that the time was well invested, as the images could be used subsequently in a variety of options at different scales. The digital print sampling process reinforced the necessity to refine images; removing stray pixels that were not immediately apparent on screen but evident once printed. Sampling also indicated the areas of visual interest that were visible on screen but lost in the lower resolution of the printed output. The loss of detail in tonal range and colour was dependent on substrate and ink saturation during the printing and finishing process. It was decided that although large files were difficult to work with, the higher resolution provided greater flexibility in the final solution. Small-scale high-resolution images could be enlarged considerably without noticeable loss of detail when printed onto cloth.

\(^{270}\) This is described on the research video as being the most tedious element of working with computers.
5.4 Part Three: Collaborative investigation with Susan Brandeis

5.4.1 Rationale and framework for the project

Handwork and crafting techniques play a vital role in Susan Brandeis’ creative process. Her major interests concern textile, rather than digital crafting, using technology to support and extend her established practice. This investigation has provided an opportunity to explore creative processes in which the textile product rather than the digital image creation are a primary concern for one of the collaborators. Brandeis’ enthusiasm to participate in the collaborative investigation has been tempered by her teaching commitments and health issues. As a busy member of academic staff at North Carolina State University, the amount of time she has been able to commit to the project has been limited. The result has been the creation of a smaller body of work than was possible during the previous two investigations. Two textile artworks were created, ‘Reflections’ and ‘Trees’. The development of ‘Reflections’ is described in detail in sections 5.4.3 and ‘Trees’ can be found in Appendix B section 5.7.

The collaborative investigation was discussed during the field study visit to North Carolina during May 2004. Digital photographs and sketches were made on site, and it was agreed that a shared memory of the visit would form the basis of the development of visual concepts271. The digital images produced for the project fuse visual memories of the locality of Carey272, with other sensory recollections, including auditory and tactile responses. These have been expressed in the work through motif, colour, line and composition.

The resulting outputs were digitally printed onto silk, cotton lawn and velvet and may be developed further by Brandeis using textile techniques such as embroidery and appliqué.

5.4.2 Creative process

The project was initiated by the researcher by posting three digital photographs and a watercolour sketch on to the researcher’s secure website. These comprised two views of the lake (Fig. 5.20), a photograph of seeds and pine needle debris from beneath the trees273 and a sketch of a mocking bird (Fig. 5.21). Each of these images evoked specific memories of the location for the researcher.

The files were downloaded by Brandeis and manipulated using Photoshop®. The intention was to share completed layers by up-loading them to the secure website. However, difficulties were

271 It was hoped that Brandeis would visit the UK in Summer 2005, when a second body of work, based on Wales, could be developed. However, due to unforeseen events, this visit was cancelled at the last minute.

272 A leafy suburban district outside Raleigh, North Carolina, USA

273 See Appendix B section 5.7 (Fig. v.viii)
encountered with this process\(^\text{274}\) and the images were returned to the researcher on a CD, causing some delay in the development of the work. The iterative process continued, with the researcher adding to the images. A variety of file transfer methods were explored to speed up communication of the images and avoid the necessity to mail files on CD. These issues are explained in detail in the final section 5.4.4.

5.4.3 Reflections

(Fig. 5.19 – Fig. 5.23)

5.4.3.1 Process

Brandeis selected the digital photograph of the reflection of light on the water at the lake to begin this image (Fig. 5.20 Layer 1). This was layered with a scanned photograph of the bark of the birch tree in her garden and the opacity adjusted to fuse the two photographs (Fig. 5.20 Layer 2). This was returned on a CD by post due to continuing problems in uploading to the researcher’s website. The composition was developed by the researcher to express memories of reflected light and music experienced in the artist’s home. The second layer added a digital photograph of shadows formed from reflections of leaves through a window and the virtual canvas was extended to provide a horizontal picture plane, divided by a stripe of water texture (Fig. 5.20 Layer 4). Space was left on the right hand side of the composition for additional imagery to be included and the image

\(^{274}\) Problems were due to file download size restrictions on the NCSU computer system.
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uploaded onto the website for Brandeis to develop. Brandeis was unable to download the images from the website, possibly due to the considerable increase in file size\(^{275}\), and limitations imposed by the NCSU computer network. The researcher transferred the files to North Carolina State University via File Transfer Protocol (FTP), however Brandeis was still unable to access them, and so the files were put onto CD and mailed to the USA.

Brandeis' next layer included the introduction of electronic hand rendered marks evocative of pine needles, which she describes as being a 'powerful and ubiquitous symbol of North Carolina'\(^{276}\) (Fig. 5.21 Layer 4). She also adjusted opacity and colour but made no major compositional changes to the piece. The third layer provided the researcher with the opportunity to include additional imagery to extend the memory theme. This included a scan of a mocking bird watercolour sketch and music notation. Both provide visual references to auditory memory of the location\(^{277}\). Still images taken from the video recording of the visit were also incorporated in this layer, linking the artist's home with the developing image (Fig. 5.21 Layer 5). Brandeis used the fourth layer to dramatically change the colour and mood of the piece through the use of a Photoshop\(^{®}\) texture filter and adjustments to the hue and saturation of the colour. No additional motifs were included (Fig. 5.22 Layer 6). Brandeis felt that the image might be complete at this point and so test digital ink jet prints were made onto silk crepe de chine and cotton lawn using reactive dyes. Considerable colour variation was noted between both substrates and the image on screen. The fragmentation of the image into small dots of colour produced a lack of colour intensity and visual detail (Fig. 5.22 Layer 6). Following a telephone conversation with the artist it was decided that a layer should be added to reintroduce detail, simplify the colour, and balance the composition.

Adjustments to the final layer involved considerable colour modification to remove the complementary colours that were optically mixing to perceptually dull the image\(^{278}\) (Fig. 5.23 Layer 7). The resulting image was re-combined with the second layer and, using the eraser tool, some areas from this were revealed. The bird motif was re-introduced subtly between these layers (Fig. 5.23 Layer 7). It was decided that test prints should be made on cotton lawn, velvet and silk crepe de chine prior to final printing of the piece.

\(^{275}\) From 2,500 KB to 382,659 KB

\(^{276}\) Letter to researcher dated 08.08.05

\(^{277}\) The musical notation is taken from ragtime music played by Marc Brandeis during the visit; the mocking bird sang in the trees outside the window in the morning.

\(^{278}\) This comprised orange, brown and turquoise blue dots juxtaposed in very close proximity.
5.4.3.2 Format

The horizontal composition of the work and inclusion of strips of alternating textural pattern is evocative of a number of Brandeis' embroidered panels, seen by the researcher\textsuperscript{279}. This influence was unintentional, and only appreciated on later reflection. The format of the piece was developed to communicate visually the flickering and subtlety of moving light and sound in the environment experienced by the collaborators. Textural elements dominate both background and foreground while the bird motif provides a focal point within the piece. The image was cropped at the third and fifth layer to restore balance to the composition.

\textsuperscript{279} See Chapter 4 Fig. 4.23 and 4.24
Fig. 5.20 'Reflections' – Layers 1 to 3

Layer 1
A digital photograph of the lake at Carey (above) was chosen by the artist from three photographs posted on the website by the researcher.

Layer 2
The water image was layered with a scanned photograph of tree bark from the artist’s garden (above). An attempt to upload the file to the website failed. The image was returned to researcher on a CD.

Layer 3 (Step 1)
A digital photograph of reflected leaf patterns was incorporated into the image using layers; the two images were merged using clone, airbrush and eraser tools in Photoshop® (detail right).

Layer 3 (Step 2)
The combined photographs were layered on top of a duck egg blue rectangle used to define the shape and size of the work (above). A band of water texture from the layer 1 photograph was overlaid onto the reflected leaf section. The file was uploaded onto the researchers website, however Brandeis was unable to access the file. The image was transferred to NCSU via FTP and later saved onto a CD and mailed to the artist.
Fig. 5.21 'Reflections' – Layers 4 and 5

Layer 4

Hand rendered electronic marks to suggest pine needles were added by Brandeis (above). The image was saved and returned to the researcher on CD due to difficulties with FTP.

Layer 5 (Step 1)

Inclusion of elements from digital video stills (above) to suggest sound and music memories: piano music and sound of the mocking bird singing. A section from a video still of wooden cladding outside the artist’s home (above left) was digitally manipulated and layered into image.

Layer 5 (Step 2)

A watercolour sketch of mocking bird was scanned and digitally manipulated to reduce opacity. The image was saved and transferred to the artist using FTP.
A filter was applied (by the artist) to the entire image to create a pointillist effect. Colours were also adjusted. The image was saved and returned to the researcher on a CD. There were continuing problems with FTP and website access due to NCSU security protocol and Mac/PC file incompatibility.

Digitally printed sample using reactive dyes onto cotton lawn. Samples were also printed onto silk crepe de chine and cotton velvet.

The detail was lost in the image; colours appear 'muddy' when viewed from a distance.

Photograph of digital ink-jet print of image (on cotton lawn using reactive dyes) indicating the loss of colour detail when compared to the digital image (above top). The use of the filter and colour adjustments has taken many of the colours in the image out of gamut for the digital printer. Although visible as light on the computer screen, these colours are impossible to print via this process onto fabric.
**Step 1**

The image was colour adjusted to remove the colours out of print gamut. As the image had been returned flattened it was difficult to make a large adjustment to the hue. The bird motif was removed by creating a mask from the original scanned image.

**Printed samples:**

*Above left:* sample of the image printed at layer 6.
*Above middle detail:* sample printed on the same substrate following adjustment (layer 7). Printed using a Mimaki TX2 textile ink-jet printer onto cotton lawn using reactive dyes.

**Step 2**

*Above right:* addition of the scanned and manipulated bird motif. Additional electronic rendering was added using the airbrush tool to blend elements in the image.

**Digital print ‘Reflections’**

When compared with the digital file, the colour change and loss of detail in the image is evident (it must be noted, however, that this image of the textile has been translated digitally through photography and paper printing and is no longer the same scale or resolution.)
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5.4.4 Discussion

5.4.4.1 Creative framework
Digital photographs, video footage, scanned photographs and sketches all contributed to the construction of the two images described. The artist's intention was to focus on the production of digitally printed imagery that could provoke further embellishment using textile processes. The researcher's interest was in developing images that were a visual response to a location, time and experience, maintaining focus on image creation rather than production of ink-jet printed raw material for subsequent textile development. Brandeis' interest in creating interesting texture rather than integration and composition of imagery is revealed in the making process described in section 5.4.3.1. This appears to have produced a tension in developing the images collaboratively.

Infrequent feedback during the making process and difficulties in communication of files also provided frustration for both collaborators throughout the duration of the project.

5.4.4.2 Digital tool use to stimulate memory
Both images produced for this investigation express the practitioners' experiences in Carey, North Carolina. Imagery used in 'Reflection,' is used to convey auditory memory cues through their translation into visual symbols, such as music notation and the mocking bird motif. The computer has enabled still photographic imagery and video to be used and merged together to achieve this. Visual sensations, involving the perception of diffused and flickering light through vegetation and on water, are also integrated within the piece. The intention was to convey visceral emotional content: how it felt to be there, rather than an accurate reproduction of what was observed.
Photographs have been digitally manipulated and merged with hand rendered material to convey this. The 'Trees' image is more visual in the way it references memory. The intention was to describe the scale and verticality of the trees and sensation of being amongst them. Light and colour were important in describing the ambience of the place and provide memory cues for the researcher of a particular experience. Brandeis describes the textural and colour intensity as being key to her multiple memories and experience of being in this location280. The use of digital tools to merge these multiple memory cues into one visual format has been fundamental in the development of the images.

5.4.4.3 Digital tool use to support creative thinking
The period of time that elapsed between the visit to Carey and development of the two images described was just over a year. Throughout this period, thoughts concerning the nature of the images to be made were being formed. Motifs that had potential for inclusion in visual concepts

280 Described in a letter to the researcher 22.09.05
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were noted during the visit; photographs were collected and drawings made. The development of two specific themes: trees, and reflected light and sound, emerged from reflection on memories of the visit.

Particular incidents of reflection are evident from recorded video data of the practice. Photographic images, that clearly link memory with an imagined format of the pieces being developed, are commented upon. Association with remembered experience is regarded as the criteria for their inclusion within the piece. A photograph, indicating the extreme height of the trees, is used to define the proportions and composition of the ‘Trees’ image and provides the memory cue to rekindle the emotive experience of the place (Appendix B section 5.7). This provides further visual ideas that help formation of the image, including the use of light and shadow in the composition.

The stage at which each layer is considered complete is tempered with a desire to leave potential for further additional material from the collaborator. Spaces were left open and the composition unresolved to accommodate the shared creative process. The video data indicates that the researcher had preconceived ideas of the final format of the pieces and comments on how the image concurs with memory and imagination. This preconception seems to be at odds with the notion of shared creative process when new visual direction might occur at any stage in the process. It suggests that some form of leadership in image development may take place in collaborative creative partnerships and raises questions about the equality of participants’ contributions in the process.

The use of complex digital layers enables an unplanned exploration of digital effects. The data reveals incidents when imagery is dropped into the wrong layer, accidentally but with fortuitous effect. Use of the eraser tool without attention to the active layer also provides greater spontaneity in the working method.

5.4.4.4 Digital tool use in creative practice

The investigation has highlighted ways in which digital imaging technology is able to enhance the creative practice by enabling concepts to be visualised and modified with ease. At the generative stage, photographic, scanned and video data can be reviewed for visual potential: colour, pattern and form; enhancing memory, providing creative associations and cognitive blending.

The facility to layer imagery, copy, cut and paste sections within images provides opportunities for exploration of concepts without risk. Previous saved versions of a file can be easily accessed from computer providing potential for new ideas to emerge from the same thread. In this investigation, the facility has been shown to be useful when collaborative ideas have faltered. The ability to
combine earlier renditions of an idea with later ones has proved to be very useful when technical
difficulties arose as a result of the printing process (Fig. 5.23).

Scanned hand rendered sketches and the use of the graphics tablet and pen, enabled gestured marks
to be combined with photographic imagery. Use of the eraser tool with the tablet and pen resulted
in greater precision and more fluid line work than is possible with a mouse; the eraser and clone
tools, used with layers, enabled multiple images to be integrated rapidly.

Changes to hue and saturation of colour were frequently made to the images during this
investigation. Brandeis has found, in her work at NCSU, that digital images need to have the colour
more highly saturated when ink-jet printing onto textiles281. It has been noted, during this
investigation, that when colours are saturated in Photoshop® detail is lost in the image. By ink-jet
printing the images onto fabric at various stages, it has become apparent that too much detail is
visually confusing and can make the colours appear dull. Increasing the colour saturation,
therefore, reduces the colour range and simplifies the image. Difficulties encountered when
digitally printing ‘Reflection’ onto fabric, resulted from some of the colours within the image being
out of gamut for the printer (Fig. 5.22 Layer 6). During the post-printing digital refinement of
colour in the new layer, these issues were resolved282 (Fig. 5.23 Layer 7).

A number of issues concerning the communication of digital design data between the collaborating
practitioners are highlighted in this investigation. It was agreed at the outset of the investigation
that digital images would be transferred between practitioners using a secure website via the
Internet. The initial transfer of images was successful and Brandeis was able to download the
digital photographs that had been loaded onto the site. Having completed work on the first layer,
however, Brandeis had difficulty uploading the new image to the website; work was saved onto a
CD and mailed to the researcher. Numerous unsuccessful attempts were made to upload the image
to the server and it was concluded that the difficulties resulted from the security protocols
embedded in the Apple Mac software used by Brandeis.

When the next layer of the images were posted on the secure website by the researcher, Brandeis
was no longer able to download the images. It was decided to try and transfer the files using File
Transfer Protocol (FTP) between the university servers at UWIC and NCSU. Transfer from the
researcher was successful to the FTP server at NCSU; however, Brandeis was unable to access the
file due to internal university security protocols. The files were written onto a CD and mailed to
Brandeis. After completing the next layer of the image Brandeis was given the security protocol to

281 Telephone conversation between the artist and researcher 08.10.05
282 Colours, viewed on the computer monitor, may not necessarily be possible to be printed onto fabric;
colours need to be checked to ensure they are within gamut through the software before printing.
access the NCSU FTP server and uploaded the images. It was not possible, however for the researcher to retrieve the files and so Filezilla® software was utilised by the researcher using the NCSU security protocol. Although this software provided an easy method for the researcher to upload files that Brandeis was able access with ease, there remained a problem in transferring files back to the researcher. It became clear, at this stage, that the problem was again related to Brandeis’ use of the Apple Mac computer. Files saved onto the FTP server at NCSU were Mac Binary encoded files, which could not be opened on the researcher’s PC despite the use of file expanding software.

Although FTP is designed not to be platform specific, and files could be transferred, a generic file type is essential if the data is to be accessed at each end. Problems with data transfer continued to cause frustration throughout the investigation although the use of FTP did speed up data transfer considerably from the researcher to Brandeis.

Difficulties concerning file transfer and printed colour, in the investigation, highlight the need for clear and regular verbal communication between creative collaborators. Email, telephone conversations and correspondence provided useful feedback during the development of the work.

283 http://filezilla.sourceforge.net/
284 Mac Binary encoded files have a .bin file extension
285 Stuffit Expander www.stuffit.com (acc. 05.03.06)
286 The TIFF file format used by the researcher is accessible on both Mac and PC.
5.5 Part Four: Independent investigation

5.5.1 Rationale and framework for the project

The independent investigation complements the earlier collaborative projects, providing insights into how digital imaging technology impacts on individual creative practice. Video recording of the work in development, research journals and the resulting digitally printed textiles were used to provide the information presented in this chapter.

The visual stimulus for the work was a visit by the researcher to China and Hong Kong during summer 2004. Photographs, sketches, colours, and assorted visual material was collected during the visit. Electronic tools such as digital video, photography, graphics tablet, scanner and design software\textsuperscript{287} were used to develop this material on the computer. Although the focus was on digital crafting, there was no intention to use electronic devices to the exclusion of conventional hand rendered techniques but rather to make appropriate use of the full range of equipment. The aim was to investigate how the integration of digital technology within practice can be used to enhance creative thinking and develop visual concepts for printed textiles.

Visits to two particular exhibitions in Hong Kong provided stimulation for the body of work produced. The first of these was an exhibition of Chinese calligraphy at the Hong Kong Museum of Art. The format of the exhibits as well as the importance of the expressive nature of the marks was noted. The second was an exhibition of ceramics and glass that referenced the ancient classic Chinese writings 'Xian Shu', (the Book of History) which describes the five essential elements on which the material world is composed: earth, fire, metal, water and wood\textsuperscript{288}. The works produced during the independent investigation were a response to the ideas generated from visiting these exhibitions.

5.5.2 Creative process

Initial ideas, from sketches and photographs made on location, were manipulated on the computer using Photoshop\textsuperscript{®} software. The process of reviewing photographic images, to collate the material for the research journal, focused the intention to build a series of images related to the Five Elements and based on the associated visual research collected in China and Hong Kong.

\textsuperscript{287} Photoshop\textsuperscript{®}, Corel Draw\textsuperscript{®} and Corel Photopaint\textsuperscript{®}

\textsuperscript{288} It was believed that the interaction of these elements explained the cycle and mechanism of nature and the physical world; by uniting them, new materials are created.
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A series of A3 watercolour paintings were produced using traditional Chinese paintbrushes, with the intention of exploring expressive mark making. The resulting images were scanned and combined with digital photographs and video stills using Photoshop®. At a critical stage in the development of each image the work was saved onto a CD and sent to a digital print bureau to be printed onto silk satin. This substrate was selected for its smooth surface that is able to provide detailed resolution and lustrous colour.

The edges on each piece were finished to accommodate a hanging device for exhibition. The investigation was designed to explore the development of the image prior to digital printing and so there was no initial intention to embellish the pieces with stitch or additional textile techniques after printing. However, two of the pieces, ‘Draig’ (Fig 5.26) and ‘Shrine’ (Fig. 5.34), were hand embellished with lustre pigments to achieve the desired metallic effects that were not possible to print digitally. The following section outlines and illustrates the stages in development of two the printed textiles that comprise ‘Five Elements’: ‘Draig’ (Fire) and Yu (Water). Descriptions of the development of the further three images: ‘Panel’ (Wood), ‘Shrine’ (Metal) and ‘Earth’ (Earth) can be found in Appendix B section 5.8.

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Fig. 5.24 ‘Five Elements’ (Digitally printed silk satin)
Exhibited in Digital Perceptions, Leedy-Voulkos Gallery, Kansas City, USA May-July 2005
Photo ©CT

289 While visiting a design studio in Shanghai, the Senior Designer had demonstrated the correct use of Chinese brushes that were later given to the researcher as a gift.

290 The critical stage can be observed on the video and is the point at which the practitioner feels confident that an appropriate solution has been reached in the creation of the image.

291 Quantum Design group, Nottingham www.quantumdesigngroup.co.uk (acc.05.03.06)
5.5.3 Draig (Fire)

Fire was the first of the ‘Five Elements’ theme to be explored. The image of a dragon was chosen not only as it is regarded as being an important Chinese symbol but also because it is a national emblem of Wales. The dragon symbol has developed into a stylised form that is replicated as decoration on many different Chinese artefacts: ‘Draig’ was influenced by photographs of costumes from the Chinese Opera in the Museum of Culture in Hong Kong.

5.5.3.1 Process

(Figs. 5.25 - 5.26)

A watercolour sketch was made using Chinese brushes on paper (Fig. 5.25 Layer 1). This was developed using layers of colour, bleach and distressing techniques to build the textural surface quality of the piece. The intention was to try to evoke the concepts ‘dragon’ and ‘fire’ through the expression of colour, pattern and texture. The paper itself was burnt, scratched and sanded to enhance the textural qualities and provide spontaneity; the image could have been destroyed in the process of its creation. The image contains all five elements of the theme: fire through burning, water as the medium for the application of paint, metal in the use of lustre pigment, earth in the pigments used to colour the paper and wood in the pulp of the paper. The resulting work was scanned at 300dpi in full colour and stored as a TIFF file.

The second stage of the process involved an exploration of digital pattern and repeat (Fig. 5.25 Layer 2). Imagery can be replicated with perfection and ease on the computer with the use of repeat pattern or copy, cut and paste commands. The intention was to create the impression of non-repeating texture using layers of repeating pattern and to reveal random elements of the background layer using the eraser tool; this enabled the physical size of the image to be increased for digital printing without losing resolution. The paperwork was scanned at 300 dpi at several stages in the process of creating the distressed paper surface. Sections of the scanned image were selected and used to generate repeating pattern (Fig. 5.25 Layer 2). Two repeating layers of pattern were generated and combined using the clone tool and eraser to blend them together. These two layers were subsequently merged. The scanned dragon image was then integrated into the textured

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292 http://www.crystalinks.com/chinadragons.html (acc.05.03.06)

293 Dragons play an important part in Chinese mythology and culture and are regarded as symbolic of imperial power, strength and fortune. The fire-breathing dragon is also seen as the embodiment of nature itself and its ‘celestial breath’ or ‘Sheng Chi’ gives power to the seasons and is considered to be the greatest divine force on earth.
background using the eraser at low opacity, bringing the background into the foreground and softening the image.

5.5.3.2 Format

The format of the piece was influenced by Chinese calligraphy and the square dragon motif (*Fig. 5.26 Layer 3*) is intended to be evocative of the 'chop' or artists seal. To create this motif, a small Chinese tin embossed with a traditional dragon motif was scanned at 300dpi. A box was placed over the tin to enable the scanner to operate without the lid being closed. The scan was colour reduced and then re-coloured to harmonise with the digital image (*Fig. 5.26 Layer 4*).

Colours from the image were identified using the *colour selection* tool and brushes made. Using a pressure sensitive graphics tablet and pen\textsuperscript{294}, flowing hand drawn electronic lines were added to echo the curves in the dragon’s body (*Fig. 5.26*). The final process involved adding coloured sections for hemming and finishing. The completed image was written onto a CD as a TIFF file and sent to a textile digital print bureau to be ink-jet printed onto silk satin.

\textsuperscript{294} Wacom *Graphire* graphics tablet
Fig. 5.25 'Draig' (Fire) - Layers 1 and 2

Layer 1
Following a review of digital photographs and images in the research journal, a drawing was made on watercolour paper using inks, watercolour paint, and metallic colours, to express a personal representation of the dragon symbol synonymous with both Chinese and Welsh culture. Since the image was to represent the element fire, the drawing was also burnt, and distressed with bleach. The drawing was scanned at 300dpi at various stages in its development (above).

Layer 2 (Step 1)
Two sections from the background of the scanned drawing were copied and developed into two repeating patterns. These were digitally layered and the eraser tool used to randomly reveal the bottom layer. The result was a non-repeating background layer much larger in physical size than the original scanned work but at the same image resolution.

Layer 2 (Step 2)
The scanned drawing was merged into the background using the airbrush and clone tools.
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Fig. 5.26 ‘Draig’ (Fire) - Layers 3 and 4

Using a graphics tablet and pen a series of electronic rendered lines were made exploring the pressure sensitivity of the device. The colours used in the line work were selected from within the image using the colour selection tool.

A Chinese metal box (top right) was scanned at 300dpi. The colours were reduced digitally and re-coloured using a palette from the image (bottom right). The re-coloured scanned box was overlaid onto layer 3 (above detail) and integrated into the image using electronic line work. This object was included to reference the ‘chop’ used in Chinese calligraphy.

The file was saved onto a CD and sent to be digitally printed.

Draig – Photograph of printed silk (left)

Digitally printed silk satin.
Size: 77cm x 156cm
Photo ©CCT

Draig was one of the Five Elements exhibited in ‘Digital Perceptions’, an exhibition of digital textile art held at the Leedy-Voulkos Gallery, Kansas City, USA, May-July 2005
5.5.4 Yu (Water)

5.5.4.1 Process

(Figs. 5.27 –5.30)

Yu²⁹⁵ was developed from a collection of photographs, video and sketches made on location at the Yu Yuan Gardens in Shanghai. Several of the photographs depict the black water teeming with koi and a section of one of these has been used as the background for the image (Fig. 5.29 Layer2). Following a review of the visual material, an expressive drawing was made using Chinese brushes, watercolour and ink, to evoke the movement and fecundity of the water at Yu Yuan (Fig. 5.27 Layer 1). A second drawing in the same colours was made using floral imagery from the Lantau Buddhist temple garden, near Hong Kong. Both drawings were scanned into the computer at 300dpi and saved as TIFF files. These images were later combined in Photoshop®.

To express the movement of water within the image, another layer was developed using scanning techniques (Fig. 5.28). Working with a flat-bottomed glass tank, coloured dye was dropped into the water and the solution stirred to create movement. The scanner lid was closed quickly and the effect captured in a series of scans. These were enhanced and colour adjusted to create a third layer within the koi image. The background, taken from a section of digital photograph, continues the theme of moving water into the background of the image (5.29 Layer 2).

In Chinese culture, fish are considered to be symbolic of good fortune and like the dragon motif, widely used in traditional surface decoration. Two small, stylised fish motifs were developed from paper-cut stencils, which were scanned and manipulated to create pattern motifs (Fig. 5.29 Layer 2). The koi depicted in the watercolour, are an expressive response to memory, video and photographic record of a place and time, and are intended to contrast sharply with the paper-cut fish motifs. Their position in the piece references the calligraphic format; it is evocative of the printed Chinese ideograph used in the artist’s chop, in contrast to hand rendered calligraphy.

Once the format of the piece had been finalised the file was written to CD as a TIFF file and sent to be digitally ink jet printed onto silk satin (Fig. 5.30). The printed silk panel did not reveal the full tonal detail of the image on the file (Fig.5.30 Layer 2). After discussion with the print bureau, the digital image was adjusted to give much greater tonal contrast. The new file was printed successfully although the subtlety of the original digital image could not be achieved.

²⁹⁵ The Chinese word Yu means both ‘black’ and ‘fish’ or ‘water’
During the development of the digital image, the aim had been to convey the interplay of light on and through surface. This resulted in experiments exploring the translation of the image onto glass and ceramic surface. The koi image was sent on CD to a bureau and digitally printed as both ceramic and glass decals. Experiments using glass and ceramic samples were made. The glass decals were applied to Desag glass and fired to 600°C; the ceramic decals were applied to earthenware tiles and fired to 800°C. During the sampling procedure some decals were applied to glass textiles in a variety of weights and fired to 600°C. The results indicated that it would be possible to pattern glass fibre in this way but that the firing process made the cloth very brittle. A sample was fired for a second time between two pieces of Desag glass to fuse the layers and trap the glass textile. The result of this experiment was interesting but it was decided not to pursue this method further due to time limitations.

5.5.4.2 Format

The format of ‘Yu’ references Chinese calligraphic artworks noted in the exhibition visited by the researcher in the Hong Kong Museum of Art. The position of the scanned watercolour image over an area of subtle background pattern relates to the use of patterned or textured papers under the gestured brush marks in the Chinese work; the stencilled fish motifs beneath are evocative of the artists ‘chop’ (Fig. 5.30 Layer 3).

5.5.4.3 Heron

A second concept to represent water, ‘Heron’, was also developed. The image was stimulated both directly and indirectly from digital video of the old city of Shanghai and was constructed from a combination of scanned watercolour, photography and video. Further details of the process used to construct the image can be found in the Appendix B section 5.8. The researcher chose to include the digitally printed silk textile ‘Yu’ in the ‘Five Elements’ work, rather than ‘Heron’, since it was considered to express the concept of water with greater clarity.

296 http://www.cuccolini.it/eng/ntd.htm (acc. 05.03.06)
297 More detailed information on these experiments is documented in the research journals.
Step 1

Digital photographs from Shanghai were reviewed and selected (above). A watercolour sketch was made following the review of digital video of the same location (above right). The sketch was scanned and saved at 300dpi.

Step 2

Photographs of the fish pools at the Po Lin monastery, Lantau, were reviewed and a watercolour sketch of a water lily made. The painting was scanned and cleaned up to remove stray pixels.

Step 3

The fish and water lily scans were digitally merged. Areas of the background were removed using the eraser tool as an airbrush and the opacity of the layers adjusted. The centre of the water lily was redrawn combining electronic painting and a photographic layer of a flower centre.
Step 4
Experiments to capture the effect of moving water in the image. A glass container was filled with coloured dye, stirred to create movement and then scanned (above left).

The scans were digitally enhanced using a variety of tools to reduce the colours and create digital effects to suggest moving water (above right).

Step 5
The scanned manipulated image was developed into a mask and this was used with the eraser tool on the combined water lily and koi image. Detail (above right) showing scanned moving water effect.
Fig. 5.29 ‘Yu’ (Water) – Layer 2

Step 1
The background layer for Yu was developed from an enlarged section of a digital photograph of a pool (Yu Yuan Gardens, Shanghai) (above right). The intention was to continue the concept of moving water into the background of the image.

Step 2
(Above) The background image was enlarged to the intended size of the final digital print (150cmx 75cms). The layered image of water lily, koi and scanned water, was overlaid onto the background layer and merged using eraser and airbrush tools.

Step 3
Introduction of two stencil fish motifs (above). These were incorporated to reference the ‘chop’ used in Chinese calligraphy; these are ideograms, printed as symbols and contrast with the calligraphic gestured signature of the artist, made with free flowing brush stokes. The stencil fish motifs were produced by scanning hand made ‘paper cuts’ purchased in Shanghai. These were digitally reduced to black and white and overlaid onto an enlarged section copied from the lily and koi image.
Layer 2 (Step 4)

The image (above) was sent on CD to a specialist ink-jet print bureau to be digitally printed onto silk satin. The background water texture did not print. Further modification of the image was required to ensure that all colours were within the printer’s colour gamut.

Layer 3

The background layer was digitally reworked to enhance the tonal contrast and reduce colours (above right). Additional sections were included for making up at the top and bottom for the hanging devices and along both sides for neatening.

The image was resaved and test samples were carried out using the Mimaki TX2 ink jet printer on a variety of substrates. After several readjustments and test prints the final image was saved to CD and then sent to be digitally printed.

‘Yu’ - Photograph of digitally printed silk satin (left).

‘Yu’ was one of the ‘Five Elements’ exhibited in ‘Digital Perceptions’, an exhibition of digital textile art held at the Leedy-Voulkos Gallery, Kansas City, USA, May-July 2005
Size: 70cm x 167cm
Photo ©CT
5.5.5 Discussion

5.5.5.1 Creative framework

The images created for the independent investigation were developed to fit within a specific conceptual framework based on the 'Five Elements' theme. This provided boundaries and constraints for the complex choices required in the creative process and limited the infinite visual possibilities in making the work. 

Some of the concepts had already begun to evolve during the visit to China: the idea of using an aerial view of Shanghai in one of the pieces occurred while photographing from the aircraft window; observation of the textural 'earthy' qualities of ceramic figures had stimulated ideas about an image in which these could be conveyed. The data reveals that these early, indistinct connections between visual stimulus and image making remained unresolved until the work began to be physically formed and the preconscious elements became foreground cognition. There is a visceral awareness of the direction of the creative development without a precise definition of the likely visual outcome.

5.5.5.2 Digital tool use to stimulate memory

The 'Five Elements' theme stimulated conceptual blending at both conscious and preconscious levels of cognition. Assumptions regarding the format of the works were based on the memory of exhibitions visited in Hong Kong and underpinned the creative decisions that took place. These visual cues influenced development of the work: the direction and shape of the digital canvas and the positioning of motifs.

Digital tools, particularly photography and video were used in the investigations to rouse memory and reawaken past experience. Photographs digitally blended with the expressive drawings, enhanced memory of experience. Word association and metonymy also provided links between imagery and memory; the name of each work defining the imagery used in its development. In 'Yu'

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299 See Earth Appendix B 8.3

300 The researcher comments that she has a feeling about how the image will look: 'handmade, earthy, crude' but is not sure about the layout. She states that she is 'beginning to feel her way through it'. Earth 27:40

301 In 'Shrine', the feeling of being inside the dark Yu Yuan palace rooms looking through the lattice screens to the bright vista beyond was rekindled when reviewing photographs. This memory became associated with imagery from another location, a shrine at the Po Lin Monastery, providing the link with the concept for the five pieces.
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the Chinese word associations include 'peace', 'water', 'black' and 'fish'; each of these elements influencing the composition and colour of the developing images. The ease with which images could be reviewed, selected, stored and combined, stimulated memory of experience and enabled rapid associations to be made between developing ideas.

5.5.5.3 Digital tool use to support creative thinking

Many thoughts, images, words and associations occur in the creative process and from this wealth of stimuli, moments of insight are required in order to direct the choice of ideas to be pursued; many are discarded. The tacit force of recognition, attributed to moments of insight, is described as intuition\(^302\) (Smith, Ward et al. 1995). The research data suggests that moments of insight occur when associative thought is linked with visual recognition; the imagined image appears to correlate with the viewed photograph in order to make the selection possible.

Sometimes a period of reflection or incubation is required prior to the moment of insight\(^303\). At various stages it was noted that a period of reflection was needed before the creative process could continue\(^304\). Knowing at what stage to cease building the image is noted as being difficult. There is however, a tacit recognition that closure has been reached when a level of complexity has been attained that communicates the imagined idea with clarity. The computer enhances this process by enabling the various stages in image construction to be reviewed, providing opportunity to step backwards and forwards and make modifications.

5.5.5.4 Digital tools

Digital video, still digital photography and scanning devices were used extensively during the personal investigation to collect imagery and record experiences. The computer provides a means of virtually mixing visual data from these sources and enables rapid visualisation of material stimulating generative ideas. Blending of hand rendered scanned imagery with photographic material affords the digital image more spontaneity\(^305\). In the hand rendered work, risks are taken in order to engineer unpredictable results. The work is set on fire; the surface is bleached and

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\(^303\) When making 'Yu' the idea of using scanned moving water occurs after some time has elapsed between the first visual ideas have been explored. It is noted on the video that the researcher had woken up 'buzzing with ideas' whereas the period prior to incubation had been unproductive.

\(^304\) When making 'Shrine', the researcher decides to leave the work for a while before making a decision, and in 'Between' the video camera is turned off and the process paused for a period of reflection.

\(^305\) When making Draig, the researcher comments on the desire to 'lose control' and the use of physical materials make this possible.
distressed. This can be contrasted with the more predictable controlled digital environment in which imagery can be manipulated but without risk using save, copy and undo functions and the history palette in Photoshop®.

The desire for unpredictability in the working method is evident in the use of brushes\textsuperscript{306}. The way in which physical brushes are held, viscosity of the paint, absorbency of the paper, speed and energy of gestured movement all contribute to the spontaneous nature of the marks produced. By comparison the digital brushes are found to be rigid, more predictable and less physically responsive to hand control. Although the digitising tablet and pen was found to be more sensitive to physical gesture than digital brushes controlled using the mouse, the marks produced lack the variety of tone and subtlety of line possible using analogue brushes. However, electronic brushes combined with the ‘clone’ and ‘pattern stamp’ tool in Photoshop® are able to emulate sections of the image\textsuperscript{307}. By combining scanned hand rendered brush marks with electronic brushes, spontaneity can be achieved with digital precision and control.

The computer enables the colour and structure of the scanned imagery to be manipulated in a way that would be difficult to replicate using hand-rendering techniques\textsuperscript{308}. Colour reduction tools were of particular benefit when blending images requiring colour compatibility between layers\textsuperscript{309}. The effect of digital colour reduction in an image is comparable with the selective visual process that occurs in human perception and manifest in drawing using physical media; it enables photographic imagery to be combined digitally more readily with non-photographic source material.

Difficulties associated with colour communication occurred in the development of ‘Shrine’ and ‘Yu’. Both works contained elements of pattern that proved hard to digitally print\textsuperscript{310}.

The problems encountered concern two colour issues: the gamut of printed colour and the difficulties of working between physical reflected colour (printed) and light emitted colour (computer display). The monitor on the system used to develop the ‘Five Elements’ images was

\textsuperscript{306} A selection of large Chinese brushes was used to create the hand rendered work.

\textsuperscript{307} The background in Draig was developed using these tools and provided a means of enlarging the physical size and, therefore, resolution of the image by combining three layers of repeating imagery into a non-repeating background.

\textsuperscript{308} When making ‘Between’ the scanned background is rebuilt using the ‘clone tool’ and ‘copy’ command and colour changed to destroy the effect of symmetry in the image.

\textsuperscript{309} Photographic images, used to make ‘Earth’, were colour reduced and later re-coloured using other layers within the piece.

\textsuperscript{310} In ‘Yu’, the area of water ripple in the background did not print even when the image was adjusted to increase the tonal difference within the pattern. After several attempts to rectify this problem the layer was redesigned with less subtlety and far greater tonal variation. A similar problem occurred with the repeating grid element in ‘Shrine’; this image was also redesigned to provide a greater tonal range.
replaced with a TFT\textsuperscript{311} monitor providing a higher screen resolution with greater colour gamut compared to the CRT\textsuperscript{312} screen used previously. When designing on the new system the full range of colour possibilities were utilised; since the colour and pattern were clear on this screen, it was not assumed that there would be a problem with printing the images. However, the colour gamut for ink-jet printers is much smaller and as a consequence both very light and dark tones proved difficult to print\textsuperscript{313} (see Chapter 2 section 2.3.1.4).

\textsuperscript{311} Thin Film Transistor (TFT)
\textsuperscript{312} Cathode Ray Tube (CRT)
\textsuperscript{313} The ink-jet print is also much lower resolution than the light emitted image on the computer screen.
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5.6 Findings arising from the investigations

5.6.1 Collaboration

Following the collaborative investigations, each practitioner was asked to respond to a series of questions designed to provide a reflection on the experience and evaluation of its impact upon the practitioners’ creative process. Analysis of this information, in conjunction with the recorded video data, indicates that digital technology supports the creative process in a variety of ways. Sharing of visual data in electronic format supported the development of collaborative ideas by stimulating associative thought. Visual material from a variety of sources was introduced into the process unilaterally; the recipient’s response generating further associated visual ideas to develop the image. The practitioners noted that this generated spontaneity and discovery within the process. Both Bernath and Brandeis commented on the excitement engendered by the exchange of files, comparing the experience with receiving gifts and the sense of anticipation on Christmas Eve. There was consensus that the process was felt to be playful, adventurous and stimulating; judgement was suspended and the sense of responsibility reduced. These are attributes widely considered to enhance creative motivation.

The punctuated flow of ideas, generated by the iterative process of collaboration, provided mandatory periods of reflection in which the practitioners were forced to refocus on the task, appraise the development of the work and make decisions concerning future progress. In the development of commercial design ideas with Bernath, this process encouraged intentions and production constraints to be examined, and objectives to be met. The creative framework, agreed at the outset of each investigation, provided boundaries that enabled visual ideas to be managed and deployed purposefully; the sense of united intention resulting from shared experience was particularly useful in this respect. When difficulties were encountered, the digital facility to step backwards and return to an earlier rendition of the developing image was useful. In work with Bell and Brandeis, it was by returning to previous layers that the ideas could be modified and difficulties resolved. In the commercial design work with Bernath, the constant playful exploitation of layers, and their transfer between images, stimulated a variety of new directions in the work.

314 The responses to these questions can be found in Appendix B sections 5.2; 5.3; 5.4
315 The video data recorded the researcher’s practice in developing the collaborative work.
316 Bell states that ‘the spontaneity was motivating’ and the shared process ‘enhanced the outcome by moving in unexpected directions’
317 Bernath states that she felt like she was ‘getting presents all the time’
318 Brandeis comments that she ‘felt an expectation, sort of like Christmas Eve’.
319 The intention was the development of imagery for digital printing
The results from the collaboration with Bell suggest that the prescription of the number of iterations in advance of developing work was not helpful in achieving closure in the creative process. The creative framework for subsequent investigations permitted a more organic, less preconceived route, with the number of exchanges being defined by the progress that had been made. The findings suggest that closure needs to be *negotiated* at intervals, throughout the collaborative process, and that frequent email communication, documenting reflection on the work in progress, is helpful. The data also indicates that there is a sense of responsibility to delay creating closure during image development, in order to leave space for the respondent’s input into the work. Respect for the collaborators prior contribution to the image, also provided a degree of inhibition in the creative process. All three collaborators stressed the importance of personal qualities in the success of the collaborative process, citing *trust* and *empathy* as being important attributes.

Shared image creation raises issues concerning the authorship of the created work and highlights the importance of trust in the partnership. All three collaborators denied that they considered authorship of the work an issue, preferring to regard the output as the result of a shared experience. The capacity to integrate responses from more than one individual via the digital medium, and to communicate and replicate it with accuracy, has considerable implications for the way an artefact is perceived and its monetary value. It raises issues concerning the nature of the work of art as a material, *hard* object or *soft* digital artefact: the product of collaborative artists and software engineer.

The act of initiating the first layer of each image was not found to impact on the practitioners' sense of ownership of the work produced. Bernath preferred to initiate the image; Bell expressed a preference to respond. It was noted, however, that the researcher felt her preconceptions, regarding the development of the work, indicated her leadership in the image creation. This may suggest that the success of creative collaborative partnerships relies on sharing of responsibility and a willingness to assume and relinquish leadership, when necessary, with acceptance of the partner.

Electronic communication in the form of file transfer via the Internet, email and telephone, facilitated the accelerated sharing of imagery and the rapid development of visual concepts. The ease and speed of communication provided rapid feedback on the developing ideas, enhanced with the ability to share and refine ideas in real-time.

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320 The stage when both practitioners felt the images were ready to print.
321 See section 5.4.4. Space is left in the image for Brandeis to include imagery.
322 Brandeis notes that she felt constrained in the creative process, valuing the collaborator’s action by needing ‘to respond with control’.
323 See section 5.4.4.3 ‘Digital tools to support creative practice’.

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motivation and maintained momentum in the creative process. Work with Bernath indicates that the collaborative development of commercial design concepts, in different geographic locations and time zones, is feasible via the use of websites. The shared process enabled a mix of cultural and personal, knowledge and experience, to be combined. Technical difficulties concerning electronic file transfer were found to be frustrating and demotivating in the investigation with Brandeis. These complications were not insurmountable, however, and could have been resolved using personal websites as the work with Bernath indicated\textsuperscript{324}.

The data reveals unanimous agreement by the practitioners that, in their view, digital technology supported the process of collaboration and enhanced creative practice. Each stated that they would consider future collaboration. However, the necessity for empathic relationships and shared values was emphasised.

5.6.2 Memory and associative thought

Analysis of the data suggests that digital imaging technology is able to support the creative process by stimulating memory and the association of ideas. The computer facilitated the mediation and storage of images from a variety of electronic sources: digital camera, video, Internet and scanner, providing the practitioner with a range of material to rekindle memory and generate associated ideas. Analysis of data from the investigations indicates that the facility to store, sort, retrieve and manipulate digital imagery rapidly, and with ease, supported the generative stage of the design process. Subsequent further review of visual material, non-sequentially in a physical sketchbook was considered beneficial once an initial review and selection of digital images had been made on the computer.

5.6.3 Visualisation

Digital imaging was able to extend creative thinking by providing rapid visualisation of developing concepts. The facilities to change scale, zoom, and pan around imagery, enabled detailed and large-scale work to be envisioned and created. Digital tools provided rapid means of copying and repeating imagery, and experimentation with repeat structures and composition. Visualisation provided opportunity for reflection and refinement of the embryonic concepts and selected ideas could be saved, combined or developed further.

5.6.4 Colour

Digital tools provided flexibility in the use of colour. Colour memories were enhanced during the investigations by combining scanned and photographic digital imagery. Images were digitally re-

\textsuperscript{324} Bernath produced her work on an Apple Mac transferring files to a website with no difficulties.
coloured with ease; adjustments to reduce the numbers of colours, or saturate hue, were found to simplify imagery, making the colours perceptually brighter and less visually confusing.\footnote{See section 5.4.4.4.}

5.6.5 Spontaneity and risk

The use of digital layering provided opportunity to blend ideas and create intricate imagery; increased complexity resulted in greater perceived spontaneity in the process through accidental ordering of layers. Duplication of layers offered opportunity to coordinate images and create new paths for developing ideas.

Amabile (1996) states that fear of judgement is inhibiting to the creative process whereas ‘playfulness and total absorption in the activity at hand; set breaking, cognitive flexibility and risk taking’ are conducive to creative performance (Amabile 1996 p.98). The digital facility to save, copy, paste with ease and the use of layers provided a risk free environment in which playful experimentation occurred. When digital tools were found lacking in gestured responsiveness, scanned hand-rendered materials were incorporated into the work with the intention of imbuing it with emotional expression and spontaneity.

5.6.6 Creative and collaborative process

Analysis of the data suggests that digital technology is able to support the creative process for the individual practitioner and enhances collaborative practice due to the ease with which visual data can be communicated and shared.

The following chapter makes a synthesis of these findings with those from the Contextual and literature review, Chapter 2 and Case study, Chapter 4.
Chapter 6 Interpretation and discussion of findings

6. Findings: interpretation and discussion

6.1 Introduction

This chapter reflects upon and discusses the findings arising from the case study and practical investigations set out in Chapters 4 and 5, in association with the theoretical part of the project outlined in Chapter 2, section 2.4 'Creativity and cognition'.

The study has investigated the impact of digital imaging technology on the creative process of printed textile practice, primarily focusing upon concept generation and creative cognition, rather than the technical details of artefact production. Nevertheless, it has been important to examine the entire iterative process of design development since, for some practitioners, the later technical stages of artefact production are crucial in the creative process.

The following sections explain the ways in which the use of digital imaging technology has been found to impact upon creative practice. This includes its use as a tool to support the creative process by enhancing memory, prompting new visual associations, and providing access to prior knowledge. Its use in the development of ideas through access to embedded knowledge in design software is also discussed, as is the importance of haptic sensory stimulation and the connection between making by hand and creative cognition. The creative potential of the facility to share digital visual data is also explained.

6.2 The digit (making by hand)

6.2.1 Making by hand informs creative thinking and results in hybrid practice where digital techniques are combined with hand making

The research has found that many practitioners, using digital imaging technology, acknowledge the importance of making by hand in the creative process (section 2.3.3). A desire for somatic intervention can occur at any stage in concept formation, from generative idea to embellishment of printed artefact. In the research data, Bell exhibits this in the use of scanned hand painted fabrics and later in the addition of painted, stitched and collaged elements in her work (section 4.2.2). Brandeis employs hand rendered sketches to associate and develop ideas and reacts to perceived

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326 This is highlighted in the case study and investigation with Susan Brandeis, where the printed cloth inspires further creative development of the image.

327 The connection between the computer as a tool for manipulating images through numbers (zeros and ones) and the use of the hand as a tool to manipulate a physical media is reflected in the word 'digit' (from Latin 'digitus') meaning both finger and an Arabic numeral between one and ten. www.m-w.com, (acc.05.03.06)
"flatness" of digitally printed cloth with the desire to elaborate the surface further, using textile handcrafting techniques (section 4.4.3.3). Bernath develops 'free expression' handcraft alongside her computer-generated work, sometimes incorporating it into digital designs (section 4.3.2.3). Work produced for the researcher's personal investigation also combines scanned hand rendered imagery with digital, providing an enhanced emotive reinterpretation of memory (section 5.5.5.4). Bell, Brandeis and Bernath express a collective view that haptic interaction with materials enhances the generation of ideas and provides the artefacts they create with increased 'emotional charge'328, (sections 4.2.2.4; 4.3.4.1; 4.4.4.4).

Anthropologists have suggested that to make with the hands is an innate human capacity and through hand experience, the brain develops manipulative, kinaesthetic and language skills which build memory and knowledge of the world (Dissanayake 2000), (Wilson 1998). The combination of kinaesthetic and tactile information supplied to the brain from hand experience is combined with sensory information from the visual system, to build the visuospatial images that are necessary for imaginative and creative thought (Wilson 1998).

Prytherch asserts that touch is 'not a single sense but many closely related sensory mechanisms' and is linked perceptually with sight (Prytherch 2002 p.1). Both provide information to the brain in different ways; haptic senses result from successive experience in which substance is encoded, whereas sight provides simultaneous experience in which shape is encoded. Both work together reflexively to inform the body and interact with the world. Research cited by Prytherch (2002)329 has shown that repeated experience enhances haptic senses and enables the simultaneous blocking of other sensory stimulation providing more acute perception. Those practitioners who have learnt haptic skills such as textile handcrafting are therefore, more likely to feel constrained by the lack of sensory stimuli inherent in digital crafting (Harris 2005). The hardware and peripheral devices that are most commonly used do not exploit the complex neuromuscular potential of fingers and thumbs, nor the hand-eye coordination or force feedback that is the natural development of hand manipulation. Less sensory stimulation provides less access to stored memory and reduces potential associative thoughts for concept generation. Norman (2005) contends that the virtual world of computers 'eliminates one of the greatest delights of real interactions: the delight that comes from touching, feeling and moving real physical objects' (Norman 2005 p.80). The research data suggests that practitioners compensate for lack of haptic sensory stimulation through additional handcrafting following digital artefact production or involvement in parallel non-digital creative hand making tasks (sections: 4.2.2.4; 4.3.2.3; 4.4.3.3) The result has been a hybridisation

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328 This term is explained in section 2.3.3 and this is developed later in this section.

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of digital and handcrafting skills, producing artefacts in which traditional craft techniques are combined with digital technology\textsuperscript{330} (Treadaway 2004d).

Traditional textile crafting methods are slow to practice. It was noted in the research that the slowness of making by hand was an advantage, as it provided the practitioner time to reflect on the work on progress (section 4.4.2.1). With the crafting processes preoccupying subconscious procedural memory, other memory can be accessed at random. This unstructured freethinking space may provide opportunity for continued mental associations to be formed, enhancing the subsequent creative action. Tardif and Sternberg, cited in Sternberg (1988 p.429) note that 'creativity takes time\textsuperscript{331}' and so provides opportunity to blend ideas. This was clearly evidenced in the case study in which Bernath stated that hand making enabled her to break from fixed design strategies and provided her with new conceptual associations (section 4.3.4.1).

Heightened perception, resulting from haptic experience, is embodied in the crafted artefact. Wilson (1998) states that work made by hands is endowed with 'a powerful emotional charge\textsuperscript{332} or 'aura'\textsuperscript{333} (section 2.3.3)(Wilson 1998 p.8). The research has found that practitioners described digitally printed textiles as frequently being flat, lifeless and lacking sensuousness (section 2.3.3). The lack of spontaneity in the digital process is often recaptured through scanning or embellishment, to provide evidence of the human hand in the process. Hand gestures powerfully communicate emotional non-verbal body language. In creative making they are able to encapsulate gesture and emotion through physical tension and pressure, drawing upon tacit procedural memory of tool use combined with memory of prior sensory experience. This emotional response becomes enmeshed in the making of the artefact and can be perceived in it\textsuperscript{334}. The findings suggest that practitioners regard this as being more difficult to achieve using digital tools alone (sections 4.2.2.4; 4.3.4.1; 4.4.3.3). Cognition is concerned with interpretation of the affect of sensory perception, and creative cognition is influenced by sensory stimulation of physical experience. Norman (2005 p.80) contends that physical objects 'involve the world of emotion' whereas the computer deals with abstraction. Research in neuroscience suggests that 'emotions work through neurochemicals that bathe particular brain centres and modify perception, decision making and


\textsuperscript{333} In his essay 'The Work of Art in the Age of Mechanical Reproduction' (1934), Walter Benjamin uses the term 'aura' to describe the emotive element that is lacking in the machine manufactured product. Benjamin, W. (1973). Illuminations, Fontana/Collins. Collection of essays; includes 'The Work of Art in the Age of Mechanical Reproduction'.

\textsuperscript{334} This equates with the Japanese concept of Kansei.
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behaviour' this changes the parameters of thought (Norman 2005 p.10). Emotion involves sensory experience, gut reaction, visceral awareness, and physically affects the body through stimulation of muscles and reflexes (Ibid). The emotional content of digitally produced artefacts therefore, resides in the perceived evidence of physical interaction of its author.

6.3 The digital tool

6.3.1 Digital imaging enhances the germinal phase of concept development through the collation of imagery

Digital tools, including digital cameras, video and scanners, have been found to be effective in enabling practitioners to collect diverse visual imagery to stimulate creative thinking (sections: 4.2.2.3, 4.3.2.2, 5.5.5.4). Images can also be sourced from the Internet and CD ROMs, providing rapid access to imagery that would have been difficult or time consuming to achieve without the technology. They can also be stored and retrieved with ease on portable electronic digital storage media such as CDs, DVDs, memory sticks, or on a local computer or website providing access to multiple users. Where there are time constraints on the design process, rapid assimilation of imagery at this stage provides more time to explore ideas in the later stages of the process. This is evident in Bernath’s use of image stores and Internet access when creating freelance designs (section 4.3.2.2).

6.3.2 Digital imaging technology enhances the incubation phase, facilitating associative thought, providing opportunity for conceptual blending and lateral thinking

Visualisation of imagery from diverse sources can be used to create an electronic sketchbook. Bell describes this as a melting pot in which digital images can be blended together in layers to form new imagery providing novel associations and speeding up the process of lateral thinking (section 4.2.2.3). The sequential viewing of these images contrasts with the non-linear reflection that is possible using a conventional sketchbook. Some practitioners find it is necessary to print out imagery to construct a physical book that can be viewed non-sequentially. This can be added to with hand rendered sketches, diagrams or other random collaged material (section 5.2.4.4). Physical handling of visual research material is useful for its ‘playful’ manipulation; time spent cutting, sticking and doodling, helps to forge connections between imagery, assisting conceptual development.

The quantity and diversity of imagery that can be accessed and stored digitally, enables new mental associations to be made rapidly. Imagery from multiple sources such as digital video, photographs and scans can be integrated and manipulated to provide memory enhancement and to stimulate
Imaginative thought (section 5.5.5.3). Generative ideas can be stored at this stage for later addition or development and communicated to others in digital format.

### 6.3.3 Memory and imagination can be stimulated through the use of digital imagery

Perception of experience involves all the senses but that of vision is particularly powerful. Vision is not *sight* but rather the mediated experience of seeing, in which perceptual redundancy abstracts or filters experience, combining it with memory\(^{335}\) (McCullough 1996). Integration of photographic imagery, within a digital image, makes use of the camera’s capacity for translating reflected light from dimensional space into a two-dimensional picture plane. This effect is incapable of providing the rich multi-sensory experience of vision\(^{336}\) (Gombrich 1982). The result is that photographic imagery is deficient when relied upon exclusively to evoke and communicate memory. This was demonstrated in the collaborative work with Bell, in which a photograph of a particular location was enhanced using the digital facility to blend it with scanned hand rendered imagery, to express the memory of the *experience* of being there (section 5.2.3.1).

Photographs provide images with linear and tonal detail but are often unable to convey the complexity of the artists’ expression without further embellishment. Brandeis and Bell have both used digital photography to enable them to produce, what they regard, as a *more literal* interpretation of the world (section 4.2.3.4 and 4.4.4.1). Their interest in the integration of photographic representation, within their digital images, reflects a wider interest by other textile artists\(^{337}\) who have embraced the recent ability to render photographic imagery on cloth using digital ink-jet printing. The visual qualities of the recent work produced by Bell and Brandeis exhibits this move from abstract pattern making, gestured hand rendering and application of colour. All three practitioners noted in their evaluation of the collaborative investigations, that the most valuable peripheral tool in their digital practice was a digital camera (Appendix B sections 5.2, 5.3, 5.4).

Photographic digital imagery is a powerful tool for rekindling memory. The comparisons between photographically recorded and perceived memory of experience have been found, in the research, to provoke further creative exploration (section 5.2.4.2). Those elements absent in the recorded experience can be expressed and combined together to enhance the developing image, providing

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\(^{336}\) Gombrich states that *‘psychologically it does not make much sense to say that we ‘copy’ what we see in the visible world. What we see extends in depth, while our painting surface is flat.’* Gombrich, E. H. (1982). *The image and the eye: further studies in the psychology of pictorial representation.* Oxford, Phaidon Press.

\(^{337}\) Hitoshi Ujiie, J.R. Campbell, Amanda Briggs etc.
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the viewer with a richer more personal evocation of the experience of the artist. Photographs were combined with scanned hand rendered imagery in many of the researcher's investigations described in Chapter 5, to integrate additional visual information, enabling gesture and emotion to be incorporated into the work (section 5.5.5.2).

Once generated, a digital image is capable of rapid proliferation as generic but variable renditions. Iterations of an idea can be modified to create multiple options for further exploration. Digital images provide greater flexibility than film based photography: multiple copies can be made and these can be infinitely varied, each one an original\textsuperscript{338} (McCullough 1996). Nevertheless, the research has highlighted how, at times, this facility for idea proliferation has caused the subsequent decision-making process to be exhausting for the artist. The rapidity of image production, compared to techniques involving non-digital tool use, encourages idea generation, and the process of reflection has been found to be of paramount importance (section 5.2.4.3). When making by hand, the slow crafting process provides time for reflection; adjustments can be made in fabrication as the design takes shape. In digital crafting the danger is that multiple ideas are produced without refinement. Use of the technology has been observed to encourage non-reflective thinking and McCullough (1996 p.53) describes those who are content to keep working in this way as 'mouse potatoes'. Digital tools can sometimes encourage this approach due to the complex memory tasks required to operate software\textsuperscript{339}. Nevertheless, the collaborative investigations indicate that the punctuated working process enables reflection to occur when work is exchanged and forces the appraisal of the developing concept (section 5.6.1)

6.3.4 Digital imaging enhances convergent thinking in design development, providing visualisation of concepts and enabling solutions to be verified

Findings from the case study and investigations indicate that digital tools enable design concepts to be explored, refined and visualised with ease (sections: 4.5.1; 5.2.4.4; 5.3.5.3; 5.4.4.4). Multiple options can be rapidly produced and explored in a variety of colour, scale, repeat pattern construction or compositions. This ability to view options as virtual ideas, before they are physically produced as printed artefacts, enhances imaginative thought, providing opportunity for reflection, prior to further adaptation and refinement. Digital techniques, such as colour reduction and accurate scaling, enable concepts to be honed to meet production requirements whilst maintaining a variety of creative options. This was found to be particularly effective in the production of the design collection described in section 5.3.4.

\textsuperscript{338} McCullough (1996), p.47

\textsuperscript{339} This is discussed further in section 6.4.2

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6.3.5 Digital imaging technology enables and enhances creative collaboration

The ease with which it is possible to store and communicate digital images provides the opportunity for creative collaborative partnerships to develop. Press and Malins (2004 p.5) contend that the future models of craft practice ‘are increasingly going to depend on collaborative working strategies.’ Polvinen (2005) states that international collaborative work on product development ‘is where the technology driven global industry of apparel textiles is rapidly moving today’ (Polvinen 2005 p.38). The investigations in the second part of this research have explored the potential of working in this way and reveal that collaboration can enhance creative thought, providing access to shared imagination, enhancing the artists expression of memory in the resulting artefact (Treadaway 2004c).

Although the collaborative investigations in this project indicate that this strategy can enhance creative practice, a number of issues have emerged including the difficulties in working with increased image file size, and problems associated with data transfer using Internet and File Transfer Protocol (FTP). During the investigation it was necessary to maintain images in layers and at high resolution to retain the level of detail required to print onto fabric at large scale. In collaborative work with Alison Bell, images were transferred as TIFF files on CD and when working with Debra Bernath transfer of files was explored via the Internet, using both secure and non-secure websites (section 5.3.5.4). The original intention was to use a single site for both up and down loads of data, but technical issues resulted in the use of two sites. Difficulties were encountered due to the combined use of both Mac and PC platforms, with the Mac user having difficulty uploading files to the secure website. To accommodate this, each artist used their own sites for uploads. File size also became a problem when uploading to the non-secure website due to financial limitations. If, however, both parties had been working with PCs linked to the secure server it is unlikely that file size or access, for both up and downloads, would have been a problem.

When working collaboratively with Susan Brandeis similar problems were encountered (section 5.4.4.4). In this case FTP was used to transfer files to the North Carolina State University server. Although the transfer was successful, there were considerable difficulties in accessing files due to the internal firewall and security protocols within the system. Nevertheless, the findings indicate that the process of image data transfer, even using very large layered files is possible in a matter of minutes using the Internet and FTP. This points to the future potential of rapid development of creative collaborations, across continents and time zones, to enhance practice.

342 To increase file size on this site would have required considerable additional expense for Bernath.
6.3.6 Digital tools are able to motivate creative practice when difficulties are encountered with analogue working processes

Both Brandeis and Bernath were able to continue their creative practice when the physical constraints of lack of space and health issues restricted opportunity to continue their work (sections 4.3.1 and 4.4.1). Both practitioners found that working digitally alleviated these constraints and provided them with renewed motivation and a new direction in the type of work that was being produced.

6.4 The digital medium

6.4.1 Digital technology can extend creative practice by providing access to embedded knowledge in silicon memory and network environments

Within the research, the practical investigations reveal how digital technology provides practitioners with access to a range of embedded skills in the software they use in their creative practice. This provides access to knowledge 'beyond replication' as the sum of embodied expertise, in any single professional graphics software package, is more than might reasonably be expected of any individual to acquire in their working life (Gale 1994 p.220). This 'distributed knowledge' (Dormer 1997 p.138) can be accessed and applied to the process of crafting with the digital medium using the practitioner's personal knowledge of making. Domingues (2004 p.159) in her paper 'Cyber art and Interfaces: the coupled body' contends that computer memory can become an extension of the human brain and be used to 'stimulate artists' imagination'. Research data, from the collaborative investigations and the researcher's own work, indicates that human memory can be extended through the storage of and access to digital images, and this can be used creatively to develop artworks that embody emotional experience (sections: 5.2.4.2; 5.3.5.2; 5.4.4.2; 5.5.5.2)

Evaluation of the work by the collaborators, indicates that the images created with Bell and Brandeis were successful in communicating shared memory and that the design collection created with Bernath was developed using shared memory (Appendix B sections 5.2, 5.3, 5.4).

The digital networks that have been used in the research to share personal memory, stimulate mutual imagination, and develop combined imagery, have successfully facilitated creative 'connexive' practice.

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344 Press and Malins (2004 p.2) use the concept of 'connexity' to explain how 'growing connectedness is the most significant social and economic development of our age,' and how 'a new networking, socially engaged logic must underlie contemporary craft practice'.


6.4.2 Interface design must provide easy access to software if it is to enhance creative flow.\textsuperscript{345}

Poor interface design and physical difficulty using GIDs is demonstrated in the research to be detrimental to creativity. The data reveals how frustrations with electronic drawing tools interrupt the flow in development of an emerging visual idea. Raskin (2000) in ‘The Humane Interface,’ contends that much of the difficulty we have with computers and related devices is ‘due to poor interface design rather than any complexity inherent to the task or to any lack of effort or intelligence on the part of users’\textsuperscript{346}(Raskin 2000 p.10).

The problem is frequently one of distraction. To be absorbed in the creative task involves the locus of attention to be the cognitive process, rather than operation of the tools. Acquisition of tacit knowledge of materials and making enables the crafting process to be reduced to background cognition, as procedural memory. Attention can then be focused on the creative task; declarative memory can be accessed and combined with current experience without interruption. The research indicates that software with complex menu structures such as Photoshop®, frequently used by textile practitioners, requires considerable practice before use becomes habitual and transparent. Knowledge of menu structures is very memory intensive, requiring mental models to be formed before software can be used intuitively. Any distraction by the system concentrates the users attention and makes its operation stressful\textsuperscript{347} (Ibid). Both the case study and practical investigations have indicated that the slow response time of the machine when processing large image files also posed a similar problem with distraction. Brandeis comments on her frustration with the slow speed of the NCSU computer system during the field study visit (section 4.4.4.3). The researcher noted loss of momentum in the design process when working with large files, particularly during the collaborative investigation with Bell (section 5.2.4.4) and later during the development of the design collection with Bernath (section 5.3.5.4).

Practitioners were found to have overcome problems of lack of fluidity with software by becoming expert in using a limited number of tools and functions. Software provides multiple methods of achieving the same end and practitioners frequently devise their own techniques for particular sequences of actions to achieve their goals (section 2.3.2.1).

Memory of menu structures and position of symbols on the display enables rapid access to software functions; however, changes in the arrangement of icons on the desktop or slight variations in menu


\textsuperscript{347} Raskin, J (2000) p.26
structures may confuse and distract. When the selection process becomes tacit, constancy in the location of icons on the desktop becomes crucial. Research into preconscious decision-making by Libet in the 1980's suggests that the brain sets in motion neurological action prior to conscious predetermination of a will to act. Any delay in locating and translating icons or labels in software therefore, poses additional distraction. When switching between software programs, those offering similar but not identical icons or functions were found to be confusing. Raskin (2000) argues that interface design should strive for simplicity and that this might be achieved by standardising functions between software applications.

Research by Frederickson and Joiner indicates that positive emotional experience enhances creative thinking. They contend that 'joy creates the urge to play, interest creates the urge to explore' (Norman 2005 p.103). Negative emotional response towards software or technology that is frustrating to use, is likely to be detrimental to creative thinking, whereas interface design that is perceived as pleasurable to operate, is likely to enhance creative practice.

6.4.3 Digital textile ink-jet printing provides a method of producing the digitally crafted artefact

Software that enables experimentation without risk, through the use of tools and layers that provide opportunity to step backwards in the creative process might be considered unlikely to yield a medium that can be crafted. Pye (1964) defined craft as workmanship that embodied an element of risk in its creation and contrasted this with manufacture, which he described as workmanship of certainty. McCullough (1996 p.189) describes the electronic medium as providing a combination of the 'individuality and responsiveness of craft with the process control of industry'. The digital craft involves working the binary code of the machine; software facilitates it. McCullough (1996) contends that, as a craftsman understands the properties of physical materials, so 'choosing the digital medium that best suits your purposes has emerged as an important component of software...'

348 In the 1980's Libet conducted experiments in which subjects were asked to choose a random moment to flick their wrist while he watched the associated activity in their brains. He found that the brain activity leading up to the subject flicking his or her wrist began approximately one-third of a second before the subject consciously decided to move, suggesting that the decision was actually first being made on a subconscious level and only afterward being translated into a "conscious decision", and that the subject's belief that it occurred randomly was only due to their perception. http://en.wikipedia.org/wiki/Benjamin_Libet (acc.05.03.06)

349 'That the interfaces of all applications arise from a small set of elementary operations confirms that the applications themselves, as rich and varied as they are from a task orientated point of view, are not at all different from one another from an interface orientated point of view. This fundamental similarity can be exploited to create powerful computer systems of unprecedented simplicity and productivity.' Raskin, J. (2000). The humane interface; new directions for designing interactive systems. Reading, Mass.; Harlow, Addison-Wesley, p.105.


expertise’ (McCullough 1996 p.216). Although a variety of graphics applications exist, including specific textile production packages, visits that informed the Contextual and Literature Review (Chapter 2) and the case study data indicate that Photoshop® is used most widely used for creative image making\textsuperscript{352}.

Access to wide format digital ink-jet printing is increasing and makes possible the rendering of digitally crafted images on cloth. Evidence from the case study and investigations indicates that digital ink-jet printing is considered a useful means of outputting digital images onto textiles (sections 4.2.2.4; 4.4.4.2) Difficulties concerning colour management were noted without exception (sections 4.2.3.2; 4.4.3.1; 5.5.5.4). For some practitioners however, these difficulties were responded to as incentives for further creative investigation and elaboration of surface (section 4.4.3.1).

6.5 Summary

Findings from the research indicate that digital imaging technology supports creative thinking from the generative stage of concept development through to the production of the printed textile artefact. The data suggests that making by hand informs creative cognition and impacts upon digital design practice and resulting artefacts. Digital technologies enable practitioners to continue to work when practical limitations such as physical space and health issues may otherwise inhibit creative practice. Rapid communication of digital images has facilitated the development of global creative collaborative partnerships.

The implications of these findings will be discussed in more detail in Chapter 7.

\textsuperscript{352} All three case study practitioners were observed using this particular software to develop their visual concepts (Chapter 4 Case Study).
7. The Future: implications of research findings

7.1 Introduction

This chapter reviews and discusses the implications of the findings from this study, described in detail in Chapter 6, for possible future practice and research. Effective methods for utilising the creative potential of digital imaging technology in professional practice are identified and areas of current related research are discussed.

The specific findings, discussed in the previous chapter, are developed to provide greater detail concerning current and potential areas of future research. Four key areas are identified: these are creative cognition and haptics, collaboration, digital printing and nanotechnology. The following sections describe the ways in which research and technological development for digital imaging may impact on creative textile practice. Changes in practitioners' future working strategies and design practice, due to advances in digital print technology and developments in nanotechnology products, colorants and processes, are discussed. Although the areas of nanotechnology and smart textiles may appear to reside outside the field of inquiry, they nevertheless represent the anticipated next stage in the future development of surface pattern for textiles. Developments in the field, described in section 7.5 of this chapter, will influence the creative use of digital imaging technology in future textile practice.

Chapter 7 also presents information that extends the contextual and literature review (Chapter 2) and locates the findings (Chapter 6) within this broader research framework. It concludes with a summary of the research objectives and key findings of the project.

7.2 Creative cognition and haptics

The findings highlight areas in which there is evidence that digital imaging technology is able to support creative practice, through the stimulation of creative cognition. The research reveals the importance of memory in the divergent stage of idea formation and indicates ways in which digital tools are able to provide memory cues. Within the convergent phase of design innovation, digital imaging enables concepts to be proliferated, honed and refined for production. It also provides a means of visualising concepts so that the verification process can be rapid and communicable.

353 See Chapter 1 section 1.4
354 See Chapter 6 sections 6.3.3 and 6.5
355 See Chapter 2 section 2.4
Practitioners are currently using software that is either useful for generic image manipulation, such as Photoshop®, Corel Photopaint®, Painter®, or domain specific software applications, such as U4ia®, NedGraphics® or Platescribe®. The latter provide rapid execution of design within constraints of production, such as colour reduction, repeat pattern construction and visualisation, but are proving less useful for stimulating creative thinking. Generic image manipulation software such as Photoshop® is useful for generating and storing imagery. Both types of software lack intuitive interfaces that enable the digital medium to be crafted fluidly in contrast to those aspects of practice, which are informed by hand tool use\(^{356}\) (Harris 2005). This research indicates that textile practitioners seek the unpredictable, spontaneous\(^{357}\) and unplanned 'happy accident', that frequently results from physical interaction with a material. The embodiment of this into the artefact, endows it with an emotional charge that the machine product lacks\(^{358}\). Future developments in software and interface design will require careful consideration of these factors. Research that is able to examine the procedure of preconscious thought and somatic reaction, which occurs in the mental processing between perception and physical response, would be useful in this area. Research by Libet\(^{359}\) calls into question the human conscious will to act. It indicates that perhaps intuition and pre-cognition, producing visceral responses to perceived experience, play an important role in the creative process. This has not been scientifically substantiated, yet is affirmed anecdotally by those who have experienced the flow of creative interaction with a medium.

Memory and experience fuel imagination and creative thinking. The digitally printed textile artefacts produced during the research project demonstrate the importance of memory in generative thought; digital tools have enabled memory of experience to be reinforced, communicated and shared (Treadaway 2004a). The ways in which memory enhances creative cognition and how this might be communicated, is likely to impact on interface design and future software development\(^{360}\).

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356 Harris states that ‘Making is essentially a sensory experience that informs the end result. Hands provide an intuitive touch for material during the crafting process. They also explore, inform, manipulate and take risks’ Harris, J. (2005). ""Crafting" computer graphics - a convergence of traditional and "new media"." Textile, the Journal of Cloth and Culture 3(1): 20-35.

357 Spontaneous is defined as 1: proceeding from natural feeling or native tendency without external constraint 2: arising from a momentary impulse 3: controlled and directed internally Etymology: Late Latin sponte of one's free will, voluntarily. Merriam-Webster on-line dictionary

358 See section 6.2.1

359 Libet, Benjamin, Anthony Freeman & Keith Sutherland, ed. (1999). The Volitional Brain: Towards a neuroscience of free will. Exeter, UK: Short Run Press, Ltd.

360 Bath University department of Human Computer Interaction. AHRC ‘Designing for the 21st Century’ creativity research.
Research into haptic digital tool use at Edinburgh University, led by Ann Marie Shillito, is exploring ways in which interface design impacts on the creative process. Working with the hypothesis that window, icon, menu, pointer (WIMP) interfaces are indirect and non-intuitive ‘The Tacitus Project’ employs a haptic system that enables users to touch, feel and manipulate virtual environments361. Findings from the Tacitus research project indicate that the device enhances the experience of crafting the digital medium, enabling practitioners to be more productive362. This research is likely to impact upon the development of future input devices, which will ‘cut cognitive load, learning times and development time by means of three-dimensional touchable interfaces which are intuitive to use.’ (Shillito, Gauldie et al. 2004 p.4).

Peripheral devices, such as data gloves, moles363, intuitive drawing input devices and innovative tablet surfaces, are likely to enhance the creative experience of working with digital tools in the future. This is confirmed in the findings of this research, which indicate that designers seek input devices that respond to gesture in a similar way as conventional drawing devices. Friction of the drawing implement on a surface provides important sensory feedback to the practitioner and enables emotion to be communicated through movement and pressure. To be effective, future technologies will need to make less use of electronic input devices and focus on direct physical sensing of the body. Research into body sensing mechanisms for immersive environments and computer control has been in progress since the mid 1990’s (Jacob 1996). These include non-command based interfaces such as 3D position and eye movement tracking, hand measuring and physiological monitors. Military, medical and academic scientific research is investigating potential neural control of computer systems in which thought processes themselves can be utilised, eliminating the need for input devices altogether364 (Sample 2005). It is likely that this research will continue to inform future developments of computer aided design systems.

7.3 Creative strategies involving collaboration

Digital technology enables design concepts to be shared by practitioners, across geographic and temporal zones, using the Internet and email. Industry has been utilising these means of

361 The Tacitus project involves research into ‘interface design which enables practitioners to work more intuitively in three dimensions by exploring spatial input, haptics (touch) using force feedback, stereo vision and cololocation.’ http://www.eca.ac.uk/tacitus (acc.05.03.06)

362 Findings from the research state that ‘usability is increased with the haptic system and perceived task load, task completion time and the number of mouse stylus clicks were all greatly decreased’ Shillito, A. M., D. Gauldie, et al. (2004). Spatial Interaction; six degrees of freedom for CAD. Challenging Craft, Gray’s School of Art, Aberdeen, The Robert Gordon University, p.10.


364 http://www.guardian.co.uk/life/feature/story/0,13026,1448140,00.html (acc.05.03.06)
communicating design data in the manufacturing process since the mid 1990s and practitioners are making increasing use of the Internet to showcase, sell and deliver artwork in this way. This research demonstrates ways in which creative practice can be enhanced through the development of collaborative partnerships. Collaborative work with Bell, Bernath and Brandeis has exploited the potential of rapid communication of digital data to enhance the creative process and develop visual concepts (Chapter 5 sections 5.2, 5.3, 5.4).

The facility to share digital images among practitioners enables fluid working methods to develop between specialists in various design disciplines (Campbell 2005). This provides considerable potential for design solutions to be realised in diverse artefacts that might not otherwise have previously been considered. Campbell (2005) contends that collaboration leads to 'more complex design thinking and analysis than possible with only one designer' (Campbell 2005 p.2).

Collaborative team working between practitioners in different locations creating design collections or artefacts for exhibition is now feasible (Polvinen 2005). The research has shown that creative collaborations, in which imagination can be shared and concepts developed mutually, are possible with websites and file sharing protocols. Polvynen (2005) contends that design innovation will become increasingly collaborative. Collaboration in design origination may enable practitioners, working outside a target market, to share design imagery, colours and consumer preferences, for the development of designs that are saleable and culturally appropriate, to that particular sector.

The research highlights difficulties in communicating files across Mac and PC platforms. Further investigation is required to establish reliable, secure and user-friendly routes for exchange of design data. Rapid advances are being made in communication technologies and development work will need to address these issues.

Individual authorship of work generated in this way becomes problematic and raises issues of intellectual property rights. Any collaborative venture of this kind must, therefore, be clear about its parameters from the outset and define ownership of the work especially where there may be economic implications.

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366 Polvinen writes: 'International collaborative work on product development and marketing...is where the technology driven global industry of apparel textiles is rapidly moving today.' Polvinen, E. (2005). "International collaborative digital decorative design project." Textile, the Journal of Cloth and Culture 3(1): 36-57.

367 See sections 5.3.5.4 and 5.4.4.4.

368 This is especially important when work is to be output for sale or mass produced on a royalty payment basis.
7.4 Developments in digital ink-jet printing

Current developments in digital textile ink-jet printing technology suggest that there are four key areas likely to impact upon its future creative deployment by practitioners. These are: printing speed, colour management, mass customisation and new surface effects and colours.

7.4.1 Printing speed

Advances in digital ink-jet technologies have increasingly focused on the production of machines capable of matching print speed of analogue rotary processes. In 2003 the first production speed digital printers were showcased at ITMA Birmingham\(^{369}\) and according to software manufacturer Lectra\(^{370}\) are being purchased in large quantities by Chinese textile manufacturers. American and European manufacturers are also investing in the high-speed technology for both manufacture and prototyping, in order to match economic production with rapid time to market and design flexibility. Ability to print on demand reduces waste and warehousing costs, providing quick response to the customers changing design requirements.

The effect of adoption of high-speed digital process on creative design production, is that companies are increasingly demanding more innovative print design concepts, which do not exhibit the traditional requirements of conventional analogue printing such as repeat structure and colour reduction. European companies such as Colour Interlink NV and Color-Web GmbH, state that their requirements for innovative digital design for ink-jet printing have led them to employ younger designers who are more receptive and capable of producing design concepts that express the new digital visual language, exploiting the design potential of the technology\(^{371}\). The research findings confirm that practitioners who innovate concepts digitally exhibit a new visual language in the work they produce.

In contrast, software developed specifically for the textile industry,\(^{372}\) encourages the production of designs that conform to traditional analogue printing methods and provide less scope for creative expression. The research suggests that future textile specific software development will need to

\(^{369}\) http://www.necgroup.co.uk/visitor/halloffame/itma.asp#top (acc.05.03.06)

\(^{370}\) Information provided by Chew Tan and Leung during a visit to the International Advanced Technology Centre, Lectra, Shanghai, July 2004.

\(^{371}\) Information from interviews with representatives from two leading European textile digital print companies: Noonan, Colour Interlink NV, and François, Color-Web GmbH at Flanders Textile Valley Xpo, Kortrijk, Belgium, September 2005.

\(^{372}\) For example Lectra’s U4-ia software
reflect this move away from algorithmic process thinking and encourage greater freedom of expression to exploit the creative potential of digital printing\textsuperscript{373}.

7.4.2 Colour management

Findings from the research reveal that colour management, in digital design development, presents a significant problem. The practitioners' approach to resolve this, impacts on creative process, either by inspiring further creative exploitation by hand painting to integrate the resulting colour, or through textile methods of elaboration such as embroidery. Alternatively, colour difficulties can be inhibiting to creative process, leading to frustration and demotivation.

The research has shown that creative practice is enhanced when colour issues are regarded in a positive way and seen as potential avenues for future exploration\textsuperscript{374}. Campbell (2005) and Polvynen (2005) confirm these findings, recommending that colour management problems be approached empirically. Campbell suggests that colour management is a service issue, stressing the need for digital print producers to accommodate the subjective demands of the designer, whilst maintaining the integrity of the system. The implication is that colour profiles on each system should provide stability in colour fidelity but that fine-tuning is always likely to be required to match individual subjectively perceived colour (Xin 2005). Those working with a particular system and its range of substrates and colours, develop a tacit knowledge of likely colour difficulties and how these might be accommodated. The knowledge of what and how much adjustment is required is developed as an attribute of the digital ink-jet print operator, rather than of the hard or software. Noonan\textsuperscript{375} maintains that testing and development of consistent production methods provides the most reliable option for colour management. Unlike the analogue print process, digital ink-jet printing requires the use of prepared substrates, which limit the spread of printed colour on the surface of the textile. Noonan recommends limiting the purchase of substrates to a restricted number of suppliers and thorough testing of preprint paste, across the fabric width, prior to test printing colours. Her experience has revealed that applications of preprint preparations are often inconsistent and can be detrimental to printed colour constancy.

Campbell (2000) also notes that post printing processes of steaming and washing greatly complicates colour management. Testing of colours can only be accurate once the printed fabric has been processed and the resulting chemical colour changes stabilised. Each stage in the colour

\textsuperscript{373} See section 2.2.2 in which digital print manufacturers seek design work that does not exhibit the visual characteristics of analogue printing in contrast with section 4.2.3.1 where textile specific software used in industry to prepare artwork for analogue production. It is described as being 'largely uncreative'.

\textsuperscript{374} Section 4.2.2.3 and 4.2.3.2

\textsuperscript{375} Noonan, Colour Interlink NV, interviewed at Flanders Textile Valley Xpo, Kortrijk, Belgium, September 2005
testing process introduces new variables, reinforcing the need for consistency at every stage in the process. Practitioners wishing to digitally print artefacts are likely to optimise their success with managed digital colour by developing a good working relationship with the operators of the print system and ensuring that all stages in the print process are kept constant. Where practitioners are working with colour reduced design work, colour accuracy may be achieved by using Pantone® colour references376 or by gaining access to a printed colour atlas, generated for the particular system and substrate on which they intend to print.

Much research work continues to take place in the development of standards, constancy, communication and management of colour. Industry is demanding greater accuracy in all aspects of digital design377 (Xin 2005) and this requirement is being met through research projects at a number of universities, including Hong Kong Polytechnic University, Philadelphia University, North Carolina State University and Leeds University378.

7.4.3 Mass customisation for apparel textiles

Digital ink-jet technology provides an ideal means of creating mass customisable products (Campbell 2005). Rapid alteration of digital files to accommodate fit or choice of surface design are possible and unlike analogue print process, set up cost is minimal and there are few economies of scale. The Internet provides access to an online digital market place, providing the customer opportunity to co-design379 a digitally printed product, providing choices such as colour, pattern or fit within defined parameters of the process. Research into mass customisation for digital printing has been carried out within academia380 and industry381 and is likely to have an increasing impact on creation of surface pattern and textile design in the future. Designers working in this way will need to understand the process of engineering pattern within product shape in order to accommodate seams and openings, as well as gaining an appreciation of customer requirements and preferences for surface pattern, so that realistic choices can be provided. These issues will need to be addressed in future design education and training.

376 http://www.pantone.com/ (acc.05.03.06)


378 http://www.colourtech.org/ (acc.05.03.06)

379 This is not the same process as collaboration in design origination, but refers to the provision of opportunity for the customer to specify the product requirements (colour, size, shape and pattern) from an existing library of designs.

380 Iowa State University, North Carolina State University

381 http://www.lectra.com/en/textiles/business_concerns.html (acc.05.03.06)
7.4.4 New surface effects and colours

Future developments in colorants, produced for textile digital ink-jet printing, are likely to be influenced by advances in nanotechnology. Chemical colour constituents and additives can now be digitally ink-jet printed onto textiles, due to the manufacturing of ingredients at molecular scale. Future nano engineered ingredients are likely to include chemicals with luminescent and photochromic properties, making possible ink-jet printed colours with the potential to change colour in sunlight and emit light in darkened environments. Light emitting designs have many potential safety applications as well as providing further innovative decorative surface pattern options (Lee 2005).

7.4.5 3D Digital printing for apparel

Research investigating the potential of rapid prototyping technology for textile and garment design, aims to lead to the creation of ‘individually tailored and uniquely detailed ‘instant’ garments that are designed in 3D on a computer, mapped to 3D scanned body measurements and printed out’ (Lee 2005 p.133). This technology uses ink-jet printed powdered polymers that are bonded together with lasers to create three-dimensional structures. Research at the London College of Fashion in collaboration with a Dutch company, Freedom of Creation, is producing prototype 3D printed textile structures and shoes. The implication of this technology for the fashion industry is considerable since it offers potential, in the future, for individual customised garments to be printed at home, without the need for a garment manufacturer or high street retailer (Delamore 2004). Integration of complex surface pattern and colour into the product is not yet possible, although further research in this area is already underway. The process may provide a more environmentally friendly method of textile garment production, particularly if bio-engineered cellulose could be substituted for the polymer currently used (Lee 2005). Garments could be created without waste and to a customer’s exact specification by integrating 3D body scanning. Design data could be

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382 Nanotechnology comprises technological developments on the nanometre scale, usually 0.1 to 100 nm. [http://en.wikipedia.org/wiki/Nano_technology](http://en.wikipedia.org/wiki/Nano_technology) (acc.05.03.06)

383 Information supplied by Dgtec France


385 Philip Delamore, Senior Research Fellow, London College of Fashion

386 Delamore states that ‘By establishing a new design and manufacturing paradigm based on the creation of clothing on demand, and with the development of suitable machinery and materials to print the clothing in one piece “in situ” it is not unforeseeable that we may one day be able to design and print personalised clothing in our homes’ Delamore, P. (2004). 3D printed textiles and clothing on demand. RMIT Intermesh Symposium, Melbourne, Australia, p.15.

387 3D body scanning involves use of a device that calculates accurate three-dimensional measurements by scanning light reflected from the body. [http://www.bodymetrics.com/](http://www.bodymetrics.com/) (acc.05.03.06)
downloaded from the Internet, avoiding the necessity for transportation of fabric and garments around the world.

This technology would require the surface pattern designer to be able to produce concepts that consider garment shape, textural surface as well as decorative embellishments in one form. 3D ink-jet printing technology facilitates the full colour printing of the construction material as the object is built (Delamore 2004). Pattern, relief, colour and structure have the potential for integration within a single design. Software, currently used for 3D printing, utilises complex 3D modelling algorithms and will require development of an intuitive interface if it is also to accommodate surface pattern and textural design facilities. Delamore (2004) contends that success of 'this new design and manufacturing paradigm' will depend on user-friendly software and interface design (Delamore 2004 p.2).

7.5 Future implications of smart textiles and nanotechnology for surface design for textiles

The discussion thus far has been concerned with the digital generation of surface pattern to be applied onto textile surface, however future developments in the design of innovative smart textiles, which incorporate electronics and nano enhanced fibres, will inevitably impact on the visual qualities of surface designs that will be required by industry and the ways in which these will be produced. The concept of surface pattern may need to be redefined; digital designs will interact within the structure of the fabric, modifying the visual characteristics and with the potential to change colour and display moving images (Farren and Hutchinson 2004). This will impact on the digital generation, method of application and visual characteristics of surface decoration. New approaches to the application of surface imagery to textiles may challenge existing print production methods.

Nano enhanced polymer fibres are commercially available and can be constructed into textiles with antibacterial, optical and olfactory properties, some of which are already on the market (Lee 2005). Also under development are fibres containing conductive filaments (McQuaid 2005). When woven, these textiles have the potential for displaying light emitting diodes using the woven fabric.

388 Lee writes concerning this 'until augmented reality can be as sensitive to touch as real cloth, it is unlikely designers will migrate to this way of working. Any new technology will have to accommodate the spontaneity and experimental nature of creativity, and the flourish of inspiration.' Lee, S. (2005). Fashioning the Future: Tomorrow's Wardrobe. London, Thames and Hudson, p.139.

389 Examples of these smart textiles were included in the 'Extreme Textiles' exhibition held at the Cooper Hewett Museum, New York 2005. McQuaid, M., Ed. (2005). Extreme Textiles. London, Thames and Hudson.

390 Research paper by Dr. Jenny Tillotson presented at 'Wearable Futures - Hybrid Culture in the Design and Development of Soft Technology' 14 - 16 September 2005, University of Wales, Newport, Wales, UK. http://www.smartsecondskin.com/main/contact.htm (acc.05.03.06)
itself as the circuit path for electrical supply. Prototypes of these photonic textiles, made by Philips Research, were demonstrated at the Internationale Funkausstellung (IFA) 2005 in Berlin in September 2005. Philips has been working in conjunction with the Textile Research Institute Thuringia Vogtland (TITV Greiz) to create these intelligent displays, which potentially will make it possible to pattern woven surfaces with digital designs and possibly even moving images. Dr Andreas Neudeck from TITV Greiz, a research collaborator with Philips, stated his scepticism that woven photonic textiles would be used in the fashion industry for some time to come, due to the fragility of the conductive filaments. Neudeck contends that the technology is more applicable to rigid textile structures such as those used in the automotive or aeronautical industries. Nevertheless, according to Neudeck, the technology is likely to change the way some surfaces are patterned in the future and will make possible direct communication of digital imaging technology onto the surface of the artefact. The implications for creative exploitation of this patterning technology are constrained only by the digital artists’ imagination and the delivery of power to the fabric display.

At present, difficulties exist in the supply of power to DC/AC converter devices, which need to be capable of changing the electrical current, and yet of sufficiently small size to be integrated into the surface of the cloth.

Future advances in flexible textile displays may evolve from the next generation of materials under development, based on polymer light emitting diodes (PLEDs). This emissive technology consists of a polymer material, manufactured on a substrate of glass or plastic, which does not require the backlighting or filters used in liquid crystal displays. PLED technology is very energy efficient and is being developed into ultra thin displays. This technology can also be used in reverse to create photovoltaic (PV) devices, which convert light into electricity and are used to make polymer solar cells (Lee 2005). These will provide bendable, disposable solar power sources for numerous applications and have the potential to power flexible PLED textile displays capable of displaying pattern and moving video images. Other applications include the development of digital wallpaper capable of presenting dynamic or colour change patterns and paper thin lighting.

391 http://www.research.philips.com/newscenter/archive/2005/050902-ifa2005.html (acc. 05.03.06)
392 Interview with Andreas Neudeck from TITV Greiz at Flanders Textile Valley Xpo, Kortrijk, Belgium, September 2005
393 http://www.cdtltd.co.uk/technology/41.asp (acc. 05.03.06)
395 Research into PLED and PV technology is being undertaken in Europe through collaboration of a number of companies including Philips and Cambridge Display Technology.
396 Presentation by Victor de la Rosa at ‘Creativity: Designer meets technology’, Philadelphia University May 2004.
panels that can be applied to whole wall surfaces\textsuperscript{397}. Applications requiring dynamic patterns, which may be responsive to light, or emotion will provide new creative challenges to designers in the future. Surface patterns that evolve in \textit{real time} will bring a new meaning to the concept of ‘design collection’ and will require agility in creative thinking and ability to visualize complex sequences of changes. Design work will exist as software to be downloaded and updated, casting the designer in a new role, as creator of intellectual property rather than physical artefact (Farren and Hutchinson 2004).

7.6 Discussion: implications arising from this research

This body of research has revealed ways in which digital technology is affecting the individual practitioner’s creative process, by stimulating memory and associative thought, and providing a facility to share imagination and foster innovation through collaborative working methods. Insight has been gained into how digital tools are able to both help and hinder the formation of design ideas and there is evidence, identified through the research, to support a case for the development of interfaces to enable printed textile practitioners to work more intuitively.

Digital ink-jet printing technology has been found to enable creative exploitation of digital imagery on fabric. This is resulting in artefacts that exhibit a visual language that contains greater linear detail and extended tonal and colour range than was previously possible to achieve using analogue textile printing methods. The ease with which digital data can be communicated is leading to the development of new ways of collaborative working and mass customisation of digitally printed products. Textile craft methods of embellishment can now be used in conjunction with digital printing, to produce textile artefacts that combine the product of the machine with that of the hand; traditional processes with digital technology.

Communication of digital visual imagery during the development of design ideas enables practitioners to mutually intervene in the creative process, producing shared concepts, raising issues of authorship and ownership. Collaborative and team working methods require careful negotiation and cooperation if they are to be effective in producing creative results. Leadership and project direction must be clear if creative solutions are to be exploited and developed\textsuperscript{398}. Further research into the effects of collaborative design on creative process is required as digital team

\textsuperscript{397} \url{www.research.philips.com} (acc.05.03.06)

\textsuperscript{398} Joanna Berzowska Paper presentation at ‘Wearable Futures - Hybrid Culture in the Design and Development of Soft Technology’ 14 - 16 September 2005, University of Wales, Newport
working can be expected to become more widespread in the future (Shneiderman, Fischer et al. 2006)\(^3\).

Farren and Hutchinson (2004) suggest that surface pattern on textiles will be created in the future through the use of dynamic colour effects and moving images\(^4\). Nanotechnology and flexible textile displays will require digital imagery for surface decoration capable of change and interaction. There will be increasing demands on practitioners to develop new innovative digital concepts, such as those capable of electronic communication and accessed as software rather than as physical product (Ibid). Three-dimensional digital printing will require designers to have expertise in 3D modelling software, in conjunction with an understanding of surface pattern, product design and knowledge of physical materials (Delamore 2004).

Education of future textile and surface pattern practitioners will need to address these issues and provide strategies to encourage thinking outside the digital box, whilst using the valuable tools it is able to provide, to support creative cognition.

\(^3\)Research into supporting group creativity is underway at Bath University

http://www.creativityindesign.org.uk/ (acc. 05.03.06)

7.7 Summary of the project

7.7.1 Research objectives

This thesis sets out a full account of the project; situating the study within the field of inquiry and providing a critical review and analysis of recent work by academics, industry and textile practitioners. It identifies three key textile practitioners and documents and analyses the creative strategies used in their textile practice. The impact of digital imaging within their working processes is examined and a series of collaborative investigations enable the findings to be interrogated. Insights from the study inform the researcher’s own creative practice, enabling the exploration and development of effective strategies for the digital generation, manipulation and output of surface imagery for printed textiles. Examples of this practice have been tested by peer review following conference presentations and publication of papers and in the exhibition of artefacts resulting from practical investigations; these are documented in this work.

7.7.2 Key findings

This thesis proposes that digital imaging is able to enhance creative practice. Digital tools can be used to assist the collection, storage, review and manipulation of imagery, from a range of sources, stimulating creative thought and motivating the generation of visual ideas. The Internet and portable digital storage media can be used to communicate imagery, and facilitate collaborative working processes that motivate creative practice. Digital tools can be used to support mutual idea generation, to develop visual concepts, and produce digitally printed artefacts. This thesis also proposes that making by hand informs creative thinking, resulting in an emotional connection between the artefact and its creator, which can be perceived by the textile practitioner in the visual characteristics of the printed output. These findings indicate that further research is necessary to inform the development of innovative interfaces for digital imaging systems that will enhance their capacity to support creative cognition within digital textile practice.

401 These can be found in Appendix C
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Bibliography


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3 [http://www.webopedia.com](http://www.webopedia.com)
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<td><strong>Digital imaging</strong></td>
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¹ [http://www.m-w.com](http://www.m-w.com)  
³ [http://www.webopedia.com](http://www.webopedia.com)
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| **Digitising pen**       | An input device that enables drawings and sketches to be input into a computer. The pen (also called a stylus) looks like a simple ballpoint pen but uses an electronic head instead of ink and is used in conjunction with a tablet PC or graphics (digitizing) tablet.  

**Discharge** | To bleach out or remove (colour or dye) in dyeing and printing textiles.  

**Distributed practice** | Practice that is collaborative but not co-located.  

**DNA** | Deoxyribonucleic acid. A nucleic acid that contains the genetic instructions specifying the biological development of all cellular forms of life.  

**DV** | Digital Video. The capturing, manipulation and storage of video in digital formats.  

**DVD** | Digital Versatile Disc or Digital Video Disc. A type of optical disk technology similar to the CD-ROM.  

**Dye sublimation** | The transference of printed images to a synthetic substrate by the application of heat.  

**Email** | Electronic mail the transmission of messages over communications networks.  

**Engineered pattern** | Surface pattern that is designed specifically for a prescribed form e.g. within the pattern pieces that will be used to make up a garment.  

**EPSRC** | Engineering and Physical Sciences Research Council  

**Ethnography** | The qualitative description of human social phenomena, based on fieldwork.  

**ETN** | European Textile Network  

1 [http://www.m-w.com](http://www.m-w.com)  
3 [http://www.webopedia.com](http://www.webopedia.com)
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<th>Term</th>
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<td>Exhaustive printing</td>
<td>Environmentally friendly printing processes that produce little or no waste residue.</td>
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<td>Filezilla®</td>
<td>Software used to facilitate file sharing using File Transfer Protocols. <a href="http://www.filezilla.org">www.filezilla.org</a> (acc. 05.03.06)</td>
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<tr>
<td>FEA</td>
<td>Finite Element Analysis. A computer simulation technique used in engineering analysis.</td>
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<tr>
<td>Freelance Designer</td>
<td>A self-employed designer.</td>
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<td>FTP</td>
<td>File Transfer Protocol. A protocol for exchanging files over the Internet.</td>
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<td>GID</td>
<td>Graphical input device.</td>
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<tr>
<td>GUI</td>
<td>Graphical user interface. A program interface, that takes advantage of the computer's graphics capabilities, to make the program easier to use.</td>
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<td>Haptic</td>
<td>Pertaining to the sense of touch.</td>
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<td>Haptic technology</td>
<td>Technology that interfaces the user via the sense of touch.</td>
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<tr>
<td>HCI</td>
<td>Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena in the interactive relationship.</td>
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<td>HKPU</td>
<td>Hong Kong Polytechnic University</td>
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<td>Hot keys</td>
<td>Specific combinations of keyboard operations, which provide shortcuts within software.</td>
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<td>Hue</td>
<td>A hue refers to the gradation of colour within the optical spectrum, or visible spectrum, of light. Hue may also refer to a particular colour within this spectrum.</td>
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<td><strong>ICC</strong></td>
<td>International colour consortium</td>
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<td><strong>Icon</strong></td>
<td>A graphic symbol on a computer display screen that suggests the purpose of an available function.¹</td>
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<td><strong>Ideograph</strong></td>
<td>A picture or symbol used in a system of writing to represent a thing or an idea but not a particular word or phrase.¹</td>
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<td><strong>Illustrator®</strong></td>
<td>Vector based graphics software. <a href="http://www.adobe.com">www.adobe.com</a> (acc.05.03.06)</td>
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<td><strong>Image resolution</strong></td>
<td>Refers to the sharpness and clarity of an image. The term is most often used to describe monitors, printers, and bit-mapped graphic images.²</td>
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<td><strong>In-house</strong></td>
<td>Within a particular company or business.</td>
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<td><strong>Intelligent displays</strong></td>
<td>A display device that is guided or controlled by a computer.</td>
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<td><strong>Interface</strong></td>
<td>A boundary across which two independent systems meet and act on, or communicate with, each other.²</td>
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<tr>
<td><strong>Internet</strong></td>
<td>A global network, connecting millions of computers, formed from many local area networks (LANs). It has no central point and uses whatever network connections it can find to transmit its own data packets.³</td>
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<tr>
<td><strong>iPhoto</strong></td>
<td>Apple Macintosh® software for the organisation of image data</td>
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<td><strong>JPEG</strong></td>
<td>Joint Photographic Experts Group. JPEG is a lossy compression (type of data compression) technique for colour images.³</td>
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<td><strong>KiDT</strong></td>
<td>Creative Institute for Design and Technology, Denmark</td>
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<td><strong>Laser cutting</strong></td>
<td>A technology that uses a laser to cut materials, and is usually used in industrial manufacturing.²</td>
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<tr>
<td><strong>Lay plan</strong></td>
<td>The sorting and arrangement of pattern pieces on fabric prior to construction of a garment.</td>
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<td><strong>Mac Binary</strong></td>
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<td><strong>Mass customisation</strong></td>
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<td><strong>Meta media</strong></td>
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<td><strong>Metallic patination</strong></td>
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<td><strong>Metonym</strong></td>
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<td><strong>Mole</strong></td>
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\(^1\)http://www.m-w.com  
\(^2\)http://en.wikipedia.org  
\(^3\)http://www.webopedia.com
<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>Mouse</td>
<td>A device that controls the movement of the cursor or pointer on a display screen.</td>
</tr>
<tr>
<td>Nanotechnology</td>
<td>Technology that exploits phenomena and structures that can only occur at the nanometre scale (single atoms and small molecules).</td>
</tr>
<tr>
<td>NCSU</td>
<td>North Carolina State University</td>
</tr>
<tr>
<td>NedGraphics®</td>
<td>Textile specific design software <a href="http://www.optitex.com">www.optitex.com</a> (acc.05.03.06)</td>
</tr>
<tr>
<td>Neuroscience</td>
<td>A field of study that deals with the structure, function, development, genetics, biochemistry, physiology, pharmacology, and pathology of the nervous system.</td>
</tr>
<tr>
<td>Non-woven textiles</td>
<td>Textiles that are neither woven nor knitted e.g. felt.</td>
</tr>
<tr>
<td>Outsourcing</td>
<td>The delegation of non-core operations, or jobs from internal production, within a business to an external entity (such as a subcontractor) that specializes in that operation.</td>
</tr>
<tr>
<td>Painter®</td>
<td>Graphics software. <a href="http://www.corel.com">www.corel.com</a> (acc.05.03.06)</td>
</tr>
<tr>
<td>PC</td>
<td>Personal computer (or IBM PC). The first personal computer produced by IBM was called the PC, and increasingly the term PC came to mean IBM or IBM-compatible personal computers.</td>
</tr>
<tr>
<td>Peripheral Input device</td>
<td>A computer device, such as a scanner or printer that is not part of the essential computer, i.e. the memory and microprocessor.</td>
</tr>
<tr>
<td>Photogram</td>
<td>A photographic image made (without a camera) by placing objects directly onto the surface of a photosensitive material such as photographic paper and then exposing it to light.</td>
</tr>
<tr>
<td>Photonic textiles</td>
<td>Light-emitting textiles.</td>
</tr>
<tr>
<td>Photoshop®</td>
<td>Graphics software <a href="http://www.adobe.com">www.adobe.com</a> (acc.05.03.06)</td>
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1. [http://www.m-w.com](http://www.m-w.com)
3. [http://www.webopedia.com](http://www.webopedia.com)
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<thead>
<tr>
<th>Glossary and Acronyms</th>
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</table>
| **Pigment** | A dry colorant, usually an insoluble powder. A distinction is usually made between a pigment, which is insoluble, and a dye, which is either a liquid, or is soluble.  

2  |
| **Pixelation** | An effect caused by displaying a bitmap or a section of a bitmap at such a large size that individual pixels, small single-coloured square display elements that comprise the bitmap, are visible to the eye.  

2  |
| **Platescribe®** | Design software www.typemaker.co.uk (acc.05.03.06)  |
| **PLED** | Polymer light emitting diode.  |
| **Pointcarre®** | Textile specific design software www.optitex.com (acc.05.03.06)  |
| **Polyester voile** | A fine soft sheer synthetic fabric.  |
| **Portable digital storage media** | External hard drive, flash, CD, DVD etc. Unlike computer memory, storage devices retain data even when the computer is turned off.  

3  |
| **Post print processing** | Textile treatment processes carried out after printing e.g. steaming, washing and drying.  |
| **Preprint production** | Development of studio artwork into production methods. This may include construction of repeat structures, colour reduction, colour separations, etc.  |
| **Pre-treatment** | Application of chemicals to the substrate prior to ink-jet printing to facilitate colouration and inhibit the movement of colour on the fabric surface during and after printing.  |
| **Process maps** | A visual description on paper used as a means of describing the processes or methods used in creative practice.  |
| **Protocol** | A detailed plan.  |
| **PV** | Photovoltaic. Able to convert light into electricity.  |

1 http://www.m-w.com  
2 http://en.wikipedia.org  
3 http://www.webopedia.com
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<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>Quark®</td>
<td>Design software <a href="http://www.quark.com">www.quark.com</a> (acc.05.03.06)</td>
</tr>
<tr>
<td>RAM</td>
<td>Random access memory. This refers to a type of computer memory that can be accessed randomly; that is, any byte of memory can be accessed without touching the preceding bytes. RAM is the most common type of memory found in computers and other devices, such as printers.</td>
</tr>
<tr>
<td>Rapid prototyping</td>
<td>Also known as solid freeform fabrication. The automatic construction of physical objects with 3D printers, stereo lithography machines or selective laser sintering systems.</td>
</tr>
<tr>
<td>Reactive dye</td>
<td>A colorant used to dye cellulose fibres.</td>
</tr>
<tr>
<td>Reverse appliqué</td>
<td>The cutting, turning under, and blind stitching of a top layer of fabric to reveal a shape created by exposing the under layer of fabric.</td>
</tr>
<tr>
<td>RGB</td>
<td>Red, Green, Blue. A colour model based on additive colour primaries.</td>
</tr>
<tr>
<td>RIP</td>
<td>Raster image processing. Hardware - software combination that converts a vector image into a bit-mapped image.</td>
</tr>
<tr>
<td>SAC</td>
<td>Scottish Arts Council.</td>
</tr>
<tr>
<td>Saturation</td>
<td>In colour theory, saturation or purity is the intensity of a specific hue.</td>
</tr>
<tr>
<td>Scanner</td>
<td>A peripheral device that can read text or illustrations printed on paper and translate the information into digital data.</td>
</tr>
<tr>
<td>SDA</td>
<td>Surface Design Association.</td>
</tr>
<tr>
<td>Secure websites</td>
<td>Websites that require a password for access to information.</td>
</tr>
<tr>
<td>Silk crepe de chine</td>
<td>A soft fine or sheer woven crepe.</td>
</tr>
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1 http://www.m-w.com  
2 http://en.wikipedia.org  
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<tr>
<td><strong>Silk habotai</strong></td>
</tr>
<tr>
<td><strong>SLR camera</strong></td>
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</table>
| **Smart textiles**    | Textiles with incorporated (micro) electronic components such as processors, sensors, etc. which can enable wireless communication with other devices; also textiles that can change or adapt their properties according to their environment. 
| **Spectrophotometer** | A photometer (a device for measuring light intensity) that can measure intensity as a function of the colour, or more specifically, the wavelength of light. |
| **Still photography** | Analogue (film) photography. |
| **Substrate**         | The base material that images will be printed onto. |
| **Tablet PC**         | A notebook or slate-shaped mobile computer. Its touch screen or digitizing tablet technology allows the user to operate the computer with a stylus or digital pen instead of a keyboard or mouse. |
| **Tacit knowledge**   | A form of knowledge that is apparently wholly or partly inexplicable. Tacit knowledge has been described as “know-how” and involves learning and skill but not in a way that can be written down. |
| **Textile practitioner** | An artist or designer working in the medium of textiles. |
| **TFT**               | Thin film transistor. |
| **TIFF**              | Tagged image file format. One of the most widely supported file formats for storing bit-mapped images on personal computers. |
| **TTM**               | Time to market. The length of time between design conception to availability for sale of a product. |

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<tr>
<td>U4-ia®</td>
<td>Textile specific design software <a href="http://www.lectra.com">www.lectra.com</a> (acc.05.03.06)</td>
</tr>
<tr>
<td>UAL</td>
<td>University of the Arts London.</td>
</tr>
<tr>
<td>UMIST</td>
<td>University of Manchester Institute of Science and Technology.</td>
</tr>
<tr>
<td>UWIC</td>
<td>University of Wales Institute Cardiff.</td>
</tr>
<tr>
<td>Vector</td>
<td>The use of geometrical primitives such as points, lines, curves, and polygons to represent images in computer graphics.²</td>
</tr>
<tr>
<td>Virtual</td>
<td>A term used for distinguishing something that is conceptual from something that has physical reality. It is used to express the digital visual concept compared with its physical realisation.</td>
</tr>
<tr>
<td>Graphics tablet</td>
<td>A device that enables drawings and sketches to be input into a computer.³</td>
</tr>
<tr>
<td>Web site</td>
<td>A site (location) on the World Wide Web.³</td>
</tr>
<tr>
<td>WIMP interface</td>
<td>Windows, Icons, Menus and Pointing device, a type of graphical user interface.</td>
</tr>
<tr>
<td>Windows Media Player®</td>
<td>A proprietary freeware software media player used for playing audio, as well as viewing video and images on personal computers running the Microsoft Windows operating system.²</td>
</tr>
<tr>
<td>Windows®</td>
<td>Microsoft Windows®. A series of operating environments and operating systems created by Microsoft® for use on personal computers and servers.²</td>
</tr>
<tr>
<td>World Wide Web</td>
<td>A system of Internet servers that support specially formatted documents. Not all Internet servers are part of the World Wide Web. World Wide Web is not synonymous with the Internet.³</td>
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</tbody>
</table>

¹http://www.m-w.com  
²http://en.wikipedia.org  
³http://www.webopedia.com
Appendix A - Case Study Protocol

Contents:

A.1 Introduction
A.2 Preparation for field visits
A.3 Case study Procedure
A.4 Formal letter
A.5 Copyright Agreement form
A.6 Information included with formal letter of introduction
A.7 Interview questions
A.1 Introduction:

The purpose of the proposed case study research is to enable the collection of data concerning the creative use of digital imaging technology by textile and surface pattern practitioners in a real life context. Three studies will inform the case study research, providing internal validity through the opportunity to examine and compare the findings.

A.1.1 Propositions:

The case study will examine the following hypotheses, that:

- Digital imaging technology is affecting the creative process in which textile practitioners engage
- The artefacts, that are produced as a result, exhibit a changed visual language
- Practitioners frequently seek to re-engage with the printed cloth resulting in hybrid craft practice
- Communication of visual ideas is enhanced using digital imaging technology

A.1.2 Construct Validity

The role of this protocol is to ensure that the case study as a whole maintains internal and external validity and is therefore reliable as research data for inclusion in the project. The structure of the protocol will act as a guide for the three studies to ensure that all areas are covered systematically and the action is potentially repeatable in similar situations.

A.2 Preparation for field visits:

A.2.1 Identification of individual participants

A number of participants will be short listed from those emerging from the literature search and field review. Their criteria for selection will be:

- Evidence of integration of digital imaging technology in their practice
- Recognition in the field as textile designers, artists or craftspeople
- Recommendation by academia, professional association or industry

A.2.2 Informal pre-interview meeting

Arrangements will be made to meet informally with the candidate to discuss availability and gauge their interest in participation in the study.

A.2.3 Procedure for gathering data

The following methods will be used to collect data:

- Digital video recording of interviews and practice as it occurs
- Digital still photography
- Audio recording
- Collection of artefacts and documentary evidence
- Written notes and sketches in a journal

Storage of video data will be on original DV tapes, labelled and numbered. The DV tapes will be converted into Mpeg1 files using Ulead® software and saved onto CD ROMs for ease of access.
and analysis. Digital still photography will be stored both on the researcher’s computer and as copies on CD or DVD. Audiotapes will be labelled, catalogued and stored. Any artefacts and documentary evidence will be filed and those small enough integrated into the research journal.

A.2.4 Pilot study

A pilot study will be carried out to test questions and data collection methods

A.3 Case Study Procedure:

A.3.1 Formal letter of introduction
(See section A.4.0)
This will be sent several weeks before the visit, to formally seek permission, introduce the project and explain the proposed research procedure.

A.3.2 Copyright agreement
(See section A.5.0)
This will be included with the letter of introduction, to be completed and returned to the researcher, to enable artworks to be photographed and the practitioners' work to be video recorded.

A.3.3 Set of research interview questions
(See section A.7.0)
These will also be sent in advance with the formal letter of introduction and copyright agreement form.

A.3.4 Outline proposal for visit
Day 1: Introductions, informal interview seeking background contextual information.
Some informal data collection, photography, discrete informal audio recording
Day2. Formal interview: video recording, still photography, development of process map
Day3: Video recorded observations of working method, discussion and photography of artefacts; informal note taking, collection of documentary evidence

A.3.5 Production of database
To include:
Review of video data and still photography
Digitisation of video data, filing and storage on CD/DVD ROMs
Filing of collected material including digital photographs, visual and written material

A.3.6 Production of case study report:
Descriptive account and analysis of study, documented in the following sections:
Context: background information likely to impact on practice or creative process
Rhythm: working method/process/structure
Mode: factors impacting upon creative process such as colour, pattern, image, composition etc.
Digital tool use: integration of technology including hard and software; use of peripheral devices such as graphics tablets, scanners, mice etc.
These sections will make comparisons between the individual studies and relate to the theoretical propositions in 1.1

**A.3.7 Follow up procedure:**

- Letter of thanks to participant
- Discussion concerning collaborative investigation work
- Draft report sent to candidate for verification.
A.4 Formal letter of introduction

Cathy Treadaway
Research Assistant,
Cardiff School of Art and Design,
UWIC
Western Avenue,
Llandaff
Cardiff
CF5 2YB

Dear ..........

Following our meeting on......in which we discussed your participation in my PhD case study I am
writing to confirm that I shall be visiting you between the following dates........Please could you
confirm that you are happy to be interviewed and recorded. I have enclosed with this letter a
copyright permission form, which I would be grateful if you could complete and return to me.

I have also enclosed some general information regarding the research and what my visit to your
studio will involve.

I am very grateful to you for agreeing to participate and look forward to meeting you again on
the..... If you have any further questions regarding my visit, please do not hesitate to contact me.

Best regards,

Cathy Treadaway,
Research Assistant,
UWIC.
Appendix A

A.5 Copyright agreement form

Name..............................................

I give permission for Cathy Treadaway, Research Assistant (Textiles) to use photographic images of my artwork in her academic research project at University of Wales Institute Cardiff.

I agree to the use of these images to illustrate academic presentations about the research project where appropriate.

(Signature)..............................................................................................................

(Date).....................................................................................................................

Contact details:

(Email)..................................................................................................................

(Telephone).............................................................................................................
Appendix A

Case Study Protocol

A.6. Information included with formal letter of introduction:
Case Study – Information for participants

General background:
The main focus of the research is to gather information about practice. This will be achieved through interview and video recording of practice as it occurs. The information will provide an understanding of the practitioner in a real world context and reveal the influences that build the intuitive processes of creative making.

Focus:
My research concerns the way in which technology is impacting on creative textile practice. I am particularly interested in creativity; how we innovate our ideas and their subsequent development. Digital technology plays a part in this in different ways for different practitioners. Most of those I have interviewed to date have claimed to be novices, not computer experts but rather practitioners who use technology as a tool and a medium. You have been approached to be a case study participant because you have a particular viewpoint or method of working that will provide useful information about your own practice and may have wider implications. Your views and thoughts will help shape the findings that may influence use of technology in the future; they are immensely valuable and worth documenting and analysing.

Aims:
As a researcher my aim is to 'talk less and listen more'. I need to be able to hear your thought processes as they occur and for you to feel as uninhibited and unrestricted as possible. The recorders can always be turned off or erased and nothing will be used without your agreement. We have to gain a rapport, a trust, and a friendship. The experience must be relaxed, fun and unselfconscious. If it becomes anything else than this then it is time to stop and you must let me know immediately.

Interview:
Before commencing the filming of practice, we will do a short interview to give background to the study. Some of the questions will be familiar and have been used in previous field study visits. The purpose of this is to give consistency between interviews ensuring that the same ground is covered with each candidate.

Examples of work:
It will also be useful to be able to see examples of previous work and document these either through video, photographs or digitally. The focus of the case study is on creativity and the generation of design concepts. Any visual material that supports and documents these methods of working will be useful and may help in discussion.

Video recording of practice:
It will be useful to have a couple of design concepts in mind prior to the case study so that real examples of work in progress can be filmed. There may be also on-going work that can be filmed and explained. It would be useful to see and film at least one example of concept generation or pre-design, information gathering or research for a design. There may be other stages in design development that are relevant and important that need to be included, including perhaps stages in the development of the final artefact or design.

I am particularly interested in seeing how digital imaging fits within the making process. I am also interested in hand use and the digital tools that are used in the design process: issues concerning manipulation of digital tools and digital crafting need to be explored. By watching digital tool use, issues are revealed concerning the way in which peripherals such as mice and keyboards act as
inhibitors or stimulants to creativity. Filming computer use is not without problems. A TFT screen is preferable for getting a good image on video, (I shall be bringing my tablet PC to use in case you do not have one).

Collaborative Practice:
As part of the research, I am undertaking practical collaborative experiments with artists and designers to explore some of the issues that are being illuminated. I will discuss the possibility of undertaking a simple collaborative experiment as a result of the case study and will bring with me a CD of an example produced as a result of previous research.

Analysis and Findings:
On my return to the UK I shall be analysing all the visual material and making a written report. This will form a chapter in my thesis that will ultimately be published by the University of Wales, with a copy held in the British Library in London, on successful completion of my PhD examination. I may also wish to make use of the findings in academic paper presentations and publications in academic journals. The material will be used only with your full consent.

Thanks:
I am particularly grateful to you for agreeing to spare the time to help me in my research. I hope that you will find the process interesting and that it will also be beneficial to you in your practice.
Appendix A

Case Study Protocol

A.7 Interview questions:

Is it possible for you to draw a map or diagram of your design process?

1. Conceptual development:
   1.1 What are the influences on your thoughts when you first start to build your ideas?
   1.2 How do you stop from becoming fixed on one approach to the problem?
   1.3 How long do you spend at this stage and how important to you is it?
   1.4 How much of your pre-design process is planned and how much intuitive?
   1.5 What parts do multiple sensuous responses: sight, touch, sound, smells play at this stage?

2. Generative stage:
   2.1 How do you capture these responses?
   2.2 How are they stored?
   2.3 Does the ability to combine source material virtually aid this process for you?
   2.4 How do your concepts first become visual? Is technology involved?
   2.5 How important are the hands and tactile senses at this stage?

3. Design development:
   3.1 Do you tend to develop your ideas in the same way for each project or do you constantly change your approach?
   3.2 How important is the computer at this stage?
   3.3 Do you proceed rapidly with one idea or do you always have several ideas on the go?
   3.4 How important is reflection time?

4. Digital tools:
   4.1 What digital devices do you use to draw/design with?
   4.2 How do they compare to tools used in hand rendered work?
   4.3 Do you use both dominant and non-dominant hand?
   4.4 What makes digital tools really good?
   4.5 How could digital peripheral drawing tools be enhanced?

5. Software medium:
   5.1 Would you regard yourself as an expert with the software you use?
   5.2 Which packages are most useful and why?
   5.3 How quickly did you learn how to use them?
   5.4 What frustrates you most about the software you use?
   5.5 Do you have a mental map of the structure of the software you use?
   5.6 If you do, how long did you take before you were able to be creative and do what you wanted without being constrained by the software?
   5.7 How does file size and memory issues impact upon your practice?
   5.8 How do you think the software interface could be improved?
Appendix A  

6. Output:
6.1 How do you deal with the issues of colour management and communication?
6.2 Does this matter to you?
6.3 What aspect of digital crafting takes the most time?
6.4 What aspect is the most liberating and beneficial?
6.5 Do you ever combine hand rendering or other techniques with digital concepts?

7. Influences:
7.1 Who are the key figures in the field of digital textiles at the moment in your view?
7.2 Who has influenced you most in your work?
7.3 Do you think hand rendering skills are declining or being enhanced by digital imaging?
7.4 Do you think as a textile designer that you have a heightened tactile sensibility; do you touch with your eyes and look with your hands?
7.5 Do you know other artists/designers working in this way who are supportive?
7.6 How important is the Internet?

Thank you!
Appendix B — Investigations

This appendix contains material relating to Chapter 5 ‘Investigations’. The content is divided into two parts: sections 5.1 – 5.4 contain the practitioners’ responses to a questionnaire outlined in section 5.1, evaluating the experience of participating in the collaborative investigations. Sections 5.5 – 5.8 contain detailed description and illustrations of additional practical investigations that are not included in the main document but which have been used to inform the research findings.

Contents:

Part One:

B.1 Questionnaire pro forma for evaluation of collaborative investigations
B.2 Questionnaire response from Alison Bell
B.3 Questionnaire response from Debra Bernath
B.4 Questionnaire response from Susan Brandeis

Part Two:

B.5 Collaborative investigation with Alison Bell
B.6 Collaborative investigation with Debra Bernath
B.7 Collaborative investigation with Susan Brandeis
B.8 Independent investigation
Appendix B Investigations

B.1 Questions for Creative Collaborative Partners:

Creative process:
1. Do you feel that working collaboratively has enhanced your creative thinking?
2. If yes, can you cite any specific ways it has helped?
3. Were there any occasions when you felt constrained or limited during the project?
4. If yes, can you cite an example?
5. Did you feel any sense of judgement or assessment within the process?
6. If yes, at what stage and do you know why?
7. Did working collaboratively motivate you and maintain your interest?
8. If no, at what stage did you begin to feel demotivated?

Memory:
9. The theme for our work was shared memory. Do you feel that the images produced reflect our shared memories?
10. If yes, which work in particular is the closest interpretation of your memory?
11. Does the process of linking images with memory of experience play a role in your usual creative process?

Digital tools:
12. Do you feel that digital tools have helped this process of stimulating and recapturing memory?
13. If yes, how?
14. Which have you found most useful in our collaborative creative process:
   (Mark in a scale of 1-10 where 1 = not at all useful 10 = very useful)
   Scanner
   Digital camera
   Camera
   Graphics tablet and pen
   Mouse

Communication:
15. Do you feel that we communicated well during the project?
16. If no, how could communication have been improved?
17. Which form of communication was the most useful?
   (Mark in a scale of 1-10 where 1 = bad 10 = very good)
   File sharing of images
   Email
   Telephone
   Meetings

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Appendix B

Authorship:
18. Did you prefer to initiate the image or work on the second layer?
19. Did initiating the creative process make you feel any different about the image at the end?
20. How do you feel about authorship of the works produced? Does the collaborative nature of their development make them feel 'less your own'?
21. Does this change depending on who initiated the image?

Visual outcome:
22. Did you generally feel disappointed when you looked at the images returned to you or pleased?
23. Which of the collaborative works do you feel most satisfied with?
24. Was the printed fabric a good interpretation of the digital image?
25. If not, can you say why?
26. Do you feel inspired to work on any of these images or fabrics further?
27. Has the experience been positive and would you consider further creative collaboration with another practitioner?
28. If no, why not?

Best and Worst:
29. What was the best part of the whole project?
30. What has been the worst moment?

Any other comments?
B.2 Response from Alison Bell to the collaborative investigation

Questions for Creative Collaborative Partners:

Creative process:
1. Do you feel that working collaboratively has enhanced your creative thinking?
   Yes, without doubt.
2. If yes, can you cite any specific ways it has helped?
   It helped me not to be too precious about my work in that sharing the creative process can enhance
   the outcome by moving in unexpected directions. I didn’t anticipate this. Nice surprise.
3. Were there any occasions when you felt constrained or limited during the project?
   No
4. If yes, can you cite an example?
5. Did you feel any sense of judgement or assessment within the process?
   No, I was happy to go with what evolved, but I knew when to stop.
6. If yes, at what stage and do you know why?
   I think this was just my own creative judgement coming into play, as it would anyway.
7. Did working collaboratively motivate you and maintain your interest?
   Yes, it was quick to respond to the images, the spontaneity was motivating.
8. If no, at what stage did you begin to feel de-motivated?

Memory:
9. The theme for our work was shared memory. Do you feel that the images produced reflect our
   shared memories?
   Yes, Arran is a very special place to some people. It’s difficult to express this easily.
10. If yes, which work in particular is the closest interpretation of your memory?
    Kilmory, the blue one as it reflects the colours well.
11. Does the process of linking images with memory of experience play a role in your usual
    creative process?
    Yes, but I didn’t realise this until recently. I now think about this much more and find it makes the
    creative process easier, in that it’s less objectively about composition. Maybe I’m a painter? It has
    expanded my “toolbox” of ideas.

Digital tools:
12. Do you feel that digital tools have helped this process of stimulating and recapturing memory?
    Yes, but only up to a point.
13. If yes, how?
    I don’t use many tools, intentionally, but they do allow me to develop ideas quickly, transitioning
    from one thought to another without too much delay. This suits the way I think in that I initially
    respond to a visual image rather than consider the narrative too much beforehand. But this is
    changing, see Q11
14. Which have you found most useful in our collaborative creative process:  

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Appendix B Investigations

(Mark in a scale of 1-10 where 1 = not at all useful 10 = very useful)

Scanner - 1
Digital camera - 10
Camera - 1
Graphics tablet and pen - 10
Mouse - 1

Communication:

15. Do you feel that we communicated well during the project?
Yes, very well. This was essential!

16. If no, how could communication have been improved?

17. Which form of communication was the most useful:

(Mark in a scale of 1-10 where 1 = bad 10 = very good)

File sharing of images - 10
Email - 10
Telephone - 10
Meetings - 10

Authorship:

18. Did you prefer to initiate the image or work on the second layer?
Prefer to work on the second layer, but only marginally.

19. Did initiating the creative process make you feel any different about the image at the end?
No, I liked the result which evolved. The process of sharing was more important to me than the end result. I didn't feel this at the time, but feel it now.

20. How do you feel about authorship of the works produced? Does the collaborative nature of their development make them feel 'less your own'?
Ownership is not an issue, I thought it might be before we started, but this never happened. This is a shared experience and memory, full of empathy and pleasure.

21. Does this change depending on who initiated the image?
No

Visual outcome:

22. Did you generally feel disappointed when you looked at the images returned to you or pleased?
Pleased

23. Which of the collaborative works do you feel most satisfied with?
Kilmory, the blue one.

24. Was the printed fabric a good interpretation of the digital image?

From what I've seen, my screen is brighter, I create with light, not pigments, but that's only to be expected. The problem of calibration is ongoing for us all. But when printed they became something else, moving into a different realm. I accepted them as being an interpretation of a file, not a copy. This is how I work with technology, not prescriptive.

25. If not, can you say why?
As above; calibration and changing from one format to another; screen to silk.

26. Do you feel inspired to work on any of these images or fabrics further?
Yes, but have a sense of hesitancy, is this because it has shared ownership?

It's because the screen image was different in that the composition looked better, more finished. Maybe it's to do with scale? But I will work on it. But not yet!

27. Has the experience been positive and would you consider further creative collaboration with another practitioner?
Yes, but they would have to be of a like mind, creatively speaking. This is essential.

28. If no, why not?

Best and Worst:

29. What was the best part of the whole project?
Columbia! Seeing the silk for the first time in a gallery setting! Manifestation of memory.

30. What has been the worst moment?
None that I can remember.

Any other comments?

I feel that empathy is essential in order to collaborate comfortably. Each needs to feel confident within their own realm.

Confidence in tools etc shouldn't be an issue in the process. It's the expression of thoughts which matters more.

I really enjoyed this experience; it took me out of my own "box".

I'd like to do more with Cathy as we seem to think along similar lines, this wouldn't lead to similar end results as before, merely allow the process to flow.

Working with abstract ideas, interpreting words and sounds might be interesting? Poetry, music.

Thank you for giving me the opportunity to develop creatively.
B.3 Response from Debra Bernath to the collaborative investigation

Questions for Creative Collaborative Partners:

Creative process:
1. Do you feel that working collaboratively has enhanced your creative thinking?
   Yes
2. If yes, can you cite any specific ways it has helped?
   *I cannot think of specific instances, but I have found that it helps me focus on what I am doing. How? When I see what the other has done, I know more of what I want to do.*
3. Were there any occasions when you felt constrained or limited during the project?
   Yes
4. If yes, can you cite an example?
   *Yes, time and waiting for hand-off back to me and to Cathy. Sometimes I felt like going off in another direction, so I had to return to the task at hand. (Not necessarily a bad thing)*
5. Did you feel any sense of judgement or assessment within the process?
   No
6. If yes, at what stage and do you know why?
7. Did working collaboratively motivate you and maintain your interest?
   Yes
8. If no, at what stage did you begin to feel de-motivated?

Memory:
9. The theme for our work was shared memory. Do you feel that the images produced reflect our shared memories?
   *Yes and No*
10. If yes, which work in particular is the closest interpretation of your memory?
    *I think that these works used our shared memory, but does not necessarily reflect our shared memory, meaning they look like floral designs but not a recollection of an experience.*
11. Does the process of linking images with memory of experience play a role in your usual creative process?
    No

Digital tools:
12. Do you feel that digital tools have helped this process of stimulating and recapturing memory?
    Yes
13. If yes, how?
    *Digital camera captures a moment in time and this I could download to my computer. The scanner scans imagery from the time of my experience in Wales.*
14. Which have you found most useful in our collaborative creative process:
    *(Mark in a scale of 1-10 where 1 = not at all useful 10 = very useful)*
    Scanner 10
Digital camera 10
Camera 1
Graphics tablet and pen 10
Mouse 5

Communication:
15. Do you feel that we communicated well during the project?  
Yes, extremely well.
16. If no, how could communication have been improved?  
17. Which form of communication was the most useful?  
(Mark in a scale of 1-10 where 1 = bad 10 = very good)
File sharing of images 10
Email 10
Telephone 5
Meetings 1

Authorship:
18. Did you prefer to initiate the image or work on the second layer?  
Both, maybe more initiate the image.
19. Did initiating the creative process make you feel any different about the image at the end? Yes, sometimes.
20. How do you feel about authorship of the works produced? Does the collaborative nature of their development make them feel ‘less your own’?  
Not at all. Feels good.
21. Does this change depending on who initiated the image?  
Not at all.

Visual outcome:
22. Did you generally feel disappointed when you looked at the images returned to you or pleased?  
Felt well, sometimes I did not care for something, but then I would try and look at it in a different way from what I was used to.
23. Which of the collaborative works do you feel most satisfied with?  
The very first one with the Poppies and stain glass windows and the very last one with all the flowers on the grass background.
24. Was the printed fabric a good interpretation of the digital image?  
Yes, except for the dark ground one, the colour was off from the digital colour.
25. If not, can you say why?  
26. Do you feel inspired to work on any of these images or fabrics further?  
Yes
27. Has the experience been positive and would you consider further creative collaboration with another practitioner?
Appendix B

Yes and no.

28. If no, why not?

Must be with someone who has similar focus and commitment.

Best and Worst:

29. What was the best part of the whole project?

The final outcome.

30. What has been the worst moment?

When trying to download and upload files, frustrating at times.

Any other comments?

I really enjoyed this process of collaboration. I find it very interesting and inspiring. It keeps the process of designing focused. I also felt like I was getting presents all the time while waiting for the designs to return. I look forward to more.
B.4 Response from Susan Brandeis to the collaborative investigation

Questions for Creative Collaborative Partners:

Creative process:

1. Do you feel that working collaboratively has enhanced your creative thinking?

*I feel that it has made me creative in a new way, and I would say that IS an enhancement. I have had to respond to actions I did not make and to positive additions to the image that did not destroy the gains of the previous step.*

2. If yes, can you cite any specific ways it has helped?

*I found that it makes me less “precious” with my decisions, less inhibited in a way. I became more playful and adventurous.*

3. Were there any occasions when you felt constrained or limited during the project?

*I was constrained only by my lack of knowledge with Photoshop (there are ALWAYS things I won't know, it is so vast), sometimes I was short on time, and there WAS always my feelings of valuing my collaborator’s actions and responding with control rather than complete abandon.*

4. If yes, can you cite an example?

*I would probably have introduced more color range into the reflections piece. I tend to want a larger range of color even if the overall effect is analogous or monochromatic. I am much drawn to color fields that give the eye some work to do in optical blending, especially across the color wheel.*

5. Did you feel any sense of judgement or assessment within the process?

*No. My collaborator was completely open, trusting and encouraging.*

6. If yes, at what stage and do you know why?

7. Did working collaboratively motivate you and maintain your interest?

*Yes. I remained motivated, but didn’t always have the time to do as much as I would have liked.*

8. If no, at what stage did you begin to feel de-motivated?

Memory:

9. The theme for our work was shared memory. Do you feel that the images produced reflect our shared memories?

*Yes. Each time I began work I thought back to our time here together in North Carolina and could bring back the air, sun, breeze and trees.*

10. If yes, which work in particular is the closest interpretation of your memory?

*Probably the tree memory because it was in my own garden and I can distinctly remember standing under the birch trees with you when Marc took our picture under. It is all the more poignant as we are going to be cutting down those trees this fall (long story).*

11. Does the process of linking images with memory of experience play a role in your usual creative process?

*Yes. Since I work with the images of place, I am always augmenting my photographic documentation with memory of feelings, sounds, smells, and emotions experienced when at the site. The memories are often more intense than the experience, filtered as they are through hindsight and the psychological and emotional reactions to sites.*
Appendix B

Digital tools:

12. Do you feel that digital tools have helped this process of stimulating and recapturing memory?
Yes

13. If yes, how?
They allow me to manipulate the image until it matches my memory. Memory is very different from photography or sketching on site. In memory, certain colors are enhanced; certain shapes come to the foreground; and emotion colors the whole to imbue meaning derived from the experience.

14. Which have you found most useful in our collaborative creative process:
(Mark in a scale of 1-10 where 1 = not at all useful 10 = very useful)

Scanner 1
Digital camera 8
Camera 1
Graphics tablet and pen 1 (didn’t have one at the time this started—just got it)
Mouse 10

Communication:

15. Do you feel that we communicated well during the project?
Yes

16. If no, how could communication have been improved?
If we could have overcome the server issues.

17. Which form of communication was the most useful?
(Mark in a scale of 1-10 where 1 = bad 10 = very good)

File sharing of images 10
Email 10
Telephone 10
Meetings N/A

Authorship:

18. Did you prefer to initiate the image or work on the second layer?
I don't think I initiated any of the images that we worked on. I actually did enjoy responding to what was there and manipulating the subsequent layers.

19. Did initiating the creative process make you feel any different about the image at the end?
N/A

20. How do you feel about authorship of the works produced? Does the collaborative nature of their development make them feel ‘less your own’?
This gets really interesting actually. I feel I have joint ownership as the images come from the printer. I believe that may change as I decide what to do with them. If I continue to work the images with embroidery or other surface design techniques, I expect I will feel more personal ownership. Nevertheless, I don’t think of these images the same as I do the ones I initiate and manipulate myself.

21. Does this change depending on who initiated the image?
Appendix B

I am not sure. I should try to initiate an image and see.

Visual outcome:

22. Did you generally feel disappointed when you looked at the images returned to you or pleased? Generally, I was very excited and attracted. I felt an expectation, sort of like Christmas Eve?—anticipation and curiosity about what you had done.

23. Which of the collaborative works do you feel most satisfied with? I am most satisfied with the tree image because I find the range of color in it more evocative and visually complete. The reflections image was REALLY wonderful back at layer 2 or 3, but I am less satisfied with it now.

24. Was the printed fabric a good interpretation of the digital image? This is ALWAYS a great variable.

25. If not, can you say why? My home printer tends to blend all of the mid range similar hues together and will not pick up the subtle variations. So that makes the reflection image really muddy visually. I haven't tried the images on the big printer with dyes yet. That is next.

26. Do you feel inspired to work on any of these images or fabrics further? Yes

27. Has the experience been positive and would you consider further creative collaboration with another practitioner? Yes, the experience has been positive. I would welcome further collaboration with this practitioner and others.

28. If no, why not? Best and Worst:

29. What was the best part of the whole project? Sharing the responsibility for innovation and development of ideas and image. This was surprisingly satisfying and sort of a relief.

30. What has been the worst moment? Trying to find a simple way to share the files electronically with the barrier of Mac/PC problems and the maximum file sizes imposed by my university server systems. I am still working on this.

Any other comments? I am a person with many responsibilities and very little time. This allowed me to develop work in short bursts of time and energy. It allowed me to share creative responsibility with someone else and play off each level of idea floated. It was generally a lot of fun.
Appendix B

B.5 Collaborative investigation with Alison Bell

The following section details two additional collaborative investigations with the textile artist Alison Bell described in Chapter 5 section 5.2.3 of the thesis.

B.5.1 Dawn

(Fig. B.1 – B.ii)

B.5.1.1 Process

‘Dawn’, the second work to be created, was initiated by Alison Bell. She describes it as being ‘quiet and reflective’ and her intention was to express the ‘memory of the tones you get in the early mornings here on the beach. Gentle lapping softness.’

The first layer of the image (Fig. B.1) comprised a lilac ground on which the artist had drawn a variety of rhythmic lines. The subsequent layers involved a combination of photographic and hand rendered electronic line work, including a layer of marks representing figures walking along the horizon (Fig. B.1 Layer3). In the last three layers, the crab shell motif has been developed into a layer of texture representing rocks. This was created by making a brush from the photographic image and enabled selection of the colour and pattern elements without use of the whole motif (Fig. B.1 Layer 4).

B.5.1.2 Format

‘Dawn’, like ‘Kilmory’, is presented in portrait format and provides the audience with a sliced schematic representation of the shore from the feet of the viewer to the horizon; there is no skyline. The line work and layers of pattern break up the coloured space to convey the sensation of distance and evoke the subtlety of light on wet surfaces at dawn.

In the final layer (Fig. B.ii), the dimensions of the image were increased by adding layers top and bottom to provide the extra fabric for the practicalities of neatening the edges and applying the hanging device for exhibiting. The final image (Fig. B.ii) was saved onto CD and digitally ink jet printed. The first print onto fabric indicated faults in the process; lines were evident in areas of solid colour and colour fidelity was poor. The print bureau subsequently produced a more accurate rendition.

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402 Personal communication 22.03.04

403 Bell writes: ‘I love this experiment; it’s so ethereal and full of feelings of early morning. I felt compelled to add the figures, vague and disconnected.’ Personal communication 13.04.04

404 Colour paper printouts were sent with the CD to the digital print bureau for colour management.
Appendix B

**Fig. B.1 ‘Dawn’ – Layers 1 to 4**

**Layer 1 (Above)**
Background comprising coloured shapes and lines to evoke the early morning on the shoreline.

**Layer 2 (Above)**
Addition of photographic elements: rippled marks on the sand and a crab shell.

**Layer 3 (Right)**
Introduction of marks suggesting people walking on the shore and pebbles at the bottom.

**Layer 4 (Left)**
Digital development of textural area from crab shell using clone tool to evoke rocks and electronic line work to suggest pools of water.
Appendix B

Fig. B.ii 'Dawn' – Layers 5 and 6

Layer 5 (Left)
Introduction of additional coloured shapes to suggest water.

Layer 7 (Right)
Introduction of extra background area for finishing the printed work. Textured section copied and pasted as a bottom band.

'Dawn' – Photograph of digitally printed textile (Left)
Printed onto silk satin using reactive dyes.
'Dawn' provides the audience with a sliced schematic representation of the shore from the feet of the viewer to the horizon; there is no sky. The line work and layers of pattern break up the coloured space to convey the sensation of distance and evoke the subtlety of light on wet surfaces at dawn.

'Dawn' was one of the three artworks selected for inclusion in the digital textile art exhibition: 'Recursions: Material expressions of zeros and ones' at the Museum of Design, Atlanta USA in 2005. Photo © CT
B.5.2 Pladda

(Figs. B.iii – B.iv)

B.5.2.1 Process

The final of the three images made collaboratively with Alison Bell was ‘Pladda’. Like the previous two images, ‘Pladda’ was based on visual data collected on the southern coastline of Arran and was intended to convey memories of the characteristic blue light of that location. The piece also explores the way in which the perception of distance is enhanced by selective sight of the viewer, in contrast with the photographic depiction of distance and scale. The islands off the coast of Arran appeared prominent on the horizon but in the photographs appear much smaller than they were perceived and remembered. The digital expression is able to combine the photographic detail and enhance it with the viewer’s perception and memory.

The image combines scanned hand rendered watercolour sketches with digitally manipulated photographs and hand rendered electronic line work. Unlike ‘Kilmory’ and ‘Dawn’, ‘Pladda’ was made from only four layers of image. The initial layer (Fig. B.iii) included the blue ground which was selected in Photoshop® using the colour selection tool from a photograph of the location. Onto this layer, scanned imagery of rocks and water were added (Fig. B.iii Layer 1). The opacity of the imagery was adjusted to merge elements together and line work was added to enable colour and texture to be integrated within the piece (Fig. B.iv Layers 2 and 3).

B.5.2.2 Format

The composition of ‘Pladda’ provides the viewer with a section of the shoreline from the pebbles underfoot to the horizon and sky beyond. The picture space is divided by the marks and colours suggesting rocks jutting out into the sea culminating in marks representing the island positioned to the top left (Fig. B.iv Layer 2). The position of this shape is important since the left side attracts the viewers’ eyes first in any image and so provides the motif with dominance403 (McManus 2003).

When completed, the image was digitally printed onto silk (Fig. B.iv). Of the three images developed, ‘Pladda’ is the closest printed textile representation of the colour of the digital image as viewed on the researcher’s screen.

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403 In ‘Right Hand Left Hand’ Chris McManus writes ‘the left half of space attracts greater attention because of the right parietal lobe. Either way our eyes are first attracted to the left side of the picture and then mover across to the viewers right side’ pp357-8 McManus, C.
Selection of colour and format from review of digital photographs. The colour was selected using the colour selection tool from a photograph taken on site, that best evoked (to the researcher) the colour memory of the location on the day of the visit.

Inclusion of digital photographs into background.

Addition of rock motifs: developed digitally from manipulated photographs using colour reduction and then drawing over the top electronically using a variety of brushes.

A scanned watercolour sketch made on site was merged with the background by adjusting the opacity and using layers and eraser tool.
Fig. B.iv ‘Pladda’ – Layers 2 and 3

Layer 2 (Left)
Addition of island shape and pattern area along the bottom edge.
The inclusion of the island shape was a mutual decision at this stage (and was anticipated by both parties) since it forms a key focal point on the horizon, in the location expressed by the image.

Layer 3 (Left)
Final addition of a layer of electronic rendered line work and texture (detail below).

‘Pladda’ – Photograph of digitally printed textile
Printed onto silk satin using reactive dyes.
Size: 183cm x 87cm

‘Pladda’ was one of the three artworks selected for inclusion in the digital textile art exhibition: ‘Recursions: Material expressions of zeros and ones’ at the Museum of Design, Atlanta USA in 2005.
Photo © CT
Appendix B

Investigations

B.6 Collaborative investigation with Debra Bernath

B.6.1. Empire State

(Figs. B.v – B.vi)

B.6.1.1 Process

This image was developed in response to a shared memory of a visit to the top of the Empire State building. Digital photographs provided the visual information on which the central section was developed, providing a *birds-eye view* of the buildings and streets below (Fig. B.13). The colours in the photographs did not express accurately the memory of the richness of the colour and so additional reference material was used to build a colour palette. Initially colours were selected from photographs of the designer’s apartment but these did not convey the researcher’s preconceived colour for the piece or the memory of the location. The reflective journal and photographic material was reviewed again at this stage, and visual material, collected during a visit to the South American collection at the Metropolitan Museum of Art, New York, was selected (Fig.B.13 *Layer2*). The *colour palette* for the image was derived from a digital photograph of a Pre-Columbian ceramic vessel; the *colour selection* tool in Photoshop® was used to isolate and collect the colours and these were used to fill a series of geometric shapes created using the *pen* tool.

In the second layer of the image (*Fig.B.14*), Bernath added a series of randomly copied motifs based on the water tower structures seen on top of the buildings, as a section of repeating elements. The researcher added a final layer to complete the work. During the development of the ‘New York Skyline’ image, an area of pattern was developed from a digitally modified photograph. Although discarded as a motif for this piece, it was included in the top section of the ‘Empire State’ image (*Fig B.14 layer 3*). In addition to this layer of texture some hand rendered electronic line work, resembling stitched thread, was added using the tablet PC.

B.6.1.2 Format

The researcher initiated the ‘Empire State’ image. At the time of the visit to the location some ideas about the composition of this piece were already being formed in the researcher’s mind so, when the photographs were reviewed later for design potential, the selection of images was rapid. The work comprises three sections, with the main area of colour and focal interest in the middle section; the top and bottom frame the piece. The bottom dark section is filled with repeating pattern motifs derived from the water tower structures seen on the rooftops (*Fig.B.14*). This motif is widely recognised by residents of the city as a symbol for New York.

The upper dark section contains the textured area developed from a manipulated photograph from an item in the designer’s kitchen. Although this pattern appeared well defined on the TFT computer screen when digitally printed on to cotton velvet this area of pattern is barely visible.

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406 Tomato red, ochre and brown are colours mentioned on the video.
**Layer 1 (Step 1)**

Photograph (left) was selected following a review of digital photographs taken from the top of the Empire State Building.

**Layer 1 (Step 2)**

(Right) Using digital layers and the pen tool, a series of geometric shapes were identified and filled with colour.

**Layer 2 (Step 1)**

The colours chosen for the concept (left) was influenced by the memory of the colour of the location, which was earthier and richer than that suggested by the photographs.

The digital photographs taken during the visit were reviewed again and the image (bottom right), a ceramic vessel from the Metropolitan Museum of Art, was chosen. Using the colour selection tool, colour data was collected from the photograph and used to fill sections of the digital image.
Layer 3

A band of texture from a digitally manipulated photograph of a cheese grater (right) from the designer's apartment was added to the top section. The photograph was solarised and an area of pattern selected. The colours were enhanced to increase their saturation and then layered over the top section of the image.

Layer 2

(Above) Inclusion of the water tower motif by Bernath: this is a widely used visual symbol for New York and has been included in the image for this purpose.
Layer 4.

Two sections of electronic rendered line work were added to the top and bottom of the central section of the image to suggest stitching (above detail). These marks were created by drawing directly onto the image (electronically) using a tablet PC and pen.

The collaborators agreed that the image was complete at this stage. The work was saved onto CD and following sample tests, was printed onto cotton velvet using the Mimaki TX2 ink-jet printer using reactive dyes.
Appendix B

B.7 Collaborative investigation with Susan Brandeis

B.7.1 Trees

(Figs. B.vii - B.x)

B.7.1.1 Process

The town of Carey is surrounded by lush vegetation and woodland; this provided the starting point for the second image. The photograph of natural debris on the woodland floor, that had been posted on the website, was layered by Brandeis with a scanned image of River Birch tree bark (Fig. B.viii Layer1). The researcher added an expressive watercolour drawing made to evoke the memory of being inside the woodland, surrounded by the trees. This was scanned, overlaid onto the layered photograph, and combined with an additional digital photograph of trees, providing an area of texture in the top section of the piece (Fig. B.viii Layer2).

Brandeis' next layer involved alterations to hue and saturation to move the image 'towards a more subdued palette'. A few hand rendered marks were also included to emphasise the leaves and branches (Fig. B.ix Layer 3). The image had become quite dark and lacking tonal contrast so the researchers' subsequent layer included a section of a pine tree branch in silhouette, at the top of the image, and hand rendered electronic work with the eraser tool to suggest pools of light filtering through the trees (Fig. B.ix Layer 4). An attempt was made to brighten the image using colour balance, hue and saturation adjustments.

Brandeis' third layer comprised colour and textural effects rather than the inclusion of any new imagery. A Photoshop® filter effect was used to break the image down into a linear and fine dot texture (Fig. B.ix Layer 5). At this stage the image was digitally test printed onto cotton lawn. The result indicated that there was considerable variation between the image on the computer screen and printed fabric (Fig. B.ix Layer 7). Different colour profiles were tested without much improvement. The bottom area of the image had lost much of the detail of the earlier renditions and it was decided to reintroduce this section in the next layer (Fig. B.x Layer 6). The dodge tool was also used to lighten some areas of the image subtly. The file was transferred to Brandeis using FTP.

B.7.1.2 Format

The composition of the tree image was developed vertically to evoke the memory of the extreme height of the trees seen in North Carolina (Fig. B.viii Layer 2). The image integrates scanned hand rendered imagery, photographs and electronic rendering using a variety of brushes and digital textural effects in order to convey this concept. The dark silhouetted branch at the top (Fig. B.ix Layer 4) increases the tonal contrast in the image and is counterbalanced by the tonal variety in the bottom section.

407 Letter to researcher dated 08.08.05
408 Colour profiles define the colour gamut of the selected printer and fabric combination.
Investigations

Fig. B.viii 'Trees' — Layers 1 and 2

Layer 1

(Left) Selection of digital photograph (of leaves and debris from the woodland floor) from several images posted on the web site by the researcher.

Layer 1 (Step 2)

(Left) Photograph digitally merged with another of tree bark from a tree in Brandeis’ garden.

Brandeis had difficulty uploading the file to the website so the file was saved to CD and returned to the researcher by mail.

Layer 2

(Above) A drawing was made (using ink and procion dyes on paper) to evoke the memory of being amongst the tall trees in Carey, North Carolina. The drawing was scanned at 300dpi, digitally manipulated to saturate the colours, and layered over the merged photograph from layer 1 (left).

A second photograph (right) was digitally layered over the top and the opacity reduced.

The file was sent to the artist using File Transfer Protocol (FTP).
Appendix B

Fig. B.ix ‘Trees’ – Layers 3 to 5

Layer 3

(Left) Electronic rendered marks were added by Brandeis in the lower section to suggest pine needles and a brush was used to suggest similar shapes on the trees in the middle section. Brandeis continued to have difficulty uploading the image and so it was saved onto a CD and returned by mail.

Layer 4

(Left) A silhouette of pine tree branched was developed digitally from a photograph by reducing the colours and using the colour range tool to create a mask. This was filled with a dark tone and layered at the top of the image. The section beneath this was lightened (using the dodge tool) to suggest the memory of light streaming through the branches.

The image was returned to Brandeis via FTP.

Layer 5

(Left) Brandeis adjusted the hue and saturation of the image and then used a filter effect to convert the whole image to dots of colour.

The file was returned to the researcher on CD.

The image was test printed on a variety of substrates at this stage. The colour of the printed image had become very dull due to both the optical mixing of the dots of colour and the slight bleeding in the substrate.

Digital print sample
(detail right)

Sample of digital ink-jet print onto cotton velvet.
Size approx: 3.5cm x 3cm
Layer 6

(Left) The image was manipulated and previous layers reintroduced to recapture the detail lost through the use of the dot filter. Layers were introduced behind layer 5 and the eraser tool used to reveal areas from this (notably in the bottom section) to suggest leaves and twigs. The central section was lightened further using the dodge tool to provide greater tonal contrast with the pine branch silhouette.

This image was sent by FTP to NCSU.
The collaborators agreed to print the image at this stage.
Appendix B

B.8 Independent investigation

B.8.1 Panel (Wood)

(Figs. B.xi-B.xii)

B.8.1.1 Process

'Panel' was developed from photographic images of the red carved and painted wooden door panels from the old town of Shanghai (Fig. B.xi Layer 1). A panel depicting a vase of flowers was selected and used to stimulate a drawing made using Chinese brushes with watercolour, inks and bleached effects. The image was scanned at 300dpi, digitally manipulated and layered with a scan from a piece of decayed wood to provide additional visual detail and strengthen the theme. The central motif was developed from a photograph through digital manipulation using the equalise function in Photoshop® to enhance the illusion of surface relief. By combining the scanned watercolour and the manipulated photographic image, it has been possible to include greater detail.

Photographs and scans of wood block printed fabric, sourced in China, were also incorporated into the image using layering techniques (Fig. B.xii Layer 2). Their inclusion references the theme of 'wood' and provides additional pattern and colour. Freehand electronic lines were added, using a graphics tablet and pen, to suggest stitched thread (Fig. B.xii Layer 3).

The image was saved onto a CD and sent to a bureau be digitally ink-jet printed on silk satin (Fig. B.xiii).

B.8.1.2 Format

The role of repetition, isolation and framing within a decorative surface are explored in this piece. Gombrich (1984) suggests that repetition 'devalues the individual motif, isolation enhances it. The designer will tend to stylise the repeated elements and animate the enhanced representation' (Gombrich 1984). Although the background pattern used in 'Panel' is non-repeating, it is perceived as such, due to the stylisation of the pattern and its cultural symbolism: the association of this type of pattern with printed textiles. The central image is framed to isolate it from the surrounding pattern. The format of the piece has been designed to question the necessity of incorporating repeating pattern in designs for digitally printed textiles where repetition is of no longer of technical advantage (Briggs and Bunce 1995).

A second image, 'Between', was produced for the theme of wood in which the central motif depicts a butterfly kite from Shanghai. The researcher decided to select 'Panel' to represent the theme of wood for Five Elements since the connection with the theme was more apparent.
Appendix B

Investigations

**Fig. B.xi ‘Panel’ (Wood) - Layer 1**

**Step 1**
Selection of the image (*above*) from a review of digital photographs of wooden painted doors in Shanghai.

**Step 2**
An A3 watercolour was produced using Chinese brushes in a variety of sizes (*above*). The intention was to produce fluid marks that referenced those seen in Chinese calligraphy. The watercolour was scanned at 300dpi.

**Step 3**
A piece of wood was scanned at 300dpi (*above*).

**Step 4**
(*Above*) The scanned wood was digitally layered with the watercolour sketch of the door. The opacity was lowered to enable both images to be seen.

**Step 5**
(*Above*) A new motif was created by reducing the photograph (in 1.) to black and white, and using the *equalise* function.

**Step 6**
(*Above*) The motif was digitally layered and combined with the image created in step 4.
Fig. B.xii 'Panel' (Wood) - Layers 2 and 3

Layer 2 (Step 1)

(Above) Decisions were made about background shape, colour and size.

Layer 3 (Step 1)

(Above) A woodblock printed Chinese silk textile was scanned at 300dpi for inclusion in the background. (Detail) The scanned textile image was manipulated using the dry brush filter to reduce the tonal range.

Layer 3 (Step 2)

(Left) The digitally manipulated scanned fabric was layered between the background and the central section. The opacity was reduced to soften the image and merge the colours. The intention was to draw attention to repetition, isolation and framing within a decorative surface. Although the background pattern is non-repeating it reads as a repeating pattern due to its stylisation and cultural symbolism: the association of this type of pattern with a textile.
Appendix B

Fig. B.xiii ‘Panel' (Wood) - Layer 4

Layer 4 (above)

Additional sections of scanned wood texture were added to the image towards the top and bottom.

Electronic line work was added to break up the solid bands of colour.

The image was saved to onto a CD as a TIFF file at 300 DPI, and sent to be digitally ink-jet printed onto silk satin.

‘Panel' – Photograph of digitally printed textile (above)

Reactive dyes on silk satin.
Size: 76cm x 155cm
Photo ©CT

‘Panel' was one of the Five Elements exhibited in 'Digital Perceptions', an exhibition of digital textile art held at the Leedy-Voulkos Gallery, Kansas City, USA, May-July 2005
Appendix B Investigations

B.8.2 Shrine (Metal)

*(Fig. B.xiv - Fig.B.xvii.)*

The central image used in ‘Shrine’ was developed from digital photographs and sketches of an incense burner at the Po Lin Buddhist monastery on the island of Lantau, near Hong Kong. The burner was a large covered metallic cauldron in which wooden sticks of burning incense were placed. The panel depicts all five elements: fire, water, earth, metal and wood.

B.8.2.1 Process

Working from digital photographs, video and personal memory of the location, an expressive drawing was made using Chinese brushes with watercolour and ink on paper. The surface was first soaked in water and folded to provide greater unpredictability when colour was applied. When dry, the surface of the work was distressed using bleach and sandpaper, before being embellished with metallic paint and copper leaf. The resulting image was scanned at 300 dpi, cropped and saved *(Fig. B.xiv Layer 1).*

To enhance the metallic qualities of the incense burner in the digital image, a section of a photograph containing the face and handle was merged with the scanned hand rendered imagery. The cropped section of the scanned image was layered on top of a dark background on to which was added sections of repeating imagery; these were developed using masks from colour-reduced photographs *(Fig. B.xv Layer 3).* Two repeating blocks of pattern were developed and layered onto the background either side of the central motif. Numerous adjustments were made to the colour and detail of these sections and these are illustrated and described in *Fig. B.xv* and *Fig.B.xiv.*

B.8.2.2 Format

The arrangement of the image and repeating elements in *Shrine* is designed to convey to the viewer the sensation of being inside a building looking out. The dark palace rooms visited in the Yu Yuan gardens in Shanghai were punctuated with carved screens that provided just such views of the garden beyond. The repeating grid sections were developed from photographs and sketches made on site and at the Museum of Culture in Hong Kong.

The photographs used in the production of the grids were enlarged and cleaned up to remove stray pixels and enhance the geometric structure. Once corrected, these elements were useful as repeating motifs and were copied and pasted in two rows *(Fig. B.xv Layer 4).* The original solution contained a two-colour grid with the central panel removed to reveal a further layer, simulating the vista beyond *(Fig. B.xv Layer 4).* When the image was printed onto silk, however, this area of pattern would not print. Even when the colours were readjusted to enhance the tonal differences, it was not possible to see the pattern area. The sections on either side of the central image were reworked to remove the second colour and provide a more open grid *(Fig. B.xvi Layer 5).*

The readjusted image was digitally printed onto silk satin *(Fig. B.xvii).* Additional metallic lustre pigments were applied by hand to the finished printed textile to lighten some areas of the print and to reinforce the concept. The piece was finished and hemmed for exhibition.
Appendix B

Fig. B.xiv 'Shrine' (Metal) - Layers 1 and 2

Layer 1

(Above) A drawing was made of a shrine at the Po Lin Monastery, Lantau, using inks and pigments on watercolour paper using Chinese brushes. The paper was crumpled, folded and dampened prior to the application of paint. When dry copper leaf was applied and distressed using a patination chemical.

(Detail above) Detail of the drawing: indicating the textured surface of the folded paper and application of copper leaf. The image was scanned into the computer at 300dpi.

Layer 2

(Above) A section of the scanned drawing was isolated and cropped. The image contained a face of a mythological creature with a brass ring in its mouth and was selected for its connection with the theme of metal.

Layer 2 (Step 2)

A photograph of the same face was selected (above). The background was digitally removed and the opacity reduced. This layer was then overlaid on the scanned drawing (right).
Fig. B.xv 'Shrine' (Metal) - Layers 3 and 4

Layer 3

(Above) Format and size of the work was defined using a dark coloured ground. The intention was to express the memory of being inside one of the rooms at the Yu Yuan palace looking outside.
(Right) Photographs of the screens from the palace were reviewed for decorative detail and a pattern was selected. This was colour reduced and converted into a stencil using a mask and copy and paste. The mask was place over a section from the scanned watercolour and copied onto the dark background at the bottom.

Layer 4 (Step1)

(Above) A second photograph of carved wooden window screens was selected to make a repeating pattern. The photograph was colour reduced and a mask created. The selected unit of pattern (above middle) was corrected to remove stray pixels and placed into a repeating structure using copy and paste (above right).
Investigations

Layer 4 (Step 2)

The repeating pattern was pasted either side of the scanned watercolour section. The background colour was gradated from top to bottom. The file was saved on CD and sent to a specialist bureau to be digitally ink-jet printed on silk satin. The resulting print on silk did not replicate the pattern within the grid nor the gradation on the ground shown on the computer screen (detail above right).

Layer 5

The file was reworked to open up the grid and reveal more of the background to provide greater tonal contrast (above detail). The file was resaved onto CD and sent to be digitally printed.
Appendix B

 Investments

Fig. B.xvii 'Shrine' (Metal)

(Above) 'Shrine' - Photograph of digitally printed textile
Reactive dyes on silk satin.
Size: 75cm x 147cm
Photo © CT

'Shrine' was one of the Five Elements exhibited in 'Digital Perceptions', an exhibition of digital textile art held at the Leedy-Voulkos Gallery, Kansas City, USA, May-July 2005.

(Above) The printed textile was hand embellished using metallic pigments (gold, copper and bronze) applied using a sponge and stencils. Detail below of a section of textile with metallic pigment.
Appendix B

Investigations

B.8.3 Earth (Earth)

(Figs. B.xviii - B.xxi)

The concept for the image depicting the element earth evolved from a visit to an exhibition of ceramic figures at the Museum of Culture in Hong Kong.

B.8.3.1 Process

Photographs of large ceramic animal figures were used as a starting point for two drawings made with watercolour using Chinese brushes on paper. The intention was to translate into the work, the surface qualities photographed and remembered from observing the artefacts. The paper was distressed using sandpaper and by cutting lightly through the surface with a knife. Once the colour had been applied and was still wet, large salt crystals were generously applied to provide additional texture (Fig. B.xviii Layer 1) The resulting images were scanned at 300dpi and saved.

The scanned drawings were used to derive an area of non-repeating texture. Sections from both images were combined into a new image using copy, cut and paste and the eraser tool (Fig. B.xix). Beneath this, a section containing an interlocking key pattern from a piece of calligraphy was integrated with an area of repeating pattern. This had been developed from a photograph of a section of Chinese carved stone relief containing horse and tree motifs. The photographic image was colour reduced, re-coloured and repeated to merge with the textural layers (Fig. B.xix Layer 2).

B.8.3.2 Format

The format of the piece was influenced by three contributing factors: a yellow fabric panel from the Chinese collection in the Victoria and Albert Museum, London, a collection of damask fabric covered boxes collected in China and an illustration from a Chinese book. The book ‘Life of Christ’ (1943) contained illustrations by Chinese artists and included a representation of the Last Supper. This image crystallised ideas concerning the format of the panel and influenced the positioning of the central circular motif and the band of contrasting tone towards the lower part of the image (Fig. B.xx Layer 5). The circular motif combined a scanned and manipulated image of a Chinese food steamer with an aerial photograph of Shanghai.

The bands of yellow damask style pattern used at both the top and bottom of the piece were developed from an image of a traditional pattern found on a Chinese CD ROM; similar damask patterns had been noticed in a Chinese textile hanging, in the Victoria and Albert Museum. In Chinese culture, yellow is symbolic of ‘Earth,’ and so was appropriate for the concept of the piece (Fig. B.xx Layer 3).

The final elements to be added to the image were two gingko leaves. The gingko leaf was collected in the Yu Yuan gardens in Shanghai, under the tree that had been planted by the owner of the gardens, four hundred years earlier. The leaf was scanned, repeated and applied to the textured section of the panel (Fig. B.xxi)

The image was saved onto CD and digitally ink-jet printed onto silk satin (Fig. B.xxi).
Appendix B

Investigations

Fig. B.xviii ‘Earth’ – Layer 1

Step 1

(Above) Following the review of digital photographs of large ceramic figures from the Museum of Culture Hong Kong, two drawings were made using inks and procion dyes on paper. The intention was to suggest the surfaces observed on the ceramic figures. The colours were sprinkled with salt and the paper etched with a sharp knife to create surface texture.

Step 2

(Above) The drawings were scanned at 300 dpi and sections cropped and combined digitally in layers to create an area of texture derived from both drawings.
(Right) A section from a digital photograph of calligraphy was integrated with the area of scanned texture.
Layer 2

(Above) The format and size of the final piece was defined using a yellow colour (chosen because it is symbolic of *earth* in Chinese culture). A section of stone relief, taken from a photograph of an emperor’s tomb, was colour reduced and re-coloured digitally using a palette from the scanned drawings (detail above right). The section was layered over the background under the central textural panel.

Layer 3

A damask repeating pattern was overlaid onto the yellow sections. This was taken from a Chinese CD ROM of traditional patterns. The opacity of the two layers was adjusted to give greater contrast to the upper section.
Appendix B

Investigations

Fig. B.xx ‘Earth’ - Layers 4 and 5

Layer 4

An aerial photograph of Shanghai was digitally colour reduced and a mask was created using the colour range tool. The resulting shape was filled using a colour selected from the textured area of the scanned image.

Layer 5 (Step 1)

(Above) A Chinese food steamer was placed on the scanner and scanned at 300dpi. The resulting image was colour reduced and re-coloured.

(Left) The aerial photograph and food steamer images were layered on top of the central textured area.
Investigations

Step 1

(Above) A ginkgo leaf from the Yu Yuan Gardens was scanned at 300dpi. It was included to link the tree of life motif in the repeating border with the aerial view of Shanghai.

Step 2

(Above) The scanned motif was selected from the background, reduced in opacity, repeated and layered onto the textured section of the image. The position and repetition of the leaf motif is to reference the use of a ‘chop’ in Chinese painting and calligraphy.

(Left) ‘Earth’ – Photograph of digitally printed textile.
Reactive dyes on silk satin.
Size: 68cm x 161cm
Photo ©CT

Earth was one of the Five Elements exhibited in ‘Digital Perceptions’, an exhibition of digital textile art held at the Leedy-Voulkos Gallery, Kansas City, USA, May-July 2005
B.8.4 *Between* (Wood)

*(Figs. B.xxii - B.xxiii)*

### 8.4.1 Process

A second image was produced for the theme of wood in which the central motif depicts a butterfly kite sourced in Shanghai. The symbolism of the butterfly, as with the *dragon* and *fish*, is of great cultural importance to the Chinese for whom it represents good fortune. The symbol is frequently used to decorate kites, which are constructed from silk stretched over a wooden structure and hand painted in bright colours.

The butterfly motif in *Between* was drawn onto a crumpled piece of watercolour paper that had been immersed in water and stretched. While damp, colour was applied using Chinese brushes and ink to create a surface texture reminiscent of Shibori or tie-dye. When dry, the watercolour was scanned at 300dpi and saved as a digital image.

The butterfly image on paper consisted of only part of the kite. The difficulty of creating bilateral symmetry in a hand rendered image and the ease with which it is possible using a computer became the focus of the development of the image. Symmetry conveys cohesion and implies mechanistic planned action rather than spontaneity or accident (Gombrich 1984). The challenge in building the image was to create a symmetrical image that continued to convey the freedom of the hand rendered marks and the random technique deployed in the creation of the background effect. The image was cropped and mirrored along the vertical axis. The background was removed and rebuilt using copy, cut and paste functions and the clone tool to create a random background. The butterfly motif was then superimposed on top and the two layers merged. By changing the background the butterfly is perceived differently; its digital manipulation is less apparent.

The changes in the background texture led to the development of the format of the whole image. The colours had been enhanced to provide a greater contrast between the motif and its background and in doing so suggested both water and sky. A digital photograph of light playing on the water at night time in Hong Kong harbour was used as a ground into which the butterfly image could be blended.

### 8.4.2 Format

The format of the piece was influenced by Chinese calligraphy. The water layer providing weight top and bottom and the asymmetric position of the butterfly motif a negative space on the right of the image. It is from this space that the kite strings, depicted as electronic rendered line work, emerge.

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409 A jade butterfly was presented to the researcher as a gift while visiting Shanghai and she was told that it was given 'to bring good fortune and happiness'.

410 The name of the piece derives from the fact that a kite is designed to fly in the space *between* earth and sky.
**Fig. B.xxii ‘Between’ (Wood) - Layer 1**

**Step 1**  
(Above) A watercolour drawing was made of a kite purchased in Shanghai. The paper was crumpled and soaked in water before adding paint to create a Shibori effect. The watercolour was scanned into the computer at 300dpi and saved.

**Step 2**  
(Above) The scanned drawing was rotated, cropped and mirrored to create a symmetrical motif.

**Step 3**  
(Above) A section of the background was selected and copied and pasted into a new image.

**Step 4**  
(Above) The background hue was adjusted. The butterfly motif was selected from the original background and copied and pasted onto the new background. The resulting effect makes the symmetry of the butterfly less apparent.
Investigations

Fig. B.xxiii 'Between' (Wood) - Layer 2

Layer 2

(Above) Digital photographs of Hong Kong harbour were reviewed on the computer and the image of light reflected in the water at night (left) was selected. The butterfly motif was layered on top of a dark rectangle positioned over the water image (above middle). The image was copied and pasted into a new file. The dimension and resolution of the image was increased to create the background for the work to be printed. Areas of electronic line work were added using a graphics tablet and pen (above right). The eraser tool was used to reveal the water image through the dark section of the image and blend it with the butterfly motif.

(Left) 'Between' – Photograph of digitally printed textile

Digital print on silk satin
Size:
Photo ©CT
B.8.5 Heron (Water)

(Figs. B.xxiv - B.xxv)

B.8.5.1 Process

This image was developed directly and indirectly from digital video footage shot in the old city of Shanghai. The image is built from a combination of scanned watercolour and still images from the video that have been blended together digitally. The watercolour drawing was made after watching the video and refreshing the memory of the visit to the location (Fig. B.xxiv Layer 1). The colours used in the drawing are able to express more accurately the memory of the experience than the video footage, which was shot at dusk, in poor light conditions. The watercolour drawing was scanned at 300dpi, digitally manipulated and combined with a still from the video (Fig. B.xxiv Layer 1). The background was constructed from digitally manipulated layers of pattern from architectural details photographed in Hong Kong combined with scanned woven bamboo (Fig. B.xxv layer 3) The heron motif was overlaid onto these layers and combined using hand rendered electronic line work using the clone, pattern stamp tool and a variety of brushes (Fig. B.xxv layer 4).

B.8.5.2 Format

The arrangement of the layers of pattern in the piece was influenced by the use of pattern and calligraphy on the surface of fabric covered wooden boxes collected in China. The background pattern elements include digitally manipulated photographs of reflections in windows of buildings in Hong Kong and scanned sections of woven bamboo that have been colour reduced. This image was digitally printed onto cotton lawn.
Appendix B

Investigations

Fig. B.xxiv ‘Heron’ (Water) – Layer 1

Step 1

Video and photographs of the Yu Yuan gardens, Shanghai were reviewed on the computer and the photograph of a heron selected. It was noted that the memory of the colours was more intense than that depicted on the video footage.

Step 2

Ideas were explored in the research journal (above).

Step 3

A watercolour sketch was made to recapture the colour memory; this was scanned at 300dpi. A section of the scan depicting the head of the bird was selected, cropped and saved.

Step 4

A still image from the video footage was captured and a section of the foliage selected and imported into Photoshop®. The section was digitally modified using the clone tool and blended with the scanned watercolour.
Layer 2

(Above) Photographs of the reflections of the sky in the windows of buildings in Hong Kong were reviewed. The image (above) was selected and cropped. The colours were flattened and reduced using the *posterise* effect (above right). The resulting pattern was layered over a rectangular shape and the opacity was reduced to merge the two layers. This shape was dropped on top of a rectangle of gradated colour that defined the dimensions of the final piece (right).

Layer 3

A scanned section of woven bamboo was digitally colour reduced and re-coloured to work sympathetically with the background layer (detail right). This layer was placed between the background and the scanned watercolour of the bird, the opacity reduced and the layers merged (right).

Layer 4

(Right) Electronic line work was added to blend the scanned brushwork with the middle layer. Colours were selected from the scanned watercolour layer and brushed developed using the *clone* and *pattern stamp* tools. The image was saved onto CD and digitally ink-jet printed onto cotton at this stage.
Appendix C - Published Paper
Digital reflection: the integration of digital imaging into the creative practice of printed surface pattern and textile designers

Conference paper presented at ‘Pixel Raiders2’
Sheffield Hallam University
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Published Papers – Digital Reflection

Abstract

Early phenomenological research into the impact of digital imaging on the creative practice of artists and designers of textiles and surface pattern indicates three key areas in which its deployment is initiating change in printed textile and surface design. These include the development of a new visual language of pattern, the evolving of new processes and craft techniques in the elaboration of surface and the use of digital communication, Internet and email as an integral resource in the generation and dissemination of work.

This paper seeks to explore issues fundamental to the changing nature of practice that arise from the integration of digital technology. New material sourced from case study research, informal recorded interviews, meetings, and personal correspondence, illustrates the way in which a selected group of individual innovatory artists and textile practitioners are using digital technology in their working practice. Reflection upon the creative strategies deployed and the visual outcomes produced indicates several emergent issues. These include the implications of working in virtual rather than physical space, the difficulties posed by the lack of global true colour fidelity, and the way in which the digital workspace is impacting on creative practice. The digital functions of cut and paste, layering and the ability to record and iterate the actions that build the surface are influencing the visual nature of the work created. This along with the rapid production of virtual surfaces is stimulating new methods and processes in their physical elaboration.

Historically, technological innovation has been instrumental in changing the visual dynamics of the final textile or surface outcome. Digital technology is likely to prove no exception. The paper indicates issues that are currently being explored through the integration of the new technology in the dialogue with the physical surface. Problems, difficulties and concerns that are highlighted indicate areas of current and likely future research in this field.
Appendix C

Digital reflection; the integration of digital imaging into the creative practice of printed surface pattern and textile designers

The technological changes in the textile and fashion industry that have occurred over the last thirty years have revolutionised the working practice of designers of printed surfaces. In such a fast changing environment there is little time to pause and take stock of the impact of the deployment of these technologies upon the creative outcomes or the inherent social and psychological implications. When the opportunity is provided for practitioners to reflect upon their work, practical insights into the nature of creative practice that have both personal and universal epistemological implications may be revealed. This paper discusses some of the emergent issues resulting from early phenomenological research into creative use of digital imaging within this field.

Through the process of observing and analysing creative practice it is possible to bend the metaphorical light of experience back into the mind of the practitioner in order to create a bridge between experience and learning (Reed and Koliba 2003). It enables a practitioner to move forward in their creative journey learning from their experiences (Schön 1987). Artists and designers practice this tacitly in much of the iterative experimentation that formulates their creative process, but they rarely have the opportunity to be objectively observed and analysed in their reflection. This is the purpose of phenomenological research, which seeks to explore the nature of the experience as exhibited in its visual and physical outcomes (Cazeaux 2000). To achieve this kind of observation it is necessary to collate a large amount of visual data indicating the methods and techniques used in the innovation and building of the design concept as well as visual evidence of the final product. To achieve this, the use of digital technology has itself proved invaluable.

The Internet has proved useful in pinpointing areas of related research and in building networks of practitioners who are interested in the field and who have been willing to participate in the project. Email communication amongst practitioners in different countries has provided a rich source of dialogue on the subject; it has also facilitated the building of invaluable research relationships.

Those practitioners who have contributed to the research project consist of textile artists and designers working in a variety of ornamented textile formats. They are consistent, however, in their use of technology within the creative process and in their decoration of surface using printed output at some stage in the production of their work. Each contributor is respected as an innovator in his or her field of practice and their inclusion in the project has been as a result of recommendation by respected figures in the field. In order to identify commonalities between practitioners a set of questions has been devised to explore practical, psychological and philosophical issues that may impact on the creative process. This forms the basis of the research interview and provides stimuli for the dialogue. A map, diagram or visual description of the creative process also helps in the description and analytical reflection of the creative journey (Lawson 1997); each practitioner is asked to describe their methodology from generative idea to end product in this way. The information from these diagrams helps to communicate to the researcher the approach taken during the creative process and also aids in the practitioners self reflection so that they are well placed to describe their journey in detail at a later stage. It also provides a control to differentiate between the self-perceived route described and the actual practice as it occurs.

411 Reflection is a term that is derived from the Latin reflectere meaning 'to bend back.'

412 Cazeaux describes phenomenology as involving theories of how words relate to experience. 'Those aspects of our being normally regarded as physical, abstract and descriptively elusive, i.e. conscious thought, memory, the actual having of experience, Merleau-Ponty declares can be shown to unfold from our condition as beings physically immersed in the world.' Mikel Dufrenne comments, 'Thus the artwork expresses a world in the sense that it lets us see the structure of experience.' Cazeaux, C., Ed (2000). The continental aesthetics reader. London, Routledge.

413 A debate about false consciousness and rigor in researching practice has been ongoing on the JISC-LIST summer 2003. The use of the expression "to identify commonalities" is used by Jan Coker 03.10.03 http://www.jlscmail.ac.uk/cgi-bin/wa.exe?A1=ind0310&L=phd-design (acc. 05.03.06)
The project to date is beginning to throw light on the ways in which digital imaging technology is impacting on the visual language deployed by practitioners as well as influencing and changing both craft techniques and working process.

Digital imaging as a tool

During the 1970's and 1980's the development of computer software for textile design focused on the provision of a production tool (Leak 1998). Software was often unfriendly and unresponsive as a creative tool and used largely for the manipulation of hand rendered imagery for pre-print production. Developments in both software and hardware over the last decade have provided affordable systems giving textile practitioners freedom to innovate design concepts electronically. The digital medium provides access to the focused knowledge and craft skill of countless others captured within the software (Dormer 1994). This has inherent dangers of curtailing creative thought within the established patterns of the software developer's logic and selected option and tool provision. As with any tool or media, it is necessary to be free of these technical constraints in order to practice creative self-expression. The creative use of digital imaging requires the same elements of craft learning and practice so that its use becomes a tacit knowledge comparable with skilled making in any other discipline (Harris 1999). The problem with the acquisition of tacit crafting skills is that they require time to develop and mature. Dormer writes:

'Tacit knowledge or "know-how" is immensely powerful; it gets things built. But it is slowly acquired' (Dormer 1994).

The opportunity to learn from practice, to reflect on mistakes or happy accident is not often afforded the computer user of the twenty first century. In a world of rapid change and tight deadlines, the software technology renews itself so rapidly that before one can be secure in the in-depth knowledge of a given package it has been upgraded, restyled and extended. Different transferable digital crafting skills are required to provide the ability to graze and pick and mix amongst software packages, platforms and devices. An example of this is revealed in the operation of a digital camera menu, which although different from that used in personal computer software, requires the same logic function and degree of mental adeptness.

It is argued by some that to make best use of any technology it is imperative to understand how to craft without the machine first (Myerson, J.). The skills of hand rendering techniques, repeat pattern construction, and colour theories are invaluable in the underpinning of the technology for design creation. It is useful to have a knowledge of photography darkroom technique to understand the "Levels" option on Photoshop but it is arguable whether this is essential when visually adjusting an image on screen. As each generation of potential designers leave school with an increasing awareness and facility to absorb software skills, acceptance of tools within the medium is likely to be less questioned and more readily practiced. There is without doubt a body of aesthetic knowledge required to frame any creative inquiry with software or technology and this

414 'The development of CAD systems for printed textiles has been influenced by production concerns. Cad is therefore seen as a production tool rather than a design medium.' Leak, A. (1998). A Practical Investigation of Colour and CAD in Printed Textile Design. Nottingham, Nottingham Trent University.

415 'One can say that computers of all kinds including those in automatic cameras, are a means of making available the effects of other peoples skills to an individual without that individual having to acquire them. However by acquiring no skills for oneself, then one is liable to be trapped by other people's thinking' Dormer, P. (1994). The art of the maker: [skill and its meaning in art, craft and design]. London, Thames & Hudson.

416 Harris states 'software, run on a computer, provides a medium with its own aesthetic, open to the influence of "crafting vocabularies", as is any other material.' Harris, J. (1999). Preparing a medium for the next millennium: The "crafting" of computer graphics: A textile makers perspective. Design Cultures 1999, Sheffield Hallam University.

417 Prof. J. Myerson cited in Peter Dormer "The Culture of Craft" Manchester University Press, 1997 pp11 'One needs a separate experience of making in order to use the computer software knowingly.'
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too involves engagement with craft and kinaesthetic skill. Collingwood describes craft as being the physical manifestation of the cerebral activity of art making\textsuperscript{418} (Collingwood 1958). The computer provides the means of making this manifestation but in a virtual rather than a physical environment and the software provides the tools with which to do this.

Most if not all of the artists who have contributed to the research project to date have raised the issues concerning software learning and handcrafting. Many make use of Adobe Photoshop® software, which has become almost universal amongst textile artists and designers working digitally. Often this is used in conjunction with other packages such as Painter®, Adobe Illustrator® and textile specific software applications. Most of those interviewed claimed to be novices, to not have explored the software fully and to have particular functions that were used repeatedly if not exclusively. The most frequently used of these were cut and paste and layering.

Charlotte Hodes is a London based artist whose digital interests have dwelt almost exclusively on these two computer functions in the development of her work. Trained as a painter at the Slade School of Art in London, Hodes has recently worked as part of the team from the London Institute exploring digital media in their art\textsuperscript{419}. Her recent work presented at the Tate Britain June 2003, included the production of a collection of printed art wallpapers in which her themes are developed through a combination of electronic and physical cut and paste techniques. The concepts are explored on computer in Photoshop® through the manipulation of scanned and photographic imagery and output through a large format digital paper printer. The printed output is then manually intercut to explore the interplay between virtual and physical cut and paste.

\textit{These works are an exploration of how the juxtaposition of the hand cut collage of scissors and glue with the collage of the computer using the cut and paste functions impacts upon the surface of the print. And how the surface inevitably becomes part of what is being represented.} (Hodes, 2003)

The use of the cut and paste function on the computer has enabled Hodes to use more detailed imagery than had been previously possible in her work. It has also made possible the conjoining of visual research from different formats, scanned textiles, photographs, and hand rendering into a single physical surface. Hodes is currently exploring the development of this work onto fabric using laser cutting and digital fabric printing technology.

\textsuperscript{418} \textit{By creating for ourselves an imaginary experience or activity, we express our emotions; and this is what we call art.} Collingwood, R. G. and cited by Paul Greenhalgh in his essay \textit{`The History of Craft'} Dormer, P. (1997). \textit{The culture of craft: status and future}. Manchester, Manchester University Press.

\textsuperscript{419} \textit{Digital Surface within Fine Art Practice} a collaboration with London Institute, National College of Art and Design Dublin and University of Art and Design Helsinki. Work produced was exhibited in the \textit{`Digital Responses'} exhibition at the Victoria and Albert Museum, London. May 2002- March 2003.
The Scottish textile artist Alison Bell makes use of imagery in a similar way. Her pre-digital textiles were hand rendered on silk using direct painting and printing of pigments and reactive dyes. Bell’s work is inspired by her environment. She lives and works on the Isle of Arran in Scotland and her work captures and evokes the colours and natural history of her surroundings. Digital imaging has changed the visual characteristics of her creative output by providing detail that would have been impossible by any other means. Like Hodes, her work blends visual source material through the digital media. Photographs, scanned images and textiles, hand rendered and computer generated line work are melted together in the virtual image through layering and cut and paste functions in Photoshop®. The final image is then digitally printed onto silk where the process is continued through application of dyes, pigment, stitch and applied fabrics. The process of electronic layering of source material provides Bell with an unselfconscious opportunity to engineer spontaneity in her work. The research indicates that the way in which she builds the layers in the image facilitates chance discovery in her creative process on the computer. Bell is driven by a curiosity and a need to experiment and explore within the media she chooses to work. As with many artists it is the manipulation and exploitation of the serendipitous moment that spurs on the creative progression in their work. Bell’s use of layering facilitates this as she builds each one and uses the eraser function to reveal and combine elements from other layers to produce a new image.

This is surely the informed spontaneity that Dormer claims that craft skill provides and artists and studio crafts people depend. Dormer, P. (1994). *The art of the maker: [skill and its meaning in art, craft and design]*. London, Thames & Hudson.
The use of virtual layers provides the opportunity to make choices in the creation of an image that would have been impossible for Bell previously. The hand painting of silk is direct and it is difficult if not impossible to alter the mark once it has been committed to cloth. The virtual layer enables the artist to try out colour combinations, line-work and imagery with speed and with no financial outlay or commitment. For the indecisive this facility is not a bonus. The ability to step backwards and change layers and colours within an image makes possible an infinite number of variations from a single starting point. The design of a work does not therefore necessarily speed up through the use of digital imaging. Bell comments in the case study research on her need to leave the work and reflect on it for a while before it is completed (Bell 2003). It is possible to become saturated with the decision-making process and lack the confidence to reach the stage at which the image is output into physical form.

**The Digital Soup – Meta Media**

The vast array of menu options, functions and facilities, devices for input of visual data: scanners, cameras, Internet, video has been described as a digital soup\(^{421}\). All contribute and can be blended together to create a digital image, each one providing a range of options and new directions for the embryonic work. It is this meta media\(^{422}\), the ability to virtually mix the imagery captured in various formats, that has provided a source of inspiration for many of those artists included in the research.

Becky Earley, Senior Research Fellow at Chelsea College of Art, described the role of the computer in the development of her visual concepts as ‘a massive scrapbook, a massive sketchbook’ (Earley 2003). Working with a digital camera and scanner she is able to make use of collected visual data from a variety of sources and blend them into one in the electronic dimension. Artist Alison Bell describes her computer as ‘a sort of doodle pad’ (Bell 2003). Her original purpose in purchasing the computer was to use it as an electronic sketchbook. Information in the form of photographs, sketches and pieces of painted fabrics, is scanned into the computer and acts

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\(^{421}\) Professor Paul Coldwell coined the expression ‘digital soup’ at the Digital Surface Approaches to current research in contemporary art practice International conference held at Tate Britain 26\(^{th}\) and 27\(^{th}\) June 2003

\(^{422}\) The prefix ‘*meta*’ according to the English Dictionary means: “after, with or implying change.” It is the latter, the implication of change that applies to the digital media emulating others at a click of a mouse button.
as a catalyst at the generative stage of conceptual development. The American textile artist Susan Brandeis uses both a physical sketchbook and imagery scanned and manipulated digitally to amalgamate and blend a variety of images from a particular geographic location to convey her sensuous response to that particular place. Her aim is to produce an image that gives the viewer multiple simultaneous glimpses of the original location comparable with the way the eye informs the mind, as it perceives a place in time. The image is digitally printed and then embroidered to provide additional layers of meaning and narrative. The computer facilitates a ‘more literal image’ of her chosen visual environment (Brandeis 2003).

The facility to blend images and techniques in a virtual environment also aids the communication of the narrative content of the work. Michael James, the American textile artist and quilter, is now able to produce his own digital fabrics for use in the production of his quilted work that are able to convey the narrative he is exploring. Before he had access to digital print technology, James commissioned others to produce fabrics to incorporate into his quilts. He is now able to create these himself and can apply imagery that is more personal and appropriate to the pieces. The detail that he can include is changing the visual outcome of his work. An example of this can be seen in ‘A Strange Riddle’ created in 2002 (James 2003). In this piece James explores the mystery of infantile amnesia discussed in one of Freud’s essays on the nature of memory. The textile explores the recurrent theme in James’ work of the intrinsic importance of patterns and their interpretation. In this piece a CAT scan image of James’ own brain is combined with letterforms developed from a quotation from Freud addressing the enigma of infantile amnesia. These have been distorted into abstract repeating pattern echoing the sounds heard by a baby but not understood. Access to digital technology enabled a black and white photograph, taken during his infancy to be scanned, enhanced and manipulated. The wallpaper from the original photographic image has been re-coloured and printed digitally on cloth to convey the subliminal effect of patterns viewed in early childhood. The digitally printed detail provides continuity and depth to the expression of the narrative.
The textile designer Hitoshi Ujiie explores the nature and substance of textile imagery through his digitally printed textile pieces. His work challenges the preconceived notion of what pertains a textile design. Through the use of digital photography his themes explore movement and scale on fabric surface as well as combining hand rendered and computer generated colour and text forms. His use of scale, lack and use of repeat, and placement of image are all explorations into what is now possible to print onto fabric. Both the digital media and the digital printed outcome have challenged the visual characteristics of Ujiie’s work.
The ability to share data between specific software applications has facilitated productive creative collaboration between textile and fashion designers. In the USA the collaborative work of textile designer J.R. Campbell and fashion designer Jean Parsons is a good example. Their research into digitally engineered prints at Iowa State University makes use of photographic imagery, digital manipulation, and digital fabric printing to produce customised 'art to wear' garments. Campbell aims through his textile designs to explore 'the visual, cultural and technological aspects of digital textile printing as he creates connections between two-dimensional print design and three dimensional garment forms' (Campbell 2003). Campbell seeks to utilise design imagery in his work that is unconventional or which is placed on the garment in an unusual way. Themes in his work have included both natural form and man made structures: bridges, cathedrals and the Buddha motif. His main interest lies in the dialogue between the image and its relationship to the garment form.
The designer and researcher Philip Delamore at the London College of Fashion is also using digital textile printing in the design and structure of the garments he designs. His interest is in the form of the garment and his work explores how the pattern pieces can themselves initiate the surface pattern design of the garment. He is also involved in research work into the printing of garment structures through rapid prototyping printed technology. Three-dimensional printing technology makes possible the creation of objects by stacking tiny layers of matter together and so creating three-dimensional objects. This is achieved using computer-aided 3D modelling and printing combined with laser technology. The future implications of this technology on the fashion and textile industry are enormous and are leading to the development of new printed textile structures with the possibility of customised seamless printed garments.

The ease of visual communication of the virtual design concept amongst practitioners highlights the way in which digital imaging is providing a platform that enhances cooperation and collaboration in the creative domain.

**Changing Craft Processes**

The assumption that ever improving technology replaces craft can be challenged by a number of textile artists who are incorporating digital technology within their process and evolving new hybrid craft techniques. For a number of the practitioners who have contributed to the project the frustration with the cloth outcome as a result of digital printing has led to a new inquiry into surface ornamentation via various craft techniques.

Alison Bell has developed a process that combines digital printing with direct hand painting, embroidery and appliqué. Her dissatisfaction with the *flatness* of the digitally printed colours has led to this hybridisation of technique to achieve the expressive colour qualities she wishes to evoke.

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423 [www.freedomofcreation.com](http://www.freedomofcreation.com) (acc.05.03.06)


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in her work. The term ‘flatness’ to describe digital printed colour has been used by a number of those interviewed for the project, as was the physical lack of hands-on manipulation of the cloth. Susan Brandeis describes how her embroidered fabrics result from her desire to ‘convert the monologue of the machine printed product to a dialogue between artist and cloth’ (Brandeis 2003). For Brandeis this dialogue is essential in her work and this drives her desire for tactility and surface qualities in the pieces she creates.

![Digital beaded textile, detail showing beading and finished piece (right) - Amy C. Clarke](image)

The digital manipulation of images inspired American bead artist Amy C. Clarke to deliberately exploit the light qualities of the image on screen to develop her craft technique. Her narrative is explored through photographic images that are scanned and manipulated in Photoshop®. Once printed, she combines the digital image with a craft technique based on Native American spiral beading, selecting the light reflecting qualities of the beads to translate the light emitting pixel of the VDU into a textile embellished form. Her work is indicative of the possibilities that exist in the integration of digital imaging into ancient craft practice.

**New Visual Language**

Throughout history technological change in the printed textile industry has led to changes in the visual outcome on cloth (Briggs 1995). Most of those interviewed for this research have felt strongly that the use of digital imaging in their process is changing their visual language. Bell describes it as extending her visual language with regard to ‘colours, textures, surfaces, and subtleties’ and describes it as a ‘totally new visual language’ (Bell 2003). Hodes describes the new visual language as being ‘completely locked into the technology.’ However, she feels that the language is not a ‘digital language, the computer is simply a tool in the process’ (Hodes 2003). The implication from this is that the computer enables the creation, development and manipulation of concepts but the physical outcome is determined by the creative action of crafting with the digital tool. The visual words are being rearranged into a new sentence; new paragraphs are being built in visual forms through the software that would not have been possible any other way.

Perhaps the most evident manifestation of this new visual language is in the use of colour. Earley describes her digital textile work as being ‘radically different... the use of colour is more ambitious, it’s more varied, the amount of texture and detail within one design is much, much broader. .... The inclusion of so much detail and colour on one piece of fabric is what the language is all about’ (Earley 2003). Previous printing techniques provided the textile designer with limitations of scale, structure and numbers of colours that could be printed. Digital printing has removed most of these constraints and provides the means to make physical almost any virtual
image. The communication of colour within the new language is not, however, without its problems.

Colour and Communication

Colour is a psychophysical phenomenon and as such is difficult to quantify and communicate between both media and people. Psychologists and biologists are able to explain the physiology of these difficulties and the practical application of this knowledge has been explored by the doctoral research of Dr. Adrian Leak who writes:

'Research into colour vision emphasises that colour depends on the action of the individual's subjective brain, therefore, the sensation that is colour is caused by the brain interpreting signals sent by the eyes when reacting to light, but light is not colour...Designers using systems, soon realise that there are restrictions in terms of colour and, therefore, they work with and around them, dependent on the specific working context' (Leak 1998).

Most of those practitioners who have been interviewed for this project have commented on the problems and frustrations of working between the virtual media, using additive light colour, and the physical subtractive printed or dyed colour. The huge difficulties of metamerism, light sources and reflective surface of substrates are of minor concern in comparison with the basic problems inherent in the communication of colour from the computer to the printed output without calibration tools and colour management software. Those textile art practitioners interviewed for the project unanimously hold to the view that this problem is too large to concern themselves with at this stage; each one works with the colours produced, addressing the issue through iterative adjustments or additional hand rendering of colour into the work through dyes, stitch or appliqué.

The aesthetic response of colour has always been paramount in the work of Alison Bell and her pre-digital silk paintings concerned themselves primarily with this. The difficulties in working with digital colour have caused her to develop a combined digital print and hand painting technique. Initially her digital work involved the printing of tonal imagery that could be flooded with colour after printing. Through the printing of colour images, Bell discovered that she was able to produce colour and line that was impossible to create any other way through the application of light digital colour on top of areas of dark tone. By applying hand rendered colour on top of the digital print the colour could be changed and further intensified. Bell's answer to the colour communication problem was to 'work with it' and use the changes in colour outcomes to stimulate further her creative process.

The flat or dull colour of digitally printed fabric was a source of concern for many of those interviewed. Susan Brandeis comments on her experience of digital textile printing:

'If you get the colours you thought you would, it's a fluke! Control of specific palette with the computer has actually been more difficult than working by hand.' (Brandeis 2003)

For Brandeis the lack of control and mechanisation of the creative process, especially colour, drives her desire to elaborate the cloth by hand through embroidery and appliqué. Like Brandeis, Becky Earley described digitally printed cloth as being 'too flat' and having 'no sensual product quality about it.' She explains how she tries to encourage students to manipulate the fabric surface after printing and to think of it as 'a stage in between' rather than a finished product (Earley 2003).

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425 Doug Bynum, director of Archroma Global Services USA producers of engineered colour standards described the problems within industry of the psychophysical phenomena of colour at the Society of Dyers and Colourists- Colour Communication Conference. Birmingham, UK. September 2003. http://www.sdc.org.uk/members/conferences.htm (acc.05.03.06)

426 'After incorporating digital printing into my work, I did even more hand work on the digitally printed cloth than I had done in previous works printed by hand, in order to reclaim it as cloth and to reinsert the evidence of my self' Brandeis, S. (2003). Post digital Textiles: re-discovering the hand. "Hands On" Surface Design Conference, Kansas, USA.
Appendix C
Published Papers – Digital Reflection

Most textile and surface pattern designers are concerned with the accurate communication of virtually created digital colour since their work is directly involved in informing others in the production process. The textile industry and software providers are working together to create world standards in colour communication that will enable the rapid transfer of accurate colour data globally and between platforms and media. Software developers, such as Lectra, have been actively engaged with those in the textile colorant industry to develop software that will manage colour through the design manufacturing and distribution network and the use of this and similar packages are being advocated within the industry. The difficulties being encountered centre upon the need for global standards within software and the certification of standards, once these are defined. This is an area of intensive and urgent research since even white does not have an internationally agreed standard.

The New York based fashion house Liz Claiborne Inc. has invested heavily in digital design and colour management systems. The success of their global operation relies on the ability to communicate both design concepts and colour data through the design, manufacturing and retail of their products. Craig Crawford, director of technologies at Liz Claiborne, is a keen advocate of the use of digital technology in the design process. Under his directorship the company has moved from all artwork being hand rendered in 1995 to over 80% produced digitally in 2003. In a company with a global structure whose concern is the sourcing and supply of its manufactured goods, on-line artwork is an important advantage. Digital designs can be viewed around the world instantly saving costs in both carriage and time and can be visualised by other members of design staff as well as those involved in marketing and manufacture. The digital production of designs also facilitates rapid alterations without costly preparation of revised artwork; colours can be changed, repeat and scale altered rapidly. The systems deployed within the company also enable fluid integration of surface pattern designs into pattern cutting and merchandising software, saving time and providing accuracy in visualisation. Crawford describes the process as ‘design by committee’; numerous people are involved in the whole design process and each one contributes to the decision-making process. Rapid communication of visual data combined with the interactive potential of the technology is changing the way designs are created. The ease of collaboration through the virtual dimension is making commercial design development increasingly collaborative.

Findings

It is becoming evident from the project undertaken to date that the creative use of digital imaging is changing the visual outcome of the work produced in a number of ways. A new visual language is emerging containing complexity of colour and image that until recently had not been possible on cloth. The ability to visualise virtually and to layer concepts and images permits a freedom in collaboration. For some artists the limitations of the media in providing the desired aesthetic outcome have resulted in the hybridisation of digital and craft techniques forging new processes with diverse outcomes.

The ability to reiterate, amend and store digital designs does not necessarily make the design process faster or more efficient. It provides greater possibilities for choice within the process and a more immediate method of rapidly visualising design decisions but the aesthetic choices remain

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427 This immense task is being tackled by the Society of Dyers and Colourists in conjunction with the American Textile Chemists and Colourists Committee C2C (Communications Subcommittee-Electronic Standards Sub Committee)

428 http://www.lectra.com (acc.05.03.06)

429 Janet Best, Colour Manager at Marks and Spencer advocated the need for an international standard for white at the Society of Dyers and Colourists annual conference Birmingham 26th September 2003.

430 Craig Crawford comments that the initial phase of developing a digital design takes as long as painting a design by hand, ‘but once you have got it in then the modifications are easy. Once your colours are matched and your palette is set the re-colourations are easy.’
to be made. The artists who have contributed the project have commented on the need to remain in control of the process and not let the software and its myriad of possibilities deflect from the creative objective of its use. Time is still required for the maturing of concepts despite the rapid production of imagery.

Design software may emulate traditional media in a virtual dimension but the physical satisfaction of hands-on craft technique has been a source of frustration for even the most experienced of those interviewed. Debra Bernath, a New York textile designer whose work is largely digital described hand rendering of work as being more ‘Zen’.

‘There is nothing like mixing the paint in front of you to see the colours created and then to adjust or change the colour. Taking the brush to the paper to create shapes is just not the same on a computer.’ (Bernath 2003)

The practitioners desire to kinaesthetically intervene in the creative process has resulted in new craft practice that combines digital imaging within it. It is likely that as a result of current research into the humanization of technology future software and peripheral devices will enhance the physical crafting of the digital image itself.

431 Scientists working in the area of human and machine haptics at MIT and Media Lab researching into the humanization of technology were recently involved in a three-day symposium with Haystack Mountain School of Crafts ‘exploring the hand as it relates to aesthetics, expression, craft and technology.’ Seelig, W. (2003). "Digital Dialogues: technology and the hand." Surface Design Journal 28(1 Pushing the Edge): 6-11.
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References:


Appendix C

Published Papers – Digital Imagination

Digital imagination: the impact of digital imagery on printed textiles

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Abstract

Digital imaging technology is providing textile practitioners with a medium that is changing and challenging the processes used in the generation and production of printed textile artefacts. The phenomenological research being undertaken at University of Wales Institute Cardiff indicates that when the technology is used as a creative medium rather than a production tool it facilitates an evolving visual language, new hybrid craft practices and the opportunity for collaboration through the sharing of digital imagination. The findings reveal that since physical experience in the world informs thought and fires imagination, future developments in computer interfaces and humanization technology will provide even greater opportunities for the creative exploitation of the media by printed textile practitioners.

A number of innovatory printed textile artists and designers based in the U.S.A and Europe who are using digital imaging in their creative practice have contributed to this research through informal interviews, personal correspondence and case studies.
Digital imagination: the impact of digital imaging on printed textiles

The use of digital imaging by contemporary printed textile practitioners is revealing changes not only in the artefacts produced but also in the approaches taken to generate concepts and imagery. The development of visual ideas in the abstract dimension of virtual space provides opportunities for artists to explore, innovate and craft in a medium that can be shared and communicated in new ways (McCullough 1996). The phenomenological research being undertaken at University of Wales Institute Cardiff indicates that the practice of artists and designers of printed textiles is being challenged by the use of digital imaging technology as a medium that extends the imagination into a new arena. The evidence gained as a result of field and case study interviews reveals how computers are providing a rich medium through which complex images can be developed, collaboration between practitioners is facilitated and new methods for physical crafting and elaboration are being provoked.

Kay argued in 1984 that the computer is ‘not a tool though it can act like many tools’ but rather a meta medium possible of conjuring ‘media that cannot exist physically... with degrees of freedom for representation and expression never before encountered’ (Kay 1984). Others who are aware of the potential of the technology have affirmed this view and Harris, Briggs, Bunce and Leak have noted the technology’s potential as a meta medium in the design and simulation of textiles. The blurring of the boundaries between production tool and meta medium in the domain of printed textile design is resulting in changes in working processes, development of new hybrid craft techniques and a changing visual language of pattern and colour on cloth. The evidence for this is revealed in the practice of those who are not constrained by the economic concerns of industry, in the work of artists and academics who have time to explore and reflect upon the processes that they employ.

The development of computer aided design technology in the printed textile industry has been largely driven by its use as a production tool (Leak 1998). Its implementation for innovation of design concepts has been less rapid than its adoption for the reworking of hand rendered artwork for colourways, repeats and for prototyping fabric samples. Even in companies such as Liz Claiborne who have pioneered the introduction of the electronic design studio, digital innovation continues to be supplemented by hand rendered paper or fabric artwork that is scanned and manipulated electronically. There is not always a temporal advantage in working in this way as it can often take as long to render artwork electronically as by hand but the opportunity to alter colours, scale and repeat is greatly enhanced once the design exists in the virtual domain (Crawford 2000) (Fig. 1). It also facilitates the communication of design visualisation between designers within the company and to suppliers and retailers, providing opportunity for intervention in the design process prior to manufacture. Crawford refers to this as ‘design by committee’ (Crawford 2003). The visual impact of these changes on commercially manufactured printed textiles is less evident than the reduction in product development cycle time and economic benefit accrued. This


however is likely to change as the developments in digital ink jet printing provide systems that meet industrial production speeds and become economically viable.

Textile design practice has always been linked with production methods and tools. Each technological change has impacted on the visual outcome of the textile produced\(^{437}\) and the technical skills required to use the technology have inevitably created a distance between the designer and the product; the original artwork being interpreted and adapted to the meet the requirements of production. Bunce argues that the use of digital imaging software and ink jet fabric printing is providing an opportunity for this trend to be reversed:

*‘By removing the intervening stage of engraving, jet printing can create closer relationships between the designer CAD, and the textile product. This may impact upon design processes and also change what designs are for and how they are seen’* (Bunce 1999).

The integration of digital processes and particularly digital ink jet printing technology are changing the visual characteristics produced and stimulating a renewed interest in physical interaction with the cloth. The digital tool is becoming a medium for digital imagining.

\(^{437}\) An example of this is the way in which floral designs have dominated printed textile designs since the importation of Indian prints in the seventeenth century. The emulation of techniques and stylistic influence resulted in the European *Indienne* designs that were subtly adapted visually to suit a European market. Prior to this floral motifs did not predominate.
Appendix C

A changing language

Briggs and Bunce contend that the legacy of technological progress in the production of printed textiles has been the adoption of stylistic change into the designer’s visual vocabulary. Each change creating ‘a visual language that contains a wide range of dialects and which expands as new developments occur’ (Briggs 1995). Briggs argues that the use of photography and digital imaging in the design of printed textiles is producing a ‘new visual language’ (Briggs 1997). The technology is providing opportunities for practitioners to explore images in new ways, for example through micro detail or combined layered image, extending the artists’ aesthetic experience and knowledge. This is being communicated through the characteristics of expressed visual language within the domain: in the nature of the imagery used, the complexity of image produced and the vocabulary of colour.

Digital inkjet printing has eliminated the need for repetition in a textile design since the traditional constraints of roller printing no longer apply. It is proposed that this newfound freedom should inspire the use and generation of new complex pattern forms (Bunce 1994). Bunce argues that CAD has the potential for providing new types of repeating pattern,

‘Computer image manipulation capabilities provide fast, accurate and flexible methods of pattern construction...In this way CAD could be used to create new types of design with non-mechanized appearances’ (Bunce 1994).

This new approach to the construction of pattern can be seen in the work of Hilary Carlisle, who is exploring the use of computer-aided randomisation techniques to apply variations to small-scale motifs. The digitally printed fabric outcome has the initial appearance of repeated image but with ‘continual visual variety’ (Bunce 2003). Hele Abild, a Danish designer, has taken a similar approach. Her digital textiles appear to contain repeating elements but in fact they change subtly across the surface of the cloth (Campbell 2003). The uses of repeat and non-repeat are explored in the work of textile artist Hitoshi Ujiie. In his textile piece ‘Falling’ (Fig. 2) he is able to convey the rhythm of repeat through non-repeating image and at the same time explore the concept of movement through image and motif. The textile ‘Everybody’ (Fig.3) which makes use of letterforms dismisses the notion of both repeat structure and conventional textile motif. Ujiie was one of the six contemporary artists who use digital printing or weaving to create their art, who exhibited work in the ‘Technology as a Catalyst: Textile Artists at the Cutting Edge’ exhibition at the Washington Textile Museum in 2002. His digitally printed installation textile pieces contained single large-scale motifs based on computer manipulated photographic imagery of natural forms. They contain no elements of repeat but are rhythmic in their arrangement within the installation (Fig. 4).

Photographic imagery has been integrated into surface pattern and textile designs for the last decade as a result of four-colour process and heat transfer printing (Briggs 1997). The potential of digital cameras to capture images has inspired a number of designers whose main concern is exploiting photography to create textile design imagery. Briggs’ research at Nottingham Trent University explored the potential of photography in relation to digital printed cloth, questioning the applicability of such complex visual images in the structure of a textile design (Briggs 1997; Bunce 2003).


439 The repeat of an image or pattern on cloth was historically necessitated by the circumference of the roller (the drop) and its width, which determined the size of the unit of repeat.
Photography also provides scope for an exploration into the way distance and scale is perceived and how focus and format can be incorporated into surface design. Digital imaging technology is providing opportunity for these themes to be explored as evident in the work of J.R. Campbell at
Iowa State University. His photographic imagery is used in the production of digitally engineered garment designs (Fig. 5). The use of photographic imagery on textile is not new but the recent ability to digitally print millions of colours on to fabric is inspiring artists and designers to combine photographic realism within their work. The textile art of the Dutch artist Wilma Kuil exemplifies this through her use of digital photographic imagery sometimes in conjunction with traditional textile motifs and often through the intermingling of virtual and physical layers of motif.

Digital photography and video is providing a rich source of visual data that can be utilised to inspire and to create design imagery. Rebecca Earley, Senior Research Fellow at Chelsea College of Art, for example, has described the role of the computer in the development of her visual concepts as ‘a massive scrapbook, a massive sketchbook’ (Earley 2003). Working with a digital camera and scanner she is able to make use of collected visual data from a variety of sources and blend them into one in the electronic dimension. A similar blending of visual data is evident in the work of the American textile artist Susan Brandeis who uses both a physical sketchbook and photographic imagery scanned and manipulated digitally to amalgamate a variety of images from a specific geographic location to convey her sensuous response to that particular place. Her aim is to produce an image that gives the viewer multiple simultaneous glimpses of the original location comparable with the way the eye informs the mind, as it perceives a place in time. The image is digitally printed and then embroidered to provide additional layers of meaning and narrative. The computer facilitates a ‘more literal image’ of her chosen visual environment (Brandeis 2003). It is evident that the use of visual imagery of such complexity could only be considered as a direct result of access to digital printing technology (Figs. 6 & 7).

Amanda Briggs details this in her PhD thesis (Briggs 1997)
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Fig. 6 Susan Brandies 'Quintessence' (detail) digitally printed, mixed media fabric construction.
Photo © Marc Brandeis

Fig. 7 Susan Brandies 'Messages from the Past', digital print, dye, felted, reverse appliqué, embroidery
Photo ©Marc Brandeis

It is this complexity and detail made possible through the use of digital imaging and ink jet digital printing technology that has became the inspiration of a new body of work for the textile artist Alison Bell. She uses layering to build and manipulate imagery that is photographic, hand rendered and electronically generated to form a complexity of image that could not have been achieved any other way. Bell describes the use of digital imaging as a 'totally new visual language', which is 'full of words that I didn’t know existed' (Bell 2003). (Fig. 8). A wealth of detail and use of layered imagery has featured in the textile art of Joan Truckenbrod since the 1970’s. Her work reveals an
exploration of superimposed image, both photographic and digital and her recent installation pieces strive to ‘produce a richly layered experience for the viewer through a confluence of numerous media: video projection, digital imagery, fiber and sound’ (Ullrich 2003). The ease with which the technology can provide connections between electronic devices is aiding the development of the vibrancy of the visual language evident in her work. The complexity of the images used by Truckenbrod, Brandeis and Bell are indicative of the potential of the emerging visual language to communicate sensuous experience and conceptual depth.

Fig. 8 Alison Bell -Berneray Bird, ink jet digitally printed silk
Photo © CT

Colour

The complexity of image has been made possible as a direct result of the availability of a huge colour palette provided by digital printing technology. Unlike analogue printing systems in which the printing of large numbers of colours is economically prohibitive, digital ink jet printing facilitates the use of thousands in any one printed image. The level of detail, hue and tonal range is also massively increased. The impact of an extended gamut and arrangement of colours is described by both Bell and Earley as contributing to the developing visual language. Bell describes it as comprising of new “colours, textures, surfaces, subtleties” (Bell 2003) and Earley states that:

‘the design work being produced now compared to 1996 is just so radically different... the use of colour is more ambitious, it’s more varied, the amount of texture and detail within one design is much, much broader. .... The inclusion of so much detail and colour on one piece of fabric is what the language is all about’ (Earley 2003).

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According to Leak, ‘the number of colours the human eye can differentiate is unknown. Scholars believe between one and ten million colours can be differentiated’ (Leak 1998). Computer monitors however, are capable of producing up to 16.4 million colours; far more than the human eye can see. This seductive and vast colour range available on the monitor inspires practitioners with the desire to achieve the same results as printed product. It fires the imagination in the virtual domain but is also the source of great frustration. The colour output from digital printers is frequently disappointing, as their gamut does not match that of the monitor. Colour is also changed by the substrate onto which it is printed and the light source by which it is viewed. The issues of colour management and communication are having a significant impact within industry and research is currently underway to overcome these difficulties through the provision of a global digital colour communication standard. The aim is to provide accuracy of spectral data that can be used in software, comparable with Microsoft Word in its ubiquity, which will provide a universal language of colour. The Society of Dyers and Colourists are carrying out this enormous task in conjunction with the American Textile Chemists and Colourists Committee.

The accuracy of spectral data, however, is not the only concern in the use of virtual digital colour. The work of Land, the colour scientist and inventor of the Polaroid camera, revealed that the appearance of a colour depends on its context, not just the wavelengths reflected from the sample. He proved that all colours perceived in a scene supply the brain with information about a given object, which is used to reinterpret this data (Leak 1998). Our perceptions are also shaped by our experiences (Merleau-Ponty and Edie James 1964). Sight alone is not vision, but what we perceive is moulded, changed and adapted by the brain (McCullough 1996) Colour is therefore dependent on perception and interpretation. For the digital practitioner, the interpretation of additive primary (light) colour information from the computer monitor simultaneously with that of subtractive primary (pigment) colour of printed product is an additional difficulty.

Leak argues that there are currently two ways of approaching the problems of using digital colour:

‘Designers using systems, soon realise that there are restrictions in terms of colour and, therefore, they work with and around them, dependent on the specific working context. When a CAD system is treated as a medium, these restrictions become characteristics of the system. From this perspective poor colour fidelity may not necessarily be so problematic. Indeed what are termed colour mistakes, when looking at a CAD system as a production tool, can be seen as catalysts for change if they are approached from a different perspective’ (Leak 1998).

Alison Bell embraces this heuristic approach to the disparity of printed colour. When she encounters a colour problem she will ‘work with it’ and use the lack of fidelity in the printed outcome to stimulate further her creative process. This is achieved by combining the printed image with a hand rendered silk painting technique to create a new expression of the original concept.

New Craft Techniques

The assumption that ever improving technology replaces craft can be challenged by a number of the textile artists interviewed for the research that are incorporating digital technology within their process and evolving new hybrid craft techniques. For some of these practitioners the frustration with the cloth outcome as a result of digital printing has led to a new inquiry into surface ornamentation; for others the technology itself has inspired development of a particular craft. The lack of hands on crafting in physical space is regarded by some as being detrimental to the printed textile outcome. Many of those interviewed have commented on the digitally printed cloth as being

441 Leak writes: ‘Printers create colour by subtractive optical mixing, the majority using a mixture of cyan, yellow and magenta inks... The printer is unable to reproduce all the colours that the average human eye can see. While some colours are common to both devices, there are printer colours not covered by the monitor and vice versa’ Leak, A. (1998). A Practical Investigation of Colour and CAD in Printed Textile Design. Nottingham, Nottingham Trent University.

flat and lifeless due to both the effect of colour and the lack of physical intervention in the process. Brandeis writes:

'To work with these kinds of fabrics we will have to find ways to re-establish a relationship with the materials, to reclaim the images from the machine, and to convert the monologue of the machine printed product to a dialogue between artist and cloth' (Brandeis 2003).

For Brandeis this dialogue is re-established through the embellishment of the textile surface by a variety of textile crafting techniques. She refers to the need for embellishment of the digitally printed surface that is 'more gestural and expressive, in order to keep the surface rich and tactile' (Brandeis 2003). Her experience of hands-on crafting of textiles has provided her with a depth of tacit knowledge that motivates her desire to physically intervene in the textile surface. Investing time and craft skill in the digital print to enhance it with the qualities that contribute to a textile's 'visual and emotional power' (Brandeis 2003).

In his essay 'The Work of Art in the Age of Mechanical Reproduction' (1934), Walter Benjamin uses the term 'aura' to describe the emotive element that is lacking in the machine manufactured product. The aura of a crafted product is a unique accumulation of responses to a material and is derived from the hands on workmanship of risk involved in human manufacture (Pye 1964). For Brandeis, Bell and Earley the printed digital image lacks aura. It demands further hands-on intervention and elaboration. Initially Bell found the digitally printed product to be inhibiting; 'I was transfixed by the quality and it stopped me looking beyond it'. She describes it as being too 'perfect' (Bell 2003). Earley describes digitally printed cloth as being 'too flat' and having 'no sensual product quality about it' and regards it as being “a stage in between” rather than a finished product. She advocates further manipulation of the fabric surface involving over printing, laser cutting or the design of a product or garment utilising the printed cloth. Each elaboration involves the introduction of the element of risk; the textile might be damaged or even destroyed in the process. The physical intervention however also provides ‘material evidence of tool usage. Something about its authorship and origins’ (McCullough 1996). The textile artefact becomes no longer the product of the machine but a crafted expression of the artist's imagination.

The ease with which it is possible to create a digitally printed fabric and the freedom with which it is possible to incorporate diverse and personal imagery has encouraged practitioners to incorporate them within their work as an expressive means of communicating their narrative. The artist Michael James now uses his own digitally generated and printed imagery, rather than artisan produced fabrics, to apply imagery that is more personal and appropriate to the pieces. The detail that he can include is changing the visual outcome of his work. This is exemplified in a piece created in 2002 called 'A Strange Riddle' (Fig. 9). James makes use of digital imaging technology to combine images from childhood memory with concepts that are personal and universal; assembling, layering and manipulating them to communicate his theme. The digitally printed imagery is constructed and embellished with machine embroidery and quilting detail and provides continuity and depth to the expression of the narrative (Fig. 10). This is similar to the approach taken by the bead artist Amy C. Clarke. Her narrative is generated through digitally manipulated photographic imagery to explore story telling, myth and legend. The themes are narrated both through the imagery used and the ancient Native American spiral-embroidered craft technique she employs. The image to be beaded is photographed, scanned and manipulated in Photoshop®. Once digitally printed, the image is applied to fabric and the beads are applied by hand stitching. The choice and positioning of the beads relates to the light reflecting qualities of the digital pixelation on the computer screen (Fig. 11). The impact of the technology on the practice of both these artists has contributed to the development of the narrative content of their work.

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Fig. 9 Michael James ‘A Strange Riddle’, ink jet digitally printed and quilted fabric
Photo ©M. James

Fig. 10 Michael James ‘The Nature of Truth’, ink jet digitally printed and quilted fabric
Photo ©M. James
The use of digital imaging as a medium to layer photographic, scanned, electronically generated imagery and colour in the virtual domain provides opportunities for the artist to imagine and explore concepts, narrative and visual arrangements without commitment or expense. Images can be amended, constructed and deconstructed providing multiple explorations and iterations in much the same way as imaginary thought is explored in the mind. The digital media captures the visual product in a virtual space, a semi reality, making it possible to be communicated back to the artist for reflection and to other artists and designers providing a means for creative collaborative intervention.

Collaboration

The textile designer J.R. Campbell explores this collaborative potential in his ‘art to wear’ developed with the fashion designer Jean Parsons. Their work involves the integration of textile design into garment shape to produce bespoke printed garments (Campbell, Parsons et al. 2002). A recent project included collaboration of a third designer, Susan Strawn, whose contribution of a knitted section to the garment used the printed imagery created by Campbell in the garment pattern designed by Parsons (Strawn 2003) (Fig. 12). The Campbell and Parsons collaboration built on previous research at North Carolina state University and by designers at [TC] 2, the Textile Technology Corporation, investigating the use of photographic imagery with complex garment pattern forms, striving to overcome the difficulties associated with the alignment of odd shaped pattern pieces, darts seams and their disruption of the surface pattern of the print. The Campbell Parsons collaboration is continuing in current research exploring the possibilities of creating bespoke customised children’s wear marketed and sold entirely through the internet.

The possibilities of bespoke or customised product is also being researched by Philip Delamore at the London School of Fashion who is concerned with the application of three dimensional printing of garments using rapid prototyping technology. His collaboration is a scientific one and reveals a new type of digital imagining possible through three-dimensional modelling process. It is also evident that the Internet and email is providing a new arena for collaborative design innovation. A recent collaborative research project involved Elaine Polvinen a textile designer from New York State, USA, Shen Li a designer from Beijing, China and Yimee Wang from Taiwan. The aim of the project was to ‘use email to develop a collaborative digital design culminating with a Chinese-inspired theme exhibition’ (Polvinen 2003) and involved the communication of imagery via a

444 See http://www.freedomofcreation.com (acc. 05.03.06)
private website and email as tiny thumbnail images. The digital media provided the platform for the meeting of minds, sharing of visual information and development of concepts as well as existing as a tool for communication.

![Image](https://via.placeholder.com/150)

*Fig. 12 J.R. Campbell, Jean Parsons, Susan Strawn, ‘Summer’, engineered garment collaboration Photo © JR Campbell*

**Imagining in a make believe world**

Imagination is defined as the *image forming power of the mind* or the *power of the mind that forms conceptions* (English Dictionary). Its role is that of visualising in a domain outside the physical world in order to *create* a new idea, description or artefact. (Collingwood 1958). The virtual world of cyberspace could be said to provide an extension to the image forming power of the mind, providing a further means for the development and visualisation of concepts. The virtual world is however the product of the imagining of others; *make believe* is central to the conception and design of software[^445] (Trend 2001). Design software provides the user with the make believe world of the utopian studio in which airbrush and oil paints can blend onto the same paper surface. The symbolic and iconic language perpetuates the metaphor. The breadth of scope provided by the virtual studio contains so much embedded knowledge and skill that it has been described as being ‘knowledge beyond replication’ (Gale 1994) since its sum is greater than that possible for any


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individual to acquire. There are however hidden dangers in this domain. There is the possibility of being enframed in the software engineers' logic (Marshall 1999) and of being seduced by the visual effects of particular functions and techniques rather than the pursuit of creative exploitation to achieve the artists' aesthetic objective (Braddock and O'Mahony 1998).

For many textile practitioners the greatest difficulty lies in their ability to enter into this world. Access is gained through an understanding of the programmers' logic and the interpretation of symbols. It requires acquisition of tacit skills to provide the freedom to interact with the embedded knowledge and tools intuitively so that the imaginative power is released to form the image. This requires time for practice and exploration and in a temporally challenged society this is may create difficulties due to the complexity of software applications. As a result, some artists prefer to limit themselves to certain functions of the software so that fluency in these techniques provides opportunity for creative thought.

The implicit logic of the digital medium does not lend itself to the spontaneity many artists crave in the generation of their work. Through experimentation and familiarity with software functions, however, it is possible to engineer a form of unpredictability. Alison bell has developed a fluid working process that provides her with a form of spontaneity she regards as essential to her practice. Using scanned hand painted silk fabric samples and multiple layering Bell is able to intervene in the image using digital painting and erasing functions. Her layers are built from line work that is input into the computer using a tablet and pen, collected images in scanned photographic form and electronic images from the Internet. The use of the virtual space for layering of images enables her to capture and trap memories that form her expressive response to the environment her textile art reflects. The images are digitally printed on to silk and often over painted and sometimes elaborated with stitch and appliqué. They are inspired in the digital domain and developed through the interaction of materials and hand crafting techniques (Fig. 13).

Fig. 13 Alison Bell 'Cuneiform', digital image © A. Bell
Imagine the future

Software has been described as a ‘collaboration between the imaginations of the creators of a program and the people who use it’ (Trend 2001). It is the potential of the virtual space to be entered and shared for the communal imagining which is so intriguing. As the imaginative and computational power of the virtual world expands so do the possibilities for digital imagining. Immersive reality is providing opportunities to enter the image space and interact and intervene creatively with it in real time (Grau 2003). The development of haptic sensors and research into the humanisation of technology being carried out at Media Lab MIT (Seelig 2003) may provide new types of interface that will ultimately provide greater accessibility for textile practitioners to enter into the digital virtual domain.

Today’s commonly used design hardware systems are not geared to the normal working practice of artists and designers and interfaces such as mice and keyboards feel alien and unresponsive. For many practitioners sketching with a pencil and paper is one of the fundamental ways of generating ideas; it is a means of making thought visible and exploring the abstract concepts held in the imagination prior to their physical development. If the computer interface is complex, slow and restrictive the creative flow may be inhibited or even halted. The research work being carried out as part of the Tacitus project at Edinburgh University is using haptic sensors to explore the issues surrounding development of interfaces that ‘would enable idea formulation and creative activities to be performed with the same intuitive and fluid transmodal interaction as sketching on paper’ (Shillito 2002).

The phenomenological premise is that experience has a questioning character and that our physical approach to the world shapes how it appears to us. Merleau Ponty contends that consciousness, thought and memory unfolds ‘from our condition as being physically immersed in the world’ (Cazeaux 2000). The ability of practitioners to touch, sense and craft their ideas in the virtual world is likely to provide an even deeper stirring of the digital imagination. The effects of this on the printed textile outcome must remain for now conjecture, a figment of our own imagination.
Appendix C

Published Papers – Digital Imagination

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Appendix C

Published Papers – Digital Imagination


A collaborative project with J.R. Campbell, Jean Parsons and Susan Strawn.


**Figures:**

Debra Bernath - *Floral stripe*, commercial digitally printed design for children’s swimwear incorporating scanned and photographic imagery
Hitoshi Ujiie - *Falling*, ink jet digitally printed fabric
Hitoshi Ujiie - *Everybody*, ink jet digitally printed fabric
J.R. Campbell - *Cathedral*, digitally engineered ink jet printed garment
Susan Brandies - *Quintessence* detail digital printed, mixed media fabric construction.
Susan Brandies - *Messages from the Past*, digital print, dye, felted, reverse appliqué, embroidery.
Alison Bell - *Berneray Bird*, ink jet digitally printed silk
Michael James - *A Strange Riddle*, ink jet digitally printed and quilted fabric
Michael James - *The Nature of Truth*, ink jet digitally printed and quilted fabric
Amy C. Clarke - *Tell Tale Apple*, beaded textile with detail
J.R. Campbell, Jean Parsons, Susan Strawn, - *Summer*, engineered garment collaboration
Alison Bell - *Cuneiform*, digital image
Digital creativity: the impact of digital imaging technology on the creative practice of printed textile and surface pattern design

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Abstract:
The development of digital imaging technology for printed textile and surface pattern design has been driven by its use as a production tool rather than as a design medium. It has been successfully deployed by industry for the reduction of cycle times in product development, prototyping and communication but its full potential in the creative domain has yet to be realised. This paper contends that it is possible to unlock the potential for innovation when digital imaging technology is embraced as meta-media containing a wealth of embedded knowledge and skills in virtual space.

The initial phase of phenomenological research into the creative use of digital imaging by surface pattern and textile practitioners being undertaken at University of Wales Institute Cardiff has revealed that creative expression is being enhanced through an evolving visual language, development of new craft techniques and the possibilities that it provides for collaboration and communication. On going empirical research described in the paper illustrates how creative practice can be explored through a sharing of imagination in virtual space and the resulting material artefact is a phenomena of both individual and shared expressive responses.
Digital creativity: the impact of digital imaging technology on the creative practice of printed textile and surface pattern design

Introduction

"Creativity is the defeat of habit by originality" Arthur Koestler

The development of digital imaging technology for the design of surface pattern and textiles has been largely driven by production concerns rather than a desire to exploit the creative potential of the medium (Leak 1998). Much of the on-going research in the domain reflects this emphasis on technology. This paper seeks to address issues that surround its creative use in concept generation and the propagation of imagery in the design of printed textiles. It draws upon the findings of the first phase of the phenomenological research being undertaken at Cardiff School of Art and Design, UWIC and a current ongoing empirical investigation into creative practice using digital imaging technology that forms the second phase of the project.

The initial findings of the research indicate that digital imaging technology impacts not only on working processes but also on the phenomenon of the created artefact. Those practitioners who have been interviewed for the study have recognised the use of a developing visual language comprising complex layered and photographic imagery, with an extended colour and tonal gamut. Digitally printed fabric output is challenging conventions of traditional pattern making and providing greater freedom in creative exploitation of surface and colour. Textile artists who are incorporating digital techniques are able to use the extended visual language to explore the narrative content of their work in new ways. For some of those interviewed this has dramatically changed the visual nature of the textile pieces being produced and for others it is extending their craft techniques to form new hybridized practice. The findings also indicate how the potential of digital communication is being exploited in practice, changing both corporate and individual working methods and providing opportunities for artists and designers to collaborate creatively at various stages in the production of both concept and artefact.

In defining the creative nature of practice it is necessary to focus on engagement with those types of tasks that are heuristic rather than algorithmic and where there is no clear and straightforward path to the design solution. For this reason the research to date has focused on those practitioners who are freed from the technical, economic and temporal constraints of industrial production and who are engaged in research, education or are involved in producing textile art. Research into the theory of creativity has provided evidence that extrinsic constraint which include manufacturing and technical considerations, meeting time deadlines, evaluation and reward can have a detrimental effect on creative motivation and practice (Amabile 1996). Those factors that have been proved to enhance creativity concern the intrinsic motivation of an individual: providing a sense of freedom, regarding work as play, risk taking, lack of constraint and self-absorption in the task (Sternberg 1988). These positive and negative motivational factors have been useful in the assessment of the technological impact upon creative practice and the second phase of the research will examine those attributes that may assist heuristic task engagement.

The potential of these research findings in a wider context will be to illuminate the ways in which both hard and software can be developed to enhance creative practice. An understanding of creative digital tool use as well as psychological implications will benefit the training and employment of future designers and the development of the technology they use. By seeking to explore these issues phenomenologically, through analytical description of conscious experience, the nature of practice is revealed both in the heuristic process and the phenomenon of the created artefact. Video


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recordings, interviews and personal correspondence have been collated along with a photographic documentation of the material artefacts produced in order to provide data for analysis. The digital medium itself has proved invaluable as a tool in the research into its implication on creative textile practice.

Tool and Medium

The development and use of computers in the process of textile design and manufacture has, until recently, been driven largely by economic reasons; to facilitate a reduction in product development cycle time through efficient preparation of pre-print design work and design visualisation. Textile computer systems were developed primarily to meet production needs rather than to enhance the creativity of designers (Leak 1998). The cost of computer aided design systems and the inaccessibility of the software resulted in few U.K. designers, working outside industry, using them to innovate design concepts at the end of the millennium. (Jenkyn Jones 1999). Developments in user-friendly software and reduction in both hardware and software costs is now providing greater access to the technology for those in the developed world. The computer can no longer be seen as simply a production tool but rather a new medium at the designers’ disposal. In 1984 Kay made a useful analogy of the computer as a meta medium possible of conjuring ‘media that cannot exist physically ....with degrees of freedom for representation and expression never before encountered’ (Kay 1984). Software applications provide a host of embedded skills and knowledge useful in the generation and manipulation of virtual imagery and provide a means of making available ‘the effects of other people’s skills to an individual without that individual having to acquire them’ (Dormer 1994).

Cognitive psychological research has highlighted the links between intelligence and creativity and established that any creative inquiry or task demands fluency in the use of knowledge in the domain in which the action takes place. For an individual to practice creatively there is a necessity for information to be acquired, skills to be practiced and knowledge to become tacit (Dormer 1994). Any creative action requires the use of long-term memory for a set of basic structures that frame the inquiry along with a set of tacit skills that provide opportunity to experiment with ideas (Sternberg 1988). For a textile designer using digital imaging technology this involves not only the acquisition of software competency but also a degree of aesthetic sensibility and technical textile or surface pattern ‘know-how’.

The impact on creative use of the digital medium is therefore dependent on the level of acquired knowledge and practical expertise with the software. The complexity of software and the ease with which it is possible to mentally map its structures affects not only the speed with which digital crafting skills can be made tacit but also the degree to which an individual is motivated to learn to use it. Creative deployment of tools requires a degree of transparency in operation as ‘better technology shifts psychological load from foreground cognition to background awareness’ and ‘establishes contexts that free us from having to keep too many considerations actively in mind’ (McCullough 1996). In successful creative deployment, digital imaging technology can provide access to a wealth of embedded knowledge and freedom to access tools and expertise beyond replication in non-digital practice. If however the technology is difficult to access, software complex and difficult to mentally model, the impact will be detrimental to creativity due to the inhibiting of the intrinsic motivation essential for creativity (Amabile 1996).


450 Amabile states that ‘the intrinsically motivated state (marked by involvement and playfulness of the task) is conducive to creativity, but the extrinsically motivated state...is detrimental’ Amabile, T. M. (1996). Creativity in context: update to The social psychology of creativity. Boulder, Colo.; Oxford, Westview Press.
The first phase of the research revealed that most of those interviewed expressed concerns with learning to use software and most declined to describe themselves as experts. Many of them had overcome difficulties in achieving software fluency by specialising in particular functions or tools within specific software packages; the most notable of these being copy, cut and paste. The specialisation in particular software functions provides fluency in practice enabling ideas to be explored without interruption to conceptual ‘flow’ and providing confidence in technique which helps to maintain intrinsic motivation.

The flow of creative thought is enhanced in situations where there is freedom and choice; where an individual feels unconstrained, can think divergently and engage in play. The bringing together of unrelated concepts or mental images enables a practitioner to break set and explore new connections to generate ideas (Amabile 1996). Digital imaging can assist in this kind of thinking amongst those individuals who have achieved a degree of transparent digital tool usage and who are fully engaged in the process. The potential to rapidly change visual ideas and store numerous variations and iterations facilitates choice and playful experimentation. Waste of materials and subsequent expense should an idea fail ceases to be an inhibiting factor when working in virtual space and so risk taking is enhanced. Artists interviewed in the first phase of the research indicated that digital imaging technology was frequently used at the generative stage of conceptual development to store images from a variety of sources. Hand rendered images, photographic material, video and electronically generated imagery can be blended together in the virtual dimension to provide new kinds of complex visual forms enabling memory, and sensuous responses to be developed and expressed in innovative formats.

The impact of this application of technology is evident in the visual outcome of the artefacts produced. Recent developments in textile digital ink jet printing technology mean that the complex multi layered images that it is now possible to create virtually can also be reproduced in material form. Those interviewed unanimously stated their belief that there was a new or evolving visual language evident as a result of digital technological deployment. Textile visual language has always been locked into technological development; each change creating ‘a visual language which contains a wide range of dialects and which expands as new developments occur’ (Briggs 1995). The use of photographic imagery, the digital layering of image and the complexity of colour and tone ‘the inclusion of so much detail ... on one piece of fabric is what the language is all about’ (Earley 2003).

**Colour and Perception**

Evidence from the first phase of the research highlighted the ways in which the difficulty in achieving colour parity between digital virtual colour and the printed output act as both an inhibiter and motivator in the creative process. The difficulty in replicating the colour gamut viewed on screen by those practitioners who were without access to colour management software tools and photo spectrometers has led to two approaches. For some the printed outcome would be considered ‘a catalyst for change’ (Leak 1998); viewed as a stage in the creative process to be accepted, worked with through the application of hand rendered colour or modified using other textile embellishment techniques. Others interviewed found colour issues de-motivating, frustrating and, as a result, inhibiting to creativity (Brandes 2003).

Colour is a psychophysical phenomenon and the perceptual limitation of colour issues means that sharing and communicating colour between technology and individuals continues to be fraught

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451 Csikszentmihalyi wrote of a creative “state of flow” or “flow experience”. “Those “in flow” are not conscious of the experience at the moment; on reflection however, such people feel that they have been fully alive, totally realized and involved in a “peak experience.” Gardner, H. (1993). Creating minds: an anatomy of creativity seen through the lives of Freud, Einstein, Picasso, Stravinsky, Eliot, Graham, and Gandhi. New York, BasicBooks.

452 The introduction of engraved plate, roller and silkscreen processes each contributed to a change in the visual format and structure of the surface patterns produced for printed textiles.
with difficulty. Current technological developments\textsuperscript{453} will assist in colour communication and solve some of these problems. The impact on creative practice will inevitably be heavily affected by the psychological viewpoint of the practitioner, access to colour management tools and the degree of perceived constraint that colour disparity places on freedom to innovate concepts.

Hybrid Crafting

The digitally printed fabric outcome has been described by several of those interviewed as being flat, lifeless and lacking sensuousness. For some this was a response to the quality of printed colour but for others it was awareness that the material lacked ‘aura’\textsuperscript{454}; that as a product of a machine it no longer conveyed the emotional charge that the human hand endows\textsuperscript{455} (Wilson 1998) This dissatisfaction has led some practitioners to regard the cloth as a transitional stage in the creative process rather than a completed artefact. The result has been a hybridisation of digital and handcrafting skills producing artefacts in which ancient and traditional craft techniques are combined with digital technology.

Anthropologists have suggested that to make with the hands is an innate human capacity and through hand experience the brain develops manipulative, kinaesthetic and language skills which build memory and knowledge of the world (Dissanayake 2000), (Wilson 1998). The combination of kinaesthetic and tactile information supplied to the brain from hand experience is combined with sensory information from the visual system to build the visuospatial images that are necessary for imaginative and creative thought (Wilson 1998). It is inevitable that practitioners who have highly developed sensitivity through manipulative crafting processes will feel constrained by the lack of sensory stimuli inherent in digital crafting. The hardware and peripheral devices that are most commonly used do not exploit the complex neuromuscular potential of fingers and thumbs nor the hand-eye coordination or force feedback that is the natural development of hand manipulation. Rather the hands are expected to move mice or keys while the eyes are looking at a monitor located in a different physical location. Although this is also the case in activities such as playing a musical instrument it is unusual in those that work a material (McCullough 1996). Research indicates that the left and right hand perform different but complimentary functions: the non-dominant hand framing the movement of the dominant. The dominant hand executes tasks that are ‘micrometric, rehearsed and internally driven or pre-programmed’ for example in writing, whereas the non-dominant hand positions the paper during the process and ‘is macro metric, improvisational and externally driven’ (Wilson 1998). Working together symbiotically, the hands are able to supply information to the brain that ‘shapes creativity itself’ (McCullough 1996). The digital tools that are commonly used by most practitioners, mouse, keyboard, pen and digitizing tablet, do not capitalise on the complex potential of the hands. These peripherals have been described by those interviewed as ‘clumsy, awkward and frustrating’ and, as sensory input devices, are inhibiting to creative flow. Current research\textsuperscript{456} into physical crafting in the virtual environment using bodily kinaesthetic skills may provide the key to the development of haptic tools that will aid a more intuitive hands-on approach to working with technology.

\textsuperscript{453} The ATCC, C2C (Communications Subcommittee-Electronic Standards Sub Committee) and the SDC, WG12 are currently working together to create a universal standard for global colour management.

\textsuperscript{454} In his essay “The Work of Art in the Age of Mechanical Reproduction (1934), Walter Benjamin uses the term ‘aura’ to describe the emotive element that is lacking in the machine manufactured product.

\textsuperscript{455} ‘When personal desire prompts anyone to learn to do anything well with the hands, an extremely complicated process is initiated that endows the work with a powerful emotional charge.’ Wilson, F. R. (1998). The Hand. New York, Pantheon Books.

\textsuperscript{456} The Tacitus Project at Edinburgh University is investigating the use of the Phantom haptic device to enables users to touch feel and manipulate virtual environments. It aims to ‘create a generic virtual environment in which the applied artist feels uninhibited and can bring their experience and knowledge to extend their creativity to the digital medium.’ Shillito, A. M. (2002). The Tacitus Project. Pixel Raiders.
Physical handcrafting requires time to practice so that skills become tacit and the tool use transparent (Dormer 1994). There is time for reflection on practice and for concepts to evolve. Digital tools provide rapid progress and proliferation of ideas requiring continuous decision-making and memory recall. The speed of work and the lack of sensory stimulus from the hands may cause entrenchment in working methods or conceptual models; there is a danger of the individual becoming a ‘mouse potato,’ content to click and gaze quiescently at the monitor without reflection on practice as it occurs (McCullough 1996).

On the other hand, the rapid production and manipulation of images can be viewed as a positive motivator to creativity. Research has found that sensory stimulation prior to creative task engagement enhances divergent thinking (Amabile 1996). The facility to rapidly generate and view large numbers of images, to assemble, reassemble, collage, layer, duplicate, store and retrieve them, provides rich source material for concept initiation. At the generative stage of the design process, the iterative cycle of building a visual concept can progress swiftly and its progress can be recorded, modified and developed more rapidly than in hand rendered work. Time can be utilised in playful exploration of concept, suspending judgement and without inhibition since the concepts exist in the semi reality of virtual space.

The perceived logic and structure of the technology can appear to limit the potential for serendipity on which creative practice thrives. Case study research indicates, however, that practitioners who are positively motivated to use digital imaging and who take a relaxed and playful approach to the creative task seem able to devise methods for achieving spontaneity. The mental attitude towards the technology seems to be key to its creative potential and personality traits have been shown to greatly affect individual creative task engagement (Amabile 1996).

Speed of concept generation and design development is also enhanced by the facility for rapid communication of visual ideas. It is possible to gain swift feed back from others and the design development cycle can accommodate external influence and technical constraints in a positive way to provide designs that are both novel and appropriate solutions to the task. Electronic data transfer saves time and a rapid response to initial ideas may inhibit entrenchment and functional fixedness that have been found to have negative effects on creative task engagement. In a world of tight deadlines and rapid change, any mechanism that speeds up the decision-making and algorithmic processes of design development is useful. However, there is considerable agreement amongst those involved in cognitive psychological research that ‘creativity takes time’ and that time is required for reflection, revision and the nurturing of the elements of generative thought. It is imperative that those wishing to reap the benefits of digital imaging within creative design practice are able to invest sufficient time in exploratory playfulness at the generative stage.

Phase 2 - a collaborative experiment

The speed and ease with which it is possible to communicate digital visual data enables intervention at various stages in the development of a design concept. The initial findings the research has revealed a number of ways that practitioners are collaborating digitally with other

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457 Evidence in case study material Alison Bell, August 2003.


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individuals with complementary skills: textile designers with fashion designers\textsuperscript{60}, designers with technologists\textsuperscript{61} and artists with designers\textsuperscript{62}. In many cases the technology is providing a means for sharing creative thought and design expertise that would be difficult to achieve without it.

Digital imaging makes available the tools with which it is possible to creatively intervene in the generative stage of conceptual development. The second phase of the research is seeking to explore these issues through empirical research in which the generative design process is being communicated and shared between the researcher and a textile practitioner. The analysis of both the process involved and the artefact produced during the experiment will provide insight into how creativity may be affected by digital imaging technology. The project has evolved out of case study research in which the Scottish textile artist Alison Bell was filmed and interviewed. Bell's textile work exhibits a changed visual language as a result of the incorporation of digital imaging in her creative process. Her textile artefacts are digitally inkjet printed on to silk and further embellished using a hybrid craft technique in which she hand renders layers of dyes and elaborates the fabric surface using appliqué and stitch.

Bell's work is influenced by the location in which she lives and expresses her concerns with the impact of man on the environment and its transactional effect. For this reason a specific geographic location familiar to both the practitioner and researcher was selected as the visual starting point for the experiment and reference material in the form of watercolour sketches and digital photographs were made. It was agreed that the concept of shared visual memory of this location would form the basis of the work produced and it was anticipated that the digital conjoining and intervention into two sets of memories would stimulate imagination and enhance creativity. A decision was made before the experiment commenced that six digital renderings would be made, each one building upon the others previous iteration but with no restrictions on what intervention or addition could be made to the previous stage. The images were saved onto CD and exchanged following each rendering. On completion of the experiment, it was agreed that the final result would be digitally printed on silk.

Any empirical exploration of creativity as a phenomenon must take account of the social and personal influences on creative motivation and note those aspects of technological use that act as both positive and negative extrinsic motivational forces. In order to be creative an individual requires freedom of self-expression that is unrestricted and non-judgemental; it must be possible to take risks, think in a divergent manner and be relaxed. The task must be considered more like play than work and be one in which the individual can become fully engaged and absorbed in without distraction (Gardner 1993). Interview feedback during the experiment indicates that the participants have been able to feel uninhibited by the process despite the evaluative nature of the study and Bell has indicated that she has found the experience 'playful and stimulating'. The empirical evidence gained to date supports the view that the potentially negative extrinsic motivational factors such as evaluation and reward can act in a positive way when the evaluation is supportive and the reward is not a distraction but providing stimulation for future intrinsic motivation (Amabile 1996). Further experiments are planned to establish the validity of the findings from this initial phase.

Although this research is still at an early stage, it is evident that digital imaging is impacting on creative practice as revealed in both the created artefact and the generative process. The effect of technological deployment on creativity is however also dependent on the intrinsic motivation of the practitioner and their psychological attitude to it. For some practitioners the mental modelling required to engage with software is inhibiting and breaks conceptual flow\textsuperscript{63} and for others the lack

\textsuperscript{60} J.R. Campbell (textile designer) and Jean Parsons (fashion designer)

\textsuperscript{61} Philip Delamore, London College of Fashion

\textsuperscript{62} Alison Bell (textile artist)

of physical tool manipulation is demotivating. However for those practitioners who have overcome these constraints through practice, play and specialisation, the technology provides access to a wealth of tools and embedded knowledge that can enhance the creative process. The ease with which electronic data can be communicated is also facilitating collaboration and providing a means of shared imagination, making thought visible, sparking insight and enabling innovation.
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References:


Distributed creativity: collaborative digital textile design practice

Conference paper for: D2B 1st International Design Management Symposium
Shanghai Jiaotong University
Shanghai, China
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Abstract

Distributed knowledge and expertise, supported by digital communications technology, is widely utilised for product design and development in the textile and fashion industry. Collaboration at the generative stage of creative textile design practice is however, rarely a shared experience.

Production speed digital ink-jet printers will soon provide a viable alternative to analogue printed textile manufacture and eliminate the associated production constraints that shape the visual characteristics of surface pattern designs. Textile ink-jet print processes are able to accurately replicate digital images, in millions of colours and across the full width of the cloth. The role of the computer in the design process is evolving from production tool, used to amend hand rendered work for manufacture, to a creative medium for design conception. The ease with which digital visual data can be communicated electronically suggests that design origination could also become a collaborative process.

Recent phenomenological research at the University of Wales Institute Cardiff, has investigated the ways in which digital tools impact upon creative textile practice. Qualitative research methods, including a case study comprising three field studies and practical investigations, have been used to collect data. Video, photography, research journals, and email correspondence have provided a record of practice for reflection and analysis. The case study was designed to enable a comparison to be made of creative strategies and digital tool use, deployed by a range of textile practitioners; these included a textile artist, craft practitioner and commercial designer. This paper specifically focuses on one aspect of the research arising from the case study and describes a collaborative investigation with a New York based textile designer, Debra Bernath.

The findings presented in this paper propose that digital imaging, combined with digital communications technology, can be used to support distributed creative textile practice. The investigation with Bernath indicates that practitioners, situated in different geographic locations and time zones, can share and develop visual concepts using the Internet. This process has been found to enhance creative practice and facilitate collaborative origination of design concepts. Issues have emerged from the findings, which have implications for further research in this field; these concern the personal qualities necessary for successful collaboration, trust and appropriation within the design process, and authorship of the resulting artefacts.
Distributed creativity: digital tool use to support collaborative surface design practice

This paper draws on the findings from phenomenological research at the University of Wales Institute Cardiff, which has investigated the impact of digital imaging technology on creative printed textile design practice. It suggests that a new paradigm exists for printed textile design, in which digital imaging and electronic communications technologies are able to support a collaborative creative process. Recent research in human computer interaction suggests that an understanding of cognitive processes used in the generation of creative ideas is necessary before any assessment of digital tool use can be made (Hewett, Czerwinski et al. 2005). Studies of creativity in psychology research by Amabile (1996), Csikszentmihalyi (1996), Gardner (1985, 1993), Smith (1995) and Sternberg (1988), have informed this particular inquiry and data has been gathered using ethnographic qualitative methods including case study and practical investigations. The paper focuses specifically on one part of this research, describing a collaborative practical investigation with a commercial textile designer; data from the project as a whole, has been used to inform the findings that are presented.

Textile Printing Processes

Printed textile design is affected and constrained by the manufacturing process. Recent developments in textile digital ink-jet printing are providing alternative methods of translating pattern and image onto cloth (Campbell 2005). Although computers have been used in industry for several decades, to prepare artwork for printed textile manufacture, it has not been possible to print digital images directly onto fabric without substantial modification to accommodate the analogue process. This required the reduction in the number of colours and generation of separations for each one, comprising repeating units that would fit the sizes of rollers used in manufacture (Bunce 1999). None of these production constraints are required in the digital ink-jet print process: the full width of the cloth can be printed in millions of colours; there is no imperative for repeat (Briggs and Bunce 1995). Digital ink-jet printing is now able to compete with analogue printed textile manufacturing on speed, flexibility, and economy, and is thought likely to supersede it in the near future (Dehghani 2004).

Changes in production methods impact the creative practice of designing textiles: apparel designers can visualise the placement of pattern within the garment shape, craft practitioners can produce one of a kind artefacts (Campbell 2005). The accurate rendition of digital image onto cloth is opening up new methods of inquiry for textile artists, encouraging original forms of image making and stimulating innovative approaches to generating ideas. Digital cameras, video, and scanners allow visual material to be gathered from many sources to stimulate creative concepts. Software enables imagery to be manipulated, transformed and merged: colour and scale can be rapidly changed, digital layers used to produce novel visual effects, diverse images can be blended together, copied, cut, pasted and transformed. Digital communication facilitates transfer of this visual data between practitioners, enabling collaborative concepts to be developed (Polvinen 2005).

In an industrial context, collaboration is integral to product development. Economic factors have led to the growth of outsourcing and manufacturing strategies in which designs for printed textiles maybe communicated via the Internet, across geographic locations and time zones to print production sites (Crawford 2003). Companies communicate design data in-house, between departments to coordinate the process of product development, marketing and sales, and outside the company to dye houses, manufacturing sites and retail outlets. Collaboration at the generative stage in textile design evolution is however, rarely a shared experience.

Research methodology

The research that has informed this paper investigated the ways in which digital technology impacts upon creative textile practice and in particular, the generative stage of concept development. Mental processes, resulting from human centred action, are difficult to interrogate and require a methodology that can have validity when complex variables are inherent. A qualitative phenomenological model is required, in which an analytical description can be made of
conscious experience. Mason (2002) contends that through disciplined noticing and recording methods it is possible to build research data that yields useful information concerning the complex multifaceted cognitive structures that ultimately result in human action (Mason 2002). The techniques of disciplined noticing, recording and reflection on practice, have guided the collection of research data in this study. Digital video, audio recording, reflective journals, photography and personal correspondence, resulting from a case study comprising three field studies, and a series of collaborative investigations, were used to generate this data. The practitioners included in the case study and investigations, were selected to reflect the diversity in creative approach and included a textile artist, craft practitioner and commercial designer. This paper describes part of this research, focusing on a collaborative investigation with a commercial textile designer.

Findings from the case study indicated that use of digital imaging technology enhances creative practice, stimulating the development of ideas at the generative stage, through the review, organisation, storage and compositing of visual data. To examine how communication of digital visual data impacts on creative practice, a collaborative task exercise was carried out. This involved the development of digital textile design concepts with Debra Bernath, a textile designer based in New York. Email and telephone conversations were used for gaining feedback during the project and the researcher documented stages in the development of her contribution in the design collection. Analysis of this recorded data, feedback from the designer and the work created, have provided information concerning the ways in which digital imaging is able to support the creative process and enhance collaborative design practice.

Collaborative Investigation

Development of the design work was first discussed during the case study field visit, in New York, in May 2004. It was decided that a series of experimental digital images would be created collaboratively, to express a shared memory of the visit. In addition, development of a small collection of commercial textile designs was also discussed. The proposal for this work was finalised during a meeting with the designer, in Wales, three months later. Visual data, recorded during the visit, became the stimulus for imagery used in the design collection. The practitioners agreed a framework for the project; this included development of visual ideas using Photoshop® software which would be exchanged, modified and added to, in an iterative process, using the Internet to communicate files. It was also decided that the final output would be digitally ink-jet printed onto a textile substrate suitable for apparel, and would express the shared memory theme.

Recent findings from experimental neuroscience research have revealed the importance of memory in the human ability to make sense of lived experience, and in the development of thought processes (Rose 2003). Ward (1995) describes the value of prior knowledge in creative thinking and states that ‘we must always rely on some type of stored information when we develop any new idea’ (Ward, B. in Smith, 1995). Memory of shared experience was considered to be a useful source of visual stimulation for the collaborative work; it also provided an opportunity to study the affect of memory within the creative process. Both visits visually informed the developing design work, and digital photographs, video and on-site sketches were made at the outset of the project for this purpose. Two experimental textile artworks were created from visual concepts based on New

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465 Detailed descriptions of this research can be found in ‘The impact of digital imaging technology on creative printed textile practice’ PhD Thesis, University of Wales Institute Cardiff (Treadaway 2006).

466 Mason writes: ‘the construction of a task exercise is the most fruitful form of research report, because it enables others to experience something of what the researcher claims to notice and then to test it out in their own experience.’ Mason, J. (2002). Researching your own practice: the discipline of noticing. London, Routledge Falmer 2002.

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York: a series of three digital ink jet printed cotton velvet panels called 'New York Skyline' (Fig. 1) and a second work, also printed onto cotton velvet, called 'Empire State' (Fig 2). These images were developed as artworks, without consideration of commercial constraints.

In the second body of work, six co-ordinating commercial designs were produced based on visual memories of the designer's visit to Wales in August 2004 (Fig 3). A selection of digital photographs, taken during the visit, were posted on the website to initiate the design process. These were responded to by the designer and the images uploaded to her website. The researcher downloaded the images, modified and added to the imagery before transferring back the emerging visual concepts via her own website. This iterative cycle continued until the designs were ready to prototype. Test samples were made using a Mimaki TX2 textile digital ink-jet printer, using reactive dyes onto cotton lawn, silk crepe de chine and chiffon. Some adjustments were made to colour balance, scale and composition before final printing onto silk crepe de chine and silk chiffon (Figs. 4 and 5).

The apparel textile designs that were developed were based on scanned and photographed Welsh flora collected during the designer's visit. Two of the designs were created to exploit the potential of the digital process to print imagery across the full width of the fabric, without repeat, and all of the designs were printed in millions of colours. Those designs, which were developed into repeating units, exploited the digital facility to replicate imagery exactly, in great detail and with ease. Digital colour tools provided opportunity to adjust tone, hue and saturation precisely and facilitated coordination between the design concepts (Fig 6).

The practitioners' tacit knowledge of designing for analogue printing process, garment pattern cutting, market sector and cultural factors were influential in the development of the design concepts. Production constraints limited the creative exploration of generative ideas and framed the structuring of the visual concepts. The approach contrasted with the experimental method used to create the New York textile art, which was developed sequentially, with the collaborators constructing and responding to previous layers of imagery. In the Wales design project, most of the concepts were developed in parallel, with changes in digital layers providing alternative design options. The collaborative nature of the process provided time to reflect on ideas and forced appraisal of the work in progress, at each point of communication via the website. The result of this reflective process was the rapid development of non-sequential concepts, in which layers were interchanged, stimulating new insights and additional ideas. Designs were developed and refined in numerous stages, without the need for the substantial investment in time that is usually required in hand rendered work. It was possible to create design concepts freely, considering co-ordination of the collection as a whole, only as the project reached a climax. Use of layers and rapid manipulation of colours, backgrounds and motifs, made the co-ordination of designs simple, resulting in numerous design options. The reflection and selection processes became key elements, within the creative practice, requiring constant re-evaluation and decision-making.

Communication

Transfer of design data between designer and researcher, using websites and high-speed Internet connections provided an enhanced environment for collaboration. This was particularly evident in the development of the design collection, providing rapid feedback on ideas and the opportunity to continually modify layer of each design. Bernath's non-secure Mac website provided an easy method of viewing and sharing work in progress. The disadvantage of this site was the limitation on file size, which resulted in designs being posted either at a lower resolution, smaller size or in separate layers. The secure website, used by the researcher, lacked the simple interface and viewing facility but enabled huge files to be successfully up and downloaded. Access via broadband provided download times in a matter of minutes from Bernath's site and uploads of very large files in several hours. The same day delivery of design data kept ideas fresh and interest sustained in the project. Email communication and telephone conversations enabled discussion and reflection on the process to take place as the work progressed.
Some difficulties were experienced during the latter stages of design development. File sizes became almost unworkable on some of the non-repeating designs, due to the amount of RAM required by the software for image manipulation. This caused frustration at the final design development stage however, it was also noted that computer memory capacity was insatiable: as soon as more was available, increasingly complex tasks were attempted. Storage of large files also became a problem and additional hard drive capacity was required with back up of files onto DVD rather than CD. Images were kept as layers and communicated at 300dpi to ensure consistency in design development and no loss of detail.

Findings

Findings from analysis of the research data, arising from the investigation, suggest that digital technology, and the facility to communicate images electronically via the Internet, enhanced the creative process. The use of digital tools: video, scanner and photographs, provided efficient and rapid review of visual material at the generative stage, prior to design development. Electronic drawing tools, including Wacom® graphics tablet and tablet PC, were used to create hand rendered electronic marks, the mouse being used predominantly for selection from menus and tools. The inclusion of a large amount of photographic and scanned imagery posed difficulties when integrating electronic line work, which appeared clumsy and crude by comparison. Colour complexity and tonal variations in the photographic motifs, resulted in the need for comparable visual qualities in the electronic line work; this was achieved using the clone tool in Photoshop®, to emulate the detail in adjacent areas of the design.

Rapid communication of visual data stimulated associative thought in the collaborative practice. Visual material from a variety of sources was introduced unilaterally; the recipient’s response generating further associated visual ideas to develop the image. The practitioners noted that this generated spontaneity and surprise within the process. Bernath commented on the excitement engendered by the exchange of files, comparing the experience with receiving gifts. There was consensus that the process was felt to be playful, adventurous and stimulating; judgement was suspended and the sense of responsibility reduced. These are attributes widely considered by psychologists as enhancing creative motivation (Amabile 1996).

The punctuated flow of ideas, generated by the iterative process of collaboration, provided mandatory periods of reflection in which the practitioners were forced to refocus on the task, appraise the development of the work and make decisions concerning future progress. In the development of commercial design ideas with Bernath, this process encouraged design intentions and production constraints, to be examined. The creative framework, agreed at the outset of the investigation, enabled visual ideas to be managed and deployed purposefully; the sense of united intention, resulting from shared experience during the visits, was particularly useful in this respect. When difficulties were encountered, the digital facility to step backwards and return to an earlier rendition of the developing image was useful. In the commercial design work the constant playful exploitation of layers, and their transfer between images, stimulated a variety of new directions in the work.

File transfer, via the Internet, facilitated the accelerated sharing of imagery and the rapid development of visual concepts. Electronic communication made possible frequent feedback on the developing ideas, providing enhanced motivation and maintaining momentum in the creative process. Work with Bernath indicates that the collaborative origination and development of commercial design concepts, in different geographic locations and across time zones, is feasible via the use of websites. The shared process enabled a mix of cultural and personal, knowledge and experience, to be combined.

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468 A machine with 1 Gigabytes (Gb) of RAM was used during the project. Designs were created at 300dpi and 9000 x 9000 pixels.

469 Bernath states that she felt like she was ‘getting presents all the time’
Conclusion

Following the investigation, Bernath was asked to reflect on the collaborative process. Her evaluation indicated that she considered her creative practice had been enhanced and viewed the possibility of future collaboration favourably. All three practitioners, who contributed to the research project as a whole, supported this view. There was consensus amongst them however, that the success of creative collaborative practice relies upon the development of empathic relationships and requires shared values. The field study visit was helpful in establishing common understanding between the practitioners and provided a mutual experience from which it was possible to derive creative motivation.

Collaborative image creation raises significant issues concerning the authorship of the generated work and highlights the importance of trust in the partnership. Bernath did not consider authorship of the work an issue, preferring to regard the output as the result of a shared experience. Nevertheless, the capacity to integrate responses from more than one individual, via the digital medium, and to communicate and replicate it with accuracy, has considerable implications for the way collaborative work is perceived and its monetary value.

Creative practice is becoming increasingly collaborative\(^{470}\) in a world, which is progressively more connected (Malins and Press 2004)\(^{471}\). Polvinen (2005) contends that international collaborative work on product development 'is where the technology driven global industry of apparel textiles is rapidly moving today' (Polvinen 2005). Electronic communication of digital visual data provides the opportunity for design concepts to be co-originated, motivated by experience and knowledge, from multiple sources, practitioners and cultures. Accurate rendition of digital imagery as printed output and use of high-speed Internet connections has increased the potential of this collaborative strategy for the design of ink-jet printed textiles of the future.

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\(^{470}\) Greenhalgh writes: 'The 1990’s could be best characterised as being to do with interdisciplinarity...The key to success has been found in the willingness to collaborate. Facilitated by high technology, co-operatives and companies are changing the way radical material culture is produced.' Greenhalgh, P., Ed. (2002). The persistence of craft: the applied arts today. London, A. & C. Black.

\(^{471}\) Press (2004) cites Mulgan (1997) 'growing connectedness is the most significant social and economic development of our age; connectedness makes redundant most of the concepts of thought and action that have dominated our culture' Malins, J. and M. Press (2004). Craft is an anachronism - discuss... Challenging Craft, Aberdeen.
Fig. 1 New York Skyline (above) and detail (below)
Digital print on cotton velvet
3 Panels size: 200cm x 50cm

Fig. 2 Empire State (right)
Digital print on cotton velvet
Size: 200cm x 50cm
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Fig. 3 Wales Design Collection

1. Poppies and church window
   (Above) Developed from a digital photograph of a stained glass window and Welsh poppies.

2. Viola and organ pipes
   This concept (above) led to the development of 3. Viola with dark background (above right) in which the scale of some of the flowers have been digitally enlarged, the background re-coloured and the blue and yellow flowers incorporated from 4. Grass.

   The concept developed from a photograph of church organ pipes combined with scanned flowers.

3. Viola dark background (above)

4. Grass (below)

   All the concepts depicted are digital repeat units and can be digitally ink-jet printed at any size.

   Test prints were made on a variety of apparel fabrics including cotton lawn, silk crepe de chine and silk chiffon.

   The detail obtained on the silk crepe de chine was particularly notable and since the files are high resolution (300 dpi) can be printed to the full width of fabric 140cms without obvious pixelation.

5. Thistles (above)

   Developed from the grass design with cornflowers and thistles.

6. Poppies and cornflowers (above)

   This final concept combines elements from all the others, linking colours and shapes in the collection.
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Fig. 4
Viola and organ pipes
Digital print on silk crepe de chine
Photo © CT

Fig. 5
Viola with dark background
Digital print on silk crepe de chine
Photo ©CT
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