The Integration of Digital Technologies into Designer-Maker Practice: a Study of Access, Attitudes and Implications.

Isabelle Risner

A thesis submitted in partial fulfilment of the requirements of

University of the Arts London for the degree of Doctor of Philosophy

May 2012

University College Falmouth

Abstract

This research is a focused investigation of the use of digital production technologies by UK designer-makers. The Critical and Contextual Review begins by examining what is known about the UK designer-maker sector. It considers how making practices relate to history and theories of craft, exploring meanings of key concepts such as ‘skill’ and ‘productive autonomy’. It reviews contemporary digital craft practice, identifying it as a genre and examines both digital economy and digital tool-use trends, relating to craft.

The methodology Chapter 3 explains how the pragmatic philosophical approach taken justifies the focus on investigations of experiential practice and the specific mixed methods adopted. A series of experiential case studies looking at emergent practice is analysed using grounded theory techniques and concludes that in using digital tools the maker’s vision is the animating force in an inherently collective endeavour. This chapter is followed by an in-depth practice-based investigation looking specifically at the collaborative potential facilitated by digital possibilities. Chapter 6 presents an analysis of professional views based on interviews that probe the range and extent of technical and creative collaborations.

At each stage of the research a reflective enquiry points towards the next step and provides successive iterations of evidence. The thesis that emerges from evidence is the contribution to knowledge of this research. It is that a cross-fertilisation between craft and digital technologies produces a hybrid networked practice that can amount to a new type of technology-enabled and networked craft – *Technepractice* – in which ‘negotiated collective engagement’ is the driving characteristic. This presents a fundamental challenge to the constructed authenticity of productive autonomy in 20th century studio craft practice. The animation of collective resources, from exteriorised skill embedded in technology to the expertise of technicians and machine operators and the use of digital data sources, requires a re-evaluation of the location and meaning of skill in digital craft practice. A full account of the digital ‘proposition’ for craft, both the opportunities and threats, places digital craft in the context of other digital creative industries and explores possibilities for extending practice from collaborations to digital business models.

Acknowledgements

This research is part funded by the European Social Fund, project no 09099NCO5.

This research is an examination of the collective character of digital craft and also the result of considerable collective effort. Therefore I would like to thank:

University College Falmouth and the Autonomatic 3D Digital Research Group for the PhD studentship opportunity and support.

My Supervisors: Dr. Katie Bunnell, who leads the Autonomatic Research Group at UCF and particularly, my Director of Studies, Dr. Justin Marshall. Both have been at the forefront of digital craft research and practice for over a decade. Dr. John Butcher formerly of University College Falmouth and now at the University of Derby and Dr. Peter Walters from UWE, who have made invaluable contributions at key moments. At a time when changes in the university sector mean that their work is particularly pressurised, they have all found time to support my research in different ways.

The academics and researchers at the numerous conferences, seminars and workshops I have attended, particularly for the written accounts on which this work draws.

The interview and research participants, all of whom were generous with their time and views.

The technicians and technical support I relied on to realise practice work, particularly Liz Mehen and her team.

Dr Larissa Naylor, whose unpublished research data was generously offered as the basis for a craft installation, detailed in the practice collaboration: Chapter 5. Family and friends and particularly Ken McMahon who, as a digital expert and author, is the best collaborator I could hope for.

Previous Presentation: Chapter 4 considers a knowledge transfer project called *Making it Digital*, run by Hidden Art and Hidden Art Cornwall, at University College Falmouth (UCF) during 2008, co-funded by Arts Council England and UCF and carried out within Autonomatic – the 3D Digital Production Research Group at UCF. This was the subject of a paper presented by the researcher at Design and Craft: A history of convergences and divergences. 7th Conference of Design History and Studies (ICDHS) September 2010 (Risner, 2010).

Practice work has been exhibited, and other elements of this research have been presented, by the researcher or informed the researcher's participation in seminars, workshops and lectures but have not previously been published.

Table of Contents

The Integration of Digital Technologies into Designer-Maker Practice: a Study of Access, Attitudes and Implications

List of Appendices — Appendix page

Thesis keywords: DIGITAL, DESIGNER-MAKER, COLLABORATION, CRAFT, DESIGN, HYBRID, SKILL, TECHNOLOGY.

List of Figures

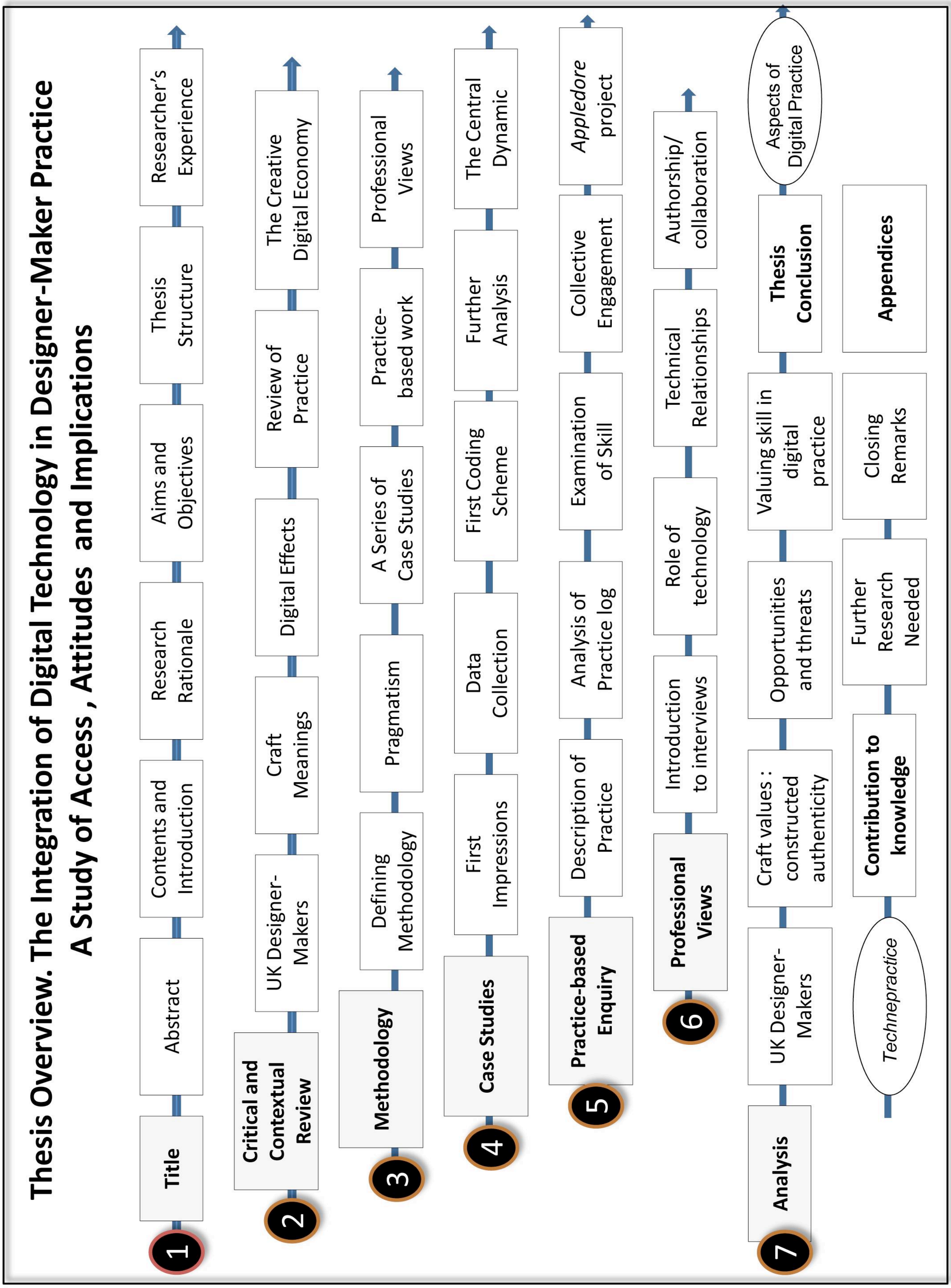


Figure 1: Thesis Overview: Chapter and Sections.

Chapter 1: Introduction

This research is concerned with implications that follow from the increased use of digital technologies by designer-makers in craft practice. These technologies are widespread and varied and encompass communications, design and production applications. Digital technologies enable, for example, the use of digital data, file sharing and 2D image manipulation. 3D applications include every stage of object production from data capture via 3D digital scanning, to design and manufacture via Computer Aided Design and Manufacture (CADCAM) applications. Digital production equipment includes laser cutters and engravers and Computer Numerically Controlled (CNC) routing and milling machines. Digital production equipment for particular disciplines are also available, such as digital jacquard looms (textiles) and digital print applications, for example, in ceramics. Recent developments in generative software and 3D printing (Section 2.5) have opened up another range of possibilities. Beyond the immediate design and production of objects, internet-based communications, networks and marketing platforms are also having an impact on the craft sector, and implications related to the digital economy follow from the increased use of internet-based digital tools. Across the spectrum of digital technology developments this research asks a basic question in relation to craft practice: *What is the impact on practice of the use of digital technologies?*

Section 1.1: Rationale for the Research

Significant work already exists in the field of digital technologies and craft practice. The experiences of makers experimenting with digital technologies have previously been researched. For example, within the TACTiCS (Toward Applying Computer Technology in Craft, Scotland) (Curtis, 2004) project, which provided video interviews with four makers using technology in the late 1990s. PhD work by Bunnell (1998), Marshall (1999) and Marshall, John (2008) among others, have also investigated the field of digital technology use in craft. All identified interest from makers and business potential and, in different ways, explored and theorised practice. A detailed review of previous research is contained in Section 2.3.1.This research seeks to synthesise and further develop this work. It looks at theories of craft and at both the opportunities and threats to craft contained within the ‘digital proposition’ (Section 2.5), particularly by exploring the working methods and productive dynamics of digital craft practice. Digital craft practice is theorised in relation to the wider digital creative economy, as it exists today. This research specifically investigates the collective and collaborative aspects of digital technology engagement and how this reflects developments in the digital creative economy and other digital creative industries. The central questions listed below are, in part, a response to questions raised within the researcher’s own practice. They reflect a desire to investigate if digital tools, often represented as a positive extension to practice, may also in some circumstances imply a degree of change in practice that fundamentally alters what we understand by craft. These questions are explored through case study analysis, practice-based work, interviews and critical analysis of available literature.

- What are the creative motivations for using digital technologies for designer-makers?
- Where is skill and knowledge located within digital work?
- How does the use of digital technologies impact on the character of craft practice?
- What is the role of organisational models that support access?
- What working practices does digital technology use imply?
- What digital creative economy opportunities do makers see?

In the decade since Bunnell and Marshall concluded their PhD research, the economic and technological context of digital craft has significantly altered. The researcher's thesis concerns not so much the use made of particular digital technologies by individual designer-makers, but seeks to theorise and chart the emergence of 'digital craft practice' from the wider field of contemporary craft and designer-maker practices. The researcher believes that this research is timely because it has been undertaken as a clearer pattern of developments in other digital creative industries, and the implications of a global digital economy, are emerging. It is intended as a way to synthesise, confirm or deny previous research findings and to build communicable models of impact on practice. The researcher seeks to identify, theorise and make practical recommendations regarding how 'digital craft practice' differs in fundamental characteristics from other forms of craft practice, particularly with regard to the implications that follow from supported access to expertise, equipment and networks that may be necessary.

Section 1.2: Aims and Objectives

The research documentation; Application to Register for a Research Degree, University of Arts London, RF3, stated that the aim of this research is:

'to produce and evaluate evidence and formulate knowledge with regard to the impact of cutting-edge technology adoption on design and craft micro businesses. The research will focus on the process of change and whether it can extend practice'

The research objectives are:

- To identify individuals and micro businesses in the object design and craft markets who are engaging with CADCAM technologies in innovative ways, describing examples of best practice.
- To research and consider the implications of access models for digital object making and selling, from online bureaux to local access initiatives such as technology workshops.

- To critically map the emerging theoretical basis for distributed making and technology adoption.
- To develop a new theoretical and practical understanding of the mechanisms and implications of designer-makers adopting new technologies and working practices, including following the process of change with a number of South West case studies. Are new definitions of practice needed or justified?
- To enhance the researcher's understanding of the process of moving towards a digital practice through exploratory practice-based research. This will provide rigorous documented insight on a personal level of the barriers, rewards and collaboration inherent in new technology adoption and thereby provide examples of technique and process, highlighting relevant issues and empathising with makers.

Section 1.3: Thesis Structure

Chapter 2: Critical and Contextual Review

The role of the Critical and Contextual Review is to provide an account of the theoretical landscape and background knowledge within which this research is situated, and in doing so identify a gap in knowledge. This review begins with an account of what is known about UK designer-makers and their current practice, the industry sector and its place within the UK creative industries. The review goes on to explore the historically bounded meanings of craft and considers the contested meanings and values that make definitions of terms such as 'craft', 'skill' and 'hand-made' both interesting and problematic. It considers how the '*constructed authenticity'* (Journal of Modern Craft, 2008b:179) and productive autonomy of studio craft practice, in as far as it is conceived of as an antidote to industrial manufacture, is challenged and exposed by contemporary digital practice, leading to the need for new definitions. Previous scholarship and writing about the implications of using digital tools, both the challenges and the potentials, are examined. A gap in current knowledge of digital practice and its impact on working methods is established. The researcher puts forward a view of how 'skill' in digital craft work can be assessed and valued. Examples of digital practice are presented through reference to a number of contemporary makers, exhibitions and conferences and the research suggests the establishment of a digital craft genre. Chapter 2 concludes with an account of how trends within digital technology in creative industries and the wider digital creative economy underpin and support the expansion of this type of hybrid practice. The Critical and Contextual Review builds the researcher's case for considering digital craft as a distinct genre, and establishes that this research is timely in the altered context of change within digital creative industries.

Chapter 3: Methodology

The methodology addresses the question of what was done to answer the research question and why this particular approach was taken. It develops and justifies a research methodology, centred on investigations and analysis of practice. A pragmatic philosophical approach underlies the chosen methodology; this triangulates evidence from a number of sources and takes a view of technology as 'an active counterpart' (Section 3.2.1) in practice, bringing specific potentialities and agendas, in an open-ended dialogue with makers. The methodology utilises a mixed methods approach that draws on elements of case study research, action research, grounded theory and qualitative interview analysis. Terminology, definitions and justifications for the inclusion of both a practice-led element examining a series of case studies, and a practice-based element examining the researcher's own work, are described and discussed.

Chapter 4: Case Studies: Making it Digital

A knowledge transfer project, *Making it Digital* (MiD), is the subject of the research reported on in this chapter. The researcher conducted a series of case studies among a small group of participants engaged in a mediated project to develop a new product using digital tools. An analysis informed by grounded theory is used to identify concepts, drivers for change and to categorise benefits and problems revealed through observations, interviews and focus group work. It concludes by identifying, describing and analysing the concept of 'negotiated collective engagement' as the driving characteristic of this investigation. The researcher, in conducting a context-specific study, closely following a small group of makers, some of whom are novice technology users, seeks to identify and model the creative and productive potential from the maker's perspective and the barriers to creative digital craft practice.

Chapter 5: Practice-based enquiry

In this chapter, the researcher's own practice and experimentation with digital tools is examined and presented through an extended action research practice-based enquiry. This examination initially focuses on how digital practice impacts on personal ownership of skill. The researcher reflects on digital potentialities and constraints, the ways in which digital tool-use is experienced and negotiated by makers. It probes how far the researcher's practice matches the collective model described in the previous chapter, depending on help, skills, embedded knowledge and technical assistance of others for successful outcomes.

The researcher then describes a project intended as an example of how digital technologies can facilitate collaboration. The '*Moving Boulders'* project is a collaboration between the researcher and Geomorphologist, Dr. Larissa Naylor of the University of Exeter, who allowed her scientific data to be used as the basis of a ceramic installation. The scientific study of boulder movements on a rocky Welsh coastline during a storm event was re-mapped and interpreted in combination with other imagery and then translated into markings on translucent porcelain panels, exhibited within a light box installation. This was a collaboration enabled through digital tool-use, as well as through access to common software, platforms and joint authorship.

Chapter 6: Professional Views

Chapter 6 continues to build on the research presented in previous chapters. The opinions of a number of professional practitioners with extensive experience of digital tool-use are investigated through a series of in-depth interviews. These interviews were designed to test the emergent thesis and research findings, in part, by probing the extent and nature of technical relationships and collaborative practice. The balance between the retention of personal productive autonomy and the need to rely on outside expertise is explored and considered in the context of individual experienced practice.

Chapter 7: Analysis

This chapter summarises the previous research and extends an analysis by citing evidence from across the thesis. It considers *Aspects of Digital Practice* (Section 7.5), reflecting on the research outcomes and stating the contribution to knowledge presented (Section 7.6). It presents the researcher's view that the cross fertilisation between craft and digital technologies can produce a new hybrid networked version of craft practice that challenges notions of productive autonomy and engages with the digital 'proposition' for craft, placing digital craft in a contemporary context alongside other digital creative industries. The keynotes of change identified in this study are collective engagement and collaboration. The researcher's identification and description of a type of digitally enabled and networked craft practice, which she terms *technepractice* (Section 2.3.8 and Section 7.5), is explored. This, in the researcher's view, involves a shift from productive autonomy to focus on authorial autonomy, re-skilling (Section 2.2.4, Section 2.3.7) and creative agency, in negotiated complex collective engagements.

Section 1.4: Researcher's previous experience

The researcher is a mature student with a professional background as a researcher and journalist, particularly in the field of consumer affairs. Having worked for leading consumer and research organisations she has experience of analysis, including qualitative and quantitative techniques. The skills involved in journalism, particularly interviewing and empathising with the narrative experience of practitioners, alongside an interest in learning about appropriate Social Science methodologies, benefited the researcher in undertaking this research. More recently, the researcher has been fortunate to be able to pursue a long standing personal interest in artistic practice and craft, by studying on the Contemporary Crafts B.A. Hons. Degree at University College Falmouth, from which she graduated in 2007, First Class. During this three year course, the researcher was introduced to an extensive range of craft related production processes, including mould making, slip casting, glass slumping. She chose to focus, in her final year, on porcelain ceramic production. She was also introduced to digital design and production methods and is therefore in the position of carrying out research having been recently introduced to some of the technologies under investigation. As a practitioner herself, although a novice practitioner in both digital and traditional craft practices, the researcher has particular insight into how makers experience and adapt to new processes.

This research arises out of the questions that the experience of this degree and the researcher's previous experience raised, in relation to possible conflicts, for example, between depth of craft making skill and the use of digital tools. Theorists tended to suggest that a craft practitioner has to know a great deal about a narrow field –the ten-thousand-hour-rule (Sennett, 2008:247) or the 'chronomanual'(Leigh, 2002:33) content of craft – both of which express the importance of time invested in honing a particular skill to produce a high quality outcome that meets craft value criteria (Section 4.6.3). Yet the researcher's previous experience reinforced a view of digital technologies as constantly being upgraded and outdated, offering multitudes of possibilities, requiring continual learning, and suggested a reliance on a variety of sources of technical help.

The ways in which practitioners reconcile digital technology use with depth of craft practice was a key theme within this research. The initial attraction the researcher felt for digital techniques could be accounted for by a desire to substitute novice manual skills with better quality digitally achieved finishes, in her own practice, for example through the speed and accuracy of laser cutting. It quickly became apparent that an accuracy and precision that provided a 'professional' quality finish was indeed achievable through digital techniques, though often it involved just as much difficulty, detailed work and dedication as doing it by hand. It was also possible, and more interesting, to achieve effects that could not be achieved by hand - the '*otherwise unobtainable'* (Harrod, 2007) – and an element of digital production (CNC milling within a mould making process) was a significant contributor to the pieces judged to be successful outcomes of the researcher's degree (Figure 2). The researcher became interested in how far digital production might be taken and began to reflect on some of the issues suggested by her early engagement with digital tools, such as a need to understand and appreciate the wider context of digital tool-use and aesthetics. Questions arose such as: what are the implications of employing a digital visual language, what connotations are conferred onto the work, should the use of digital tools be transparent or hidden in the piece? Reflections settled on the central question: what is the impact on craft processes and values of employing a digital approach? This research therefore resulted from a first-hand appreciation of the issues inherent in successfully integrating craft and digital practices.

Figure 2: Isabelle Risner, slip cast porcelain teapot, Degree Show 2007, photograph Ken McMahon.

To conclude this introduction, this research explores the view that; from the language of digital aesthetics to implications for working practices, using digital technologies brings its own set of complex conditions. It is an attempt to unpick and make explicit the 'digital proposition' (Section 2.5.9) - the ways in which a choice of digital tools brings with it particular agendas and potentialities, and how individual practice exploits and explores specific applications. The intention is that a better understanding of the digital framework within which digital craft is produced will allow makers to respond better, to the opportunities and the implications for their practice. This research therefore takes an interest in implications of using digital technology within practice (rather than technology *per se*) as its main concern.

Chapter 2: Critical and Contextual Review

Section 2.0: Introduction

In deciding where to look for critical and contextual review material, the researcher began with the two broadest contexts within which this research is situated: 'art, craft and design' and 'digital'. Within the 'art, craft and design' context the review focuses on literature that can help to contextualise and understand the 'experiences of UK designer-makers' during the processes of designing and making 3D objects using digital technologies. Within the 'digital' context the focus is shifted from designing and making to digital trends within the creative industries, to the characteristics and opportunities of the digital creative economy.

The first section attempts to establish what is meant by UK 'designer-makers' and place some economic estimates and markers around this industry sector (Section 2.1) Having established the intended use of 'designer-maker' within the research and its relationship to art, craft and design practice, it then goes on to look at craft histories and theories in detail. The focus here is on a detailed understanding of craft practice (rather than design or art) because the research is centrally concerned with productive technologies and the challenge or opportunity they present to makers' skills. It is the craft element of practitioners' work (along with marketing and commerce) that is the focus of this research into changes in practice.

In Section 2.2 an analysis of 'craftsmanship' and aspects of the meaning of 'craft' is organised through a discussion of four major questions at the heart of the digital challenge. These are:

- What identifies craft production?
- How do we understand and value craft skill?
- Why is productive autonomy so valued in craft production?
- What do we know about the myth and reality of craft's relationship to industry?

Moving from craft to the 'digital' field of literature, potentially encompassing the global digital marketplace and future developments, it was important to identify some issues that are relevant (and have been outlined within this review) but which it was not necessary or desirable to deal with in great depth. The issues shown at the bottom of ***Figure 3: Overview: Critical and Contextual Review*** (below the main focus) are examples of relevant areas within the wider digital field which are excluded from the detailed review. Overall, it is hoped that the broad view of 'digital' is balanced by an in-depth view of 'craft', and this review intentionally focuses very much on craft theory and practice and how these may be impacted by digital practices. This underlines the research focus: designer-maker experiences and changes in making practices, rather than digital business developments. The researcher conducted a review of the full range of text-based and visual reference material, including academic research and reference materials, books, journals, catalogues, conference and policy papers, exhibitions, websites and collected additional material by talking to interested parties.

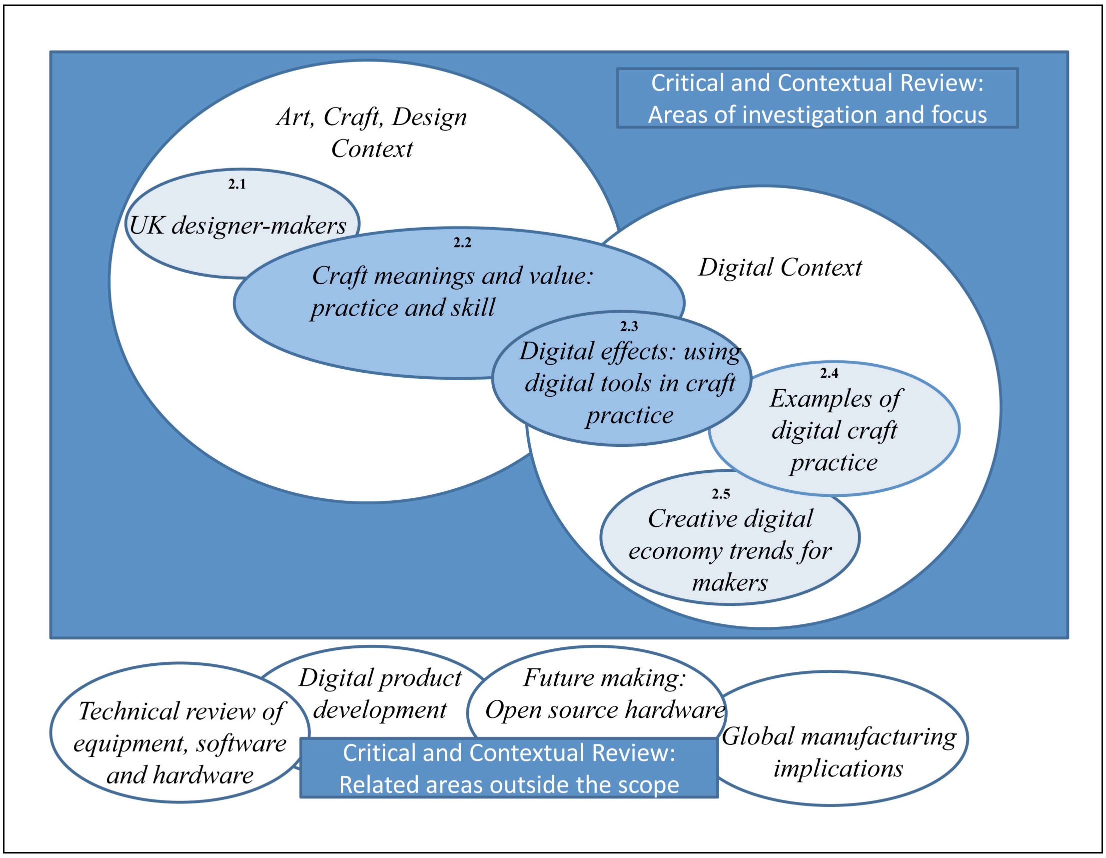


Figure 3: Overview: Critical and Contextual Review

Section 2.1: UK Designer-Makers

This thesis title identifies UK 'designer-makers' as the group under investigation. Who are they? And how many of them are there? From the outset of this research these have been rather difficult questions to answer. At an early stage of this study the researcher talked to a small group of current makers and almost immediately discovered that the term 'designer-maker' was not a very popular one (see Section 4.4). For many of the makers who were interviewed the terms 'designer-maker' and 'craft' are not the ones they most readily identify with. In fact, the researcher found wide acceptance of a variety of shifting and changeable self-nominated identifiers, with some makers favouring 'designer', and others more specific terms such as 'jewellery-maker' or 'furniture designer'. In general, there was a willingness to embrace a multiplicity of terms, depending on circumstances and the pragmatic usefulness of the title in context. Terms that referred to materials and making were generally focused and applicable to a smaller well-defined field, such as 'weave' or 'jewellery', emphasising the specialist nature of the work, whilst terms referred to in broader marketing contexts were more widely applicable and aspirational, and tended to be 'designer', or 'artist', rather than 'craft maker'. In both cases 'designer-maker' and 'craft' tended to lose out, yet these are the precise terms this critical review focuses on. The researcher feels this requires some explanation.

Initially, it was important to identify terms that had a resonance within the literature and on which previous research had been based, in order to access relevant published material. Previous closely related academic research in this field had cited 'designer-makers' (Bunnell, 1998, Marshall, 1999) and although other studies use the more general terms 'art' and 'design' practice (Marshall, 2008) or have been concerned primarily with a material field such as textiles (Treadaway, 2006) or industry sector such as jewellery (Wallace, 2007). Findings from previous related art, craft and design academic research are discussed in detail in Section 2.3.1.

Numerous searches within academic databases and electronic journals and newspapers were undertaken using a variety of alternative terms such as 'designer-maker', 'maker', 'designer', 'craft', 'contemporary craft', 'artist craftsman', 'craft artist', 'craft maker', 'jeweller', 'furniture maker', 'ceramicist', 'textile artist', 'metal artist' and so forth. These tended to reinforce the impression that the term 'designer-maker' is one that is in current use, but is not one that is very widely used. Searches, for example among electronic journals and newspapers, return relatively few results for the term 'designer-maker' (generally less than 50), certainly a tiny fraction of the results returned for 'maker' (though these are often associated with terms such as film maker) which in turn tend to be considerably fewer than the results found for 'craft' or 'designer'. The type of material that included the 'designer-maker' label was felt to be relevant, although it often referred to reviews of mixed exhibitions or facilities for makers or organisations that represent designer-makers as a group. So jewellers, furniture makers, ceramicists, textile artists are more commonly written about as separate sectors, than referred to as 'designer-makers'.

However, for this research, which sought to look across specialisms, at cross-disciplinary practice, a generic term was needed and, as far as significant generic studies had been done before, designer-maker seemed to be the most commonly used term. The researcher feels that there is no other single alternative term that is more useful but that a number of terms are needed to access all the relevant material. There is some limited evidence that the term is becoming more popular, for example the Guardian and Observer newspaper archive records 21 uses of 'designer-maker' in the ten years 1.1.1990 to 31.12.1999, rising to 61 instances in the 11 and a half years from 1.1.2000 to 16.6.2011.

Designer-maker carries with it (in common with artist craftsman or designer craftsman) a suggestion of relating to a specific historic period, perhaps most strongly the 1990s. One reference suggested that the 'designer-craftsmen' within the 1950s UK furniture making sector had evolved into the less gender specific 'designer-maker' in the 1970s.

'*The term 'designer maker' evolved from 'designer craftsman' in the late Nineteen Seventies during a period that has been called the British Furniture Craft Revival (alongside the other craft disciplines). The word 'craftsman' was beginning to be devalued in popular culture with its obvious additional sexist connotation'* (Broun, April 2005)

Within Tanya Harrod's craft history reference text *The Crafts in Britain in the 20th Century* (Harrod, 1999) the term is used rarely, one exception is when Harrod uses it to describe encounters between designer makers and industry in the 1980s (Harrod, 1999:416). Harrod charts every nuance of shifts in craft meanings and significance but uses the year '*1989 as a rough ending'* and the researcher suspects that the absence of the term designer-maker within Harrod's text itself dates the term primarily to the 1990s. A further historical reference is to a Crafts Council exhibition held in early 2001 titled: *Industry of One: Designer-Makers in Contemporary Britain'* this was reviewed in Crafts Magazine as featuring:

'*The rise of the designer-maker over the last 20 years… this exhibition demonstrates how designers have been forced by the lack of mainstream manufacturing opportunities to take a more entrepreneurial approach to getting their work made…. Some of these designer-makers make the pieces themselves, some contract a manufacturer, and some simply design.*' (BH, 2001: Crafts:169:15)

The show brought together both designers who had found mainstream success, like Ron Arad and Tom Dixon, with less well known makers, some working in recycled materials; it clearly took a broad inclusive approach to what constituted a designer-maker, although the emphasis again was on design for industry.

The contemporary relevance of the term designer-maker is therefore difficult to judge. The Design Council website recognises designer-maker as one of a dozen or so career paths in design, giving the following introduction:

'*Operating on the edges of commercial design practice are many crafts-based designer-makers. Bridging the gap between purely artistic endeavours and commercially briefed work, designer-makers design and manufacture limited edition, one-off or bespoke products for retail.'* (Design Council, 2012)

Here again the emphasis is placed on commercial products, with a focus on 'manufacture' and 'products for retail'. The Crafts Council website tends not to use the term at all, instead repeatedly using 'makers' and 'contemporary craft' although the National Register of Makers webpage within the Crafts Council site has the following introductory text:

'*The largest online directory of designer-makers in the UK, the National Register of Makers includes over 3,000 contemporary craft makers, highlighting the new professionals alongside established names.*' (Crafts Council UK, N.d.)

To attempt to further assess current usage, a word search within the preliminary London Design Week Festival (September 2011) website (www.londondesignfestival.com) was conducted. This is a nine day design festival with over 200 events and describes itself as *'...both a cultural and a commercial event. The programme ranges from major international exhibitions to trade events, installations to talks and seminars, from product launches to receptions, private views and parties'* (London Design Festival, 2011). A text search revealed a small but significant number of references (8) to 'designer-maker' including results for maker organisations, those offering studio space or advertising group exhibitions and links to a range of festival events. In contrast, 'designer' returned 223 results and 'craft' 85. A variety of alternative combinations also seems more popular, for example the separate words designer and making returned 26 results, whilst design and making produced 81 and design and craft returned 70. This small experiment is difficult to interpret beyond a general view that, in 2011, 'designer-maker' was a term that was used by organisations that need to talk about more than one specialism, it was also used by some individual makers but was not a broadly popular self-descriptor. The lack of popularity may be related to some extent to a lack of positive clarity about the term and a sense that it is somewhat dated, and limits the maker to the field of products for retail (for example, *artistic* interpretation and *design* innovation could be considered as sidelined by the focus on designer-*maker)* .

Harrod relates how the term 'maker' has at times been caught in skirmishes between art and craft territorial battles, criticised, for example, by Dormer in the context of the 1987 conference *The Vessel Forum* which sought to establish the art credentials of vessel forms: *'Vessel is such a gutless word, so much like 'maker' – and so much a part of the new craft vocabulary with its lack of precision and honesty.'* (Harrod, 1999:427). Harrod relates how successive attempts to move away from the well-defined terminology of craft specialisms and practice are intricately linked to the history of attempts to re-define and re-position craft, in this case towards art. The term designer-maker, at times, appears to suffer from a similar suspicion of lack of clarity and well defined substance and is associated with attempts at the re-positioning craft in a more broadly-based context. It does appear to the researcher, however, that inclusive terms such as 'maker' and 'practitioner' are now well accepted and respected terms in contemporary practice. Other researchers have also noted the tendency towards post-disciplinary practice in modern art (Adamson, 2007:168) and trans-disciplinary or hybrid practice in design (Marshall, John, 2008:308). Adamson, for example, concludes that the generic terms of reference for modern art: 'work' 'site' and 'practice' tell a story about the openness of post-disciplinary art that can be unfavourably contrasted with the studio crafts' restrictive insistence on making 'objects' in 'studios' in particular 'materials' (Adamson, 2007:168). The researcher considers that a generic inclusive interpretation of the term is therefore appropriate within a thesis looking at new technologies which encourage diversity of practice, cross fertilisation and inter-disciplinary work.

The researcher defends the use of designer-maker within this research on precisely this basis, as shorthand for the multiplicity of specialisms, as an imprecise and broad, and usefully 'gutless', umbrella term for individuals that design and make, rather than as a term makers identify with. So, within this research, it serves as shorthand for a repetition of a list of materials (from ceramics to wood), occupations (from furniture makers to metal workers), and possible areas of work (from bespoke and batch produced objects to installations, public art and architecture related practice). Any work, in fact, within which individuals or small businesses are designing and making objects on a relatively small scale including work of functional, conceptual or decorative purpose. The concept of '*intelligent making'* (Cusworth and Press, 1996) in relation to this type of practice is discussed below, Section 2.2.1.

Within this broad field the researcher is particularly focused on the 'contemporary craft' sector, in the sense of makers who are engaged, for at least part of their time, in development and production of contemporary craft objects for retail, and a number of research participants in Section 4.2 would fit this description. Indeed, the research case studies in Section 4.2 were engaged on a knowledge transfer programme run by Hidden Art, who use the term designer-maker: '*Hidden Art helps designer-makers and designers transform their passion into products.*' (Hidden Art, N.d). However, other research participants fall outside the contemporary craft field (usually because their work and self-description identifies more often with a broad definition of art or design). 'Designer-maker' within this literature review, then, is intended to encompass the multi-faceted, diverse and difficult to define wider conglomeration of artists, designers and craftspeople who are engaged, for at least part of their work, in 3D object design and making – it is useful as a portfolio term (a reflection of portfolio working, discussed below). It is broader than contemporary craft, *per se*, and here used to mean work that is broader than making objects for retail.

2.1.1: Industry Statistics

UK Government and industry body survey work in this area, generally aimed at establishing reliable estimates of the 'Craft Industry' sector size and worth, have been carried out primarily under the direction of the Crafts Council or, more recently, Creative and Cultural Skills (CCS) the Sector Skills Council for craft and other creative industries. These surveys use a variety of approaches and definitions.

The last major Crafts Council survey was conducted in 2003 and published as: *Making It in the 21st Century* (McAuley and Fillis, 2004). The introduction states that the survey is based on 2,083 respondents '*confirmed to be working professionally as makers, designers or artists*'. Two guiding principles for inclusion were inherited from the previous 1994 survey. These were retained for comparison and require that respondents were working from '*their own ideas or in collaboration with other makers, from original designs*' and '*took responsibility for all the working processes through to completion'* (McAuley and Fillis, 2004:3). The definition therefore broadly relates to the originality of ideas and the holistic nature of the designing and making process. These respondents were categorised by a mixture of material and craft sectors: textiles (23%), ceramics (21%), jewellery (15%) and metal (11%) being the four largest, with seven other smaller categories.

From these 2,083 respondents, an estimate was made of 32,000 makers generating a turnover of £826 million for England and Wales for 2003. This does seem to cover a relatively narrow definition that is related to the hand-making of craft objects for sale, as the authors acknowledge, for example, in a subsequent article about the survey.

'Given these varying definitions and interpretations of craft, the authors' working definition reflects both the tradition of craft and the contemporary nature of some craft production: Craft is taken to mean an object which must have a high degree of hand-made input, but not necessarily having been produced or designed using traditional materials, produced as a one-off or as part of a small batch, the design of which may or may not be culturally embedded in the country of production, and which is sold for profit' (McAuley and Fillis, 2005)

The authors also acknowledge that those working in the sector *'often view themselves as artists, designers or makers, rather than business people'* (McAuley and Fillis, 2005) . This survey can be viewed primarily as an attempt to measure those working in the contemporary crafts for retail sector, in many ways a sub-sector of a wider, more diverse group that works between and within art, craft and design. A distinction can also be made between 'the whole craft sector' and 'the contemporary craft sector' (Yair, August 2010:2). The first relates to the working definition of Creative and Cultural Skills whose Craft Impact and Footprint (Creative & Cultural Skills, 2008) statistics are based on official UK population and business data and produced as part of a series of UK creative industry sector statistics, placing the Crafts sector alongside sectors such as Design, Cultural Heritage, Visual Arts, Literature, Performing Arts and Music. The results of the Craft Impact and Footprint work (Creative & Cultural Skills, 2008) inform the Craft Blueprint (Creative and Cultural Skills, 2009) which uses this description: *'The crafts sector comprises individuals and businesses operating in contemporary crafts, traditional and heritage crafts, and certain skilled trades across all the categories in the table below'.* The table includes: ceramics, glass, heritage and traditional crafts , iron and stone, jewellery and silversmithing, musical instrument making and taxidermy among its categories and attributes the largest employment percentage in crafts to 'Graphic Crafts' (37%) including 'bookbinding, calligraphy, illustration, lettering, papermaking and printmaking', followed by textiles (15%) and jewellery (13%) (CCSC, June 2009:13) (Creative & Cultural Skills, 2008:3). According to this estimate the whole crafts sector is worth £3 billion annually to the UK economy with at least 88,250 creative practitioners working in the craft sector across the UK (CCSC, June 2009:15).

The two sets of figures (McAuley and Fillis and the CCSC: Craft Impact and Footprint) are not directly comparable; they cover different geographic areas and methodologies (the figures for similar sounding sectors such as textiles and jewellery have very roughly double the numbers in the CCSC figures). Both sets acknowledge problems with definitions and data collection. CCSCs' main aim is comparability with statistics profiling other creative sectors. CCSC acknowledge that its figures are also likely to be underestimates *'which are unable to capture the full production cycle or the many ways that craft professionals contribute to the wider creative economy'* (CCSC, June 2009:16) and that *'craft data presented here should be seen as an introduction into the sector and one where further investigation is necessary'* (CCSC, June 2009:16). Even this larger survey data, then, is likely to represent a sub-set of design, art and crafts people engaged in design and making. This point is made by The Crafts Council: '*active economic impact is likely to be significantly larger*' (Yair, August 2010:2).

Both sets of data agree few makers produce a full-time income from craft: *Making It* reports that 37% undertake 'portfolio' working, (makers with multiple jobs) combining a variety of craft and non-craft income streams. Whilst £25,826 was the average reported turnover (McAuley and Fillis, 2004:7), 41% reported a turnover of less than £10,000 and 36% of full-time women craft makers were earning less than £10,000 per annum (McAuley and Fillis, 2004:9). The more recent Craft Footprint statistics similarly report that 55% of craft makers earn less than £20,000 per annum (50% of men and 67% of women) (Creative & Cultural Skills, 2008:18) with 21% of all makers working on a part-time basis (Creative & Cultural Skills, 2008:11).

In the South West, where this research is based, the statistics show that craft is an important contributor to the regional economy. *Making It* reports '*substantial non-urban activity forming what could be termed clusters, such as those around Bristol and the South West'* (McAuley and Fillis, 2004:6), with 19% of respondents based in the South West (behind London 20% and the South East 17%). The Craft Footprint shows 10% in the South West (8,425), the fourth largest region behind London 18%, South East 14% and East of England 11%. In these statistics the high number of self-employed craft practitioners in the South West is highlighted, 47% compared to 37% nationally, as well as the relatively high number that are working part-time, 26% compared to 21% nationally. Regional research confirms that the contemporary crafts field is particularly important in the South West.

2.1.2: UK Designer-Makers and Craft Conclusion

This research uses the terms 'designer-makers' and 'craft' despite finding that these are not the terms that makers represented in the study would most closely relate to, preferring narrower sector and specialism-specific titles.. The term designer-maker is used as broad generic shorthand for those involved in designing and making rather than as representing a well-defined economic group, it is used in keeping with the principle of using broad terms that allow for diversity and inclusivity but retain the link to the fundamental practice of material transformation. The broadest terms are used because the use of digital technologies is relevant to a very wide spectrum of makers and making contexts. Designer-makers in the sense of those largely hand-making contemporary craft objects for retail as one income stream, broadly identified in the *Making It* survey, are a core group for whom 3D digital production technologies and digital marketing opportunities may be relevant and are largely based in, or have come from, material craft specialisms, such as textiles, ceramics, wood and metal. The meanings and values of craft are therefore the backdrop and context of their making experiences. For those who think of themselves within a broader spectrum of artists and designers (and may have potentially less personal concern over outsourcing elements of production – see Section 4.5) but are producing objects for sale that fall within the hand-made, bespoke, batch produced or limited production run categories, it is likely that the work they produce in this context will be viewed by the public as craft production.

Within the craft industry sector literature, it is worth noting that craft is clearly understood as an innovative sector with words such as dynamism, flexibility and commitment frequently used to describe craft practice. Emphasis is particularly laid on the ability of craft practitioners to develop new ideas and processes through making. The foreword to the Craft Blueprint describes craft as *'lively, entrepreneurial, independent-minded'*. The section on innovation states that:

'opportunities are presented by developments in digital manufacturing and technology. The new digital culture evolving in craft is significant with practitioners using digital design to explore new working methods, aesthetics, forms and surfaces and to work collaboratively with clients, users and other practitioners. Digitisation also provides an opportunity to further develop business models, with a new ability to increase economies of scale, as well as the possibility of creating a more personal service' (CCSC, June 2009:22).

These developments are the subject of Section 2.5. As we have seen, designer-makers operate in many guises: as material specialists, jewellers, furniture makers, ceramicists. They can be identified under titles as diverse as artist or product designer, darting in and out of selling arenas that vary from craft and design fairs, to direct e-selling, to a whole range of collaborations, installations, galleries, exhibitions, bespoke orders, or licence agreements with manufacturers. Sometimes some of them teach, sometimes they make, sometimes they design, sometimes they market and much of the time they do other self-directed activities that enable them to remain economically viable and creatively engaged. They are bricoleurs – piecing together elements of interest. They are closely associated with 'portfolio' working and identified as having transferable skills particularly relevant to the 'information age' economy. (Press and Cusworth, 1998:9). Existing research therefore identifies both digital potential and a predisposition towards active engagement in flexibly identifying and fashioning novel solutions, a pre-disposition towards innovation. These are highly relevant factors in the potential to adapt to (and exploit) new technology approaches, as they have in the past (Woolner and Wynne, 2006:4). This research investigates the implications for practice of working in a digital way.

Section 2.2: Craft Meanings

How designer-makers view using 3D digital production technologies within their practice will depend, to some extent, on how they view themselves, their work and their tools, and how new technologies and practices fit within, or are able to adapt to, a particular tradition. What craft can be, for them or their customers, relates to what it has meant for makers that have gone before, they in turn having been influenced by prevailing meanings within the craft, design, art and industry narratives. This section looks at craft meanings by addressing the following questions:

- What identifies craft production? (Section 2.2.1)
- How do we understand and value craft skill? (Section 2.2.2)
- Why is productive autonomy so valued in craft production? (Section 2.2.3)
- What do we know about the myth and reality of craft's relationship to industry? (Section 2.2.4)

These questions have been chosen because each pertains to an element of 'normative' craft practice or perception that could potentially be disrupted by the interjection of digital technology methods. Section 2.2 is therefore intended to establish the prevailing understandings of craft practice as the background against which digital technologies are a highly visible addition.

2.2.1: What identifies craft production?

The makers who formed the core case studies for this research, some of whom were embarking on experimental use of digital tools for the first time, could be forgiven for not wanting to associate themselves too closely with 'craft'. Craft retains, at least at the level of popular concept, some degree of backward-looking associations, what Adamson describes as the 'pastoral' aspect of craft (Adamson, 2007:103 -137). The designer-makers interviewed would generally rather be seen in the 'maker' or 'design' fields which initially resonate better with a digital and a contemporary outlook. In some cases 'designer' was just more appropriate to their background and skills. However, the researcher contends that it is craft practices and associations that need to be understood in relation to one-off and small scale manufacture, in order to be able to understand how digital practices can be integrated into making without sacrificing the positive craft '*added value'* of the objects produced.

Richard Sennett in his recent book *The Craftsman* (2008) seeks to locate craftsmanship in people who are '*dedicated to good work for its own sake'* (Sennett, 2008:20). He explores aspects of craftsmanship which he locates in a wide range of working practices (far more than just the small group of makers who work with their hands). Three important elements he identifies are: the time invested in becoming skilled, a self-critical problem-solving, problem-finding relationship to work and, lastly, a relaxed intensity of concentration whilst engaged in the activity, an attitude both towards engagement and letting go. They suggest a performative aspect to craftsmanship, an activity engaged in for fixed time periods, drawing on experience to confidently improvise within a core competency that is owned by the individual and has been developed over time. Many of Sennett's examples come from musical performance. The time involved in building skills is crucial to Sennett's outlook:

'*the so-called 'ten thousand hour' rule…10,000 doesn't mean anything in itself, it's a rough estimate, meaning you have to be engaged in work for a very long time – three or four hours a day for six or seven years – to learn the panoply of ways to do something, to become 'skilled'… there have to be many ways to make something work for you to really feel a craftsman's confidence'* (Sennett et al., 2008:53)

The element of *rhythmic* engagement in Sennett's conception of craftsmanship (Sennett, 2008:176), has parallels with the work of psychologist Mihaly Csikszentmihalyi, who identifies craft as one activity that could engender '*optimal experience*' an activity that is an end in itself, where '*time no longer seems to pass the way it ordinarily does*' (Csikszentmihalyi, 1992:66). This is a conception examined in detail by Bunnell in relation to craft, as is Csikszentmihalyi's dynamic model of creativity which sees a three-way cyclical relationship between the individual, their field of practice and the contextual domain (Bunnell, 1998). Marshall also uses this dynamic model of creativity, explaining it as a three-stage process in which the maker refers to existing formal knowledge within the culture in which he or she is situated, produces new work or uses a new method, which, if considered successful, then moves into the wider domain (Marshall, 1999:322). Sennett describes four elements in intuitive leaps: '*reformatting, adjacency, surprise and gravity'* (Sennett, 2008:209-212). The first two elements relate to reflection on experience and the bringing together of two unlike domains resulting in the 'poesis', surprise and '*wonder that a thing exists'* followed by realisation that problems still need to be resolved. What is challenged is the romantic notion of creativity as a mysterious, essentially intellectual, phenomenon. For these writers, then, craft is about engagement, experience, time invested and creativity that is grounded in practice.

A more conservative characterisation of craft production is provided by Howard Risatti in '*A Theory of Craft: function and aesthetic expression'* (2007). His notion of craftsmanship is, at heart, about the physical transformation of material by hand and the integration of designing and making in one process. For Risatti, machines and industrialisation are in the realm of design, a two-stage process that separates an object's conceptualisation from its production. '*a design is always an abstraction; never is it the same as the thing intended to be made from it.*' (Risatti, 2007:163). His analysis is conducted with extended reference to David Pye's Workmanship of Risk and Workmanship of Certainty (Pye, 1995). He sees Pye as failing to properly account for the Workmanship of Risk – craftsmanship – in all its aspects, by treating it too simply, in opposition to the Workmanship of Certainty; industrial production. For Risatti there are many kinds of workmanship. He points out that fully automated industrial production involves no workmanship of any kind and that some kinds of workmanship require only practical manual skill, following a designer's plan and may involve no creative input. Risatti acknowledges the importance in craft of the concept of risk and sees handwork in craft as a special kind of workmanship that emphasises '*the tension and drama involved in truly difficult handwork*' (Risatti, 2007:165) and asserts that craftsmen conceptualise the object *during the process* of making. Risatti sees craftsmanship as something more than either design or workmanship. '*It involves risk at the level of workmanship through technical manual skill as Pye claims, but it also involves an element of abstract conceptualising as in design'* (Risatti, 2007:168) .

Risatti's philosophical basis for craftmanship's distinct value is based on the Aristotolean grouping of knowledge in three categories: theõria (theoretical or cognitive knowledge), praxis (practical knowledge from doing) and poiĕsis. Poiĕsis refers to '*knowledge involved in the making, producing or creating of some**thing**'* (Risatti, 2007:162). In craftsmanship '*theõria and praxis coming together as poiĕsis, as a creative, form-giving act of the imagination. In this creative, form-giving act the skilled hand and the inventive mind together embrace material as part of the making process'* (Risatti, 2007:202). This concept is based on the integration of cognition and action, thinking and doing in a creative form-giving act. It echoes pragmatist philosophy (see Section 3.2) and emphasises a sense of potential and change within the act of making, the human intelligence and physical presence at work in an integrated live, making, act. Risatti's definition of a craft process then has links to Sennett's performative skilled engagement, but the range of activities Risatti would allow as craft is much more restricted, for example allowing only certain categories of object exploring the character of craft through historical analysis of human physiological need for 'containers' 'covers' and 'supports'. He recounts the close association of craft objects to the human body and particularly the hand, the 'handsome' object, good to handle. He believes that craft is an ancient, universal and deeply meaningful activity:

'*In the conceptualizations that brought craft objects into being as physical entities can be seen the workings of consciousness itself. Making craft objects is one of its earliest tangible manifestations. Craft objects stand as concrete expressions of the power of human creativity to wrest a realm of culture from nature. In the twenty-first century they remain a vital living tradition that reaches back to our prehistoric ancestors. For craft objects still carry within them the visual memory of their generating natural forms and the human overcoming of nature in the creation of a world of human expression. Unfortunately in our affluence and the comfort it has provided, it is often forgotten what this means: forgotten is the intensity and drama of the struggle to wrest a modicum of security and leisure from nature that craft objects embody'* (Risatti, 2007:64-65).

This is the premise upon which the claim for the distinctive character and power of the craft object lies, as an expression of '*wresting of culture from nature'*. It demonstrates the resonance to environmental concerns that craft can mobilise through an invocation of an ancient connection to natural forms. Risatti's definition of craft is, at its core, one of functional objects that are hand-made. This leads him to some very tight definitions that call into question the inclusion, for example, of traditional figurines, jewellery and tapestries, which he ultimately views as outside the craft realm (Risatti, 2007:35). It is tempting to see his analysis as reactionary and dismiss it as part of what Paul Greenhalgh calls '*the ideology of nostalgia'* that surrounds the perception of craft (Greenhalgh, 1997a:105). Many commentators have tried to dis-associate craft from this nostalgic aura. Britton, for example, in a call for new techniques to be taught alongside traditional ones, says '*We can't avoid the climate of appropriateness that moves on with time and changing purposes. Nostalgia is a dead end.*'(Britton, 1991). However, the researcher believes that Risatti's analysis is more than nostalgia, it stems from a desire to claim craft's ground and worth in its own right, not to consign it to history but to stake out craft's territory and ward against his fear that '*in the face of great prestige awarded fine art and design in our society, craft will eventually disappear as a recognizable field of activity*' (Risatti, 2007, p.xiii). It provides a substantial account of how to view craft in a much longer timeframe than that of industrialisation. It identifies a '*normative ground*', a categorisation structure for craft objects.

For Risatti, craft's unique ground is in its ability to bridge nature and culture, to reflect both ancient physiological needs and cultural meaning. In an examination of non-functional contemporary studio craft, which looks at many examples, Risatti sees these as metaphorically linked to function, as '*critical craft objects'* whose communication strategies often involve the subversion of function or other craft conventions, such as the human scale and whose subject matter is still, therefore, very much craft. These are objects that reference the functional. Risatti is also concerned to see craft in relation to industrial production '*when confronted by machine-made multiples, the craft object takes on an urgency it didn't have in the pre-industrial world; this is why the handmade object of craftsmanship needs to be accorded a more prominent place in our thinking, for it sheds a light onto the world that offers a needed counterpart to that anonymousness and "unlimited-ness" that industrial production encourages'* (Risatti, 2007:202). Some of the meanings associated with craft, then, are about the integration of designing and making in a live skilled activity – which for some commentators translates into continuing, or at least referencing, ancient traditions of *hand mak*ing the *functional* objects required for day-to-day human existence, a role brought into sharper focus by distinction from industrial production.

Craft writers may not agree on the limits of craft objects but they do tend to agree on the central role of sensitivity to *materials* and the importance of *tacit* knowledge – the practical learned ability to perform a task that cannot be formally written down (propositional knowledge).

Sennett sees craftsmanship as a way to '*give people an anchor in material reality*' and re-integrate historical '*fault lines dividing practice and theory, technique and expression, craftsman and artist, maker and user*' (Sennett, 2008:11). The continual involvement with material underlies Sennett's conception of how craftsmanship achieves integration of practice and theory. Sennett's reported guiding intuition about his book, that 'Making is Thinking'(Sennett, 2008: acknowledgements) aptly describes his understanding of the indivisible nature of thought and action within craft. Marshall re-states the role of material at the heart of any craft practice, relating that in his case study interviews '*the most common definition of a craftsperson presented was an individual with a knowledge of materials and process*' and cites many other commentators who agree on the centrality of tacit knowledge, materials and processes to craft (Marshall, 1999:111).

Adamson deals with craft's material specificity in opposition to art's optical effect. This echoes Risatti's claim that '*the central concern of fine art is with opticality while that of craft is with physicality*' (Risatti, 2007:138) .Whilst art is meant to be looked at, craft always entails a material encounter. Adamson cites Peter Voulkos and his colleagues in the 'Abstract Expressionist Ceramics' movement of the 1960s as placing '*themselves at the very limits of their craft, in a gesture of dissatisfaction and ambition but…..Voulkos's work was…after all, made of clay*' (Adamson, 2007:48). He was, in Adamson's view, ultimately unable to overcome the materiality of ceramic.

Another element of craft character is its connection to the everyday, its quotidian aspect. A simple dictionary definition of vernacular is: *the commonly spoken language or dialect of a country or region* (Websters, 2005). Paul Greenhalgh has described it as an important element of craft:

'*The vernacular refers to the cultural produce of a community, the things collectively made, spoken and performed. It is as close to nature as a culture can get; the unselfconscious and collective products of a social group, unpolluted by outside influence'* (Greenhalgh, 1997a:31).

Greenhalgh traces how the vernacular, as the 'authentic' voice of society, became noticed and valued as a cultural phenomenon in opposition to industrialisation, particularly as part of the Arts and Crafts Movement of the late 19th Century. '*It was of great symbolic importance to William Morris and the founders of the Arts and Crafts movement. The rural and handmade aspects of craft production arose at least partly as a result of the desire to return to the vernacular world* ' (Greenhalgh, 1997a:31). The vernacular links us back to Risatti's '*wresting culture from nature*' the elemental normative ground of craft. Vernacular craft forms, as the popular culture of a social grouping, although not in Greenhalgh's view essential to craft, do give a structure and meaning to certain forms. Objects everybody needed and lots of people made, like containers, covers and supports, retain their popularity as craft forms. If you make a vessel, a quilt or a chair you are operating within a craft structure and language that carries with it a range of associations and values. The researcher considers, however, that the vernacular (which could refer to a cultural norm for any grouping at any time or geographical location) has too often been approximated to the 'pastoral'- the idea of a bygone UK rural village, a pre-industrial idyll discussed below (Section 2.4).

Adamson's examination of craft's 'supplementarity' is also concerned with this sense of the bounded subject matter in which craft deals. This is the sense in which craft is about craft whilst art can be about anything. Adamson's examples of the supplemental include how craft is used within Droog Design in the 1990s and the work of Gijs Bakker (Adamson, 2007:33). He points out how early Droog designs, whilst fashionable and contemporary, were based on craft imagery and process and were hailed as the end of thinking of craftsmanship as reactionary. Some, for example, emphasise tactility and individualisation, intentionally departing from the perfection of high design goods. He sees them as a successor to the American 'designer-craftsman' styles of the 1950s which '*attempted to inject human warmth into the mass production process*' (Adamson, 2007:34). Adamson sees the quality of Droog objects (described as 'craftsy' rather than 'craft' by Droog founder Renny Ramakers) as making use of the bounded supplemental range of craft meanings. Ultimately supplementarity is seen '*as an idea that can be put in the service of particular artistic operation*' (Adamson, 2007:33). These then, are a range of craft associations that can be accessed and referenced.

Other commentators have questioned how much of the success of Droog Design could be attributed to its craft appeal. Verhoeven, in a paper given at the New Craft – Future Voices Conference, Dundee, July 2007, contrasted the popularity of *craft process* within Droog Designs to the parlous state of traditional *craft practice* which he describes as *'almost dead'* (Verhoeven, 2007:184). Verhoeven highlights a number of values that he believes pertain to craft and examines how these are played with, commented on and exhibited within Droog work. Verhoeven says that values associated with craft could '*begin with a list such as the following: the value of object, material, process, workmanship and tradition* and that *secondary values may also exist such as sustainability, uniqueness, authenticity, meaning and experience'* (Verhoeven, 2007:187). In each case he uses a Droog work to illustrate how these 'craft' values are communicated; his example for 'material' is a seemingly traditional vase, complete with process marks, which is in fact made of soft polyurethane (Hella Jongerius 'Urn' 1993). His conclusion is that craft adds value by creating objects that speak to an audience on the level of *'sets of collective experiences we can all relate to'* (Verhoeven, 2007:196). Droog Design objects often work by challenging or playing with collective craft assumptions and expectations of objects or materials.

Taken together, these elements amount to an outline of the character of craft; Sennett's view of the value of engaged craftsmanship; Greenhalgh's understanding of the vernacular; Adamson's examination of supplementarity and craft's boundedness; Risatti's and Verhoeven's association with particular forms, values and cultural references. The researcher agrees that craft is *'not a movement or field, but rather a set of concerns that is implicated across many types of cultural* *production'* (Adamson, 2010a:3). For the researcher, this set of concerns focuses on three key elements: skill, cultural meaning and the creative production of objects and the researcher uses the following description: ***the engagement of a maker in a skilful process resulting in a creative form-giving act linked to practices and objects that reference cultural meaning***. This is a characterisation, an idea of what craft production as a whole is concerned with, for the researcher, rather than any attempt at a fixed definition of craft. The core of this understanding is a concatenation: the linking of skill to cultural meaning in small-scale or one-off creative production. This description follows from the influential definition of craft practice as '*intelligent making'*, a term used within an examination of craft practice by Cusworth and Press (1996) which emphasises the bringing together of a variety of knowledges and skills with cultural meaning (contextual awareness) through innovation, autonomy and creativity to achieve objects that have 'relevance'. Cusworth and Press quote the view, expressed by Alison Britton, that '*our main responsibility is the skilful achievement of relevance'* and suggest this entails '*a mix of formal knowledge, tacit knowledge, physical and mental skill, contextual awareness, innovation and personal creative autonomy'* (Cusworth and Press, 1996:4). A summary of the key skills involved lists: identification; invention; expression; judgement; construction and presentation (Cusworth and Press, 1996:5).

For the researcher, craft has a fluid character, a complex mix of elements and concerns which combine and re-combine in new and shifting configurations. The emphasis will change in different contexts, but underlying each configuration is a set of concerns (those which have been highlighted here include skill, material, process, engagement, tacit knowledge, experience, object, tradition, the everyday, authenticity, uniqueness, creative expression, innovation, meaning and humour – the last in relation to Droog designs). These amount to a character that can be used, referred to and subverted with great effect. This is by no means an exhaustive list and the researcher is aware of many other concerns, not examined here, with which craft has been associated, just some examples are: amateurism, hobbyism, environmental concerns, feminist art or political, spiritual or aesthetic idealism. These are aspects that are less relevant to this research because it is primarily concerned with productive rather than aesthetic implications of digital processes. All craft objects, including those realised through digital technologies, carry with them some elements of the possible range of craft associations and values and need to be considered in the light of how they relate to their particular craft character.

2.2.2: How do we understand and value craft skill?

If craft centres on the application of skill to the creative production of objects of cultural relevance, how do we understand craft skill? Skill, in a variety of guises, is a ubiquitous building block of craft narratives and a foundation stone of craft practice. *Manual* skill is arguably the element that is most challenged by the use of digital production technologies. Can craft practice exist where the skill (often understood in the restricted sense of the skill of the maker's hands or in the use of hand tools) has been displaced by the use of digitally controlled production technologies? To answer this question it is necessary to understand a variety of meanings associated with skill and the absence of skill.

For Sennett, skill occupies centre stage in his notion of the craftsman, indeed he believes that '*all craftsmanship is founded on skill developed to a high degree'* (Sennett, 2008:20). He starts with the claim that the generic idea of skill is of '*trained practice'* and is seen in opposition to the '*coup de foudre, the sudden inspiration'* (Sennett, 2008:37). Sennett distrusts the idea of sudden appearance of innate, untrained talent believing such inspiration really draws on a well of experience and practice. He deconstructs '*intuitive leaps'* and gives an account of their structure; his notion of skill is one of artisanal skill, hard won and owned by the maker through repetitive practice. There is an assumption here of primarily physical, hand-making skills. Sennett, for example, talks about how modern machines can pose a '*threat to developing skill'* (Sennett, 2008:39) citing the misuse of CAD (Computer Aided Design), in which he believes machine capabilities, by short circuiting physical processes such as drawing, separate the head and the hand and remove the need for repeated practice and the learning that is associated with it. This is not an inevitable outcome of digital engagement for Sennett, however, as he includes examples such as Linux programming as a craft skill, based on continual problem-finding and problem-solving, where skills are built and extended (Sennett, 2008:26).

A different view of skill comes from Adamson's examination of the use of craft skill within modern art. He acknowledges skill can be narrowly conceived as '*knowing how to make something*' (Adamson, 2007:69) but concludes that it is largely an embarrassment to artists who discount their manual ability for fear it will detract from the transcendence of the work. Adamson looks at the writing of several theorists on skill, from David Pye, to Michael Blaxendale and again, at the philosophical basis for '*learning by doing'* provided by John Dewey. Despite Pye's avowed dislike of the word skill, Adamson believes he equated skill to the '*judgment, dexterity and care'* with which work is carried out, a phrase that often re-appears in relation to the Workmanship of Risk in Pye's writing. Adamson points out that Pye viewed 'risk' as a flexible category, the degree of 'risk' involved in workmanship could vary, it isn't either there or not. '*Compared to tearing a sheet of paper, using a pair of scissors will reduce the risk of not achieving a straight edge'* (Adamson, 2007:73). Skill is demonstrated by '*purposeful constrained physical action*' limiting error in manual operations. Skill is about technique, the accuracy with which you control tools in the service of an intended outcome. You need a skill to achieve an outcome but there is no attendant moral worth attached to being very skilled. So, skill is based on experience and trained practice and is required for a successful outcome, as it can limit the risk of failure in difficult procedures. In this conception one can imagine that a machine could provide an effective limitation of risk and the skill could be displaced, although Pye doubted that any machine would ever be able to perform with the subtlety and judgement of a skilled craftsman (Frayling, 1991:31). This is a view of skill as a means to an end.

Adamson contrasts this view with a notion of skill as a culturally powerful medium. He does this through Blaxendale's study of 16th Century German limewood sculptors, where weaknesses in this particular type of wood, 'starshake' had to be negotiated with huge technical skill if the sculptures were not to literally fall apart. Sculptors had to choose how to negotiate this risk of failure, in a demonstration of skill intertwined with complex stylistic decisions. This is also further examined as a demonstration of skill in the service of cultural meaning (the sculptors were working in circumstances of extreme political and religious upheaval and under threat of violence at any moment) their skill is culturally significant, '*a deep-seated cultural metaphor*' according to writing by Thomas Crow (in a study of Blaxendale) (Adamson, 2007:76). Whilst Adamson remains unsure whether this account of skill can be pushed so far, he agrees that the cultural specificity of a skill needs to be accounted for '*What Pye helps us to see is that skill's traditional claims to authority, to "just rightness", reside primarily in the craftsman's refusal to do it any other way*'(Adamson, 2007:78). Skill is more than just knowing how to make something, the way it is used *demonstrates* cultural capital. A similar concern with the demonstration of highly-attuned skills can be seen in many craft traditions, for example, the work of Bernard Leach. The demonstration of skill within craft work can be seen as a cultural metaphor, as a socially constructed demonstration of a position taken in relation to production. Adamson argues that productive potential exists in examining the skill demonstrated within craft objects in order to gain insight into the cultural values of the maker and society that the maker comes from: he describes this as '*materialist analysis in the service of cultural critique*' (Adamson, 2007:78). Adamson concludes '*how profitable it can be to think of craft skill in the most general terms, as Dewey and Albers conceived it: not as a discrete set of techniques, but as a way of being within society*' (Adamson, 2007:100).

A theory of skill in relation to modern art and *productive labour* is set out in recent work by Roberts: *'The Intangibilities of Form: Skill and Deskilling in Art After the Readymade'* (2007). Roberts provides a framework for understanding and analysing shifts in modern art practice by looking in detail, and from a Marxist perspective, at changes in art, art studio practice and authorship. He asks what constitutes skill in art after the readymade and whether modern '*artistic authorship as a 'open ensemble of competences and skills' is grounded in the division of labour and the dialectic of skill-deskilling-reskilling?'* (Roberts, 2007:2). Roberts traces changes in artisanal skill and the prevailing organisation of studio practice, from the *collective* workshops of the 14th to 16th Centuries, the 17th to mid-19th Century *atelier master-run* apprentice workshops, to later *master-sculptor* models, where the master worked in an executive role with wage labourers. He quotes from a biography of Rodin by Ruth Butler that describes the division of labour in the workshops of Rodin around 1875, the year of his death: '*On any given day in one of Rodin's studios, someone was roughing out a clay, while others* *were constructing an armature, using a machine to enlarge or reduce a clay or plaster, sawing a block of marble, or using a pointing machine to transfer the plaster onto the marble block*' (Butler in Roberts, 2007:143). Rodin is seen as directing assistants on numerous commissions and '*authoring his work at a distance'*. Whilst modern painters may have tended to work with a contracted division of labour in solitary studio practice, other modern artistic practice embraced *'a new kind of collective (studio and extra-studio) practice'* (Roberts, 2007:144). This includes embracing some kinds of manufacturing and commodity production through making use of '*readymades, copying without copying and the craft of reproducibility'* - terms Roberts uses for the myriad of ways objects and images that have already been the subject of non-artistic labour are incorporated into practice. Practice that today is often expanded beyond the studio, for example, to museums that are sites of production and which finance, support and promote the production of new work across multiple sites (Roberts, 2007:188).

Roberts sees the work of artists using readymades, from Duchamp in the 1920s onwards, as being in a dialectical relationship with changes in the organisation of productive labour. Where productive labour (generally) became de-skilled, art moved to immaterial forms of intellectual and conceptual expression and towards art in which skill was not removed but displaced to take different forms such as the organisation and manipulation of pre-existent objects. The artist's vision and autonomous authorship, the control of process *all the way down* was retained (unlike in the productive labour sphere) and thus art's separate identity was retained, despite moving on from purely artisanal skill as a claim for legitimacy. Roberts traces artistic re-skilling, for example, through the rise of the artist as *curator*, reflecting on the continuity between many of the skills possessed by immaterial workers in the modern economy (advanced communication skills and cultural knowledge, team work and creative exchange) and artists. He sees this reflected in the model of the studio that emerges with Duchamp:

'the studio is neither a place where assistants are taught in the style of the master, nor the place where the subjectivity of the artist is performed in a confrontation with his materials. Rather, it is a place where plans are executed, research pursued, conversations conducted, decisions and connections made, and materials sorted and assembled… the artist's hands are now in explicit co-operation with the hands of the non-artist' (Roberts, 2007:147).

Roberts puts forward a view of artistic skill that takes a number of forms beyond artisanal skill, for example, the displacement of skill into immaterial labour, into the organisation and manipulation of pre-existent objects, (such as readymades), or executive roles such as orchestration. Adamson, commenting on Roberts' work, points out that Roberts insists on the continuing relevance of all three modes which can be re-configured and combined in many different ways: '*The Readymade does not make skill obsolete but on the contrary opens up new configurations*' and that Duchamp *'often combined the mechanically produced and the artisanally made within a single artwork'* (Adamson, 2010a:460). Roberts concludes that '*Without the penetration of general social technique into art, without art's objective deskilling,* *art is pulled back into the socially constrained realm of artisanal skill…*' (Roberts, 2007:228). It appears from this analysis that artistic labour was able to progress and remain relevant as a critique of, and in a dialectical relationship with, productive labour through a shifting skills-base.

The question then arises whether changes in the perception and practice of *craft* can be seen to follow a similar shift to that of the pattern of skill within modern art? Just as art, through the impact of industrialisation, was re-imagined and defined and reflects new productive modes, could it be the case that digital craft, through the impact of the digital revolution, is a re-defined productive mode that reflects digital productive skills?. Accounting for and locating skill in digital craft practice is further discussed in Section 2.3. It is clear, however, that a movement from purely artisanal skill towards a mixture of physical and intellectual skills has already been noted in contemporary craft practice, this, for example, is the focus of the '*intelligent making'* model of craft which emphasises relevance and contextual awareness (see Section 2.2.1). The use of readymades and manipulation of extant meanings in found objects and images is also a common contemporary craft strategy. The interrelationality of skill and deskilling - the '*craft of reproducibility'* (Roberts, 2007:5) - work that uses artisanal skill in combination with other elements certainly seems to be apparent. Digital practice can often involve an extended division of labour through extra studio technical help and expertise, the innovative collection, manipulation and curation of digital data, or orchestration of outsourced manufacturing. Digital practice as a 'collective' enterprise is the subject of this thesis and returned to many times but it is worth noting here that the main question that arises for the researcher is whether the undoubted skills involved - such as orchestration, communication, curation - a new set of skills for a new type of production, (perhaps used in concert with more traditional artisanal skills and interpretive skills) are in fact capable of being manifested and understood as *craft* skills. In summary, Roberts provides a compelling account of the change and retention of artistic authorship through adaption of skills. These accounts, then, see skill through a variety of lenses: as a matter of personal accomplishment, as a technical necessity, as of cultural meaning and value and, finally, in relation to changes in productive labour. The broadest conception of craft skill - as a way of being in the world - allows for craft skill to adapt to, and reflect contemporary modes of production.

2.2.3: Why is productive autonomy so valued in craft production?

The Oxford English Dictionary definition of autonomy begins with its political meaning (adj): *The condition or right of a state, institution, group, etc., to make its own laws or rules and administer its own affairs; self-government, independence* (OED, 2011a*)*. It goes on to further explain the term with reference to Kantian philosophy and *freedom of will* in opposition to heteronomy (subject to external rules and laws). The third more general definition explains the term as: *liberty to follow one's will; control over one's own affairs; freedom from external* *influence, personal independence*, at least one quote links the term to artistic practice whilst another describes the term as a variable quantity '*a certain amount of autonomy'.* Autonomy, then, is about freedom and independence of thought and action and has a strong link to artistic practice. It is something that can be experienced *to a degree* (not an absolute state) and within particular spheres (e.g. *political autonomy)* but has been conceived of as a duality, in opposition, to heteronomy: subject to external law, power or control.

Within this research, the researcher has considered the role of autonomy in three particular contexts within craft practice. From the outset the researcher acknowledges that separating out three types of autonomy within practice is a device, a simplified distinction, which cannot be easily identified within complex interwoven craft practice, which combines design and making, theory and practice. however, for the researcher, the distinction is helpful in understanding a shift in the emphasis of digital practice, in essence a shift of emphasis within personal creative autonomy but one the researcher has chosen to highlight by distinguishing between productive modes.

The first type of autonomy is productive autonomy; by this the researcher means the physicality of hand-making as well as the independence of self-employed labour, where a maker is free to organise their own time and has independent working practices with control over materials and tools, able to make an object from start to finish, without being subject to external influence.

The second type of autonomy is authorial autonomy, realised through control over the ideas and content and in authorship of the outcomes of work, the sense of independent skilled intention and freedom in developing an individual approach. For the researcher, within a craft process, authorial autonomy implies a degree of authorship of process.

Lastly, autonomy of the object; autonomous art objects achieve the quality of transcending their origins to stand as self-contained and independent statements.

Autonomy can therefore be applied to many different aspects of craft but it is productive autonomy that has been most closely associated with 'traditional' craft, in the sense of craft as a mode of production in opposition to industrial mass production (See Section 2.2.4). As well as different areas of practice that autonomy can relate to, there is also the question of degree of autonomy and whether autonomy needs to be absolute. For example, it is accepted that artistic autonomy, authorship, is not compromised by the inclusion and re-narrativisation of extant visual images and forms such as 'readymades', authorship is vested in the overall artistic intent and outcome. In a similar way a series of questions regarding productive autonomy can be asked:

- Does productive autonomy need to extend to *personal physical engagement and control* over the entire process of production, end-to-end, to be legitimate?
- Or can it just extend to *control* and *responsibility* for directing production?

- Could productive autonomy be vested in the *choice* of productive methods?
- Or can some *degree* of productive autonomy be legitimate in craft practice?
- Or is the degree of productive autonomy a personal choice of the maker depending, to some extent, on *enjoyment and engagement* in particular processes?

In a sense, the argument presented here is that digital craft represents a shift from the greater productive autonomy (real or imagined) of traditional craft towards a greater emphasis on authorial autonomy and a version of productive autonomy that allows for an extended division of labour. The equation of autonomy with personal productive autonomy (in the sense of doing all the work yourself) constrains craft to an 'artisanal skill' model of division of labour. For digital craft, retaining authorial autonomy, despite employing the extended extra-studio division of labour model, is crucial in gaining access to the *extended network* of necessary skills, equipment and data required for digital work. This does present a central challenge to the traditional view of craft production as autonomous studio production - a fully integrated individual designing and making process *from start to finish*.

The research thesis contends that evidence from analysis of digital craft practice suggests a shift in the balance and emphasis of autonomy, from productive autonomy (perhaps artisanal skill) towards greater authorial autonomy. The intention here is not to suggest in digital craft practice a split of ideas from making but to be able to describe a shift in the location of productive autonomy, at its most stark a shift from personal physical *hand* making to *control* over remote and collective processes. Within an 'intelligent making' (Cusworth and Press, 1996:4) model of craft - bringing together various forms of knowledge, contextual awareness and personal creative autonomy - both productive and authorial autonomy are combined and described as 'creative autonomy' in keeping with the integration of designing and making in craft. The researcher believes that digital craft makers retain creative autonomy but by describing elements of creative autonomy separately, as productive and authorial, the researcher can focus on the loss of a narrow element of productive autonomy and the retention of *control* over process rather than *physicality* of making. This research relies on evidence from the lived experience of designer-makers and seeks to reflect complex, interwoven, shifting and sometimes contradictory patterns of work. At times practice could be described both as autonomous in some respects (arising from the independent intentional authorship or sole working practices of a designer-maker) and heteronomous in others. All practice is subject to external controls and conditions in some respects (for example obvious constraints are imposed by legal requirements, from meeting tax and planning obligations to copyright). Relative autonomy in one sphere is counterbalanced by constraints in another.

Nevertheless, the concept of autonomy in artistic production (in contradistinction to de-skilling and heteronomy in waged productive labour) is an important one that has a privileged historical significance, (Cooley, 1980, Braverman, 1998) particularly in relation to the dialectical relationship between artistic and productive labour. Roberts contends that the autonomy of artistic authorship - retained through the freedom of skilled intention - is indeed the essential characteristic of art's critique of productive labour, despite the evolution of the nature of skill in artistic practice to encompass curation and orchestration of pre-manufactured elements and an extended division of labour.

'*In other words, if art is always and already embedded in the technological relations of its time, then the technologies of copying, simulacra and surrogacy are the material basis of art's modern semiosis and not mere stylistic options*' (Roberts, 2007:14).

Roberts examines artistic authorship's dialectical relationship to the general tendency towards de-skilling in industrialisation. He concludes that within art, (unlike within productive labour) *'re-skilling is emergent from the post-artisanal conditions of deskilling'* (Roberts, 2007:87). The researcher believes that digital craft, like modern art, requires immaterial skills. For the researcher, this reflects a move away from absolute productive autonomy, perhaps this could be described as: working *for yourself*, rather than necessarily *by yourself*. A further discussion of the concept of re-skilling is contained in Section 2.2.4.

Adamson's view of craft, from the perspective of its contribution to modern art, is essentially as providing the artisanal skill within artworks. He discusses the autonomy of the art object. Art is autonomous where craft is supplemental '*Modern art is staked on the principle of freedom, its potential transcendence of all limits, including (even especially) those of craft*' (Adamson, 2007:4). The supplemental refers to craft within art, the mastery of the technical means by which an artwork comes into being, which needs to be subjugated to the interests of the overall work. He quotes Theodor Adorno's condemnation of craft for its own sake as '*retrospective infatuation with the aura of the socially doomed craftsman'* seeing the legacy of the Arts and Crafts movement a '*masquerade*' carried out by '*despisers of art*' (Adamson, 2007:11, quoting Adorno). Craft is something required to create art that shouldn't be obvious in the finished work. It holds a similar supplemental position to the decorative. This is a position examined through the work of Derrida: *The Truth in Painting*, *1978*, the deconstruction of how the frame of a painting is intrinsically bound up with the work itself, a study of art's contingent autonomy. The craft of the framer, however, must not upstage the art of the painter. Adamson asserts that *'proper craftsmanship draws no attention to itself; it lies beneath notice, allowing other qualities to assert themselves in their fullness'* (Adamson, 2007:13). This account equates craft with the physical realisation of art work and, in a sense, art has realised its autonomy precisely by getting away from craft. Adamson points to the tendency of craftspeople to discount the importance of skill in the sense of mere technique. However this does not address contemporary craft as having a separate identity and presence as a productive mode, that in its realisation of artistic and cultural 'relevance', the inclusion of conceptual ideas and cultural meaning, the 'intelligent making' model of craft does exhibit autonomous authorship – the independent skilled development of an individual approach. For Adamson, work in which the identity of craft is foregrounded, either by reference to the kinds of concerns with material engagement or cultural association explained above in Section 2.2, still retains the bounded character of craft; craft objects cannot be autonomous, they belong to craft.

Adamson acknowledges that art's autonomy is also constrained in other ways. It does not exist in a separate realm. Sennett recounts the story of the famous Renaissance goldsmith Benvenuto Cellini who moved from the world of guild craftsmanship, assay and metal production to one of court patronage, making fabulous gilded objects such as a golden salt cellar in 1543, depicting multiple figures. Sennett considers such work to be art rather than craft because of its distinctive autonomous originality and break with collective craft gilding tradition, but focuses on how Cellini's ability to create original autonomous works was severely constrained by having to please his patrons (Sennett, 2008:73). It's a familiar story from the history of art and, like every other type of production, neither craft nor art is immune from commercial pressures, both have limited autonomy. Sennett contrasts the sudden inspiration of the lone original artist with the slow, collective agency of a body of craftsmen, suggesting that it is actually the latter that may have more *social* autonomy, more freedom to pursue their accepted craft without the interference of patrons. For the researcher, placing greater emphasis on authorial autonomy may shift the apparent categorisation of work towards art, but autonomy can be detected in many different guises within practice. Freedom in one respect may be constrained in another, it is an interwoven and complex mix that changes in emphasis and balance and may often be obscured, rather than an apparent and obvious quality. The researcher contends that the evidence from digital craft practice (examined in Chapters 4, 5and 6) tends to emphasise a sense of *creative collective agency* rather than the productive autonomy of an individual maker (Sections: 4.3, 5.3, 6.4) in as much as an individual maker may need to bring together many different areas of knowledge and expertise, outsource elements of production, use collectively held digital data and so on.

Autonomy, not so much of the object created but as a condition of practice, or as a lifestyle choice, is a powerful element of craft's appeal for practitioners. Surveys in the contemporary crafts sector, where a condition of inclusion in the McAuley Fillis survey, for example, was that makers '*took responsibility for all the working processes through to completion'* report a high degree of work satisfaction (rating 94%) and suggested that *'lifestyle fulfilment'* was among key words used to describe the sector. This again was linked to self-employment '*the strength of their entrepreneurial spirit is shown by the high figures for self-employed craft businesses, 87% compared to an overall UK figure of 68% for all businesses in 2001 – a true indication of a greater willingness to be an owner-manager*.' (McAuley and Fillis, 2004:3) This can be seen as an indication of a desire for an independent autonomous lifestyle. Some makers have identified autonomy as a key characteristic of their practice '*autonomy…implicit in controlling the designing and making of an object from start to finish and in developing an individual approach'* (Bunnell, 1998:16).

Autonomy is therefore vested in different spheres for different commentators; where Adamson sees autonomy vested in art that can freely examine any subject, Roberts sees it vested in independent artistic authorship. The founders of the Arts and Crafts movement, like Morris, saw autonomy as vested in the dignity and independence of craft production '*joy in labour'* although commentators have pointed out this primarily relates to the image of the Arts and Craft movement and Morris, himself, often had to compromise. '*Morris has been embraced primarily as an emblem. He is quite simply the man who stood for skilled craftsmanship and against the enormous impersonalism of the factory system*' (Adamson, 2011:43).

For the researcher, autonomy in craft, understood as a *degree* of independence, freedom or personal control, exists both as autonomy in authorship and autonomy in production, and achieves particular relevance or emphasis in particular types of practice, the 'intelligent making' model of craft, for example, brings together both types with a broad reference to 'personal creative autonomy'. However, the researcher believes that in digital craft practice the focus is shifted towards new interpretations and versions of practice, that have a craft perspective but work with contemporary productive modes. On the productive autonomy side – a historically important and continuing element of craft's appeal – working independently does not necessarily equate to producing work in isolation. It is concerned with control over your own labour (in opposition to heteronomous wage labour) and can extend to control over, or inclusion of additional labour, to *authorship at a distance* within authorial autonomy, just as it can within artistic practice. Furthermore, digital tool-use may be implicated in helping to provide a more economically viable and sustainable practice-base for makers, by, for example, making a wider range of work, projects and platforms accessible, thus providing support for autonomous practice in a different way. The conceptualisation of autonomy in opposition to heteronomous labour is implicated in the conception of craft in opposition to industrialisation and this aspect is examined below.

2.2.4: What do we know about the myth and reality of craft's relationship to industry?

A lot has been written about the model of 20th century studio craft production as foil and counterbalance to industrialisation. This section of the contextual review will briefly review some of this work, with the intention of establishing a tendency within scholarship towards identification of '*constructed authenticity'* (Journal of Modern Craft, 2008a) in studio craft practice – that an element of the appeal of modern craft practice lies in the attraction of a supposed autonomous pre-industrial (pastoral) craft-based working lifestyle, free from the alienation and division of labour implied by industrialisation. That part of the appeal, the *raison d'etre* of modern craft is to represent and present (as symbol and active possibility) an alternative productive mode to industrialisation.

This conceptual opposition of craft and *industrial production* depends on the idea of the 'craftsman' as an individual depending on largely self-sufficient resources, it references self-reliance and independence, a reverence for mastery and the craftsman's productive autonomy and sets this in opposition to objects created through large-scale corporate manufacture, referencing passive consumerism and waged labour's dependence. Some valued objects that are identified by an approximate label based on an idea of small-scale production processes (I made it myself, I know who made it, it's hand-made) are distinguished on this basis from standardised machined objects, externally bought-in. The value of the 'hand-crafted' as '*unique, sophisticated, precious, expressive and enduring'* may only translate to knowledgeable insiders (if the product on sale is divorced from its origins), but marketing will attempt to re-connect the product with these associations: '*Craft is seen as pre-industrial by these consumers – it comes from the past and is old-fashioned and rooted in a place and tradition'* (Hickey, 1997:96). Commentators have shown how this particular historically situated view dates from the beginning of the 19th century and that, prior to the onset of modernity, craft and industry were synonymous terms.

However, modern craft, as an oppositional force to industry *is* more of a conceptual opposition than based in detailed craft history. Tanya Harrod has charted the nuanced history of the perception of craft, particularly in relation to modernism, in minute detail through each decade of makers and craft thinkers in the 20th century. Her analysis begins with the legacy of Morris and charts craft's shifting identity, its role as an expressive medium for the zeitgeist of particular decades (whilst at the same time representing the continuity of material tradition) and particularly illustrates the contested value of craft objects:

'*the distaste that figures like Read felt for the inter-war craft movement also flowed from the fact that craft objects were unstable, unsatisfactory commodities with a tendency to confuse categories. The inter-war crafts were rich in objects that hovered between commodities and gifts and which physically looked like necessities – in the form of simple bowls or plainly made furniture – but in fact operated more like luxuries'* (Harrod, 2008:23).

Harrod concludes her detailed history with the view that the collective identity of 'the crafts' is 'uncertain and fragile' and ultimately 'inchoate' (Harrod, 1999:465). The overall impression is of a core identity that adapts to contemporary culture giving makers scope to reflect contemporary issues. Harrod refuses to define craft beyond 'made and designed by the same person' and looks to where work was exhibited for any categorisation. Craft does not play an immutable role and can be re-defined.

Richard Sennett in 'The Craftsman', 2008, seeks to look further back in craft's history, to discover a positive attitude towards machines by comparing the Enlightenment and Arts and Crafts conceptions of technology. In Diderot's Encyclopedia Sennett finds evidence of an engaged and questioning relationship to machinery and formulates the attitude of Diderot's circle as: '*The enlightened way to use a machine is to judge its powers, fashion its uses, in light* *of our own limits rather than the machine's potential. We should not compete against the machine. A machine like any model, ought to propose rather than command, and humankind should certainly walk away from command to imitate perfection*' (Sennett, 2008:105). The idea of a machine's place as subject to humanising adaptation, reined in and directed towards specific human purpose, has echoes of McCullough (1998) (who also traces craft history through Diderot) and is contrasted to Ruskin's Romantic Craftsman whose overriding message was a rejection of a debased role of machine-minding, a message which equated to an anti-technology theoretical position, if not practice. Sennett traces the idealisation of this doomed and defiant craftsman through Veblen and C Wright Mills to conclude that '*Between the Enlightened and the Romantic views of craftsmanship we ought certainly, I believe, to prefer those of the earlier time, when working with machines rather than fighting was the radical, emancipatory challenge. It remains so*' (Sennett, 208:118). Sennett sees craftsmanship in the shared practices of both much earlier and later craft engagements with machines, from Enlightenment workshops to the open knowledge systems of Linux programmers, creating an historical link founded on craftsmanship that is based in a set of shared working practices and attitudes: in '*skill developed to a high degree'* through trained practice (Sennett, 2008:20) and problem-finding and problem-solving, driven by practice and experience more than by a lifestyle ideology. Digital craft sits comfortably within the tradition of the skilled crafts practitioner learning difficult and complex techniques, through the slow acquisition and aggregation of shared knowledge, building on experience and creating new possibilities for object making.

Tracing these changing narratives Sennett similarly argues that the image of craft is culturally constructed and intimately linked to a wider ambivalence about material culture.

'*Such ambivalence about the man-made has shaped the fortunes of the craftsman. History has conducted something like a set of experiments in formulating the craftsman's images as drudge, slave, worthy Christian, avatar of Enlightenment, doomed relic of the preindustrial past'* (Sennett, 2008:293).

Sennett argues that whilst the basic tenets of craftsmanship as practice endure, the cultural value placed on such activity is changeable. In a detailed examination of the different approaches taken to craft during the mid 18th century Enlightenment and subsequently during mid 19th century industrialisation, Sennett identifies a shift in attitudes to craftsmanship and, crucially, to machine-use that occurred with the pervasiveness of industrialisation. Sennett characterises the Enlightenment through an examination of Diderot's Encyclopedia or Dictionary of Arts and Crafts,

'*appearing from 1751 to 1772, the thirty-five volume Encyclopedia became a best seller read by everyone from Catherine the Great in Russia to merchants in New York. Its volumes exhaustively described in words and pictures how practical things get done and proposed ways to improve them'* (Sennett, 2008:90).

Sennett considers the craftsman to be the emblem of the Enlightenment working with new machinery to overcome and solve problems with a vitality and contentment reflected in the images and interviews with craftsmen and artisans, contained within the Encyclopedia. Sennett contrasts this view of the craftsman's agency and directed control over machinery in solving problems, to a degraded and antagonistic relationship towards mechanisation a century later. As industrialisation becomes widespread and machinery develops in sophistication and specialisation, there is a tendency towards de-skilling and the employment of machine operatives (Braverman, 1998). A growing sense of the machine as part of the development of automated production, machines set up to perform specified tasks, displacing skilled workers who were using tools and machines in more flexible, skilled ways:

'*As machine culture matured, the craftsman in the nineteenth century appeared ever less a mediator and ever more an enemy of the machine. Now, against the rigorous perfection of the machine, the craftsman became an emblem of human individuality, this emblem composed concretely by the positive value placed on variations, flaws, and irregularities in handwork.*' (Sennett, 2008:84).

Sennett goes on to explore the romantic view of craftsmanship expounded by John Ruskin and exalted within the Arts and Crafts movement. Ruskin, he claims, understood the central role that thinking, making mistakes, and reformulating problems and solutions played in creative work, he valued the freedom to experiment and the experience of 'salutary failure'. Ruskin saw industrialisation as essentially an assault on quality, quality of life, work and objects made. Machines reduced the condition of humanity. It is this social and political element which distinguishes the Arts and Crafts movement and has been the subject of many studies, for example Greenhalgh '*This vision of craft as unalienated labour, provided the intellectual and emotional underpinning to left-wing thought in British society throughout the entire period*' (Greenhalgh, 1997a:34).

Ruskin raged against the industrialised uniformity of products and working conditions in the machine age, believing workers in medieval guilds led better lives in higher quality institutions than they did in modern factories. Sennett fully acknowledges Ruskin's nostalgic romanticism, (and lack of concern for rising living standards and vastly improved access to goods) his point is that the conception of craft is historically and culturally determined in relation to perceptions and fears within the prevailing material culture of industrialisation. Sennett claims that we live today with this legacy of craft conceived as an antidote to machine domination:

'*Culturally we are still struggling to understand our limits positively, in comparison to the mechanical; socially we are still struggling with anti-technologism; craftwork remains the focus of both'* (Sennett, 2008:84).

This is a subject which has been a central concern to many writers, for example within Marxism and accounts of de-skilling (Braverman, 1998, Cooley, 1980, and Roberts, 2007). For craft history, the Arts and Crafts intellectual legacy seems difficult to overstate. Almost every craft writer refers initially to Ruskin and Morris for their modern historical agenda, as would be expected, because industrial manufacturing is perceived as a dominant historical shift and the Arts and Crafts movement, the main champions of an alternative view, from within the craft field. Ezra Shales, in a recent article in American Craft, argues that craft suffers from an oversimplified identification of industry with 'alienation'.

'*The idealisation of the individual atelier as a bulwark against 'alienated labor' has remained widespread even now, as new disciplines, such as digital craft, challenge the primacy of traditional processes'* (Shales, 2008:78).

Shales asserts that not all factories can be lumped together, Staffordshire's ceramic producers sought to be classified as 'manufactories' where manual skills prevailed despite mechanisation. He goes on to cite the work of Judy Attfield, author of *Wild Things* (2000) who advocates that such labour should be appreciated as craft. Other writers have been keen to point out that the clear cut image of craft in opposition to industrialisation is just that, an image that bears little resemblance to historical facts. Greenhalgh asserts that '*the model of a sudden, technology – machine-driven transformation of culture and society has been widely rejected by the historical community'* (Greenhalgh, 1997b:109). Frayling, in the *Myth of the Happy Artisan* (Frayling and Snowdon, 1982), traces the unbroken chain of retrospective regret for craftsmen from an earlier age back to 'Merrie England' and Edward I. Frayling challenges the idea that craftsmanship, as an autonomous livelihood in the field of pottery existed in any widespread sense at all, and concludes that the '*history which underpins much of the 'craft revival' is, in fact nostalgia masquerading as history.*' Greenhalgh points out that:

'*The space between design and craft – a space which we now use to organise our education systems, media networks, industries and cultural organisations – was opened up for ideological and political reasons by Arts and Crafts thinkers. It is not at all clear that, for example, the real methods and conditions used, say, in the furniture industry in the later nineteenth century, were fundamentally different from those used by Arts and Crafts studios'* (Greenhalgh, 1997a:39).

Greenhalgh goes as far as to suggest that craft, as we understand it, was 'invented' in the late 19th and early 20th century in the sense that craft as a thing in itself, a noun as well as an adjective, came into being (Greenhalgh, 1997a:36). Adamson echoes the view that a modern craft paradigm exists from the mid-19th century when the economic role of the artisan was partly displaced and '*craft took on a largely symbolic and often elegiac character, most completely realised within the ideology of the Arts and Crafts movement'* (Adamson, 2007:6).

Some forms of small-scale industrial production, as an expression of vernacular forms of object making within modernity, or as repositories of craft skills, hold as strong a claim to being categorised as craft as the more traditionally recognised 'craft' of individual hand-making studio practice. The case for which, within UK ceramic studio practice, at least, has been identified as more of an invention than continuation of tradition (Frayling & Snowdon, 1982:16). Frayling and Shales are among writers who have sought to distinguish myth from reality and free craft from a blinkered set of compounded idealisations. Shales, for example, has recently written: *'Can makers of ceramics (or its historians) let go of Ruskin and Morris and stop seeing the factory in terms of timeworn sanctimonious sermons? Craft history can no longer afford to hold onto the stereotype of industry as "alienation." In addition to reconsidering the factory, craft advocates would do well to drop three other abstractions bedevilling "handicraft": the idealization of the autonomous craftsperson, the valorization of the autonomous object and the criterion of "pleasure in work" as a measure of art.'* (Shales, 2008: 78). Shales' call is for craft advocates to break out of this self-imposed straightjacket.

Craft practitioners have always had a more messy, pragmatic and diverse understanding of practice, they are inherently 'bricoleurs' adapting and using whatever is to hand and suits their purpose, advancing '*the knowledge and understanding of craft practice through the production of artefacts that have employed or subverted advances in technology'* (Woolner, 2006:4). suggesting that some craft practice maintains a close interest in, and relationship to, modern productive technologies. Jönsson has described how production techniques do not necessarily follow coherent linear progressions, with older forms existing side-by-side, living-on or being re-discovered. Industrial production that seemed the antithesis of craft, to 19th century craft followers, re-appears as a fascinating heritage of labour intensive craftsmanship, from the perspective of a later generation of craft practitioners and has provided a spark for a number of successful industry/craft collaborations (Jönsson, 2007:241). The myth of autonomous studio practice has been challenged by earlier generations of craft practitioners, for example through British ceramicists in the 1980s who referenced modern art and industrial traditions. Craft and industry, as mutually distinct categories has often failed to be a convincing model for a border zone of workshops, small scale industry, 'manufactories', collaborations and specialist craft units (Yair et al., 1999, Shales, 2008, Greenhalgh, 1997b). Commentators see recent changes in small scale production and bespoke manufacturing as altering that oppositional role: *'Now, after two centuries of being conceptually severed, there is once again a convergence between the two terms'* (Adamson introduction to Cardoso, 2010:321). The increasing availability of customised, small-batch and bespoke goods is evidence of the growth of this flexible middle ground in production processes, as is growing demand for more customer input and *'things made in small batches, suited to specific needs and amenable to upgrading over time*' (Cardoso, 2010:328).

The theme of the re-assertion of *humanity* and *experience* through technology, as an active engaged force rather than as passive machine minder, is also what's at stake in the re-formulation of craft's historic relation to industry. Distinctions have been drawn between the machinery and technologies of alienated industrialisation and flexible, multi-purpose digital technologies used to underpin specific practice; '*creative computing has long since escaped the glassed-in worlds of authoritarian control. And while many people still suffer at back-office* *data entry, at least somewhere, somehow others are making the leap from rote computer operations to satisfying practices*'. (McCullough, 1998:270).

A19th century idealised concept of autonomy in craft production traps within a web of constructed authenticity elements such as pastoral forms, studio practice and an implicit anti-industrial stance. This view has been perpetuated by considering craft within the restricted timeframe of modernity, and a narrow oppositional cultural role, as if craft's primary purpose was as a counter-balance to heteronomous industrial production. The researcher, however, feels that autonomy (both in terms of artistic and personal productive freedom) is an important concept and quality to keep hold of, however the autonomy of digital craft makers does not equate to the personal productive autonomy of hand-making. Roberts concludes that in art re-skilling occurred that was '*emergent from the post-artisanal conditions of de-skilling'* (Roberts, 2007:87) because art finds '*autonomous forms of transformation, and these forms of transformation will of necessity find their expression in other skills than craft-based skills: namely, immaterial skills'* (Roberts, 2007:88). Autonomy then, that sense of freedom and control of a project *all the way down,* is retained in art despite the stripping out of its artisanal base, whereas the levels of skill in productive labour are irrecoverable *'because of the systematic lowering of skill across sectors under the technical division of labour'* (Roberts, 2007:87). Whereas productive autonomy, and particularly the idealised concept of productive autonomy, may constrain craft to a narrow oppositional role, autonomy *per se* is the pathway to re-skilling, to moving beyond manual skill to autonomous transformations that integrate material and immaterial skills and a variety of productive modes.

2.2.5: Conclusion

This section began by asking four questions about craft:

- What identifies craft production?
- How do we understand and value craft skill?
- Why is productive autonomy so valued in craft production?
- What do we know about the myth and reality of crafts relationship to industry?

The questions were framed in this way because they delineate the narrative path of this section of the Critical and Contextual Review. In summary, craft is a special and identifiable productive category that has a shifting but recognisable set of material and intellectual concerns at its core, including skilled intention and material engagement in the realisation of objects of cultural significance. Skill is a vital element, it is understood and valued in a number of ways but exists both as artisanal skill and as intellectual and organisational skill in many diverse configurations. Autonomy in craft production has been eulogised through the Arts and Crafts legacy and a historical downplaying of craft's role (and authorship) both pre and within industrial production. Models of object making that contain elements of *artisanal skill*, *intelligent making* or *extended* *networks* are all consistent with autonomy in personal craft practice, although the balance and emphasis of autonomy (which in any case is never absolute) in authorship or production may shift. Digital craft, with its use of *extended networks* of skills and sites of production and its emphasis on organisational skills and orchestration of data may present a new form of hybrid autonomous practice that is well placed to benefit from an extended definition of the allowable models for craft practice.

Section 2.3: Digital Effects

This section of the Critical and Contextual Review examines previous scholarship regarding the use of digital technologies in craft practice. It looks at related academic research and craft theory writing, presenting current debates, particularly with regard to how craft practice is impacted by digital technology use (and how digital technology use is impacted by craft practice). It then goes on to discuss, in detail, how the value of craft skill has been accounted for and can be accommodated within digital practice. The researcher puts forward a range of criteria that digital craft must meet to avoid losing faith with craftsmanship and sets out possible criteria for the evaluation of skill within digital craft. These criteria are intended to provide a way to assess craft value without restricting the digital craft domain within single authorial intent or purely personal productive autonomy. The three 'yardsticks' or 'markers' of craft practice that the researcher believes are fundamental to a retention of craft value, and how the researcher has distilled these values from the body of craft theory writing, are discussed further below. The following is a brief summary of three 'markers' of craft skill in digital practice:

- the retention of *risk of failure* (that the quality of the result is not pre-determined).
- that the process and outcome is *uncommon*.
- that skills (wherever they are sourced from) are used *creatively*.

The researcher suggests these criteria can act as a way to establishing craft value in digitally enhanced making and go hand-in hand with creative (both productive and authorial) autonomy, in that they are descriptive of productive innovation and the development of an engaged, committed and singular (though not necessarily individual in the sense of a single person) approach. They root digital making firmly in the craft sphere, irrespective of whether an *extended network* division of labour is employed.

2.3.1: Related Art and Craft Research

Digital practice is a relatively popular subject for recent craft theory (in the context of craft theory being a much smaller body of writing than theory associated with either art or design) because it speaks to the contemporary, to what is happening now and can be understood in the context of the wider digital creative economy. A small group of makers, who are often also academic researchers and innovators, have been keen to document their practice, giving theorists a body of evidence to draw on. It is also attractive theoretically because it presents a powerful challenge to assumptions about the nature of craft practice, in particular the notion of craft as anti-technology, and in documenting diversity of practice it confounds any perception or characterisation of craft as necessarily conforming to a model of exclusively hand-made individual practice.

McCullough's seminal text '*Abstracting Craft: The Practiced Digital Hand'* (1996) is the central book-length text dedicated to exploring digital craft theory. It is now over a decade since its publication and there has been a series of conferences, articles, debates as well as a succession of PhD research contributions that have brought digital practices into the spotlight, for example PhDs by Bunnell (1998), Marshall (1999), Harris (2000) and Yair (2001), and more recently by Wallace (2007), Wood (2006), Treadaway (2006), and John Marshall (2008) that look at specific craft disciplinary cross-overs or technology applications. The *PixelRaiders* Conferences at the V&A and Sheffield Hallam in 2002 and 2004 were dedicated to digital issues and there were major contributions on the subject at several other conferences including: *Challenging Craft* Conference in Aberdeen 2004, *NeoCraft* in Nova Scotia in 2007 and *New Craft, Future Voices* in Dundee in 2007 and at *Design and Craft: a history of Convergences and Divergences* in Brussels 2010. Craft writers including Dormer (1997), Harrod (2007), Press (2007) and Jönsson (2007) have developed theory. The agenda has also been set through professional practice. The ascendancy of digital practice has been documented, for example in the success of high-profile makers such as Masterton (Autonomatic, N.d.-a) and Mann (2011), *Jerwood Contemporary Maker* finalists in 2008 and 2009 respectively. Section 2.4 briefly reviews a selection of makers' work and a number of UK exhibitions that have taken place over the last few years, including *'Interface'* the Devon Guild of Craftsmen touring exhibition in 2006 which featured: *'leading makers who integrate digital processes into their craft practice'* (Woolner and Wynne, 2006) and '*Labcraft – Digital Adventures in Contemporary Craft'* - a Crafts Council touring exhibition in 2011 (Crafts Council UK, 2011b).

The field of inquiry in related PhD work was reviewed. A search of the Index to Theses (2008), ADIT search (Art and Design Index to Theses) (2008) and internet searching of university websites has revealed a number of PhD theses in related areas.

The three most closely related are:

Re: Presenting Making. The Integration of New Technology into Ceramic Designer-Maker Practice, Bunnell, K., Robert Gordon University, 1998.

The Role and Significance of CAD/CAM Technologies in Craft and Designer-Maker Practice; with an Emphasis on Architectural Ceramics, Marshall, J. Open University, 1999.

An Exploration of Hybrid Art and Design Practice using Computer-Based Design and Fabrication Tools, Marshall, John, J., Robert Gordon University, 2008.

Bunnell, writing over a decade ago, established the potential for the use of digital technologies to extend practice, both through integrating digital technology use into her own practice-based research and through the analysis of contextual data, including artists' statements and interviews with stakeholders in the field. In her thesis Bunnell was able to establish a number of common responses to the use of computer technology in practice. CAD was identified as being successfully integrated and particularly useful in areas such as: encouraging the fast flow of ideas, pattern and image storage and manipulation, colour variations and repetitions. The nature of craftsmanship via the computer was explored and, following on from recently published work by McCullough, Bunnell concluded that:

'*Importance of the holistic nature of the activity into which computer use is integrated relates to arguments for the re-integration of theory and practice set out by Cooley (1990) and a 'pragmatic' approach to the design of information technology set out by Coyne (1996).' (Bunnell, 1998:151)*

Despite some misgivings about computer interfaces not offering the immediacy and complexity of sensations analogous with the hand, Bunnell believed such interfaces may be developed and concludes that CAD extends craft, rather than having a detrimental effect.

Bunnell also identifies a number of potential impacts on business practice, such as the ability to engage in quantity batch production, component manufacture and file transfer, enabling complex organic and machine aesthetics to be combined in intricate forms. Bunnell identifies access and funding for makers as a key barrier and considers analysis of 'post-fordism' which suggests that a combination of recession, disruption to global demand, increased demand for high quality personalised goods and flexible new technology capabilities could see a resurgence in craft fortunes. She concluded that:

'*An integral or collaborative role for designer-maker practitioners within new contexts was felt to embody the potential to effect a dynamic shift from the marginal position they currently occupy to a wider range of professional opportunities. A context specific project could provide a framework within which the findings of this research could be developed and analysed in order to assess the impact of integration in a 'real world' situation.*' (Bunnell, 1998:163).

This research attempts in part to meet this challenge by applying Bunnell's analysis to the study of a group of craftspeople engaged in learning digital tools and developing new products within a real life project: '*Making it Digital'*. It extends Bunnell's work by theorising digital craft as a new type of practice within the context of the working practices and commercial opportunities available through the digital creative economy, a decade after Bunnell was writing.

Marshall's (Justin) PhD (1999) looked at the use of CADCAM in the context of contemporary craft practice and architectural ceramics. It is another significant contribution in this field and further establishes the potential of CADCAM technologies as well as theorising the relationship between craft practice and technology use. Marshall's definition of craft is based on that provided by Cusworth and Press (Cusworth and Press, 1996) '*intelligent making'* and this is combined with a pragmatic characterisation of technology that lays the ground for seeing the active contribution of technology within the dialogue between maker and material. Marshall used mixed methods, including conducting a small grounded theory study among four makers engaged with digital technology in their practice (Bunnell was one of the participants). Marshall concludes that CADCAM technologies are '*principally considered by the makers studied as tools, and that they are active in changing the way the makers both act and think'* (Marshall, 2000:407). Marshall also noted problems with access and costs and one of his conclusions, endorsed by his peer reviewers, is that the provision of communal facilities 'CADCAM centres' could play a significant role.

Marshall's (John) more recent PhD (2008) explores the use of digital technologies in four disciplinary fields: sculpture, product design, architecture and craft, identifying a form of 'technology-led practice' and 'transdisciplinary discourse' (Marshall, 2008). The contextual review explores relationships to technology and recent developments in the democratisation of digital technology use. The research concludes that increasing numbers of practitioners are able and willing to work across disciplinary boundaries. It reviews a large selection of design art 'boundary objects' and develops categorisation tools related to both the functional capabilities built into objects and the means by which they were created. The research maps some characteristics of conventional design practice towards characteristics of a 'technology-led practice' (for example standardised to personalised production, parts to systems), concludes that a common technology-based discourse exists in the space between conventional, creative disciplines and argues for computer-based tools as a '*Lingua Franca*' between practitioners. Marshall also concludes that many of the practitioners contacted for the study would support the notion that '*computer-based tools were increasing their opportunities for a more economically sustainable practice*' (Marshall, 2008:302).

Other PhD research of interest to this study includes:

WALLACE, J. (2007) Emotionally charged: a practice-centred enquiry of digital jewellery and personal emotional significance, Sheffield Hallam University.

Wallace's work is concerned with developing digital jewellery, and explores the potential to enhance personal and emotional significance within jewellery through the incorporation of digital elements. This work considers the '*limited and prescriptive nature of existing approaches to digital objects'* and looks towards establishing a divergent and alternative digital aesthetic. From the researcher's point of view it is of particular interest that Wallace highlights the connective character of digital capabilities, finding among participants: '*That the participants regarded the objects as private when considering them as non-electronic, but shared when considering them as electronic, suggests a shift in perspective of electronic and non-electronic objects that is worthy of further investigation; the potential of digital jewellery objects to span the context of both personal and shared experience'* (Wallace, 2007:164).

YAIR, K. (2001) Craft and industry: investigating the nature and value of collaboration between crafts practitioners and manufacturers within the new product development process, Sheffield Hallam University.

Yair uses case studies and analysis to establish the importance of the contribution crafts - based designers can make within an industrial product development role. She explores the qualities that craft can offer by adding value to products and creating new tacit organisational knowledge. Yair investigates collaborative encounters in which craft knowledge and intelligent making are put to use within design for manufacture, resulting in learning opportunities and greater competitiveness from knowledge - based capabilities. For the researcher it is the ability of the craftspeople concerned to communicate, experiment and be flexible that stands out.

WOOD, N. (2006) Transmitting craft knowledge: designing interactive media to support tacit skills learning, Sheffield Hallam University.

Wood explores the use of interactive media and video recording to record craft practice and elicit craft knowledge. She is particularly interested in traditional craft skills which may be disappearing. The work establishes a methodology for the transmission of craft knowledge using investigations of skills of craft practitioners in the fields of traditional bowl turning and clog making. It is a practice-led approach that draws on the theories of Polanyi, Dewey and Schön to understand and theorise craft learning. For the researcher the work provides a detailed examination of the complex personal, tacit and context-specific nature of craft skill and the difficulties of capturing and interpreting craft skill accurately. Wood develops a methodology that uses observational video to develop bridges (pointers towards good practice from experts) to aid practice-based learning by the novice. One conclusion the researcher draws is that craft practice, even in traditional areas, does not consist of a single 'right' way to make an object but depends on personal exploration and experiential learning, emphasising the fluid and personal nature of craft skill.

TREADAWAY, C. (2006) Digital imaging: Its current and future influence upon the creative practice of textile and surface pattern designers, University of Wales Institute, Cardiff.

Treadaway focuses on the impact of digital technologies within textile design, looking at how digital technologies play a role in ideas generation and manipulation of visual imagery, and how this can be best integrated with hand-making, resulting in hybrid practice in which digital techniques are combined with textile craft skills. Treadaway highlights the collaborative potential of digital technologies through sharing and communicating of imagery within a number of practice investigations. Reflection on these investigations concluded that sharing visual data supported the generation of collaborative ideas through stimulating associative thought and a playful sense of discovery and spontaneity through file sharing (Treadaway, 2006:182).

HARRIS, J. (2000) Surface tension - the aesthetic fabrication of digital textiles: (the design and construction of 3D computer graphic animation), Royal College of Art.

Harris works in the field of 3D computer graphic (CG) animation, creating and developing computer graphics that simulate digital textiles and textile movement for screen-based environments, through the development of 3D CG 'cloth'. Harris seeks to understand the term 'craft' in a 3D CG context and achieve digital results comparable to previous material work by investigating the associated meanings of craft and computing and the potential for 3D CG to act as a sensory *medium*, highlighting the potential for engaged complex virtual craft.

The previous research, then, has established that digital technologies play an active role in practice and that specific potential exists to extend both creative and digital craft business practices. As described above, the existing research had investigated a number of aspects of digital practice from the creation of new digital aesthetics, to trans-disciplinary practice and digital technologies used in textiles. A gap in knowledge was identified in investigating the working practices implied by digital practice (such as the need to gain access to expertise and equipment) and developing a model of digital craft practice as a genre, as a digital creative industry sector in the context of the UK digital economy, as it exists today.

2.3.2: Can digital engagement deliver craft?

The question of whether it is possible to craft on a computer, or with a machine, is central to the possibilities for digital craft and explored in a number of the theses described above through practice-based work in a large variety of fields, from Marshall working on CADCAM designs for decorative architectural plaster work, to ceramics, jewellery and digital textiles. The most often cited book in this field is that of Malcolm McCullough. *Abstracting Craft: The Practiced Digital Hand* (McCullough, 1998) which is extensively referred to by Bunnell, Marshall and Marshall, John. Within *Abstracting Craft* McCullough argues there is an increasingly close relationship between digital work and craft practice. He maintains that the hand and brain activities involved in using computers have parallels with craft values and practices such as personal commitment and the need to build tacit knowledge. McCullough is essentially concerned with how a traditional notion of craftsmanship can be applicable to computing, for example how the hand can be accommodated or re-integrated into the process of digital craftsmanship. Part of the book is devoted to ideas around how better sensory frameworks and better software might ultimately accomplish '*a multisensory grasp of sophisticated intellectual structures*' (McCullough, 1998:36). McCullough's sees the potential for CADCAM to re-integrate notions of craftsmanship because '*no other equally prevalent application of computers is so closely related to that traditional locus of artisanry; the making of three dimensional things*' (McCullough, 1996:189) .

McCullough asks the question: '*What will it take for anyone to regain the sense of productive autonomy and personal impetus that we expect of a genuine craft?*'(McCullough, 1998:190). His answer looks towards the development of computing as a rich medium, capable of yielding to engaged workmanship through improvements such as better haptics and increased notational density that affords '*quasi-continuous operations formerly only available from physical materials'* (McCullough, 1998:214), so that computing begins to provide a craft-making experience in which the maker is personally involved in the constant 'live' manipulation of material. McCullough looks for ways in which a deep engagement and continuous interaction with the affordances and constraints of a medium can be maintained.

McCullough also goes on to talk about the wider employment context of digital craft. He views the digital workplace as moving towards craft in its need for creative engagement and a greater sense of authorship:

'if there is a unifying theme to the economics of the 1990s, it is the expansion of authorship…the passivity once associated with both work and entertainment is giving way to something more participatory –" interactive" – which at least means some active response to a dynamic model, or better yet creative contribution to process, and with these a certain reunion of work and play' (McCullough, 1998:262).

McCullough envisages a possible new class of post industrial artisans, freelancing through networked communities, engaging in *'contingent collaboration'* and suggests *'a healthy future for humanely scaled, personally involved and knowably talented work*' (McCullough, 1998:268).

McCullough concludes by seeing signs of optimism in craft attitudes and practices applied to computers that can increasingly stir imagination through better sensory engagement and the development of the '*cultural and critical conventions of an established medium'* (McCullough, 1998:271). However, ultimately McCullough's view, from the perspective of 1996 before the explosion of social networking and mass communication and media self-publication platforms, is of an individual maker bringing craft to computing: '*The possibility of craft lies not so much in the technology as in the outlook you bring to it. The great paradox of computing is that the better this thinking apparatus becomes, the more we appreciate the value of a conscious human being'* (McCullough, 1998:272).

The researcher contends that as well as a sense of individual crafting with computers that is both described and anticipated by McCullough, through technology and practice advances, the practice of digital craft also, in fact, implies a shift towards collective engagement through staged production and an extended division of labour within which the knowledge and skills of a variety of (craft and non craft) facilities and professionals are harnessed towards a craft outcome. This marks a shift beyond the individual craftsperson towards a focus on collectively crafted outcomes. This is further explored in Section 4.1

The idea of computing as a medium (as a working material) is one also explored by Harrod. Harrod has discussed how digital artist Casey Reas argues that software should be seen as:

'*a kind of material or sensation: that different softwares have different qualities or atmospheres like, say, oak as opposed to limewood; or rigid as opposed to flexible materials; or like the quality of light in London as opposed to New York. It is, for instance possible to look at a car* *and know which software package was used in its design'* (Harrod, 2007:229) quoting Casey Reas.

Harrod has written extensively about digital craft, for example within an essay titled: *Otherwise Unobtainable: The Applied Arts and Politics and Poetics of Digital Technology* (Harrod, 2007:225). The phrase 'otherwise unobtainable' the sense in which an '*important ingredient of the ideal new media-applied artwork*' (Harrod, 2007:236) is the realisation that it '*could not have been made in any other way*', has entered the canon of digital work. John Marshall reports that in interviews with practitioners they *'considered the unique opportunities offered by these technologies to create objects not possible to produce by other means as their key benefit. This recalls Harrod's 'otherwise unobtainable' – indeed 3 practitioners (11%) referenced or paraphrased this term'* (Marshall, 2008:162). A sense of innovation in the use of technology, that makers can do something new and perhaps unexpected, is therefore a central quality identified in digital craft work. This focus on new possibilities echoes the researcher's belief that there is a shift towards concern with agency rather than autonomy (see Section 4.5).

Harrod is concerned that the quality of digital craft work is considered on a case by case basis, arguing that some contemporary objects may come to be seen '*rather like early cinema, they are partly of interest because of the strangeness and novelty of the technologies used in their production*' (Harrod, 2007:235). The sense of the evolving history of craft is key to her perspective, reminding us that there is no standard practice, (other than perhaps a conceptual notion of idealised craft), against which to judge new practice.

'crafts have endlessly re-defined themselves, and re-defined their practices in relation to fine art, design, modernism, education, patterns of consumption, class, politics and all sorts of currents in social and cultural history'….demonstrating… ' just how multivalent and constructed the idea of craft is' (Harrod, 1999:10).

As Harrod points out '*What is of particular interest is the way in which artists, applied or otherwise, wisely, wilfully, tend to do low-tech things with this high technology*' (Harrod, 2007: 233) operating as outsiders with '*something of a hacker mentality*'. The craft practitioner's individual approach, doing something different, is an attitude that can be extended to the use of digital tools. Craft can be distinguished through the use of computers as an exploratory medium, by innovation and an individual approach, aimed at producing something 'otherwise unobtainable'. For the researcher, however, the 'individual' approach does not necessarily mean through the agency of an individual maker, it could be a novel approach developed and accomplished through an outsourced or collective effort.

In summary then, existing writing in the field of digital craft, reviewed above, has shown how digital technologies can extend craft capabilities and potential opportunities, enhance cross-disciplinary work, humanise computing and that technology plays an active role in practice. They have also explored and discussed through research how craft skills are personal and fluid and that crafting with a computer is a similar personal exploration, encouraging connectivity and potentially leading to computing as a craft medium. These are an indication of the generally positive views within an overall view of digital technologies as *extending* practice.

2.3.3: Objections to the digital within craft?

Sources of objection to the use of digital technologies in craft include the loss of the pleasure of hand making and, in the objects produced, the loss of imperfection, variation and therefore authenticity produced by a close connection to the physicality of making. The proposition is that digital technologies offer cold, efficient perfection and cannot deliver craft values. Yet, as practice described above (and in Section 2.4) demonstrates, neither of these outcomes is a function of technology use *per se*. Craft hand-making skills are sustained by the intellectual, imaginative and sensory pleasure practitioners take in physical interaction with materials, and it seems likely that this will remain the central motivation for many makers (Dormer, 1997:157). It is common to find, and the case within the researcher's own practice (Chapter 5), an element of hand-making is retained and integrated into digital practice. There is also the possibility of incorporating haptic devices, which use virtual interfaces to enable the use of hand gesture and physical movement, directly within computing applications. One example of a maker using a haptic interface is Farah Bandookwala (N.d.) (Jerwood Makers Open selected artist, 2012) whose interactive sculptural pieces use rapid prototyping and CLoud 9, 3D modelling software integrated with *'a haptic interface designed to enable you to use touch and sight together to not only see your work, but also to feel it'* (Anarkik 3D, N.d.). Whether a haptic device is used or not, very close involvement with materials remains central to digital craft practice, and, in many cases, an element of hand-making is also retained, certainly a very close concern with the fine detail of the physical outcome.

The supposed digital aesthetic of coldness is also not inevitable. The possibilities for beauty of digitally crafted work and alternative digital aesthetics have been much explored by makers and writers such as Wallace (Wallace and Press, 2004) and Harris (2005). Fortescue (2010) points out that a number of core craft association and meanings can be enhanced by the use of embedded digital elements. He develops his argument by particularly focusing on the inclusion of video and sound within work shown at the 2010, US exhibition titled: *The New Materiality - Digital Dialogues at the Boundaries of Contemporary Craft*, curated by Fo Wilson at the Fuller Museum of Craft (Brockton, Massachusetts), (Fuller Museum of Craft, 2010). He sees video and sound as enriching the sensual and narrative content of work and *'drawing out the physicality of 'the virtual'*. One effect he notes in work that incorporates elements of video and sound technology can be the association of particular technologies that are emblematic of their era, in effect, allowing makers to make *time* an important aspect of work and play with the inherent meanings of the technologies themselves (Fortescue, 2010).

With regard to imperfection, it is argued that hand-making skills imbue contemporary craft work with an individuality and humanity (demonstrated in variation and imperfection) that cannot be achieved by digitised data or, perhaps more worryingly, complex variation and imperfection can be achieved by digital tools but only through programmed replication that loses authenticity and becomes a mere simulcra of craft (Dormer, 1997:145). In effect, the presence or absence of apparently hand-made marks in the finished object cannot be seen as a reliable indicator of the production process employed.

Dormer's early contribution to this debate is contained within the influential 1997 book: *The Culture of Craft* which he edited. In Chapter 8: '*Craft and the Turing Test for Practical Thinking*' Dormer defines his use of the term distributed knowledge as encompassing both the aggregated knowledge within complex industrial products and the embedded knowledge within tools and technologies. He argues that: '*It is not craft as 'handcraft' that defines contemporary craftsmanship: it is craft as knowledge that empowers a maker to take charge of technology*' (Dormer, 1997:140). Dormer argues that the ingredients that give technology '*its organising and mould-making power'* are simplicity, distribution of knowledge through systems and organisations, and ubiquity - that may result in a sameness that comes from the underlying knowledge embedded in the software (Dormer,1997:142). A pre-determined machine aesthetic that, as digital making becomes more widespread, becomes more recognisable. Dormer considers these issues in relation to the '*Turing Test for practical thinking'* – a test for the ability to distinguish a computer generated conversation from a human conversation, and imagines that in future craft objects may become indistinguishable from those produced by machine (or through a system of distributed knowledge) and concludes that this would challenge one of the foundations for the status of craft – that it produces things that machines cannot imitate (Dormer, 1997:144).

A counter balancing argument in this debate sees the desire for, and admiration of, perfection as an equally human quality. Digital technology's attraction for some craft makers is the appeal of developing and producing perfected surface finishes with previously unimaginable mark and form-making accuracy. For these makers, exploring and making use of an enhanced ability for complex accuracy under their direct control, results in uniquely crafted objects that are capable of communicating individuality (in absolute distinction to the mass produced) but in a different way from hand-made goods. Masterton has shown how this type of engagement at the level of both CAD software manipulation and CAM tool parameter alterations can develop a distinctive language, unique to the maker, transcending the boundaries of standardised tools. Masterton believes that, as more makers adopt digital technologies and tool packages become more streamlined, objects will increase in visual similarity and more makers will choose to adapt tools, for example through innovative software programming, prompting questions about whether '*the real craft is in the coding of these tools, modifiers and filters'*. (Masterton, 2007:9)

A different, less positive connotation attaches to the term ‘hand-made’ or ‘hand-crafted’ in the context of mass produced goods from developing countries, which might be the product of ‘sweated labour’ and this introduces a further ambiguity in the understanding of the term. How objects are produced (hand, machine, mass or small scale), their apparent categorisation (from visual and material inspection or style) and the context of their presentation and marketing (as art, craft or design) interact in such a complex matrix, that little can be accurately assumed or understood, without specific information on provenance. Adamson, for example, has written about these shifting patterns of categorisation in the identification of some types of craft (Droog or the DiY movement) within, or in distinction to, a political stance or design (Adamson, 2010b:32).

In conclusion, the perfectly machined complexity of a unique crafted object does not equate to the efficiently machined functional uniformity of the mass produced, where efficiency and speed in the use of material are more likely to be of paramount importance. However, without any knowledge of process the two could look very alike. Objections to the use of digital technologies in craft tend to attribute to computing a rather sterile and unifying influence, perhaps fearful of a superficial and instrumental encounter with menu-driven packages. However, for makers from a craft background who have experience of engaged enquiry, it seems more likely and indeed is borne out in the evidence of exhibited work (see Section 2.4) that in fact there are many diverse and eclectic individual outcomes which craftspeople have arrived at, in part, through digital technology use.

This research focuses on the repercussions of digital technology integration within the productive stage of craft practice and a central challenge to their use is the contention that they will replace skills. Sennett, for example, argues that repeated practice and the effort of having to work out solutions through slow incremental change, can sometimes be too easily replaced by efficient software ‘*the person serving as passive witness to and consumer of expanding competence, not participating in it’* (Sennett, 2008:44). The next section considers the issues of locating, assessing and understanding the role of craft skills in digital practice.

2.3.4: Skill in digital work

The main focus of concern for this research is the impact of using digital technologies on the day-to-day practice of makers. How does it change what they actually spend their *making* time doing? A central issue that has emerged from case studies is the ability to ‘leverage’ knowledge and skills, for example, embedded knowledge in digital processes but also the skill of technical professionals mediating production processes. Leveraging of skill is a tendency noted by other researchers; Karen Yair, who conducted a study of craftspeople working with industry, explains how one of her participants described this effect ‘*Beebe’s past experiences, however, had indicated how sacrificing some degree of control could allow her work to escape the limitations of personal skill, whilst continuing to be informed by craft knowledge*’ (Yair, Tomes & Press in

Marshall, 2000:130). This ability to use digital technologies to enhance skill, to improve the quality of result through the division of labour, is a key quality that attracts makers' attention. You can do things you can't do by hand, or do things to a better quality than you can do by hand. If the creative and material skill contributing to an object explicitly resides in, and is sourced from, a wider spectrum than the individual maker, how can the object still be understood as craft? How should we understand and evaluate the location and meaning of skill in digital craft work?

Craft validity in relation to technology and machine use is a function of the precise nature of the process developed and employed. If it cannot be reliably defined by the simple use or otherwise of machines, identified by recognisably crafted products or by the individual craftsperson, what indicators can be used to identify craft in a production process? Martin Woolley has developed a taxonomy to identify some major value-added indicators of craft objects. It seeks to identify qualities that contribute to and define values in craft *objects*. The researcher has used this taxonomy because it is a comprehensive and recent contribution that fits well with the findings from the research participants in the case studies view of value in craft objects (Section 4.6.3) Wooley's values are (in abbreviated form):

- Materials (precious, rare, natural, requiring complex or skilful processing, associated with particular historical/cultural traditions).
- Positioning of the work within a 'body of work' of a known practitioner.
- The degree of 'discernible skill' with which the work is imbued.
- The quality of artistic development and integrity evident.
- The 'uniqueness' of the work in comparison to the mass-produced.
- Alignment with a regional or heritage aspect.
- Association with an uncommon set of making skills.
- The use of uncommon processes and tools.
- The potential for error associated with risk taking (Woolley, 2007: 180).

Using these indicators of value in craft objects and thinking about those aspects which are related specifically to process (and therefore to where digital production technologies play a primary role) the researcher believes that a simpler set of three indicators of craft process, in relation to objects where a substantial element of digital technology has been employed, can provide a useful framework to identify and gauge 'craft'. Woolley understands the tension between technology's potential to replace craft skill and its power to enhance. He says that in terms of the relationship of craft to *'intelligent technologies… Discussions circle around whether such facilities dilute the product outcomes as 'craft' objects or merely extend the craft* *ethos in a new direction*' (Woolley, 2007: 172). The researcher believes that technology has the potential to *both dilute and extend* and that a judgement about dilution or extension can be made by looking at how the technology has been employed. In her own practice, an initial dilution of craft (as technology took over the role of engraving, see Section 5.3) became an extension once the work had become more differentiated, complex and evolved. The three indicators the researcher wishes to examine in more detail are *risk of failure, uncommonness* and *the creative use of skill*. The *creative use of skill* relates to Woolley's 'artistic development and integrity evident' as well as the degree of 'discernible skill'. The researcher believes that each of these concepts needs to be defined in a contemporary context, but can be made serviceable to negotiate value in digital craft practice by a careful examination of their appropriate use.

2.3.5: Risk of failure

The risk of failure during the process of making, as an indicator of craft, was theorised by David Pye through his contrasting terms '*the workmanship of risk*' and the '*workmanship of certainty*'. For Pye the 'workmanship of risk' – craft – exists only when the outcome depends '*wholly or largely'* on the nexus of '*care, judgment and dexterity'* which Pye identifies as '*every operation during production is determined by the workman as he works'* in contrast to 'workmanship of certainty' in which '*every operation during production is predetermined and outside the control of the operative once production starts'* (Pye, 1968:52). For Pye, the workmanship of risk covers a huge range of tool use and is a variable quality (no simple risk/certainity duality can be assumed) but the crucial point is not what technology is employed but that, when the 'workman' becomes an 'operative', there is a shift in control. The outcome has moved beyond a dependence on the actions and the direct control of *the individual maker*. The outcome is pre-determined.

This account is of particular interest in digital making because it proposes that automated processes (*the workmanship of certainty*), where there is a pre-determined outcome once the process has started, are a non-craft (though not necessarily of lower value) activity. This 'live performance' aspect to making (that could go wrong or turn out differently from planned) is echoed by other commentators. For Sennett, craft value is vested in 'trained practice', the hours that have been put into acquiring exceptional control and skill (Sennett, 2008:172). In both cases there does seem to be an assumption of both *an individual maker and a directness of control over making*. The digital characteristics of using others' skills and knowledge and some automatically controlled elements that could be repeated (through edit/undo commands, or running a programme for a second time) therefore lays a direct challenge to finding craft value in digital processes. It is a challenge that centres on the role and engagement of the maker – expressed as the 'risk' of failure - *during the process of making*. Woolley summarises risk as the '*potential for error associated with risk taking*' and allows that skills-based risk can take a number of forms, such as the risk of using a new or difficult material, but concludes that '*it* *boils down to one basic premise: the ability to execute a difficult process, or processes and communicate this…*'(Woolley, 2007: 178).

How is risk relevant to digital production? The simplest answer is that mistakes do occur in digital processes. Many makers, including the researcher (see Section 5.2.2) have commented on how an unexpected outcome has propelled practice forward. Within digital practice it is also important to see risk as a cumulative quality, once significant time and effort have been built into successive stages of a making process, the risk of failure (for example in complex final machining, just as in a final kiln firing) is far greater because of the repeated steps necessary to regain the same stage of making. In many ways this kind of risk, based on complexity and time invested, is more appropriate to digital practice than the idea of being on the brink of failure as the object is realised in a single making process. The immediate involvement of the maker and the risk of failure are not totally removed by digital processes, but may be confined to some specific and particularly later parts of complex staged processes. In common with traditional practice, risk is also present in the choice of materials and in the scale of ambition, the difficulty of the work proposed. As the researcher argues within her own practice analysis in Section 5.3, mistakes can also be sources of learning and new creative approaches that can prove fruitful. Maintaining the sense of an innovative and fresh approach, an exploration, is certainly part of using digital technologies. Therefore the researcher concludes that identifying the presence and level of *risk of failure*, that the outcome is not pre-determined, continues to act as an indicator of craft skill within a digital making process. Even where processes move beyond the control of an individual maker, where there are multiple or shared contributions, for example, where highly skilled machining or delicate additive processing plays a role, risk of failure remains a variable and identifiable quality .

2.3.6: Uncommonness

The imperfection and personalisation of craft objects has been theorised as a foil for mass production. Craft value is seen in the one-off, the unique, the human object. *'There is a tendency, for example, to see regularity, neatness and 'perfection' as cold, and irregularity as 'warm'* (Dormer, 1997:143). The trend towards automated product personalisation (see Section 2.5) uses this sense that an object that has been created for an individual or has no exact copy has a special value. For digital craft, discussion has centred on the maintenance of uniqueness through complexity (where complex programming has been developed to create an individual object) or by maker control mechanisms, such as suggestions that individual files would need to be written and deleted to ensure digital craft object exclusivity. Digital accuracy and ease of repeatability (perhaps with built-in variation or machined uniqueness), does weaken the sense in which a craft object can be identified by its one-off status. A mass-produced, designed and machined item could be unique with slight variation, a digital craft item may be extremely regular and precise. The researcher has expressed the view that a misplaced duality - that an object is either mass produced or unique - (see Section 2.2) fails to recognise the tradition of intermediary, batch-produced, customised and licensed designs. Workshops, small scale industry, 'manufactories', collaborations and specialist craft units have traditionally bridged craft and industrial production. (Greenhalgh, 1997) (Shales, 2008) (Yair et al., 1999). As such, digital craft represents a new form of hybrid practice, and establishing provenance assumes particular importance.

Woolley lists three aspects of uncommonness: '*The 'uniqueness' of the work in comparison to the mass-produced, association with an uncommon set of making skills and the use of uncommon processes and tools'* (Woolley, 2007:180). The last of these is mentioned specifically in relation to the history of craftspeople exploiting scaled-down versions of technologies used in industry. Woolley acknowledges that in relation to the use of uncommon processes and tools '*crafts people have always been good at exploiting and manipulating technologies. They use scaled-down versions of tools in industry, and this has always been true*'. He attributes this quote to Hugh Aldersey-Williams (2007) in an article titled: A Perfect Fit? Published in *Crafts 204:37*, who is himself quoting Martin Woolner, Director of the Innovate Centre for Creative Industries, University of Plymouth. Woolner was the co-curator for *Interface,* a major touring exhibition of digital craft which began at the Devon Guild of Craftsmen in 2006. In Woolner's foreword to the exhibition catalogue he emphasises a close connection between the history of craft practice and advances in technology. He concludes that:

'*The Crafts, due to their historical association with the development of technologies, are in a strong position to encourage makers to take on the responsibility of interpreting, through the production of objects, society's technological evolution'* (Woolner and Wynne, 2006).

Woolner is asserting that craftspeople have an established history of appropriating technology and that there is a cultural significance to the interpretation of skill within digital craft. Craft objects, and the skills used to make them, can reflect and document the way in which technology adapts and changes. Having learnt how to use an uncommon and difficult digital technology process in a skilful and appropriate way (or having understood, found, developed and incorporated the necessary skill from another source) is then an indicator of craft skill appropriate to digital craft practice. In a similar way a heritage craft value attaches to rare skills in traditional craft practices. Some digital skills, such as software expertise, developed as a specialism by individual makers over a number of years, could attract a similar value associated with uncommon making skills, processes or tools. The researcher therefore concludes that the production of a unique object or a level of uncommonness of object or process can remain an indicator of craft skill within digital production. It is interesting to note that some digital technologies, particularly additive manufacturing technologies such as rapid prototyping, are in fact print technologies, developed to enable printed variations and copies, yet used by makers in a craft context to create one-offs (Centre For Fine Print Research, 2009 Symposium).

2.3.7: Creative use of skill

In the context of this research, what is meant by the creative use of skill is: authorship, innovation and the development of particular approach to the skills and process employed, which the researcher considers are vital components of craft skill in digital practice: the part of authorial autonomy, as described in Section 2.2.3, related to skill. Woolley mentions skill in relation to objects in several guises: 'requiring complex or skilful processing', 'uncommon set of making skills' and 'the degree of 'discernible skill' and creativity in terms of 'the quality of artistic development evident' and 'the 'uniqueness' of the work'. Craft theorists all agree that skill is important, and it is often described in relation to creativity, the degree of difficulty in exercising the skill and its use for something new, *' the creative imagination in the employment and guidance of sophisticated technical manual skill through the hand'* (Risatti, 2007:168). The discussion of creativity and skill has also been linked in craft theory to an integration of ideas and practice. Greenhalgh for example:

'*The philosophy of craft developed by the Arts and Crafts pioneers had a core of immutable ideas. Perhaps the most important of these posited that creative practice – art – was inseparably part of the physical process of making. In short, craft was premised on the understanding that cognitive and manual activity were effectively the same'* (Greenhalgh, 1997:41).

He goes on to chart how it is this integration of creativity in skill which sets craft apart from the historic artistic quest for the expression of unfettered creative thought that *'eliminated the manual vehicle of artistic expression: skill'* (Greenhalgh, 1997:42). Sennett sees creativity as consequent upon the mastery of skills, the ability to use skills creatively is then the culmination of craftsmanship. For Sennett creativity results from the open, evolving, difficult process of craft -'*the experimental rhythm of problem solving and problem finding makes the ancient potter and the modern programmer members of the same tribe'* (Sennett, 2008:26). In Sennett's analysis, creative potential exists in the relaxed exercise of skill focused towards the creation of new possibilities, delivered through the working of expert knowledge and deep engagement in process. Sennett's creative use of skill could be seen in a partnership between individual and collective knowledge (as in Sennett's example of Linux programming) where a highly skilled community member adds a new element. Pye's insistence on active physical and mental control during making allows for craft value to be contained in tacit knowledge and material experience and in the ability to use tools creatively at the time of making, but excludes a wider timeframe and context beyond the individual for creative input of skill.

To make the creative use of skill relevant to digital craft practice, the timeframe and focus of creative input need to be widened to accommodate more than the individual mastery of manual skills or individual creative flow (Csikszentmihalyi, 1992) at the point of production. In digital craft, creative expression exists within ideas, in deciding what to do in the first place and bringing together possibilities (such as the ability to animate help and leverage skills of others) and in the dynamic resolution of many influences. The coalface of creative use of skill within digital processes may be at the level of file manipulation and software interventions (rather than at the point of material transformation through machining). In many digital processes there exists a partnership between maker and machine and technical help, which has a variable creative content. At one extreme, little or no creative use of skill can be identified in using a single sophisticated tool for a pre-determined machined outcome, perhaps a straightforward piece of laser cutting that could have been accomplished by hand (though with more effort). At the other extreme, a digital craft process could be an in-depth, engaged, complex, creative encounter based on extensive experience and the skilled adaptation of digital tools (for example, one element of a software program could be a bespoke addition) (Masterton, 2007:9). To what extent an object has added value as a result of the creative use of the maker's own skills (from marshalling ideas to software manipulation), contributed skills, or the use of embedded skills is a judgement that must be based on close examination of the specific processes used. Within this analysis, creative use of skills is defined as inclusive of the maker's knowledge and skills, knowledge and skills sourced from technical help and embedded in software and machinery. It is a directed partnership, both with the digital technologies themselves and technical skills and experience harnessed toward a successful outcome. Roberts uses the concept of re-skilling to describe the emergence of art practice that incorporates a variety of modes of art making, for example, in which '*the interpretative re-narrativization of extant works of art converges with the re-narrativization of the ready-made in the electronic flow of production*' (Roberts, 2007:184). Adamson, commenting on Roberts' work, describes:

'*a triangulation between…artisanal skill (like a sculptor with a chisel); deskilling (exemplified by Duchamp's found objects); and re-skilling (in which the artist is a producer in the same way that a film producer is – a manager of capital)…As Roberts points out, Duchamp himself often created so-called assisted readymades, which combined the mechanically reproduced and the artisanally made within a single artwork*' (Adamson, 2010b:28).

The researcher believes that the idea of re-skilling, as one form of skill, seen in the creative use of digital technologies and directed partnerships that leverage skill and orchestrate making, is relevant to digital craft. For Roberts, re-skilling arises out of autonomous artistic authorship in relation to productive labour. The researcher sees the creative use of skills, including immaterial skills, as part of the focus on authorial autonomy within digital craft practice. The researcher concludes that the extent to which the creative use of skill can be identified in digital process is a variable indicator of craft value.

These three properties of the craft process - risk of failure, uncommonness and creative use of skill - act like pillars supporting the value of craft, working in complex interaction with each other and other object values such as material rarity, maker's reputation or heritage association. The researcher's initial question about whether digital technologies were diluting or extending the craft content of practice can be judged by examining process against the yardsticks of creative use of skill, risk of failure and uncommonness, by identifying the *depth* of skill and engagement in process from both the primary maker and other contributions. Without a significant element of these qualities within making processes, digital making fails to become digital craft.

2.3.8: Conclusion

The exercise of a particular depth of skill does not logically follow a neat digital/non-digital divide and is not digitally determined. As Peter Dormer comments '*Pressing clay into moulds is probably one of the most basic senses in which practical knowledge is distributed from a skilled to an unskilled producer*' (Dormer, 1997:140). You can make things by hand according to a mould of someone else's design, just as much as you can do so with a computer.

The successful use of software and machines (which are often, for cost, logistical and health and safety reasons, beyond the reach of individual makers) requires makers to make alliances, use the skills and knowledge of others, leverage embedded knowledge and encourages collaborative endeavour. Ultimately, it also requires the re-statement of creative autonomy. Creative autonomy implies both authorship and productive responsibility, having made choices and judgements, having developed a particular approach, perhaps through animating, orchestrating or negotiating the skills and knowledge of others. This may generally begin and end with an individual maker, who nonetheless travels down a path of collective knowledge, animating work with skilled contributions from many sources, potentially adding value from *collaborative value chains* (Section 2.5.1). Creative collaborations, in the sense of joint authorship, can also be facilitated by digital tools and this forms part of the researcher's practice-based enquiry (Section 5.6). This type of inter-related practice and collective knowledge requires an organisational set-up that can support it. There are many different models of support for networked practice emerging, examples include location-based workshops and research facilities, to virtual manufacturing facilities and online communities (Section 2.5).

The researcher considers that for digital craft, objects are open to misinterpretation in the absence of contextual information regarding makers and processes. The quality of a process, and its qualification as a craft process, is not dependent upon the use or otherwise of CADCAM. The meaning of 'craft' and identification of 'craft' objects can be judged by the presence of risk of failure, uncommonness and the creative use of skill and may also depend, in common with all craft objects, on the audience and the context in which it is viewed. The knowledge of the maker and processes is linked to the value of the object for a particular audience (Section 4.6.3).

Press has theorised digital making as 'connected craft' by an extension of concepts provided by Pye and Dormer. Press argues that Pye's *workmanship of risk* and *workmanship of certainty* are consistent with Dormer's distinction between 'personal knowledge' and 'distributed knowledge'. Press argues that contemporary digital makers apply tacit knowledge to '*the tools, systems and opportunities provided by distributed knowledge…enables makers to assert a vital* *new relevance and value for craft*' (Press, 2007:265). The researcher argues that the effect is wider and deeper than the application of an individual's tacit knowledge to the conditions created by distributed knowledge; it extends to a broader engagement with the working practices, organisational models and trends in digital tool-use, of the wider digital creative economy. It is about craftspeople engaging with the '*digital proposition for craft*' (Section 2.5.9), in a similar way to other digital creative industries, its organisational and creative *modus operandi*, the discovery and animation of diverse skills, facilities and entrepreneurship that fuel its emergent working practices (Section 2.5). It is not just the use of digital design and manufacturing technologies and the knowledge embedded in them, but extends, for example, to the use of digital data (as a creative source material), incorporating digital elements within work, digitally-sourced knowledge and digital networks (working with and through the internet), digital relationships with users and customers and digital marketing strategies. A bridge to the digital creative economy is created that craft makers, once operating with digital tools, may be drawn towards. Key skills include locating, animating, negotiating and orchestrating the use of resources, such as the skilled workmanship or digital knowledge of others and integrating this with the maker's own creative autonomy. The markers of digital practice from other creative digital industries also apply to digital craft, such as trends towards collaborative value chains, convergence of systems and customisation of output (Section 2.5). These ideas about digital practice are explored further in chapter 4,5,and 6.

This section has reviewed writing that goes some way to establishing the existing knowledge of the design, artistic and business potential of digital craft Bunnell (1998), Wallace (2007), Treadaway (2006), Yair (2001). Other writers have theorised craft's engagement with technology and computing as a medium, Marshall (1999), McCullough (1998), and some have recognised its connected nature and its innovative character, Press (2007), Harrod (2007). Theories of craft skill and process, Pye (1995), Dormer (1997), Press (Press and Cusworth, 1998), Woolley (2007) alongside craft values identified from original research in Section 4.6.3 have been used to distill and magnify criteria that can be used to locate the value and meaning of craft skill in a digital context. The researcher contends that a shift in the focus of craft skill beyond the individual maker and towards collective engagement and collaborative value chains would be consistent with the use of digital technology, and that leveraging distributed skills and networks provides rich potential for extending practice. In making this shift, makers are meeting the *modus operandi* of the digital economy and employing the organisational and orchestration skills required of many modern workers. The evidence chapters that follow explore this proposition.

The next Section, 2.4 discusses categories of digital practice exploration, in relation to a review of practice. The researcher explores whether digital craft can possibly be identified as a genre, by looking at similarities in applications of technology within individual craft practice. However, at this stage, the researcher wishes to introduce the possibility of a new type of practice emerging: ‘technepractice’. For the researcher, practice that exhibits a significant degree of integration of digital working methods, collaborative value chains (see Section 2.5), data manipulation and digital object characteristics, seems to the researcher to potentially belong to a particular and new category. The researcher uses the term, *technepractice* to argue for that this is an identifiable type of work. Technepractice is used as a way to express a connection with ancient craft tradition (technē is usually translated from Greek as craft and is also the root of the word technology) and a networked future. The intention is that this term expresses the idea of craft and digital technology combined in practice that extends beyond the individual maker and integrates many aspects of digital practice (Section 7.5). The researcher uses this term, within the context of this research, to mean a particular type of networked, integrated, re-skilled, craft and digital technology practice. It is, of course, not inevitable that every maker engaging with digital tools will work in an extensively collective way using networks of resources and knowledge bases, but a tendency towards a shift in practice away from personal productive autonomy towards authorial autonomy and practice that combines elements of artisanal skill, outsourced skills and skills such as negotiation and orchestration, is consistent with the research findings explored in Chapters 4, 5, and 6, and with digital creative industry trends discussed in Section 2.5 below.

Section 2.4: Review of Practice

This section of the Critical and Contextual Review presents examples of contemporary work. It reviews the published projects from a variety of makers, using information largely taken from websites and exhibition catalogues, in this respect it is a brief review of the public face of the genre. These pieces have been selected for their relevance as illustrations of work from major UK digital craft exhibitions and practitioners known to be working extensively with digital tools. They have been organised within five themes of exploration within digital craft work that the researcher sees as going some way to explain the narrative progression of digital practice. This leads towards the explanation of digital trends within creative industries more generally, contained in Section 2.5.

The five themes are:

- The emergence of digital practice: CADCAM tools.
- The manipulation of digital imagery and data.
- Material craft enhanced.
- Making connections to audiences.
- The existence of a genre.

The work shown in Section 2.4 has therefore been chosen to provide examples of the range, possibilities and progression within the field, from early applications of CADCAM (in furniture making and ceramics) to recent rapid prototyping and co-creation experiments. The focus is primarily on the UK, as the research is concerned with UK designer-makers, as explained in Section 2.1. It is not intended to be a comprehensive account of digital craft history. Illustrative examples have been represented in a number of UK-based exhibitions that have taken place over the last few years. These are, in the main, exhibitions the researcher has visited or from work she has first-hand knowledge of. This is because the researcher feels that the powerful personal connection that is made by seeing a work in the original - '*the here and now of the work of art - its unique existence in the place where it is at this moment'* (Benjamin and Underwood, 2008:II) - is worth acknowledging and celebrating.

The examples are drawn, in the main, from work that is one-off: individual pieces that are an expression of design and craft skill. For the researcher, the sense that work that is often accomplished by leveraging expertise and skills, beyond the individual maker's immediate personal skills within a collective engagement encompassing specialist equipment and output, forms the backdrop and landscape against which digital craft should be viewed. The work reviewed here appears to involve productive complexity, although in this review of work as it is publically presented, the researcher has no first-hand knowledge of processes. However, all the pieces demonstrate the role of digital technologies within the themes chosen. Where collaboration forms part of the published project the researcher has tried to include this element of description. The researcher contends that a move away from a traditional focus of individual craft productive autonomy and towards a broader authorial and collaborative approach, that harnesses a diverse range of skills and facilities, is discernible from many of these examples and goes hand-in-hand with an expansion in the reach and ambition of digital craft projects. This is the theme that cuts across the five categories of exploration, chosen to give a narrative framework, to explain the progression of digital craft practice. Many of the makers whose work is reviewed have individual practices that span involvement in education, design, craft and art and draw on a range of diverse professional skills, working in many industry sectors, for example, some include 'engineer' among their self-descriptions, others include 'industrial designer'. Some are actively involved in acknowledged collaborations either on an on-going basis or for one-off projects, with software experts and developers, outsourced production facilities or specialist manufacturers.

Exhibitions which the researcher has attended include annual exhibitions of contemporary craft work such as *Collect* (Collect, 2011) and *Origin* as well as the Contemporary Craft fair at the Devon Guild of Craftsmen in *Bovey Tracey* (Devon Guild of Craftsmen, 2011), degree shows at *University College Falmouth* and *New Designers* (New Designers, 2011) in London. The researcher has also attended (and in some cases contributed at) several conferences with associated exhibitions including: *Networks of Design* (2008) , *Digital Technology in Contemporary Craft Practice*: Crafts Study Centre, Farnham (2009), *Cutting Edge, Lasers and Creativity Symposium*, Loughborough University, (November, 2009) and *Design and Craft: a history of convergences and divergences*, Brussels (2010) (Gimeno-Martinez, 2010). She has also visited (and collected catalogues from) a large number of exhibitions, including several highlighting digital work such as: *Interface* (2006) (Woolner and Wynne, 2006), *Jerwood Contemporary Makers (2008)* (Dods, 2008), *Telling Tales* (V&A 2009) (Williams, 2009), *Labcraft* (2010) (Fraser, 2010) and *Power of Making* (V&A 2011) (Charny, 2011). In addition, the researcher has carried out studio and gallery visits and conducted desk and internet-based research on many other conferences, exhibitions and makers. A limited selection of work from an international field is also referred to.

2.4.1: The emergence of digital practice: CADCAM tools

CADCAM covers a huge range of design and manufacturing systems and processes but as a general description, within this craft context, refers to 3D models of objects generated within Computer Aided Design (CAD) software; these are then used to generate the operating instructions for Computer Aided Manufacturing (CAM).

CAD – Computer Aided Design – refers to software that enables design drawings to be made on computer. Initial developments began in the automotive and aerospace industries in the 1960s and 1970s, rapidly expanding with personal computer-based engineering and architecture applications in the 1980s . CAM – Computer Aided Manufacture – refers to manufacturing machinery such as CNC (Computer Numerically Controlled) cutters, routers and mills that remove material according to the instructions from digitally controlled programs. 3D models can also be used to provide coded instructions for machines that build objects, in additive manufacturing processes, often referred to as 3D printing or Rapid Prototypers (RP). Again, there are many RP systems (which make use of a variety of materials including plastics and metals) and employ 3D CAD models to build objects in fine layers. Examples of RP systems used to create work showcased at *Interface* (see below) included Fused Deposition Modelling (FDM), Stereolithography (SLA) and Selective Laser Sintering (SLS). RP systems are evolving into Rapid Manufacturing systems, in which a finished object for sale is produced through a 3D printing application. See Appendix 4: Glossary of terms.

- Fred Baier is widely acknowledged as one of the early pioneers of the use of computing in design and manufacture of one-off furniture pieces. A profile by Penny Jones in *a-n* magazine comments *'Fascinated with maths and with computers as a design tool, much of Baier's work of the 80s and 90s was developed through the application of commercial and home-made computer technologies. He worked as a "guinea-pig designer" helping to formulate programming for 3D design computer modeling'* (Jones, June 2008). Baier's crafted and flamboyant designs are often clearly related to digital geometry and the software used in their conception. Jones also highlights how Baier has developed a studio and commissioning practice that spans commissions, public art and teaching, acknowledging the need to subcontract to '*other specialists in various disciplines'* and says of Baier '*While he acknowledges the transition he has made from artist craftsman to collaborator and designer, a tension remains between his desire to be independent, "to make things from my own stock of ideas" and the need for collaboration in the current commissioning climate'* (Jones, June 2008).

Figure 4: Fred Baier: 1/2 Cube+Cone-Cylinder =Table, photograph. F.Baier.

A pair of bedside tables. Photograph: F. Baier, reproduced by permission.

Website: www.fredbaier.com (Baier, N.d.)

In industrial ceramics, where mould-making, modeling and prototype production are highly skilled, lengthy and therefore expensive processes, the background to the introduction of CADCAM lies in industry transformation and fundamental drives towards greater efficiency that have been well documented: *'Before CADCAM, modeling methods were rooted in three basic techniques which had remained virtually unchanged for over 100 years…turning, profiling and hand modeling*' (French, 1997:159). French goes on to outline the huge advantage of the technology for speed of product development, stating in 1997: *'Before the computer (BC?) it took two years to develop a tableware range; now it takes twelve weeks'* (French, 1997:164). CADCAM was introduced first in the 1990s by the largest ceramic companies and is now widely available and used by a range of independent ceramicists, many of whose working practices span commercial product design and one-off ceramic installations, art and craft pieces.

- Just one example of a maker who has incorporated CADCAM techniques over many years is Jeroen Bechtold. His website documents this history and the advantages of the technology: *' Since early 1995 I have been working with the CAD/CAM standard in the ceramic world: DeskArtes. With this tool communication is fast and the distance between designer and factory is unimportant. Clear images of the object-to-be can be rendered and sent over the internet to clients all over the world'* (Bechtold, N.d). An example of an early 'printed' design, later made in porcelain, is shown below.

Figure 5: Jeroen Bechtold: "@-version KOR white".

Bohemian Porcelain, white, designed 1998. Image: www.jeroenbechtold.nl. Available at: http://www.jeroenbechtold.nl/gallerysite/t-pots/17.html [accessed 10.4.12].

Website: www.jeroenbachtold.nl (Bechtold, N.d)

2.4.2: The manipulation of digital imagery and data

The 1990s, then, saw many individuals, particularly those whose experience spanned industrial and independent practice, beginning to make extensive use of digital technologies. Exhibitions of work highlighting digital technologies followed within a few years, and have encouraged the spread of practice. For example, how digital technologies have informed practice within industrial ceramics was one aspect of the *Object Factory* (2008), exhibitions curated by Marek Cecula (2011) which included 200 pieces by 50 artists, designers, and industrial manufacturers, from Swedish artist Kjell Rylander and Dutch designers Hella Jongerius, Jurgen Bey and Marcel Wanders. Originally shown at the Gardiner Museum in Toronto, 2008. Object Factory II, showed in New York at the Museum of Arts and Design in 2009 (Museum of Arts and Design, 2011). Many of the exhibits reflected digital processes including printing.

- For example this Willow Pattern plate that goes 'out of focus' from Robert Dawson (also shown in *Jerwood Contemporary Makers* 2010) (Jerwood Contemporary Makers, 2010).

Figure 6: Robert Dawson, Willow pattern with Uncertainty, 2003.

Print on bone china, 27cm diameter, 2003. Image: www.aestheticsabotage.com Available at: http://www.aestheticsabotage.com/images/uncertainty_25/ [accessed 10.4.12].

Website: www.aestheticsabotage.com (Dawson, N.d.).

- Dawson's work richly mines the themes of ceramic pattern and reference, often abstracting and playing with recognisable form and scale. Another example is shown below, a dramatic illustration of how scale alone can alter the perception of work. Digital print production technologies (described as print) appear to have played an instrumental role in delivery of such diversely scaled pieces.

Figure 7: Robert Dawson, Old New Borrowed Blue, 2008.

Print on ceramic tiles, 3.6 x 7.5 m, 2008, Churchill Hospital, Oxford. Image: www.aestheticsabotage.com. Available at: http://www.aestheticsabotage.com/images/churchill_41/ [accessed 10.4.12].

Website: www.aestheticsabotage.com (Dawson, N.d.).

Early adopters of CADCAM for 3D modeling, visualisation and manufacture of objects among independent craftspeople included makers working in furniture and ceramics. Within the UK designer-maker field, *Interface* in 2006 was one of the first exhibitions curated with the intention of bringing together the work of makers highlighting the use of digital tools. *Interface* was a collaborative exhibition developed by the Devon Guild of Craftsmen and *Innovate Centre of Expertise for the Creative Industries,* University of Plymouth (forerunner of *ICCI: Innovation for the Creative and Cultural Industries*). It showcased the work of 14 makers using digital technologies in craft and design. At the time, in 2006, the use of digital technologies such as CADCAM that had been developed within the medical, engineering and architectural industries was still relatively 'new' to art and design practitioners (Burlet, 2006:1). All the exhibitors within *Interface* were making use of CADCAM. *Interface* was a particularly interesting exhibition in that the making process for each exhibit was documented and displayed through photographic and process samples and textual explanations from makers.

- Tavs Jorgensen was among several South West makers whose work was showcased at *Interface* and within *Object Factory* and crosses commercial, digital and artistic boundaries. In the *Contour Range* shown below, Jorgensen has taken inspiration from digital processes: *'The initial idea … came from seeing the characteristic layered appearance on items created by 'Rapid Prototyping'…Enlarging and emphasising them would create a strong visual feature which also reflected the nature of the construction process used.' (Jorgensen, N.d.).* The description of the process involved in making the Contour Range is contained on Jorgensen's website. It gives a strong sense of the labour- intensive nature of this early rapid prototyping (RP) ceramic innovation, and the need for specialist technical support. Elements of hand making were combined with Laminated Object Manufacture (LOM) carried out by Warwick Manufacturing Unit (part of Warwick University) to make MDF models, used as master models that were then developed through a series of plaster and rubber moulds to achieve finished objects.

Figure 8: Tavs Jorgensen, Contour Bowls, 2002, *ceramic.*

Image: www.oktavius.co.uk. Available at: http://www.oktavius.co.uk/gallery.html#rp_and_ucup [accessed 16.10.11].

- Jorgensen has gone on to innovate with digital processes in other materials. For example, the glass series: *One Liner,* shown below. These follow from his research into techniques that can achieve the translation of digital drawing into 3D form, the top profile of each bowl representing a single line drawn in space with a *Microscribe*, a digital input device that records the hand drawing movement as data. Selected data then forms the basis of a further process involving the use of the digitised profiles to create kiln-formed vessels. The central idea here is to extend the possibilities for the expression of the hand, through gestural movement, in 3D objects.

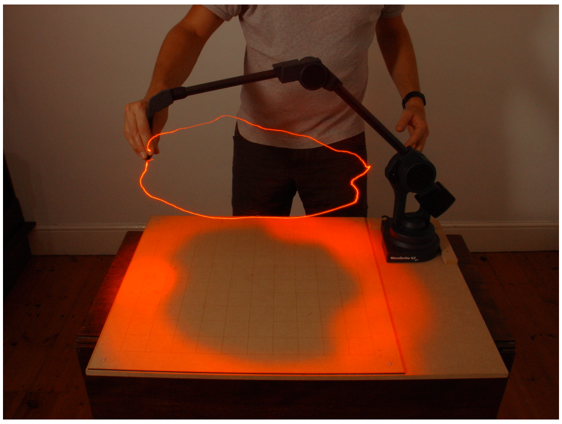


Figure 9: Jorgensen: Drawing with a Digitiser, photograph T.Jorgensen

Figure 10: Jorgensen: One Liner Glass Bowl, 2008-9, photograph T.Jorgensen

Figures 9 and 10: Photographs: Jorgensen, reproduced by permission.

Website: www.oktavius.co.uk (Jorgensen, N.d.).

- The ability to use digital data as a source of creative content and the basis of the form of 3D objects is a vast area of exploration for makers. For example, data related to the freezing of movement is one area of exploration that has been popular with several makers and featured within *Interface* in the form of '*Ripples Dish'* by Brian Adams. Adams describes the dish and the 3D rapid prototyping process through which it was made on his website (Brian Adams Ceramics, N.d.) saying '*Ripples Dish is like a 3D photo. It emulates a normally brief and ephemeral moment of ripples on water and like a photograph, freezes that moment in time. It captures the complexity of the radiating rings and the interference pattern that the two converging ripples create'*. The mixture of a highly skilled and labour-intensive traditional ceramic plaster moulding process with a digitally enabled process to model the physical expression of frozen movement, is an example of how craft and technology began to extend existing possibilities for makers. Adams comments: '*I wanted to use the technology to make an object that while* *simple and familiar, is impossible to create by conventional means. The aesthetic of the object does not proclaim or celebrate its digital origins and yet this object is truly a product of technology*' (Brian Adams Ceramics, N.d.).

Figure 11: Brian Adams, Ripples Dish, 2006.

Slip cast ceramic, earthenware or porcelain, 2006. Image: www.brianadamsceramics.co.uk . Available at: http://www.brianadamsceramics.co.uk/pages/products_ripple_dish.htm [accessed 10.4.12].
Website: www.brianadamsceramics.co.uk (Brian Adams Ceramics, N.d.).

- Another example of work concerned with capturing the expressive possibilities of time series data is shown below. Geoffrey Mann has won numerous awards and featured in many international exhibitions including MoMA and at MAD, New York. He has developed series of works that manipulate data captured through cinematography, processed through CAD and realised through rapid prototyping. The glass installation shown below is part of a series focussing on flight trajectories, in this case of a bird, '*creating a solid trace echo of a bird taking off'* (Mann, 2011).

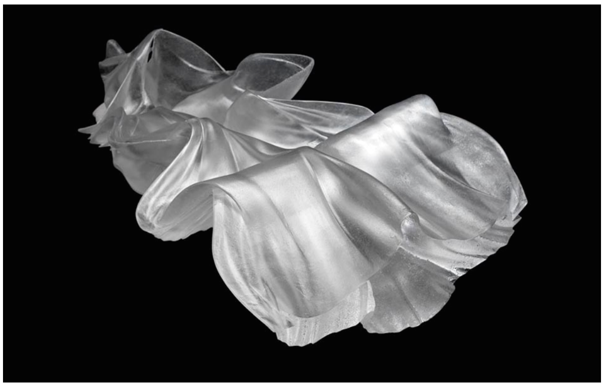


Figure 12: Geoff Mann, Flight take-off, part of Solid Air, Long Exposure Series, 2009.

Cast Clear Glass, 65 x 40 x 35 (cm), manufactured by Lhotsky Mold Melted Glass Studio, Czech Rep, shown at Jerwood Contemporary Makers, 2009. Image: www.mrmann.co.uk.

Sylvain Deleu. Available at: *http://www.mrmann.co.uk/long-exposure-series-flight-takeoff* [accessed 10.4.12].

- Based in Scotland, Mann's practice spans education, design, craft and art. Often some elements are outsourced to skilled crafts makers for whom Mann has great reverence. *The Cross-fire Series*, of which one element is shown below, is an experiment with the expressive qualities of recorded sound. An audio recording of a domestic argument from the film American Beauty (1999) has been transposed to create the effect of the sound deforming the domestic teapot. This piece is part of a series commissioned within the AHRC funded project: Past, Present and Future Craft Practice (PPFPC), based at the Duncan Jordanstone College of Art and Design, University of Dundee (Past Present and Future Craft, 2011) and exhibited at *LabCraft 2010* (Crafts Council UK, 2011b) among other venues.

Figure 13: Geoff Mann, Cross-fire, part of Natural Occurrence Series, 2010.

3D modeling and animation produced by Chris Labrooy (Labrooy, N.d.), commissioned by Past, Present & Future Craft Practice. Audio sample: American Beauty. Image: www.mrmann.co.uk. Available at: http://www.mrmann.co.uk/natural-occurrence-series-crossfire [accessed 10.4.12].

Website: www.mrmann.co.uk/ (Mann, 2011).

2.4.3: Material craft enhanced

Working with new materials, or pushing the limits of what has been done in traditional materials, is another key area of exploration for makers who are often from a traditional craft skills background but working with digital design and manufacturing facilities. Three makers whose work explores the possibilities presented by material, process, machining and software manipulation are Michael Eden, Drummond Masterton and Richard Hooper.

- Eden often works with the juxtaposition of traditional form with new processes and materials. He describes his work as: *'efforts to bring together traditional ceramic craft skills and digital technology, including 3D printing, additive layer manufacturing and non-fired ceramic materials'* (Eden, N.d.).
- Eden comes from a background as a traditional potter and the work successfully draws on a tension between old and new narratives and the desire to innovate: '*I choose to use new technology because it allows me to create 'impossible' objects, ones that I can't make on the wheel or with other conventional methods. But both the starting and end point is the story that I'm exploring and attempting to communicate*' (Eden, N.d.:Blog 16.5.2011). The piece shown below, titled *Bloom,* is a recent example in a series of reflections on traditional ceramic tureens.

*Figure 14: Michael Eden, Bloom. 2010***.**

Additive layer manufacturing, Nylon with 'soft-touch' mineral coating, 2010. Image: www.edenceramics.co.uk. Available at: http://www.edenceramics.co.uk/product5.html [accessed 10.4.12].
Website: www.edenceramics.co.uk (Eden, N.d.).

- Drummond Masterton is a metal smith specialising in creating bespoke, highly detailed and complex 3D forms and surface patterns in machined aluminium. Masterton draws inspiration from landscapes of personal significance. For example, his explanation of the making of the *Terraincup* (below) is detailed on the Autonomatic website (Autonomatic, N.d.-a). He describes the steps involved in producing this version of the mountain of Ben Nevis, from choosing the map data and scale, the appropriate z-axis measurements and mesh size, cutting tools and machine parameters, a series of software transformations, strategies for dealing with file errors and the necessary test pieces involving rapid prototyping and finally a series of milling operations that 'exceeded 60 hours'. This labour-intensive, engaged crafted effort is in the service of a poetic moment when '*the product would reveal the landscape as the coffee was drunk similar to watching a cloud inversion from a hilltop'*. Masterton particularly exemplifies makers who are using digital tools in order to enhance the level of accuracy and detail they are able to achieve. It is an example of how technology can be a route to greater engagement and control in crafted work, not a way to simplify or step back. He achieves a greater degree of direct control through inserting his own programming, or open sourced additions, into software used to dictate the tool parameters of the CNC milling machine he employs, a slow open-ended process of software and tool adaptation to his own ends (Masterton, 2007:9).

Figure 15: Drummond Masterton, Terraincup, 2005.

CNC milled from aluminium billet. Image: www.autonomatic.org.uk. Available at: http://www.autonomatic.org.uk/team/dm/terrain.html#/ [accessed 10.4.12].

Website: http://air.falmouth.ac.uk/research-groups/autonomatic (Autonomatic, N.d.-b).

- Liverpool-based sculptural abstract artist and woodturning specialist Richard Hooper is another early CADCAM advocate and exhibitor at *Interface*. He generally works in laminated birch plywood and uses a wide variety of machinery from saws and lathes to digitally controlled CNC mills and routers (Hooper, N.d.) to produce technically perfected pieces that often explore complex, geometrically derived forms, inspired by mathematics. Again, with a practice that also spans education, Hooper states that: '*I have received research support from my university employer to attend formal training in CAD and to work collaboratively with industry in the realisation of my concepts…For me… the idea is the central investigation even more than the actual* *physically manifested object'* and cites his exploration of digital manufacturing techniques used by engineers, pattern-makers and mould-makers as inspiration. (Woolner and Wynne, 2006:24).

Figure 16: Richard Hooper, Trefoil, 2005, photograph. R.Hooper.

Birch plywood, H: 160mm, W: 400mm, D: 350mm. Photograph: R.Hooper, reproduced by permission.

Website: www.richard-hooper.co.uk (Hooper, N.d.).

2.4.4: Making connections to audiences

A very different aspect of digital technology applications has been explored by makers looking to enhance the way in which they can connect with their audiences, reach out to co-create work or find new models for interaction with the public.

- Automake was a collaborative project drawing on the perspective of craft maker and researcher Justin Marshall. It explored the idea of a re-negotiated boundary between producer and consumer, and between craft and industrial production. Described as an *interactive generative design project*, Automake used bespoke software to allow users to create varied and complex forms through a relatively simple process of manipulating computer-generated mesh envelopes, within which selected components were randomly placed by the computer, until a finished form appeared. The results are then translated into CAD files that can be output through rapid prototyping as 3D forms in a number of materials (Automake, N.d.). The form building software was developed in collaboration with Ertu Unver, a computer CAD and programming expert from the University of Huddersfield. Users can create an infinite variety of unique, one-off structures (Atkinson et al., 2008:3). The Automake website presents a selection of objects co-designed by visitors to an Automake exhibition held at The Hub: National

Centre for Craft & Design in Sleaford in May 2008. Objects were manufactured in SLS nylon by *3D Systems* who sponsored the exhibition.

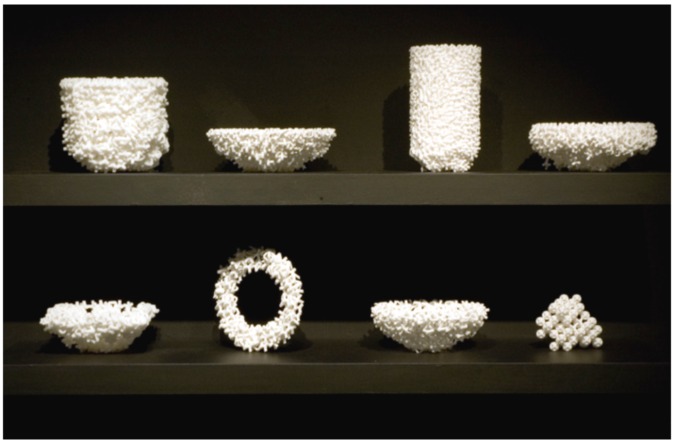


Figure 17: Automake, Selected rp (SLS nylon) objects, co-designed by exhibition visitors.

Automake is a collaborative research project, started in 2006, which sits within the broader 'Post Industrial Manufacturing Systems' (PIMS) research initiative instigated by Paul Atkinson at the University of Hudderfield. Justin Marshall was invited to develop generative software concepts created by Lionel T Dean for his Future Factories project.
Image: www.automake.co.uk. Available at:
http://www.automake.co.uk/gallery/exhibition/index.html [accessed 10.4.12].

Website: www.automake.co.uk (Automake, N.d.).

- Automake is an example of how a screen-based interface which presents users with choices (within strong boundaries set by the system's designers) can be engineered to allow for a degree of exploration and creativity; a collaborative value chain. The resulting objects raise questions of authorship (is authorship shared between the exhibition visitor, the system designers and the output manufacturers?). Atkinson, the project instigator, comments: '*Visitors returned again and again to see the expanding displays, with those whose work was selected and manufactured proudly bringing friends and relatives to see the results of their endeavours...The system enabled them to engage in a form of design and production that questioned their familiar relationship with the object'* and goes on to describe these kinds of increasingly common design systems as ones in which *'The graphic designer's role has moved from creating fixed products to a more fluid digital presence, where they may not be totally in control of the content constantly being added to their original creation'* (Atkinson, 2011). He likens the designer's role in such systems to that of the conductor of an orchestra or director of a film – where the director is recognised as the creative force but the process is one of co-creation.

- Another example of work that combines digital technology and craft in order to promote interaction and direct involvement from visitors is the *Interactive Work-table and Escritoire* by Jason Cleverly. This piece was developed as a commission for *The House of Words*, an exhibition celebrating the 300th anniversary of the birth of Dr. Johnson (famous for his 1755 dictionary). Designed as an interactive digital book housed within a '*playful recreation'* of a version of Johnson's writing desk (Tyzlik-Carver, 2009), this piece uses a digital version of a traditional pen and paper to allow visitors to input their own word entries and their own definitions. The results from two exhibitions have been compiled in an internet-based listing and can be viewed online.

The House of Words

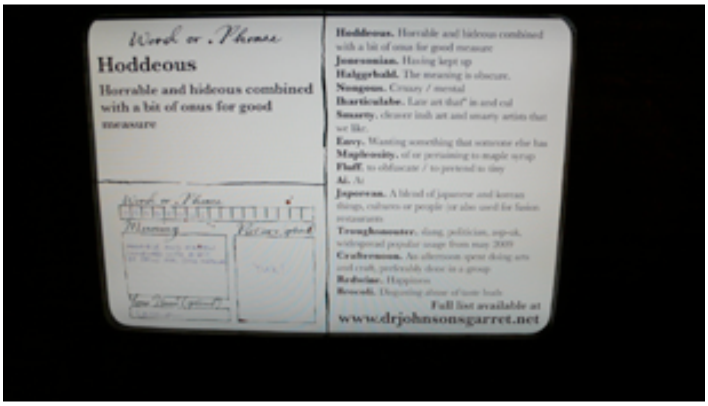


Figure 18: Jason Cleverly, Interactive Work-table and Escritoire, 2009.

The technology underpinning the installation combines the commercial Digital Pen & Paper solution from Celtic Internet, based on Anoto functionality, and open source content management system Drupal customised by UCF programmer and technologist Tim Shear.

Image: www.drjohnsonsgarret.net. Available at: http://www.drjohnsonsgarret.net/about [accessed 10.4.12].

Website: www.drjohnsonsgarret.net (Dr Johnson's Garret project, 2011).

- Hundreds of words and matching personal definitions have been left as a response to this exhibit and reveal a fascinating creativity and involvement in language. The resulting compiled entries provide a cross-section of imaginative and funny uses of English, from Abought (to stop a purchase at the last minute) through lluummlum (a word to use when you are obsessed with plums) to ZOMG (Oh My God to the max). This piece required digital expertise including specially written software and developing a new application for digitally watermarked paper. The project is a collaborative research project between artists, academics and technologists at University College Falmouth, Kings College London and Celtic Internet (Dr Johnson's Garret project, 2011).

- Jayne Wallace works as a digital jeweller and researcher exploring the potential of digital jewellery within personal experience and human relationships (her PhD research is briefly reviewed in Section 2.3). Her work is concerned with the emotional and reflective potential of digital technology use within jewellery. Some aspects of her recent research have been exhibited within the Crafts Council Craft Cube Series (2010). This research centres on memory and memory loss. The Crafts Council explains: '*The selected works are reflective pieces based on source material gathered from care staff at Alzheimer's Society day care centres and people living with memory loss as well as in-depth co-creative research with an individual living with dementia…Viewers enter the CraftCube to interact with the pieces and uncover the personal stories around them'* (Crafts Council UK, 2011a). Wallace uses technology to enhance the connective and meaningful aspects of her jewellery, in this case the ability of the locket to contain and display multiple images, that can be changed and added to.

Figure 19: Jayne Wallace, A locket that can forget.

Developed in partnership with Newcastle University and the UK Research Council's Digital Hub (SiDE). Image: www.digitaljewellery.com. Available at: http://homepage.mac.com/wallacejayne/CraftCube%3APieces.html [accessed 10.4.12].

Website: www.digitaljewellery.com/ (Wallace, N.d.).

- Public Artist, Chris Tipping's ***1497 Plates*** is a digital craft collaboration that has been documented by Tipping's main collaborator Katie Bunnell (2010). This project was commissioned by Bath and North East Somerset Council to commemorate the Combe Down Stone Mines Stabilisation project. A large scale map of 788 bone china dinner plates was made and exhibited, each plate with its own complex layered imagery exploring various aspects of mining technology, heritage and natural history. The 788 dinner plates form a large-scale permanent installation, whilst in Combe Down 691 households affected by the stabilisation works were gifted a ceramic plate, one small part of the map, representing not only the individual household but the mining underworld beneath it.

- A close collaborative dialogue was required to realise the project, from dealing with large-scale complex digital data and the development of imagery to final ceramic installation. The project combined the use of digital designing, hand drawing and digital ceramic print technology as well as consideration of dialogue, narrative and interaction with a number of stakeholders. Bunnell comments '*there was also a sense that Tipping was excited by the imagery as it developed, but felt distanced from it – he wanted to be more hands on, but had to rely on Bunnell as his interpreter or cypher*' (2010:460). Bunnell comments on the ability of *Autonomatic* (N.d.-b) as creative crafts practitioners themselves, to provide '*a level of creative engagement that goes well beyond the Bureau Services that have developed around digital design and production technologies*' highlighting questions over the identity of the digital crafts practitioner as '*sympathetic cypher'* (Bunnell, 2010:462).

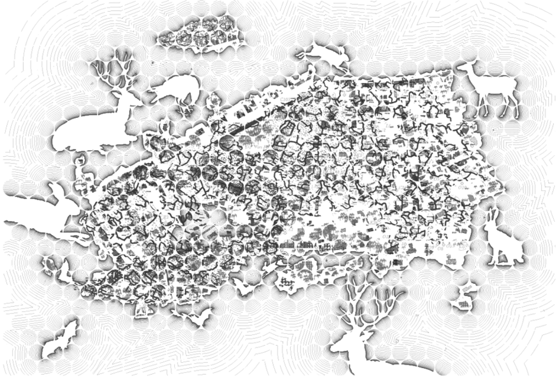


Figure 20: Artist's Map, Combe Down Stone Mine, image: K.Bunnell.

Figure 21: Details of map on bone china dinner plates, photograph:C.Tipping.

Public artist Chris Tipping worked in collaboration with Autonomatic, at UCF, Oxford Archaeology, Hydrock, Scott Wilson and the project team, and Digital Ceramic Systems. Image reproduced by permission.

All of the projects briefly reviewed in Section 2.4.4 combine a collaborative approach between academics, technologists, makers and audience in *collaborative value chains* (Section 2.5). They all required considerable technical expertise and the ability to work in close partnership with technologists.

2.4.5: The existence of a genre

The most recent exhibition dedicated to digital craft in the UK is *LabCraft – digital adventures in contemporary craft.* This is a Crafts Council Touring exhibition that was seen at UK museum and gallery venues until March 2012. It highlighted the work of 26 makers in the field *'who combine the hand, mind and eye, technical mastery of tools and material and aesthetic sensibility, with cutting-edge digital technologies such as rapid prototyping, laser cutting, laser scanning and digital printing'* (Crafts Council UK, 2011b). The exhibition was clearly couched in terms of digital tools providing a new direction: *'Today we live in a Digital Age; a time when technological advancements are presenting craft practitioners with liberating opportunities. A new visual language is emerging. …These tools enable the production of objects that move beyond the limitations of the hand'* (Crafts Council UK, 2011b).

Among the 26 exhibitors chosen by curator Max Fraser were several that had featured at the earlier digital exhibition *Interface,* such as Autonomatic's Justin Marshall, Tavs Jorgensen and Drummond Masterton. The exhibition particularly chose to highlight the collaborative role of digital manufacturing centres and university-based research facilities, with video interviews and process explanations, for example, from Metropolitan Works – the digital manufacturing centre of London Metropolitan University. This is the manufacturing centre used by exhibitors such as Tomoko Azumi and Assa Ashuach (Metropolitan Works, N.d.). Three of the featured textile artists work within the Textile Futures Research Group (TFRC, N.d.) of the University of Arts London: Phillippa Brock, Melanie Bowles and Jo Pierce and, as noted above, several exhibitors were from Autonomatic, the 3D Digital Production Research Cluster University College Falmouth. By highlighting the role of resource and production centres and groups of makers associated with particular centres, the exhibition underlines the importance of the role of shared production resources in the facilitation of new digital work.

- The exhibition demonstrated the range of materials within the scope of digital craft, with work in textiles, glass, metal and wood, as well as plastics. It also sought to include a range of makers using digital tools at all stages of their careers, from relatively recent graduates such as the RCAs' MA 2008 graduate Zachary Eastwood-Bloom, whose partially eroded beech coffee table titled: *Information Ate My Table* is shown below.

Figure 22: Zachary Eastwood-Bloom, Information Ate My Table, 2010.

'*A table becomes dysfunctional through digital interference'* MA Show, RCA, 2010. Image: Zachary Eastwood Bloom. Available at: http://www.zacharyeastwood-bloom.co.uk/photo_6035368.html [accessed 10.4.12].

Website: http://www.zacharyeastwood-bloom.co.uk/ (Eastwood-Bloom, N.d.).

- This piece seeks to question the relationship between functionality and information overload using a digital conceptual theme for form and content. *LabCraft* also included a large number of well established makers such as Geoffrey Mann and Michael Eden whose work is described earlier in the section, as well as Professor and Head of Design Products at the Royal College of Art, Tord Boontje (Tord Boontje, N.d) whose exhibit titled: *100 years* was a laser cut fabric panel with a delicate tree ring and wood grain pattern.

- The piece shown below, exhibited within *LabCraft,* is by Nina Tolstrup. Titled *Branch Out,* it is made in wood and iron. Found branches have been scanned and altered in a 3D program. The manipulated branches have been rapid prototyped and cast. These connected pieces form simple skeletal structures that could be used to make basic items of furniture such as a trestle.

Figure 23: Nina Tolstrup, Branch Trestle, Studiomama.

Trestle made in wood and iron. Photograph: Hector Serrano. Available at: http://www.studiomama.com/downloads/SM_BRANCHTRESTLE.jpg [accessed 10.4.12].

Website: www.studiomama.com/contact.html (Tolstrup, N.d.).

2.4.6: Conclusion to review of practice

This brief review of published digital work shows examples of how boundaries and possibilities for making are being tested and expanded as a result of conditions brought about by increased access to, and use of, digital technologies. An in-depth investigation of the views of a number of professional practitioners in the field is documented and analysed in Chapter 6. Some of the categories of experimentation and development of work, shown within the above section include:

- Transformation of 2D imagery - using scale, pattern and repetition to reframe.
- Digital data as 3D - geometry, mathematics, location, time series and sound data used.
- Material craft enhanced - increased complexity, accuracy and individualisation of data and machining, material experiments - for example, rapid prototyping materials from ceramic to plastics and metals.
- Making connections to audiences - co-creation, exploring user/producer relationships.
- The existence of a genre - digital craft exhibitions, conferences, research groups and 'visual language'.

The examples given in this section are of work that demonstrates developments within these themes. The researcher considers that this work, taken together, is indicative of the increase in scope that digital capabilities bring to craft. For the researcher, these developments, in the specific context of craft, hold together as a group of developments, all linked to and dependent on digital technologies. These are developments that enable a panoply of new directions and opportunities to be explored by makers. They potentially drive change that impacts on the entire gamut of issues involved in making, from the material used, to the form, the making process, the meaning and relationships to objects and audiences. The researcher considers that the evidence of the scope and type of changes made possible, the ability to talk about them within themes and as categories of development and exploration, alongside the existence of exhibitions, adherents and institutional groups that can be defined as related to the field, suggest the emergence of a new *genre* - '*a particular style or category of works of art'* (OED, 2011c) - works that can be considered as digital craft. For the researcher, this amounts to a fundamental shift, a step change for one avenue of craft practice. Section 7.5 discusses the researcher's view that digitally enabled and networked craft, which integrates many aspects of digital practice and shares characteristics across many areas of impact, from working methods to collaborative value chains and creative use of data (Section 7.5), can also be viewed as a distinct type of practice. The researcher has used the term *technepractice* to identify work that combines many aspects of digital practice.

How the projects reviewed in Section 2.4 have been realised, and therefore the exact contribution of technology, of digital facilities and expert help, of *a network of resources* brought together, are in many cases unknown to the researcher. However, they do suggest a direction of travel. Indications of moves towards needing to work collaboratively, towards harnessing outsourced resources, expertise and specialist knowledge, and production centres, are discernible in many cases. For some makers from a craft background, a traditional focus on productive autonomy does appear to be giving way to a broader authorial and collaborative approach, through which projects can expand in reach and ambition.

Alongside having its own exhibitions, aesthetics, adherents and practices what are the attributes that we could expect a new craft *genre* to exhibit? In *Smart World* (Ogle, 2008) Richard Ogle discusses the term '*idea-space'*. Described as *'socially and culturally embodied idea-spaces that populate the extended mind*' Ogle explains that idea-spaces can consist of '*myths, business models, scientific paradigms, social conventions, practices, institutions and even computer chips - rich with embodied intelligence that we have progressively offloaded into our physical, social and cultural environment'* (Ogle, 2008:2). For Ogle, we don't always have to think for ourselves because we can draw on the extended mind of an idea-space, and creative leaps forward are often the result of the combination of unlike idea-spaces: '*the imaginative and insightful transfer of powerful, externally embedded intelligence from one idea-space to another'* (Ogle, 2008:4). The fertile creativity that results from idea-spaces connecting, merging and integrating, and how this follows the patterns of network science, are the subject of Ogle's proposition. From the researcher's point of view the seemingly disparate connection of craft and digital domains is just such a fertile connection of two well established *idea-spaces*, full of their own meaning, associations, practices and repositories of knowledge. It is often the powerful juxtaposition or combination of strengths from both idea-spaces that gives digital craft work its ability to surprise, delight or provide rich textures and meaning by re-framing either, or both, digital and craft contexts. The next section of the contextual review looks at how the global digital economy provides a set of conditions and parameters, the building blocks of the digital idea-space, the digital economy part of a combined digital/craft integration that could potentially provide new making and marketing opportunities for makers.

Section 2.5: The Digital Creative Economy

It has been widely acknowledged in a series of books, conferences and Government reports that significant structural change in the creative industries, for example, within consumer product design and manufacture, is being driven forward by digital technology capabilities. In the UK, Government reports such as C*reative Britain: New Talents for the New Economy* (Department for Culture Media and Sport, 2008) and, more recently, a series of *Creative Industry Knowledge Transfer Partnership, Beacon Reports* (Creative Industries KTN, 2011), have outlined issues concerning support and funding for innovation in the creative industries, calling for investment in skills and knowledge transfer programmes, which are deemed necessary to take advantage of new trends. Official bodies such as the Technology Strategy Board, which funds technology innovation and research and is responsible for the sector-specific UK Knowledge Transfer Networks, aim to '*stimulate and support business-led innovation*' (Technology Strategy Board, N.d.), in part, by fostering understanding of the role of digital tools. A series of recent research projects and reports, sponsored by the Creative Industries Knowledge Transfer Network, covers issues ranging from the Future of Digital Content, to Exploiting Digital Tools, to Bridging the Physical and Digital Worlds and look at issues including Intellectual Property, Sustainability and Creative Consumers. These are all available online (Creative Industries Knowledge Transfer Network, 2011).

2.5.1: Future trends: digital and physical connected

Structural changes and opportunities within the UK digital economy have attracted considerable attention and research, directed at identifying trends and business potential. In some specific ways this research is particularly relevant to digital craft makers. The crafts sector, for example, was one of five industries selected to be considered in the series of Beacon Reports titled *'Bridging the Digital and Physical Worlds'* (Creative Industries KTN, 2011) alongside fashion, architecture, design and, film/gaming. This project began with a baseline report (McCormick, 2011) that identified three key, broad, digital trends affecting all of these industries. These were:

'***Collaborative Value Chains* -** *Linear, top down value chains with the customer on the bottom are increasingly rare. Users and customers are able to contribute to the value of new experiences and artefacts. Such collaboration challenges the accepted definition of IP, and established routes to market.*

***Converged Systems* -** *Tools and techniques that have existed independently are increasingly converged. The ease of use of such convergence will determine the extent to which such systems impact upon industries.*

Customised & Localised *– Customised manufacture does not require the physical space and resource of mass manufacture. Localising the point of manufacture will reduce environmental impact and provide new opportunities for local communities and institutions.*

(McCormick, 2011:5)

These three broad themes can be thought of as covering three distinct areas of concern: *people, systems* and *products*. Firstly, *collaborative value chains* implies a greater involvement and integration of *people,* a breaking down of traditional distinctions between groups such as users, customers or audiences, on the one hand, and producers or makers, on the other. Projects like the ones outlined in Section 2.4.4 demonstrate this inclusive approach to creating value. For the researcher, in the context of this research, it also implies an enlarged sphere of contributions to the production of work, for example, the skills and knowledges sourced from machinery, technicians, machine operators, digital experts, mentors, peers, production partners and digital making and marketing platforms. Within this research, collaborative value chains refers to this sense of an enlarged collective digital approach, based on ease of data transfer and communication, the integration of people and expertise. *Creative collaborations*, within this research, is used to mean a different kind of collaboration, for example, the experiment in joint authorship, seen in the researcher's own practice work in Section 5.4. Creative collaboration is reserved to describe practice that involves a high level of creative input from both, or all, the parties, an interchange of expertise and options that extends and adds to the practice of both parties. Secondly, the convergence of *systems* implies the use of common tools across creative industries, so that trans-disciplinary practice is enhanced. A spread of tools through ease of use to a broader public, as well as the ability to use common systems to more easily share data, content and information. Lastly, the impact on *products* suggests a trend towards localised individual production, whether that is bespoke, customised or personalised products created on demand. It is clear that these broad trends are all relevant to digital craft.

Within each of the industries considered, the emphasis and impacts of change that the report identifies vary, for example, within fashion the growth of customisation is highlighted, whereas in architecture the emergence of complex digital Building Information Modelling (BIM) systems as collaborative development platforms is featured. In relation to Design and Craft the *Baseline Report* (McCormick, 2011) highlights the increasing use of CADCAM tools, the sharing of designs through online communities and the emergence of amateur access to digital making (for example through instructables.com): in effect, the democratisation of craft tools. The report highlights '*a rebirth of the maker movement for the digital age where people of all skill sets converge to share knowledge and designs*' (McCormick, 2011:5). The role of designer is seen as changing in parallel with other creative industries '*As is happening in the fashion world, professional designers are becoming more akin to a choice architect by creating a variety of solutions rather than a single design. More powerfully, organisations such as*

Shapeways enable designers to flatten the value chain from conception to sale, empowering them to realise designs, to share their designs or sell their designs' (McCormick, 2011:11).

For craft specifically, the report talks of the '*blending of digital and physical creativity*' and goes on to cite the '*democratisation of artefact creation'* and '*new channels of distribution and new ways to engage with new and existing audiences*' as among the impacts on craft. The potential change in the role of the maker is central to the overall message of these reports. They envisage, in parallel with other creative industries, the maker in an enabling role, perhaps even designing and providing a collaborative platform for the creation of customised products.

2.5.2: Future trends: digital tool-use within the creative industries

A parallel series of creative industry reports titled: *The Creative Industries: Exploiting Digital Tools*, (Creative Industries KTN, 2010) investigated the theme of future trends in digital tool-use across the creative industries, identifying seven key future trends in digital tool-use. Whilst these reports tend to focus on media industries such as TV, film and gaming for their scenarios and examples, rather than craft, it is interesting to view their conclusions through a craft perspective. The seven key trends are:

1. Creative collaboration

Tools will evolve from a single-user model to a multi-user, real-time collaboration model.

2. Tools in the cloud

Digital tools will increasingly move into the cloud.

3. Natural user-interfaces

Next generation interfaces for tools will move creative professionals on from the mouse paradigm.

4. Merger of creatives and developers

As both creating and developing become cheaper and easier, the two skillsets are increasingly combining.

5. Just-in-time production

A blurring between content distribution and the editorial, driven by dynamic content assembly.

6. Data-driven creativity

Data will be increasingly important in informing the creative process itself.

7. Tools as creative collaborators

Tools become much more sophisticated in their support and technical knowledge.

(Creative Industries KTN, 2010:4)

Each of these trends can easily be interpreted through a craft paradigm. The emergence and the potential for *creative collaboration* in digital craft practices through digital technology use is, of course, part of the premise of this thesis. In addition to creative collaboration, a variety of assisted and collective working practices within which others' expertise, skills and collective facilities make a collaborative contribution is investigated in Chapters 4, 5, and 6. The *merger of creatives and developers* can be seen as relevant to the integration of skills and input from makers and technical expertise. *Tools as creative collaborators* can be identified in the contribution that, for example, software pre-sets and options within CADCAM and rapid prototyping systems make to outcomes and also in the researcher's view of tools as pragmatic partners, 'active counterparts' in the creative process (see Section 3.2.1). The potential for skill leverage, to access a machine skill, also falls within this category (Section 4.7.5). *Data driven creativity* is often seen within media applications as referring to increasing use of metadata in providing and informing the choice of customised viewing for *just-in time production,* but is just as relevant to digital craft in the sense of the use of novel digital data to express physical form, and in bespoke and customised one-off object production, both seen as a key digital potentials identified by the Making it Digital participants (Section 4.7). The remaining two digital tool-use trends, *tools in the cloud* and *natural user-interfaces* are equally relevant. Tools in the cloud supports the extension of freelance collaborative groupings on craft project work via outsourcing of production and communication of data, as well as converged, open access marketing and selling platforms discussed below. Natural user-interfaces can be seen in development of haptic interfaces specifically designed to support craft applications (such as Anarkik3D's console used as an example in the report (Anarkik 3D, N.d.).

The general picture of *collaborative* working through *converged* systems to produce *customised* output does seem to be one that is broadly applicable across creative sectors. Within the *Digital Tools Beacon Implications & Recommendations* (Creative Industries KTN, 2010) are a whole series of implications and recommendations. These range from the technical investment needed by companies, to changes in skillsets and opportunities that are identified. Although it concerns the creative industries generally, one of the most interesting implications identified, from the point of view of this research, is the call for integration between 'craft skills' - meant here in the sense of first-hand tacit creative input, such as sketching - and technology across creative industry sectors. The report states:

'Individuals will need both 'craft' skills and the ability to use the latest tools & technologies, producing ever-better outputs, and doing so via more natural interfaces' (Creative Industries KTN, 2010:10).

Yet this view of a promising future of more natural and intuitive tools is tempered by a warning that the value of creative input can be undermined or assumed by digital capabilities and amateur access. The report explicitly states:

'… as more and more amateurs get access to digital tools, do quality expectations lower?… The definition of what it means to be a creative professional is under threat, given the democratisation of tools to consumers and a rapidly changing skills base' and goes on to say *'As more advanced tools get into amateurs' hands, creative professionals need to protect their point of difference…'* concluding that *'There will be a need going forwards to protect, recognise and reward creative 'quality'* (Creative Industries KTN, 2010:10).

So, from this report there is a clear concern to take action to ensure that digital tool-use trends, the democratisation of tools, does not undermine creative quality and professional status. Within the context of this craft research, that concern is expressed through an analysis of the traditional value and perception of craft skill and a discussion of how in an era of digital tool-use craft skill can be retained, measured and valued. Section 2.3 examined how craft 'quality' associated with skill and engagement can be demonstrated and understood. This will be further examined within the case studies and practice work (Chapters 4 and 5). These chapters aim to provide some evidential basis for testing the propositions outlined above concerning general digital tool-use in relation to craft. The question is asked: can collaboration, convergence and customisation be identified in the digital craft practices examined and what are the implications for skill?

2.5.3: Future trends: creative industry models of commerce

There is emerging evidence, within the art, craft and design business sectors, of new organisational and business models operating via online platforms which fit the patterns of future trends in digital tool-use, such as collaborative value chains, converged systems and customisation, detailed above. This section looks at a few specific examples and draws on developments previously documented, for example in: (Bunnell and Marshall (2010), Scott, D. (2010), Atkinson (2010)).

There are examples of new ways to engage and participate in product development and design, via collaborative making and online selling platforms. These range from new ways for amateurs, enthusiasts and professionals to engage, such as instructables.com (Instructables, N.d.) and sell work, such as etsy.com (Etsy, N.d) to creative project funding platforms like kickstarter.com (Kickstarter, N.d.) and multi-media portfolio spaces and networks like behance.com (Behance, N.d.). The rise of interest in making among a wider public has been documented in texts such as *Handmade Nation: the rise of DIY, art craft and design* (Levine and Heimerl, 2008) and the boundaries between amateurs and professionals examined, for example, in *Professionalism, Amateurism and the Boundaries of Design* (Beegan and Atkinson, 2008) which traces encouragement of amateur practice back to the Arts and Crafts movement, and points out how amateur practice necessitates a blurring of boundaries as *'the vernacular makers are intimately connected to the user, indeed they often are both designer and user. In these cases, the fluctuating boundaries between designer, maker and user have disappeared altogether'* (Beegan and Atkinson, 2008). As the researcher noted in Section 2.1, designer-makers often operate in a number of sectors, across disciplines, and through digital technologies are able to access manufacturing and marketing platforms that can facilitate different levels of engagement from amateur maker to professional design collaborator, potentially accessing a wider range of opportunities.

As well as specialist design companies using additive manufacturing (see below) for products, there are also major developments in on-demand manufacture of one-off products which are accessible to a wider range of makers. There are a number of examples of companies that offer web-based software and manufacturing services, such as 3D file sharing, printing or marketplaces for selling printed objects. Shapeways, based in New York and the Netherlands is one example of a company offering 3D printing and support services so that makers and designers can design, personalise, buy and sell custom-made products (Shapeways, 2011). Another example is Ponoko.com. Ponoko are a small New Zealand based company that offers customisation and fabrication facilities that enable makers to use and share existing files or upload their own designs with buying, selling and making areas on its website. Both sites have details of many thousands of projects and products that have been user-generated and made. Products range from jewellery to puzzles or home décor items and a wide range of materials are possible. In May 2011 Shapeways announced they have added 3D ceramic printing to the materials on offer saying '*Shapeways announces today a new service for 3D printing in glazed ceramic. This is the first Shapeways material that is food safe, enabling designers and consumers to create personalized ceramic tableware'* (Shapeways, 2011). Ponoko's materials catalogue http://www.ponoko.com/make-and-sell/materials, has a similarly wide range. These companies sometimes work with established designers, or in collaboration with manufacturing facilities in other locations, in Ponoko's case, for example, Razor Lab in the UK use Ponoko systems (Razor Lab, 2011) to deliver local laser cutting services. Localised manufacture is an essential part of the vision for distributed manufacture. Another example of a company offering web-based services to makers, enabling them to design and make products using patterns, fractals and parametric box software tools is Eindhoven-based Studio Ludens (Studio Ludens, 2011). They offer creative design tools linked to a gallery of uses and opportunities, for example by linking a repeated pattern design made with the Repper software provided and combining it with an image reproduction service, like that offered by customisation company Zazzle (Zazzle, N.d.), finished products such as mugs, ipad covers and jewellery can be made.

Collaborative value chains can be seen in a variety of business models such as; direct-to-consumer marketing strategies, companies where products are made only if sufficient orders are placed, and platforms that allow ideas to be tested in a virtual form before production. These are examples of the kind of global communications-based business and organisational models that are providing new possibilities for craft and design professionals and the wider community of makers and consumers. One company that makes individual pieces to order is; *Unto This Last.*

- The company website describes *Unto This Last* as specialising in '*Local craftsmanship at mass production prices'* (Unto This Last, N.d). The company operates from a workshop and selling space in Brick Lane. The idea is that *'everything you buy from us is made at the back of our shop, on a digital router'*. *Unto This Last* specialises in delivering on demand micro-manufactured furniture, in materials such as birch ply. The company cuts costs on warehousing and packaging, for example, by not keeping product in stock but making it to fill customer orders in made-to-measure variations, from a back catalogue of designs (Unto This Last, N.d). The work included in *Interface* was *Spline Chair* (shown below) an innovative design that celebrates its digital origins. This is an example of how digital manufacturing technologies are enabling a business model that marries the craftsmanship of made-to-order goods with a digitally accessible store of designs and digital manufacturing techniques. Bunnell and Marshall envisage that this model could be expanded to involve online interaction with designers and customers: *'Through the example of Unto this Last, is it possible to imagine a future where crafts practitioners marry their intimate understanding of designing through making with the capabilities of digital design, production, Web 2.0 and e-commerce? If it is then, this means that right now more crafts people need to acquire digital skills.'* (Bunnell and Marshall, 2010:9).

Figure 24: Unto This Last, Spline Chair.

Birch Plywood, shown in white. H: 80cms. Image: www.untothislast.co.uk. Available at: http://www.untothislast.co.uk/Seating/Spline.html [accessed 11.4.12].

Website: www.untothislast.co.uk (Unto This Last, N.d).

- Fluid Forms is a small company that designs, makes and sells gifts made through digital manufacturing combined with craftsmanship, products that are often based on data supplied or selected by customers. Products include clocks and earrings from street map data or wooden bowls which are 3D renditions in relief of location data (Fluid Forms, 2011). Using innovative design-production-tools and online interfaces, they allow customers to take a hand in deciding what their product looks like, creating a personal connection to the product. They are an example of digital manufacturing of small scale one-off items that bridge the gap between one-off bespoke products and standard manufactured products, offering personalisation by incorporating customer variation.

Figure 25: Fluid Forms, Earth Bowl Stripe with lemons and butterfly.

Earth Bowl,300 x 300 x 65mm. Photograph: Karin Lernbeiß. Available at: http://www.flickr.com/photos/fluidforms/3309405132/sizes/m/in/photostream/ [accessed11.4.12].

Website: www.fluid-forms.com (Fluid Forms, 2011).

Customisation is arguably one of the biggest areas of expansion for internet-based small craft and design making enterprises. These are just two brief examples of new business models; a huge variety of large and small internet-based interfaces offering customised and bespoke products have emerged. Freitag, for example, offered bespoke bags made from carefully selected truck tarpaulins. Website visitors choose their own sections of tarpaulin via a ‘design your own bag’ web interface and the bags manufactured in Switzerland (Freitag, 2011). Similarly, large companies like Nike offer bespoke products, with customers able to choose materials, colours and add text for iD straps (NIKE inc, N.d.).

2.5.4: Advances in 3D printing

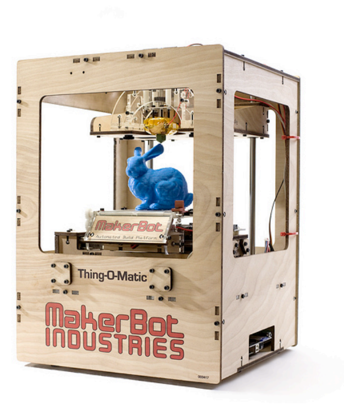


Figure 26: MakerBot Thing-O-Matic, MakerBot Industries.

3D printer. Image: www.makerbot.com. Available at: http://www.flickr.com/photos/makerbot/5526691737/sizes/m/in/photostream/ [accessed 12.4.12].

Websites: www.makerbot.com www.thingiverse.com
(MakerBot Industries, N.d, Thingiverse, 2012).

Rapid prototyping and rapid manufacturing; 'additive manufacturing' is, in itself, a distinct area of development producing new opportunities and models for making that look to be able to provide one of the fundamental shifts of post-industrial manufacturing. One important aspect of this shift is towards the democratisation of making and availability of open source hardware - being able to print physical objects from freely available files - within the digital creative economy. There are also many companies working with designers to create products that explore the potential of additive manufacturing.

- Belgian company Materialise research and make rapid manufacturing systems and products in a wide range of fields. They develop lighting, furniture and accessories through .MGX by Materialise. *'Manufactured using a variety of 3D printing methods, the .MGX by Materialise collection combines the best of modern and traditional craftsmanship… each piece is individually drawn and created by laser beam, and carefully finished by hand'* (MGX, N.d.). Working with high profile contemporary designers they have created a collection of unique products with lighting designs and lampshades being some of their most celebrated products, winning many awards.

Figure 27: Bloom.MGX designed by Patrick Jouin for .MGX by Materialise.

Table lamp with shade which collapses or expands to release or contain light. Photograph reproduced by permission.MGX

Website: www.mgxbymaterialise.com (MGX, N.d.)

- In September 2011, curator Murray Moss worked with Materialise on an exhibition titled: *Industrial Revolution 2.0: How the Material World will Newly Materialise'* an installation at the V&A, as part of London Design Week (MGX, N.d.). An exhibition '*of 'printed' works that wittily reference eight of the museums key pieces and spaces'* (London Design Festival, 2011) and described by Jonathan Glancey in The Guardian online: '*The 3D prints on show at the V&A from Saturday are delightful, yet there should be no question this is a design process that will quietly revolutionise the way we imagine and make things from table lamps to prototypes of buildings and buses. Its commercial applications are infinite, although it will also allow designers to play ever more and, happily, just for the sake of it'* (Glancey, 2011). In the context of recent press coverage of additive manufacturing, this kind of view of it as a fundamental change is not uncommon (Moskvitch, 2011).

Another renowned design company working with 3D printing is Freedom of Creation (2012). FOC is a product design company specialising in 3D printed designs including lighting, furniture, jewellery and other objects. The Amsterdam-based company has received many design awards. The Freedom of Creation website reports that in September 2011 they took part in a promotion at Bijenkorf department stores in The Netherlands (Freedom of Creation, 2012), selling both their collection and the 3D printers themselves, available as a kit for DIY assembly, one indication of how this technology is edging towards becoming mainstream (Freedom of

Creation, 2012). FOC was acquired by US company 3D Systems Corporation in May 2011. The 3D Systems press release explains the acquisition as part of a strategy: *'our quest to democratize access and accelerate adoption of compelling and affordable 3D content-to-print solutions for consumers and professionals alike'* (3D Systems, 2011a). Further evidence that 3D Systems are committed to the expansion and widespread use of rapid manufacturing is also indicated by the way in which, in September 2011, they made freely available a Rapid Manufacturing SLS Design Guide that helps designers to effectively develop good files for 3D selective laser sintering applications, giving detailed help across many categories of object from axles, baffles and bearings to chains, hinges and threads (3D Systems, 2011b).

2.5.5: Generative Software

- Future Factories is a research and design initiative that explores the concept of mass-individualisation through generative software and digital manufacturing. The concept is explained as; a way to create added value through the design freedoms and manufacturing flexibility of digital technologies. '*A key area of interest is the combination of computer scripts and CAD to create meta-designs with the capacity to change over time'* (Future Factories, N.d.). These virtual meta-designs can then be 'printed' as real-world products via additive fabrication (Rapid Prototyping technologies) *'offering the potentially for an endless stream of one-off variants*' (Future Factories, N.d.).

Figure 28: Lionel Dean, Future Factories, Holy Ghost.

Series of 'buttons', generated by computer script and printed in SLS nylon so that no two are the same. Photograph, L.Dean, reproduced by permission.

Website: www.futurefactories.com (Future Factories, N.d.).

- The development of advanced software that reflects biological structures and growth is also a central concern of the work of designer Assa Aschuach. The design and production methodology that underpins '*Digital Forming'* envisages the use of co-design software to allow individuals to get involved in the design process of their products (Digital Forming,N.d.).Established as a company in 2008 (with Aschuach as one of four founding partners) and attracting a UK Government Innovation Grant, Digital Forming is developing an ecommerce platform for 3D mass customisation, through concept brand UCODO.com (User Co-designed Objects). Aschuach, talking about his Osteon Chair, shown below, says: '*The software intelligently calculates and creates internal lattice structures based upon an object's form and intended function and optimizes the strength of the materials used in the product'* (Metropolitan Works, N.d.). Aschuach believes that these technologies give a foretaste of future product design and production.

Figure 29: Assa Ashuach, Osteon Chair.

Produced by EOS laser sintering Image: www. assaashuach.com Available at: http://www.assaashuach.com/osteonchair.php [accessed 10.4.12].

Websites: www.assaashuach.com (Ashuach, N.d).
www.digitalforming.com (Digital Forming N.d).

- Another company using computer simulations and algorithmic tools to generate designs are Nervous Systems, described as a 'generative design studio'. Nervous System produces a series of delicate and beautiful art, jewellery and housewares . '*We write computer programs based on processes and patterns found in nature*' (Nervous System, N.d.) programs which can then be used to create objects. The recently launched Hyphae lamps are described as 'grown'. Tools on the Nervous Systems sites allow users to generate and play with mesh warps and patterns (Nervous System, N.d) and design their own custom pieces.

These examples are not a comprehensive review, they are intended to give a brief taste of the types of business developments that digital technologies used in design and craft manufacture facilitate, and how they relate to the broader trends identified in the 'digital proposition'. The main focus of this research is the impact on individual craft practice rather than post-industrial manufacturing, however, the researcher believes it's important to present the broader context of possibilities because designer-makers are adaptable and flexible and, in using digital tools, may then be able to migrate to newly accessible areas of collaborative, converged and customised digital opportunities. The business models reflect the same digital 'proposition' that faces individual designer-makers engaging with digital tools.

2.5.6: Future trends: is a craft and design convergence implied?

If you accept the broad direction of travel of future trends in digital tool-use as being towards, *collaboration, convergence and customization* does that mean that craft production which is making extensive use of digital technology will move closer to design? If both craft makers and designers, indeed all creative industry professionals using digital technologies, are more likely to be working collaboratively via converged systems on data held in the cloud and making individualised work, is the distinction between a craft maker and a designer (or between animator and fashion designer) less pronounced? One view of future *product design* in relation to new technological, social and cultural considerations comes from the MIT media lab and the 'design methodology' *Future Craft.* At CHI 2008 (Human-Computer Interaction Conference) a paper titled '*Future Craft: How Digital Media is Transforming Product Design*' (Bonanni et al., 2008) was presented. It reviews the *Future Craft* course curriculum which is structured around the three themes of *public, local, and personal* design, as strands in emerging and future product design in the context of digital media and technology use. The descriptions given of these three themes are as follows:

> ***Public Design*** *introduces the newfound capacity of individual designers to develop a global identity, engage in complex issues such as ethics and environmental sustainability, and collaborate across geographic and cultural boundaries of projects.*
>
> ***Local Design*** *proposes tools for design and manufacture at the scale of individual communities, fostering sustainable, empowering and appropriate products.*

> ***Personal Design*** *offers human-scale technologies transforming the longstanding relationships between our bodies and the world.* (Bonanni et al., 2008:2)

Under the theme of *Public Design* the authors highlight three strands, the growth of open source communities and platforms for sharing knowledge and collective intelligence in design. The growth of interest and information in product provenance shown in greater transparency in tracking and publishing manufacturing practices, the ability to engage directly with consumers and producers. And finally, the potential for designers to develop a networked online identity, spanning personal blogs and websites, social networks, photo sharing and video, to have an identity which can be global. The authors envisage internet distribution enabling targeting of *'custom-designed products to communities and individuals'* adding '*These types of sale promote individualized design, including fitted products and functions that more closely match the desires of a group of people. In turn they can have the benefit of promoting local manufacture, avoiding inventory, overhead and overseas manufacturing'* (Bonanni et al., 2008:4) . Services that test the market for a product, promote sharing of products, re-use or up-cycling, are all potentially made possible or enhanced through online *Public Design* initiatives.

Under *Local Design* the authors suggest that key trends include a combination of mass customisation, mass craft and local production. Mass customisation – for example where generic products are altered to meet individual needs. Mass craft – the making of high tech products through low tech means and de-technologising – for example through simplifying products and selecting materials that are local and appropriate to users. Finally local production - seen in a growth in local manufacturing facilities for example FabLabs. *'Personal Fabrication combines all of these technologies into a micro-factory that can be installed far from global manufacturing centers*' (Bonanni et al., 2008:5).

Personal Design considers how digital device design and wearable technologies are changing the possibilities for individual, physical and emotional connections to products.

In summary, the paper sets out the potential for designers to have a global identity and engage in networked collaborative practice whilst actually focusing on localised production and personalised products. The *Future Craft* curriculum is clearly focused on addressing what it sees as '*the wide ranging effects of digital media on the kinds of products that we make as a society, in the hope of addressing and resolving many of the worsening problems surrounding industrial production. Novel technologies and interactions make possible a wide range of improvements toward social and environmental sustainability'* (Bonanni et al., 2008:10) and, as such, is one view of where product design should go. However, the researcher has reviewed it at length because she considers that this approach suggests that the impact of future trends in digital technology application in sustainable product design, will be more a question of design moving closer to the individual, bespoke, local, authenticity that has been the traditional province of craft values, rather than the other way around. Clear boundary distinctions between craft and design practitioners are not always obvious (as individual may work across specialisms), but can usually be identified in particular projects, and identified by craft or design methodologies used for particular projects. Where design migrates towards small-scale, one-off, user-defined objects this may become more difficult.

2.5.7: Future trends: retaining craft character

Many craft makers, of course, already use digital communications technologies extensively, most, for example, have personal websites for marketing and selling their work. The previous Section 2.4 demonstrates how having an online presence, certainly a minimum of a website, explaining your concepts and work, with pictures and possibly a blog, presenting the 'official' version of your professional identity is now fairly ubiquitous. Those who are also using digital technologies for productive work are likely to be using digital technologies and communications to access manufacturing facilities including technical workshops, bureaux or research facilities, specialist manufacturers and technical expertise. Alongside these direct online marketing and making opportunities, the wider digital economy and digital tool trends identified here suggest more pervasive changes which are also reflected in how consumers view and buy craft. Research commissioned by the Crafts Council in 2010 suggests that craft is in a strong position to benefit from consumer trends that reflect some of the same economic and cultural concerns identified by *Future Craft*. Reporting a '*strong correlation between consumer trends and craft values'* this research cites greater consumer interest in a number of areas that are a good match for craft including interest in:

'rare, hard-to-find possessions which serve as talking-points and which demonstrate the buyer's connoisseurship….objects with a genuine local connection seem well placed to continue their growth in popularity. The craft object, rich in stories, associations and provenance, fits this trend….Growing interest in customisation, niche interests and personalisation …the popularity of craft activities at festivals, workshops and make-your-own kits and a ….willingness to source purchases via the web suggests latent potential for online retailing. These sources look set to grow in significance, as does the power of peer recommendation and review' (Morris et al., 2010:9).

What this suggests is a correlation between a consumer interest in craft engagement, in personalised and special objects that have a narrative content at a time when digital technology trends towards collaboration, convergence and customisation should enable the development of new business models to deliver these ends in new and interesting ways.

2.5.8: Future trends: conclusion

This section of the Critical and Contextual Review has attempted to place digital craft within the context of changes in digital tool-use across the UK Creative Industries, and outline, briefly, some of the writing about the broad theoretical context of digital tools, manufacturing and marketing applications. It describes some individual companies and initiatives as an indication of well known examples (however, in a dynamic and fast changing sector, any survey of current initiatives will date very quickly) so the focus has been on establishing the broad shifts, for example, collaborative value achieved through increased consumer participation in product design and greater opportunities for networked and collaborative projects. The increased use of converged systems, seen in the 'lingua franca' of common software and hardware platforms used in trans-disciplinary practice (Marshall, 2008), and makers accessing technologies through online services. Finally customisation, the development of the *'market of one*' (Manchester FabLab, 2011), the potential for personal products, locally produced.

The researcher has chosen to restrict the content of this section to a narrow, craft-focused assessment of digital tool-use in relation to future trends in digital tool-use in other creative industries. However, it is worth pointing out that, just as developments in the use of digital technologies within craft can be seen as consistent with themes identified in the developments of digital tool-use within the Creative Industries generally, so, in turn, this view of future trends in the Creative Industries can be expanded to see a consistent pattern with trends identified in the wider global digital economy. There have been a number of influential economic texts which seek to elaborate on collaborative organisational patterns in global economics. For example, *Wikinomics - how mass collaboration changes everything* (Tapscott and Williams, 2006) posits a move towards open models of economic collaboration through collective online communities and looks at how business can harness collective capabilities. *The Wealth of Networks: how social production transforms markets and freedom* identifies economic changes such as the rise of conditions favouring non-proprietary models of production and peer production and the opportunities presented by the networked information economy (Benkler, 2006). *What's mine is yours: how collaborative consumption is changing the way we live* (Botsman and Rogers, 2011) charts collaborative consumption initiatives from social lending marketplaces and currencies to retail food co-operatives and shared ownership and use schemes, from cars to gardens.

Other texts consider aspects of future trends in production such as *Fab: the coming revolution on your desktop - from personal computers to personal fabrication* (Gershenfeld, 2005) an account of a MIT outreach programme to set up small localised manufacturing facilities around the world or *Shaping Things* (Sterling, 2005) an account of how developments in metadata and RFID tags might transform categories of products and access to information about them. These shifts, broadly from *industrial product manufacture* to *post-industrial manufacturing* are relevant to craft because they may provide opportunities that designer-makers, and in particular digital craft, technology-enabled and networked – *technepractice* makers, are well placed to exploit. For craft, there is a sense of an open, collaborative global playing field, open to the influence of very small scale, specific individual projects, companies and collaborations that can potentially impact on a global scale. The broad themes from *Future Craft: Public, Local and Personal Design* capture the scope of product design trends intended to meet new societal and cultural imperatives, trends which leave the door open to craft initiatives and chime well with craft consumer interests.

The Crafts Blueprint (Creative and Cultural Skills, 2009) expresses these opportunities in the following terms:

'*Digitisation is revolutionising the way in which items are bought and sold, creating significant new opportunities for craft makers, retailers and galleries. Technology has opened up new markets for global export, facilitating connection between consumers and producers and provides enhanced opportunities for customisation and user-centred design. Online, practitioners can provide additional information to customers which contextualises their work and can help build brand. Again, exploitation of the opportunities afforded by technological development demands enhanced skills across the craft sector'* (Creative and Cultural Skills, 2009:23).

The broad digital capabilities outlined in this section, from collaborative value chains, convergence and customisation, to the trends in digital tool-use examined in Section 2.5.2 amount, in the researcher's view to a 'digital proposition' for craft. A framework for thinking about areas of potential and development. The researcher contends that viewing digital craft in the light of trends identified in other digital creative industries and digital tool-use, brings a perspective that enables a general sense of the potentialities to be brought into focus.

Section 2.6: Conclusion to Critical and Contextual Review

This Critical and Contextual Review has attempted to define the scope of, and place some definitions around, the UK designer-maker industry sector (Section 2.1); to discuss perceptions and value within craft practice and argue that digital craft is defined by a shift from productive to authorial autonomy and a greater degree of collaboration (Section 2.2). It then reviews previous scholarship in the digital craft field and argues that the retention of craft in digital practice can be measured through an assessment of skill focusing on the retention of risk of failure, uncommonness and creative use of skill (Section 2.3). Section 2.4 reviews selected makers' work and seeks to establish the perceived character of digital craft as a genre. The final section of the critical and contextual review (Section 2.5) looks beyond the craft sector itself to the wider digital creative economy. It considers how the move towards greater collaborative and collective engagement are reflected in, and contribute to, a wider pattern of change driven by digital technology use within the creative industries and the wider productive economy. It concludes that the broad patterns of future trends in digital tool-use, collaborative value chains, convergence of systems and customisation of products, form the context of the contemporary digital making environment and are reflected in practice. This is what the researcher means by the 'digital proposition' for craft. Reconciling the retention and promotion of craft character and craft quality, whilst navigating and exploiting the imperatives and opportunities of future trends in digital tool-use, are the twin goals and the major challenge presented to makers. An exploration of these themes runs through the critical and contextual review of digital craft that has been presented here.

A recent position paper in the journal *Craft Research* explored the combination of post-industrial design, open source shared engagement and netpolitical craft (Von Busch, 2011:113) and used the '*Counterfeit Crochet'* project of artist Stephanie Syjuco, (a collaborative project to encourage makers to translate into crochet versions of designer bags working from downloaded low resolution jpegs) (Syjuco, N.d.) as an example of how online connected craft can empower participants to be *fashion-able*. This article explored collaborative economics, a resurgence in craft and the success of online craft selling platform etsy.com (Von Busch, 2011:116) and highlights the retention of a craft attitude towards technologies *'to make them into open tools that can do new crafty things'*. For von Busch there is a discernible craft character that is retained in the final outcomes *'At the end of the day the new technologies in craft exhibit new connections and interfaces between the distributed tools of computer networks and a very hands-on romanticism of the tactile crafts'* (Von Busch, 2011:121).

The evidential chapters (Chapters 4, 5 and 6) relate research into practice and the researcher's own practice-based enquiry to the contextual and theoretical framework provided above. These chapters focus on the opportunities and threats perceived by makers, the location of skill in digital practice and how the ‘digital proposition’ for craft – indications of how issues related to converged systems, customization and collaborative value chains – can be identified and manifest themselves, in practice. In the case of converged systems, traditional craft tools have, as has been noted above, often come from industry or have been accessible to amateurs, so that craftspeople are familiar with using common systems. Equally, individual makers often move between making work within spheres ranging from producing their own domestic craft, craft for sale, teaching and design for industry, using different production methodologies and facilities. Customisation is, of course, part of the normative ground of craft practice. In the researcher’s view it is collaborative value chains, rather than convergence or customisation which poses the most interesting departure, and the greatest challenges and opportunities, within digital craft practice. One reason is that it represents some degree of disjuncture from the image of craft’s past, another is that it takes a lot of time and organisational skills, encouraging a new type of practice. Collective engagement can be pursued in a wide variety of forms, from technical assistance to creative collaborations. Identifying, investigating and reflecting on collective engagement and collaboration in production, and sometimes authorship, are the main focus of the research into practice, examined in the following chapters.

Chapter 3: Methodology

Section 3.0: Introduction

This research has been carried out in association with the *Autonomatic Research Group*. Autonomatic is the University College Falmouth (UCF) Research Group in 3D digital production (Autonomatic, N.d.-b) and is based at UCF in the South West of the UK. Autonomatic has been at the forefront of practice-based research and knowledge dissemination within the field of 3D digital production and craft practice for a number of years. UCF has extensive digital production facilities and research into practice-based digital production techniques is carried out by researchers within Autonomatic, alongside other research projects.

At the outset of the research, in 2007, anecdotally, it was apparent that there was a lot of interest in digital production tools from makers but little clarity about the implications of new practice models. This research was conceived of as a focused investigation of designer-maker practice. Practice and particularly experimental and emergent practice using digital tools, as it is undertaken by the research participants and the researcher herself, was the starting point and has remained the locus of investigation. In the context of this research as an exploratory study it was decided early on to gather information from a number of different perspectives, for example, it includes both practice-led and practice-based elements (Section 3.2). The research reflects on participants' motivations, ambitions and relationships to technologies to assess the impact on their practice. It uses real-world descriptive investigation to reflect on emergent practice. Across the study, primary data is gathered through observation, discussion (including semi-structured interviews) and reflection on practice and direct involvement in object making (rather than, for example, theoretical modeling of technology capability and use). Practice has been related to in-depth contextual and theoretical understanding.

The need to study makers first-hand arose from a concern to look in detail at the 'process of change': including the expectations of makers, the experience of using new technology and the likely longer term impact on their businesses. This was at the heart of the research proposal which states the research aim is to:

'*produce and evaluate evidence and formulate knowledge with regard to the impact of cutting-edge technology adoption on design and craft micro businesses. The research will focus on the* ***process of change*** *and whether it can extend practice'*

With a key objective being:

'*To develop a new theoretical and practical understanding of the mechanisms and implications of designer-makers adopting new technologies and working practices, including following the*

***process of change** with a number of South West case studies. Are new definitions of practice needed or justified*?'

From a methodological standpoint these parameters imply certain methodological assumptions. They point towards a small scale, local, detailed 'rich' practice enquiry that also sits within, and considers, the context of change in the global digital economy. This raises methodological issues. For example, is it possible to conduct a useful investigation that seeks to make connections between a very local context and a global one, between personal practice and public policy, and considers the similarities and differences between new methods and traditional practices?

The main methodological question posed was: how will this research be able to draw *conclusions* from accounts of *emergent* practice of *technological change* within individuals' practice and relate this to broader contextual data? Consideration of the four most central concerns of the research question (the process of *change*, charting *emergent practice*, the implications of *digital technologies* and the *contribution to knowledge* that was possible) all raised a series of questions of their own:

- **Charting change**

How does the researcher consider that change comes about? From the bottom-up (within individual practice) or the top-down (from following global advice), or some other way? How is change recognised or best promoted?

- **Emergent practice**

At what stage is emergent practice identifiable as a type? Is it productive to look in-depth at a series of specific cases or personal practice in the context of the type of emergent practice being reported on, and what is the breadth of data needed?

- **Human/technology relationships**

Within what conceptual and philosophical framework is the researcher's view of human/technology interactions situated? Does the nature of this relationship change when *digital* technologies are being used?

- **Contribution to knowledge/generalisability**

How can the investigation and collection of data about individual practice be related to broader digital economic theories and collective meanings? Can qualitative and quantitative data be combined? How does the study deal with generalisability and contribution to knowledge? How should contingent conclusions about a process of change be presented?

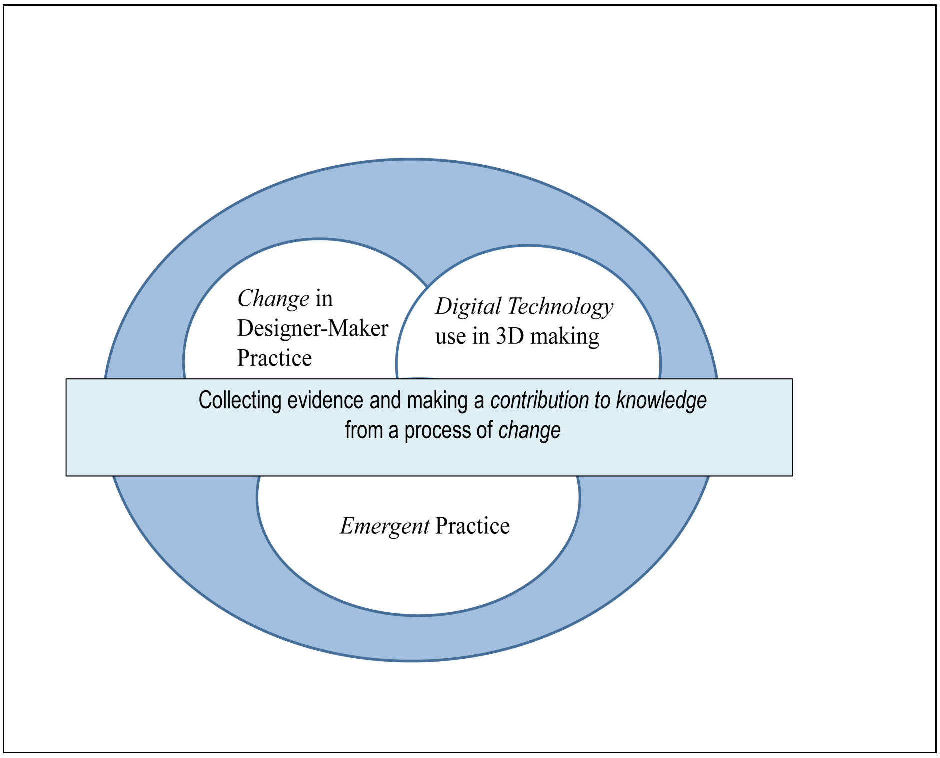


Figure 30: The four central issues for methodology to address

This chapter explores the methodology in relation to these central concerns. It begins with the researcher's understanding of ontology, epistemology and methodology and goes on to describe the philosophical approach taken towards this research and justifies the specific qualitative methods used. It brings together a coherent account of the hybrid, mixed methods approach developed and used, and seeks to clarify the relevance of using narrative data from a number of sources, including an in-depth investigation of the researcher's own practice. It explains how the project began with a very wide focus that was narrowed through engagement with a series of case studies and further interrogated through increasingly more focused methods, including first-hand practice-based work and ending with data collection among professional users targeting the specific questions raised, following the emergence of the researcher's thesis.

Section 3.1: Defining Methodology

'*Visualizing Research'* (Gray and Malins, 2004), is a key text for practice-based researchers in arts-related research fields, it traces the recent history of art and design research, offering both practical guidance on, and exploring definitions of, and distinctions between, methodology and methods. It was the researcher's recommended starting point for an investigation of methodology. Within Gray and Malins a strong emphasis is placed on the need to define, to some extent, the philosophical standpoint of the researcher and the proposed methodology from the outset, in order to be in a position to decide on appropriate methods.

With reference to the work of Schön (1983) and that of Guba and Lincoln (1985), Gray and Malins ask fundamental questions about what art and design research could be and why and how artists and designers might do research. They conclude that these are not just questions about what interests a researcher and what might be useful but in part an:

'*epistemological question about the nature of the relationship between the knower and the known. Schön says 'a practitioner's stance toward inquiry is his attitude towards the reality with which he deals*' (Schön cited in Gray and Malins, 2004:19).

In order to address this issue Gray and Malins discuss the importance of considering your stance towards ontological (the nature of reality, the 'knowable') and epistemological (nature of relationship between the inquirer and the 'knowable') questions, before an appropriate choice of methods is made. They acknowledge that social science methods have often played an important role within artistic research. In particular, quantitative and qualitative methods, broadly represented by surveys (quantitative) and case studies (qualitative) have been associated with two very different outlooks from the philosophy of knowledge: positivism and constructivism. These two approaches can be briefly characterised by posing the following question: broadly speaking, do researchers in the arts consider themselves to be detached scientific observers conducting and reporting on experiments that seek to discover a single 'real world' (objectively), or are they engaged as participants in the creation and description of 'constructed' realities (subjectively)?

In reading about, and reflecting on, possible ontological positions, it quickly becomes apparent that fundamental ontologies are linked to alternative philosophical frameworks of coherent ideas and interpretive tools, often described as philosophical 'paradigms', these range from feminist theory or Marxism to naturalistic inquiry, critical theory or post-structuralism, each one with its own school of advocates and detractors and an entire history of scholarly debate and application within particular disciplines behind it. Empiricist and deductive paradigms have tended to be associated with and particularly useful (or popular) for scientific breakthroughs, whilst interpretative paradigms have tended to be associated with social science or cultural re-assessments.

Gray and Malins simply note that for art and design research:

'*With regard to the 'knowable', the kinds of projects that have been tackled seem to embrace both positivist and constructivist research ontologies*' (Gray and Malins, 2004:20).

It is, however, the case that prevailing opinion in social science, where small scale qualitative data is concerned, has turned particularly to postpositivist interpretive paradigms (feminism, Marxism, cultural studies, constructivism, queer theory) (Denzin and Lincoln, 2005:3). Denzin and Lincoln, whilst recommending that social scientists need to be methodological bricoleurs bringing together perspectives and methods from different disciplines, warn against the synthesis of fundamental philosophical paradigms, belief systems that denote 'particular ontologies, epistemologies and methodologies'. The researcher has used a bricoleur approach to methods but kept to the pragmatic paradigm in which the study is situated. This concern not to mix paradigms stems from the work of philosopher Kuhn (1962), who used the term 'incommensurable' to characterise the holistic nature of the changes that take place in a scientific revolution. According to Kuhn, science doesn't proceed in an orderly fashion towards the 'truth' but operates according to prevailing paradigms, systems of belief in which anomalies eventually surface leading to a sea-change in views. The extent to which it has become important within research to give due regard to how perception, understanding and meaning alter within a paradigm and are the function of it, is evidenced by the establishment of the Sociology of Science as a professional discipline (Oberheim and Hoyningen-Huene, 2009).

The issues of central concern to this study are the province of several distinct disciplines, including histories and theories in the fields of Craft, Product Design and Human Computer Interaction, Philosophy and Social Science alongside knowledge of practice (and active enquiry) in the fields of Craft and Social Science. They seek to describe, understand and use insights and tools that originate from a wide range of sources including academic texts and practice in a cross-disciplinary way. Elements have been borrowed to describe and strengthen the researcher's understanding, to interrogate rich descriptive qualitative data and ultimately to help bring into view a relatively new and emergent landscape of practice. For example, from the point of view of the series of case studies conducted for this research it was the tools and frameworks of Social Science: *the study of human society and social relationships* (OED, 2009), that was felt to be most appropriate. The research sought to identify and report on changes in practice, and the nature of practitioners' relationships to tools and other human sources of help and knowledge including peers, mentors and technicians along with the wider working context. Areas of inquiry include, for example, how access to technology is influenced by knowledge networks or ability to communicate with technology gate keepers. The researcher felt, from the outset, that her own limited experience with digital tools suggested that any investigation needed to look at more than the capability of the technologies themselves or survey the number of machines technically accessible, it needed to broaden the focus to how socio-economic as well as technological relationships impacted on, and influenced, changes in practice. Social science then, is one disciplinary focus and the ideas of social constructivism certainly influenced case study methods as detailed under Section 3.3 below. Human computer interaction and studies of technology use are another area of interest and academic literature concerned with the philosophy of technology have also been drawn on (see Section 3.2.1). However, the researcher, as a craft practitioner herself, recognises that her own viewpoint is primarily one based in craft practice, characterised by a strong commitment to the idea that a way forward is generally found through practical experience and actions that bring about a new situation, by engaging with materials or people in a live setting. It is therefore craft theory and the actuality of craft practice that is felt by the researcher to be the central perspective from which the researcher's personal philosophical standpoint emerges. The basic philosophical ontology within this study is therefore one of pragmatism, a philosophy closely associated with craft practice by a number of craft theorists as described below (Section 3.2.1.). It is a pragmatic study of practice. This emphasis on pragmatic practice extends, for example, to how the research itself was conducted, in the belief that ideas and experiences produce outcomes that are constantly under review. This reflects pragmatic philosophy, Dewey, for example '*proposed that goals be treated as 'ends-in-view' – ends that are alive and active only as they exhibit continuous interplay with the means that are devised and tested in order to secure them'* (Hickman, 1990:12). In this way, the researcher believes that it is part of normal experience for a research plan to need to be flexible and adaptive in evolving to meet changing research agendas and opportunities. Therefore, although a planned research path was clearly laid out, this research was also able to evolve through live engagement with projects, people and practice and through successive iterations in a dynamic, flexible and responsive research design.

Section 3.2: Pragmatism

Craft theorists including (Marshall, 1999) and (Sennett, 2008) have identified the philosophy of pragmatism with the experience of craft practice. Sennett suggests that '*craftsmanship finds a philosophical home within pragmatism*' (Sennett, 2008:286). These writers are referring to pragmatic philosophy expounded by John Dewey and George H Mead, among others, in the US late 19th and early 20th century and to more recent interpretations. The Oxford Dictionary of Philosophy identifies Dewey's pragmatism as rooted in a regard for science as a:

'*humanistic conception of practice…inspired by science'* and goes on to say *'Dewey's enormous influence owed more to his skill at expounding the pragmatic, scientific, and democratic progressiveness of the America of his time than to accurate or technical philosophical argument. But his development of the pragmatism of James and Peirce remains influential. In his hands enquiry is a self-corrective process conducted in a specific historical and cultural circumstance*' (Blackburn, 2008).

In '*Creative intelligence: essays on the pragmatic attitude*' (Dewey, 1917), which included a contribution from Mead titled '*Scientific method and the individual thinker*', both Dewey and Mead emphasise the pragmatist's focus on 'experience' and 'practice', eschewing the more purist theoretical positions of their philosophical counterparts.

'*It will, I suppose, remain for a long time incredible to some that a philosopher should really intend to go to specific experiences to determine of what scope and depth practice admits, and what sort of consequence the world permits to come into being. Concepts are so clear, it takes so little time to develop their implications, experiences are so confused, and it requires so much time and energy to lay hold of them*' (Dewey, 1917:63).

The belief that it is essential to use specific experience as a basis for enquiry, (that this is a legitimate sphere of science) that experience is too rich and complex to be abstracted into 'sense datum' separate from our inferences, is matched by an active conception of the integration of experience into new realities and possibilities.

'*The individual in his experiences is continually creating a world which becomes real through his discovery. In so far as new conduct arises under the conditions made possible by his experience and his hypothesis the world, which may be made the test of reality, has been modified and enlarged'* (Mead, 1917:225).

The roots of pragmatism appear to integrate a high regard for science and the richness of individual experience into a philosophy that locates the focus of enquiry and change at the level of what is done, what takes place and how it is experienced in the widest sense.

'*experience can be seen as the irreducible totality of people acting, sensing, thinking, feeling and making meaning in a setting, including a perception and sensation of their own actions*' (McCarthy and Wright, 2004).

This research takes this pragmatic view of experience and change, that the most useful and productive accounts of change will be in the detail of individuals' experiences as they make compromises and accommodations with the situations, capabilities and material circumstances that unfold and confront them. This account of change, that it is not something that primarily cascades down or is contained in ideas and theories but something that is created in the circumstances, including prevalent ideas, among those who are effecting change, is the reason that a series of case studies, alongside the consideration of published ideas and literature, were considered essential to this research. That it is necessary to attempt to gather detailed knowledge of individual holistic experiences *in situ* follows from the pragmatic philosophy adopted.

Contemporary secondary sources, such as (Hookway, 2008), report that scholarship concerned with pragmatism in a wider sense has experienced something of a revival in recent years through philosophers such as Richard Rorty and Hilary Putnam. Hookway traces how current thinking relates to classical pragmatic ideas (such as the 'pragmatic maxim' which has become less well regarded) but explains how current trends in pragmatic philosophy have retained an emphasis on practice:

'*He (Putnam) has identified four characteristics of pragmatism: the rejection of skepticism; the willingness to embrace fallibilism; the rejection of sharp dichotomies such as those between fact and value, thought and experience, mind and body, analytic and synthetic etc; and what he calls 'the primacy of practice'* (Hookway, 2008:5).

These broad pragmatic concepts are philosophical principles with which the researcher readily identifies, the following is therefore a restatement of them within a personal interpretation, intended to provide the broad perspective of the researcher's pragmatic philosophical approach:

- An ontological belief in the material and practical reality of the world and that it is best understood through situated studies.
- A belief that conclusions are provisional and always under review.
- A belief that dichotomies, as abstracted simplifications of complex and sometimes contradictory ranges or states, should be treated with suspicion.
- A belief that active enquiry, practice, is the best route towards establishing a better understanding and bringing about a new situation.

The researcher's basic philosophical outlook is therefore associated with pragmatism, a philosophy identified as reflecting craft practice, the subject of the research. In addition, the phenomena and participants under study are rooted in experiential and practical making.

It is also a study of *emergent* designer-maker practice where an individual's work is often a novel and innovative exploration, very often attempting to bring into play new technologies and processes. Trying things out and modifying designs during the process of making takes precedence over simply putting into practice a fixed idea. Dewey's philosophy uses the concept of 'ends-in-view' to describe this constant re-formation and is a 'view of the world as marked by change' (McCarthy and Wright, 2004:53). This philosophical viewpoint specifically denies the primacy of theory over practice and believes that knowledge is created through action and interaction:

'*The test of ideas, of thinking generally, is found in the consequences of the acts to which the ideas lead, that is in the new arrangement of things which are brought into existence*' Dewey, 1929 in (Corbin and Strauss, 2008:2).

Dewey's development of pragmatic theory centres on this lack of separation between ideas and actions. Indeed the outcomes are what matter in proving the worth of the concept; theories are not valued as separate sources of knowledge.

'All the pragmatists, but most of all Dewey, challenge the sharp dichotomy that other philosophers draw between theoretical beliefs and practical deliberations. In some sense, all inquiry is practical, concerned with transforming and evaluating the features of the situations in which we find ourselves' (Hookway, 2008:4.2).

For Dewey, ideas are integral to experience, there is a strong sense from Dewey's writings of the past and future integrating through daily lived experience that creates new meaning in a continuous interactive evolving process:

'*But experience in its vital form is experimental, an effort to change the given, it is characterized by projection, by reaching forward into the unknown; connexion with the future is its salient trait*' (Dewey, 1917:7).

This philosophy is reflected in the craft process where ideas, materials and the physicality of making are equally interlocked and directed towards an evolving outcome. 'Designing through making' itself expresses a key differential between industrialised and craft processes, where the outcome is often not determined but negotiated, evolving through practice, where there is a 'risk of failure'. Each final piece embodies variations and decisions that have been made along the way and, in a sense, is only conditionally final. Whether this sense of a conditional outcome (that a project is evolving and open to change can be maintained) whilst engaged with digital technologies and machines, designed to do certain specified tasks, is part of the question posed by this research.

The question of studying *emergent* practice (that may perhaps be unique and never repeated), then from a pragmatic viewpoint, is valid in that all practice is forged in experience and is to some degree experimental, performed to bring about a new situation. Individual, specific, experimental experiences and solutions to problems in all their complexity are the proper concern of research, rather than, for example, a possible focus of research on abstractions of 'typical' occurrences.

3.2.1: A View of Human-Technology interaction

The third central concern of this research (following on from the philosophical location of a view of *change* and *emergent practice*) is how human/technology relationships are considered and whether this alters fundamentally when *digital* technologies are used. Taking a pragmatic approach enables a view of human-technology interaction that sees technology as a dynamic extension to practice, in a creative and iterative sense. Marshall (2000), (2002) has explored how this conceptualisation of technology within craft can be understood with reference to Dewey's pragmatism:

'*Pragmatism's …notion of creativity being grounded in engagement with materials and technologies (an active process) rather than a mysterious mental phenomenon provides a model in which the processes of doing are not merely the carrying out of predefined creative ideas, but play an essential role in the development of original new works.*' (Marshall, 2002:13)

Marshall rejects two alternative characterisations of technology. A conservative characterisation, which views technology as just a tool, a functional means to an end, located within the positivistic tradition of scientific enquiry: this view sees technology as neutral and content free, a simple process of cause and effect. Marshall equally rejects an alternative approach to technology, which sees technology as a '*dangerous encroachment'* (Marshall, 2002:13) into craft skills and experience, enframing (Heidegger and Lovitt, 1977) the way in which we experience the world, cutting off direct contact. Within this 'critical characterisation of technology'(Marshall, 1999:170) contemporary theorists such as Fry have argued that technology '*mediates the world as knowledge, image and touch*' (Fry, 1992:261) cited in Marshall, 2002:6). Marshall's approach sees technology as having an active role within a pragmatic process, as a force that feeds back into a creative thinking and doing iteration. This allows for technology to influence but not overpower the making process, it acknowledges the maker's responsibility to '*reflect on the way in which the technologies we employ change our perception of the world*' (Marshall, 2002:13) and in doing so gives a grounding for the pragmatic concept of technology-enriched practice.

Similarly, Hickman identifies that Dewey viewed technology as much more than straight line instrumentalism, more than '*a recipe… a certain number of steps which if followed to the letter, ought to lead invariably to the end desired*' saying that:

'*Dewey did not treat tools and instruments as value-neutral but rather as teeming with values and potentialities that form the basis for intelligent selection of ends-in-view, or things to be done*' (Hickman, 1990:13).

Hickman goes on to explain how Dewey's view of individual practice extends to his view of the wider progress of technology within history, saying Dewey rejected historical determinism*: 'a key element of his account of technology is that it involves individual and corporate responsibility for pro-duction of the future'* (Hickman, 1990:106).

The researcher, whilst identifying with pragmatism, has found it useful to reflect on and incorporate other approaches to human-technology interaction. Marshall draws on the work of Heidegger, in describing the second approach to technology that he rejects, the 'enframing' of our choices. This tradition is one that stems from the phenomenological philosophical paradigm, including an approach to information technology which posits a more fundamental technological '*way of being*' in the world. This has been described, for example, by Introna, in a recent overview of phenomenology's view of information technology:

'*phenomenology suggests that there is a co-constitutive relationship between us and the phenomena we encounter in our engagement with the world. In this sense phenomenologists would suggest that to understand the technology/society relationship we need to reveal how they co-constitute each other - i.e. draw on each other for their ongoing meaning and sense*'(Introna, 2011).

Introna's account also reviews two alternative approaches to the philosophy of information technology in order to give greater clarity to his description of phenomenology. Firstly (in a similar vein to Marshall) technological determinism, a framework in which 'tools' are an extension of human 'users' capability that operate in a more or less uniform and predictable ways. 'Users' are led by the technology to behave in certain ways, so that, for example *'the Internet's open and non-hierarchical architecture can more or less* cause *a society that uses it to become more open and less hierarchical*' (Introna, 2011). The researcher considers that this view is at odds with a pragmatic approach which asserts that adaptation of tools is forged through experience in use.

Secondly, Introna puts forward a constructivist view. Constructivists do not just challenge the empiricist view of technology but the entire empiricist paradigm, for example that the world is properly to be understood as '*universal'* and has *'singularity'* and '*a set of fairly specific, determinate, and more or less identifiable processes'* and that reality is '*independent of our actions and especially our perceptions'* (Law, 2004:5). Introna examines the view of information technology as socially constructed, drawing on the work Bijker, Pinch and Hughes 1987, Bijker 1995, Law 1991, Latour 1991. These accounts look for how technology is itself the outcome of '*complex and subtle social processes and practices*', for example, alternative technologies might have arisen in different cultural, political or economic circumstances, as designs are rejected and particular research paths pursued. Furthermore technology can be used in different ways. From this viewpoint technologies don't have predictable, uniform outcomes but in design and use are part of a 'co-constructed' and 'reciprocal' relationship between society and technology, they are actors entwined and embedded in particular contexts and narratives. This means that it is important to understand how technology is being used through detailed descriptive accounts, a viewpoint in large part reflected in a pragmatic concern with actual situated practice. Science and Technology Studies writers such as LaTour and Woolgar insist that analysis of technology requires a greater degree of thinking about subjectivity, contingent outcomes, the complexities of technology and societal inter-relationships for example through the workings of '*interpretive flexibility'* so that:

'*we need to understand technology in use as a constant process of interpretation and understanding, or, if one allows the textual metaphor, as an ongoing accomplishment of reading the technology text. Substantial evidence from studies of new technologies supports this second sense of interpretive flexibility. For example, research into the supposed effects of Internet-based technologies shows the centrality of counterintuitive outcomes*' (Woolgar, 2005).

A pragmatic approach (like constructivism) stresses the importance of testing the strength of data and analysis supporting the particularity of interpretation in context and limits the claims it makes for conclusions, insisting on a careful and considered iterative and reflective interaction with data. It would not, however, claim that reality itself is socially constructed, placing greater emphasis on the potentiality of individual experience and change. One of the key perspectives added by a constructivist analysis, such as the account from Law, is the sense in which researchers should actively consider what has been left out, what is not being said, what is 'othered'. The constructivist view of technology, then, doesn't just see what technology has been developed and applied but seeks to understand what other possibilities have been sidelined or excluded.

In terms of this study, the researcher recognises that these are tiny snapshots of extensive and necessarily complex philosophical positions, briefly summarised here as alternative views. They are included because the researcher wishes to position her own view of the relationship of human technology interaction within the broader context of information technology and human computer interaction philosophies, in order to justify and clarify the choice of what has been studied within this research and the methods chosen.

It is entirely possible, then, to view technology and what matters about technology and therefore what is worth investigating, in many different ways. The table below is a summary of how some of the philosophical views of technology reviewed above might relate to the general research problem in this study – the use of 3D digital making technologies – how the philosophical approach might affect the specific focus of research questions asked and the kind of data collected. This table is intended as the researcher's own reflection on how a philosophical attitude might have a direct implication for the emphasis of a study, it is not a systematic or exhaustive model. For example, if you view technology as primarily a value-free tool under human direction (positivist paradigm) then what might matter most is being able to access technology, the cost of equipment and understanding what it can achieve, although this is not to say that a positivist approach might not also be interested in investigating the history or development of technologies, but it is an indication of possible research emphasis.

View of technology	**Possible locus of investigation**
Value-free tool under human direction	Studies of price, availability, technical capabilities.
An extension of human capabilities	Studies of learning and training, technical capabilities.
As something that determines outcomes	What aesthetic or behavioural changes in outcomes can be seen as resulting from technology use.
Indicators and outcomes of co-construction	What are the human values/organisational models that led to the production or use of a particular technology, how do technologies reflect society and differ in use from plans.
As active counterparts in new experience	What novel possibilities do technologies open up, how are they experienced, awareness of re-purposing and adaptation of technology.

As this suggests, a wide range of issues from the functional to consequential, societal, experiential or temporal concerns with technology can be imagined as the central focus of research. From the point of view of this research - an investigation of how the use of digital technologies may impact on designer-maker practice - it is the technological philosophical framework of thought provided by pragmatism, following from the craft research by Marshall (2000) (2002) and therefore the 'experiential' focus that is the substantive viewpoint. The researcher adopts a view of technology as an *active counterpart* in new possibilities, a sense that technologies bring potentialities and agendas but that the experience of makers brings into existence new outcomes and uses. The focus of investigation, the emphasis of data collection, is therefore at the level of individual designer-makers, their experience including attitudes and ideas about the technologies and what they do (and might) use them for alongside the researcher's own practice experiences.

The somewhat prolonged discussion of alternative philosophical frameworks has been included here because the researcher finds many of the insights provided by alternative philosophies of technology very compelling. The researcher acknowledges that it may be philosophically indefensible to claim to hold onto several incomplete and possibly conflicting philosophical standpoints (both pragmatism and constructivism, some measure of phenomenological insight alongside some elements of feminism and Marxism that are also pre-existing knowledge systems to her). She is also acutely aware of the high level of oversimplification employed in the expression of complex frameworks in the above summaries. To the researcher, however, it does seem defensible, indeed important to retain an awareness and appreciation of particular insights and include ideas and methods (rather than entire paradigms) as 'tools' that have arisen from encountering alternative philosophies. Dewey's view of 'tools' explicitly included tools of all types including conceptual as well as physical instruments of inquiry (Hickman, 1990:36). This is acknowledged precisely in an attempt to be transparent about a methodological approach which actively embraces the researcher's own complex experiential understanding (ideas that the researcher has been exposed to could not in any case be completely isolated or disregarded) and is prepared to act as '*bricoleur - theorist who works between and within competing and overlapping perspectives*' (Denzin and Lincoln, 2008:6). This standpoint, of course, allows the researcher to take on board 'tools' that seem to resonate with the research from a number of sources, and acknowledges that this reflects her own background and experiences, including as a professional writer and researcher, as a craft student, maker and scholar, but keeps within a pragmatist paradigm.

Other researchers, however, have also acknowledged that strict paradigm divisions are not, in practice the most useful way forward (Corbin, 2008, Morgan, 2007). For example, a pragmatist philosophy (and constructivist perspective) is consistent with the choice of a version of grounded theory as an analysis tool within this research. Corbin, in the 2008 third edition of her grounded theory text book '*The Basics of Qualitative Research*' devotes the introduction to a discussion of interactionism/pragmatism. She explains that the writings of Dewey and Mead '*present an innovative philosophy of knowledge, easily recognizable as the framework for our own methodology*' (Corbin and Strauss, 2008:2). Corbin explains how pragmatism underpins the grounded theory approach to generating theory through interaction with the research data. She gives a comprehensive account of how pragmatism correlates with grounded theory citing Dewey's concerns with 'process', 'action and interaction', 'the accumulation of collective knowledge', 'the perspective of the inquirer' and the contingent nature of truth – that it is equivalent to '*for the time being this is what we know – but eventually it may be judged partly or even wholly wrong'* (Corbin and Strauss, 2008:4). Grounded theory seeks to create theory through a continual process of refining iterations of data and interpretation, a pragmatic process which might be considered analogous to the process of crafting an object through repeated interactions of materials, process and ideas. Dewey explicitly rejected the idea of a single discoverable external 'truth' in favour of this sense of contingent knowledge based on active experience, informing action:

'*But the chief characteristic trait of the pragmatic notion of reality is precisely that no theory of Reality in general, uberhaupt, is possible or needed…….. The only way in which the term reality can ever become more than a blanket denotive term is through recourse to specific events in all their diversity and thatness'* (Dewey, 1917:55).

Corbin, in asserting her philosophical approach as pragmatic, also acknowledges her debt to post-modernist and post-constructivist paradigms explaining:

'*I agree with the constructivist viewpoint that concepts and theories are constructed by researchers out of stories that are constructed by research participants who are trying to explain and make sense out of their experience and/or lives, both to the researcher and to themselves. Out of these multiple constructions analysts construct something that they call knowledge'* (Corbin and Strauss, 2008:10).

Marshall's pragmatic view of technology, as an active counterpart in the creative embodiment of rich experience through action is reflected in work by McCarthy and Wright '*Technology as Experience*'(McCarthy and Wright, 2004) which also takes pragmatism as a starting point. In this account the emotional 'felt experience' of technology takes centre stage. McCarthy and Wright review how the 'turn to practice' in studies of technology and particularly human computer interaction have moved much of the research within the discipline from rationalist studies towards field-based phenomenological and ethnographic accounts that privilege situated social practice but continue to understate the 'felt' emotional experience of using technology. By unpicking and analysing what is meant by the richness of the pragmatist view of experience and discussing ideas about various threads of experience from a number of fields, McCarthy and Wright suggest greater emphasis needs to be placed on dialogues in human technology relations, the sense of openness and becoming, the potential for aesthetic experience of situated creativity (McCarthy and Wright, 2004:77). A discussion of four threads within 'experience' 'the sensual, the emotional, the compositional and the spatio-temporal' (McCarthy and Wright, 2004:80) leads to a conclusion that reviews:

'lived, felt experience as prosaic, open, and unfinalizable, situated in the creativity of action and the dialogicality of meaning making, engaged in the potential of each moment at the same time as being responsive to the personal stories of self and others, sensual, emergent and answerable' (McCarthy and Wright, 2004:184).

This pragmatic view of experience brings into view the potential for 'charm, enchantment, love, excitement, alienation and irritation' in the experience of technology and that case studies should '*express a sense of the felt life or event'* (McCarthy and Wright, 2004:187) and considers the potential for literary or art-related approaches to better reflect these concerns than formal '*hierarchical modes of thinking'*. McCarthy and Wright's work is reflected in this research by a concern to include narrative accounts, which tell the story of emergent practice in an individual experiential, unfinalised way. It also provides a pragmatic rationale for including an element of personal practice-based work that places 'self' and 'identity' and '*the potential for enchantment rooted in the experience of novelty*' (McCarthy and Wright, 2004:192) as an acknowledged concern within the overall research (Section 3.4 below).

A discussion of the researcher's view of the nature of change in craft and technology relationships brought about by digital technologies is included in Section 7.2, as it follows from the research findings. The fundamental perspective in this thesis, however, is that an additional inherently and explicitly collaborative and collective element is made available to makers through the pervasive and shared nature of digital platforms, and the need to source expert knowledge and equipment. From a pragmatic point of view this presents makers with a digital agenda and possibilities for collective engagement and enriched experience in practice that, in many ways, were not previously available. How that is exploited and used by makers can only be seen through an examination of individual practice. A summary of the philosophical aspects taken on board in the researcher's view of human technology relationships is included in Section 3.2.4.

3.2.2: Fuzzy Predictions

The fourth central concern of this research identified at the start of this chapter is generalisability and its relationship to the possibility of contribution to knowledge. Can conclusions drawn from the study of a handful of individuals or personal practice be tenable or applicable beyond an interest in the views expressed in the study itself? Corbin insists on the need for shared conceptual language as a basis for discussions, knowledge-based practice and recommendations for change. '*I believe we share a common culture out of which common constructions are arrived at through discourse. Concepts give us the basis for discourse and arriving at shared understandings*' (Corbin and Strauss, 2008:12). For Corbin this is the aim and justification for research, and pragmatism and constructivist ideas stand side by side. Corbin explains that pragmatism avoids radical relativism in '*which no version or interpretation can be proven and therefore no certainty about any given one can be assumed*' (Corbin and Strauss, 2008:4) by allowing and tolerating assumptions that the physical reality of the world exists and that the nature of truth is contingent. Grounded theory based upon pragmatism ties ideas to action, through active analysis of data to arrive at a limited, temporal sense of conclusions, which may nonetheless provide useful shared insights. Findings then are not assumed to be generalisable (as in a positivist view, if your sample is correctly formulated or your experiment correctly carried out), or only relevant within their original context (as in a constructivist view) but may be transferable to another situation or population, but research may need to be conducted to establish how good a ‘fit’ a new situation is with the original research. A discussion of exactly what aspects of grounded theory have been employed within the case study analysis in this research is contained in Section 4.4.3.

Flyvbjerg (2007) looks at five common misunderstandings about case study research. Misunderstanding No.2 is that ‘*one cannot generalise on the basis of an individual case; therefore the case cannot contribute to scientific development*’ (Flyvbjerg, 2007:391). Flyvbjerg assesses a scientific test for ‘falsification’ based on the work of Popper. Falsification is explained as a rigorous test of scientific propositions: ‘*if just one observation does not fit with the proposition, it is considered not valid generally and must therefore be either revised or rejected. Popper himself used the now famous example of ‘All swans are white’* (Flyvbjerg, 2007:394). Flyvbjerg concludes that rare occurrences, the identification of *black swans* as Popper proposed, can falsify a general proposition and should therefore lead to further investigation and theory building, and have often ‘*helped cut a path towards scientific innovation*’. Flyberg reformulates misunderstanding No.2 as:

‘*One can often generalise on the basis of a single case, and the case study may be central to scientific development via generalisation as supplement or alternative to other methods. But formal generalisation is overvalued as a source of scientific development, whereas ‘the force of example’ is underestimated’* (Flyvbjerg, 2007:395).

Specific, grounded, descriptive data can therefore provide insight alongside broader theories. This point is made as a way of emphasising a belief in a continuum of knowledge across disciplines that does not privilege hierarchical knowledge systems, recognising that a contribution can emerge from diverse or novel data.

Other researchers have echoed this sense in which data may be useful in a way that does not rely on an empiricist view that, if you have enough data and control for variables, outcomes will be predictable and repeatable. Bassey reviews social science notions of generalisability in the field of educational research (Bassey, 2001). He recounts his original view; that describing specific singularities to which teachers could strongly relate was more useful than searching for empirical generalisations. However, this idea develops into a view that limited ‘fuzzy’ predictions can usefully be made. He develops this from a review of fuzzy logic, an accepted mathematical and scientific area of study, rooted in the idea of multivalency, where answers and values are part of a spectrum, a matter of degree or correct for more than one value, rather than simply true or false. In a social science context generalisations can be made as fuzzy ‘predictions’, the idea that findings may fit a range of possibilities but that ‘*fuzzy generalisation which extrapolates the findings to similar people-events-situations and suggests that similar findings may be discovered elsewhere’*. Verification relies on having enough detailed descriptive information about the original situation to see how circumstances may ‘fit’ new research conditions. Conclusions can be drawn and may be true for other studies. He highlights the difference between saying the world is a predictable place and this is how it operates, to saying I can tell you how it operated this time and may do again in similar circumstances. Successive studies can confirm or deny findings.

These three accounts (Bassey, 2001, Corbin and Strauss, 2008, Flyvbjerg, 2007) are from very different perspectives but share an attempt to define a research space that is less definite in its findings than traditional scientific study and more contingent on specific circumstances. This is research that believes a contribution to knowledge can result from shared understandings, cumulative cross-disciplinary studies and by using a variety of sources and perspectives. This study emulates this approach because it is a good fit with the experience of craft practice, itself often a specific, culturally embedded practice of relevance that brings together disparate elements.

3.2.3: Mixed methods

From the viewpoint of pragmatism, observing practice locally, employing qualitative interview techniques does not preclude the use of quantitative data sources and the possibility of making connections between the two. For example, identifying the ability and desire for individual designer-makers to create bespoke or customised objects (through the use of digital facilitation and renderings of personalised data within objects – Section 4.4) can legitimately be linked to quantitative data or global accounts of the growing trend towards the customisation of mass manufactured consumer objects. Although each account of customisation has to be acknowledged and accounted for as operating in a different context, for different economic reasons and within different parameters of choice for consumers, nevertheless a connection can be made between different forms and sources of data, different reports of customisation. This depends on the use of mixed methods and the validity of combining quantitative and qualitative data.

Morgan (2007) justifies the use of mixed methods with reference to pragmatic philosophy. He does not believe research could be carried out in a wholly objective or wholly subjective way, as he points out:

'*although one often hears arguments about the impossibility of "complete objectivity," it is just as hard to imagine what "complete subjectivity" would be…. Any practicing researcher has to work back and forth between various frames of reference, and the classic pragmatic emphasis on an intersubjective approach captures this duality*' (Morgan, 2007:72).

Morgan pays tribute to the contribution that the focus on metaphysical and top-down 'philosophy of knowledge' questions has made. In his view an understanding of paradigms has, in part, led to a re-birth of qualitative research and a degree of shift away from the domination of quantitative methods (and the associated epistemological emphasis on empiricism, objectivity and deduction). However, he believes that the paradigms themselves:

'are not abstract entities with timeless characteristics; instead, what counts as a paradigm and how the core content of a paradigm is portrayed involves a series of ongoing struggles between competing interest groups'.

Morgan identifies and analyses four distinct versions of 'paradigms' and shows how Kuhn's own description of 'paradigm shifts' changed over his lifetime. He goes on to call for greater communication between researchers.

'*a pragmatic approach would deny that there is any a priori basis for determining the limits on meaningful communication between researchers who pursue different approaches to their field. Instead, a pragmatic approach would place its emphasis on shared meanings and joint action…*' (Morgan, 2007:67).

Morgan develops the pragmatic approach to the concept of intersubjectivity as the basis for shared understanding and shared conceptual meaning.

'*In a pragmatic approach there is no problem with asserting both that there is a single "real world" and that individuals have their own unique interpretations of that world*' (Morgan, 2007:72).

Pragmatism, mixed methods and intersubjectivity therefore allow the researcher to make the crucial link between local practice and global change, between makers' experiences and a global digital agenda and, therefore, to link individual case study experiences to the wider theoretical and contextual framework, the 'digital proposition' identified in the Section 2.5 of the Critical Contextual Review, dealing with digital creative industry trends.

3.2.4: Summary of Philosophy

Within this research then, an overall pragmatic philosophical standpoint is maintained. This informs the view of how experiential practice is constituted and that the main point of the investigation is to examine how technologies are experienced, viewed and used in practice, what new situations and possibilities makers see and imagine. It is an investigation of how technologies that were not specifically designed and made for craft or designer-maker purposes, are being used and re-purposed towards exploratory design and making practice, how this is achieved and what value makers see in digital technology use. This pragmatic philosophy specifically, by focusing on situated practice but drawing in perspectives from other disciplines and using mixed methods, enables a view of digital craft practice to be taken from a number of standpoints that can be compared and contrasted. It aims to arrive at some shared meanings and understandings, working from the specific knowledge of individual practice to conditional findings as a basis for contribution to knowledge. The perspectives of constructivism contribute to the view of case study methods (see Section 3.3 below) and the broader identification of trends and collective societal meanings. The constructivist understanding and consideration of what has been forgotten or left out, 'othered', is also relevant. For this study that meant reflecting on how the available software and technologies, and the lack of availability of others, might impact on attitudes and outcomes. Or reflecting on why particular issues, such as an attachment to hand-making which might have been expected to emerge, did not (Section 4.5). Ideas from phenomenology inform the view of why the relationship between humans and technology is so important. For example, the simple idea that exteriorised skill is contained within digital production technology and acts as both a memory of skill and platform available to the current generation of designer-makers is one the researcher has found instructive. (Introna, 2011:2.2).The idea that designer-makers can build on outcomes from embedded knowledge in technology is an important one within this work, expressed as the potential of digital technologies to enable 'skill leverage' (Section 4.4). This doesn't extend to the conclusions that Steigler has arrived at or in a fully fledged belief in the fundamental genetic co-constitution of technology and society (Introna, 2011:2.2). More generally, my own interpretation of pragmatism and constructivism rejects a deterministic view of inevitable technological outcomes, it allows for a sense of to and fro, a more loosely evolving relationship between makers and technology and the surrounding practice conditions that needs to be unpicked and understood in particular contexts. It particularly identifies with McCarthy and Wright's sense of unfinalised possibility and potential contained within technology interactions. A summary of the framework within which technology-human relations are viewed in this research is:

- How technology is used depends both on the embedded parameters of the technology itself and the **rich experiential interaction** created in use, technologies are open to human direction and adaption, part of the dialogue of **unfinalisable becoming**. Understanding requires **situated study** of individuals experience.
- Technology is concerned with the historical **exteriorising** of skill – it enables a collective human resource of knowledge to be accessed and therefore acts as a platform on which makers can build, **leveraging skills**. Digital technologies both reflect and reinforce **collective engagement** in aspects of technology use.
- Technologies arise out of the **socially constructed** world in which we live and therefore are part of the cultural, political and economic trends that prevail and need to be understood within contemporary socio-economic and cultural practices, for example regarding the **collective meanings** associated with the digital economy.

Figure 31: Summary of researcher's methodological attitude toward technology

Section 3.3: A series of case studies

Chapter 4, Making it Digital, concerns a series of cases studies following a knowledge transfer project conducted at University College Falmouth in 2008. The parameters of the Making it Digital project, participant selection and the nature of their engagement with digital making technologies, for example, in the development of a new product, is discussed under Section 4.2. This section reviews the theoretical basis on which the research into this series of case studies was conducted. Grounded theory was chosen as the most appropriate tool, supplemented by case study research methods. Making it Digital presented an opportunity to study relatively new and scarce practice, among a group of makers engaged in a short intensive project; this meant that a reasonable amount of data could be collected, in a number of ways, within a limited time frame and later subjected to intensive analysis. Grounded theory presents an open-ended analysis tool in which the depth of analysis can follow from the data collected. It is particularly appropriate to relatively new phenomena as it does not assume prior shared knowledge and meanings. Corbin explains that, within a grounded theory approach, the researcher's goal could be 'thick description', 'conceptual ordering' or 'theory generation'. She does not believe that theory generation is necessarily a higher order aim than generating accurate descriptions or analytic schemes saying that:

'*Not everyone wants to develop theory. In fact, theory development these days seems to have fallen out of fashion, being replaced by descriptions of 'lived experience' and 'narrative stories'….a researcher should choose the approach to, and aims for research that are most suitable to the problem of study and most likely to make a professional contribution*' (Corbin and Strauss, 2008:56).

In itself, description can provide insight and understanding that can, for example, be tested against findings within wider populations. Analytical schemes (conceptual ordering) begin to define meanings and shared language that can form the basis for professional discussions and comparisons, whilst theory, for Corbin, at least has a more pervasive aim:

'for us, theory denotes a set of well-developed categories (themes, concepts) that are systematically interrelated through statements of relationship to form a theoretical framework that explains some phenomenon (Hage, 1972;34). The cohesiveness of the theory occurs through the use of an overarching explanatory concept, one that stands above the rest. And that, taken together with the other concepts, explains the what, how, when, where and why of something' (Corbin and Strauss, 2008:55).

The primary aim of this research was to provide 'thick description' of maker's views within the cases being studied, what influenced the participants' choices, how much time and training and support was required, what barriers and advantages participants saw, their ambitions for this type of practice. From this, the research went on to begin to develop an analytical 'conceptual scheme' that aimed to enable discussion around meanings within the phenomena, such as the breadth of understanding of the term 'hand-made'. Finally, a narrative account of the dynamics of the practice, partly resolved and explained through diagrams, resulted in 'an overarching explanatory concept' from which preliminary conclusions could be drawn from the data gathered. How such an analysis was conducted, and how the explanatory overarching concept of 'collective engagement' was arrived at, is discussed in Section 4.5.

3.3.1: Rich information – multiple data sources

To address the question of emergent practice, among a scarce population in a relatively new field where some confusion over the legitimacy of using digital tools exists (Section 2.3), it was necessary to try and be open-minded about linguistic categorisations and meanings (Section 4.4). A broad range was included in the data gathering exercise alongside formal interviews, such as; focus groups, informal discussions, attending and involvement in exhibitions, considering objects themselves and how the Making it Digital programme was documented, promoted and reported. Data was also gathered at several times and sites, for example, through studio visits or as part of professional practice workshop events as well as during direct making sessions within the university setting.

Corbin states that qualitative research ' *allows researchers to get at the inner experience of participants, to determine how meanings are formed through and in culture, and to discover rather than test variables'*(Corbin and Strauss, 2008:12). For Corbin the aim is trying to 'obtain multiple perspectives on events and build variation into the analytic scheme'. There is an inbuilt bias towards complexity.

Gray and Malins acknowledge the diversity of practice within research and celebrate new and innovative methods, concluding:

' it is clear that researchers have ….invented hybrid methodologies involving a synthesis of many diverse research methods and techniques. So a characteristic of 'artistic' methodology is a pluralist approach using a multi-method technique, tailored to the individual project. Increasingly, this has involved the use of multiple media to integrate visual, tactile, kinaesthetic, experiential data into 'rich' information' (Gray and Malins, 2004:21).

Complexity and multiple data sources chime well with constructivist and post-constructivist methodologies. Law quotes the work of Sociologist of Science and Technology Michel Callon, '*instead of imposing a pre-established grid of analysis upon…. the observer follows the actors in order to identify the manner in which these define and associate the different elements by which they build their world, whether it be social or natural'* (Law, 2004:101).

The view that research should proceed in an orderly fashion from question to answer; from deciding what you want to know, assuming a single truth that is out there that you need to find out and report on, essentially by translating one specific data set into your own categories, moving smoothly to analysis and conclusions, is fundamentally challenged by these perspectives.

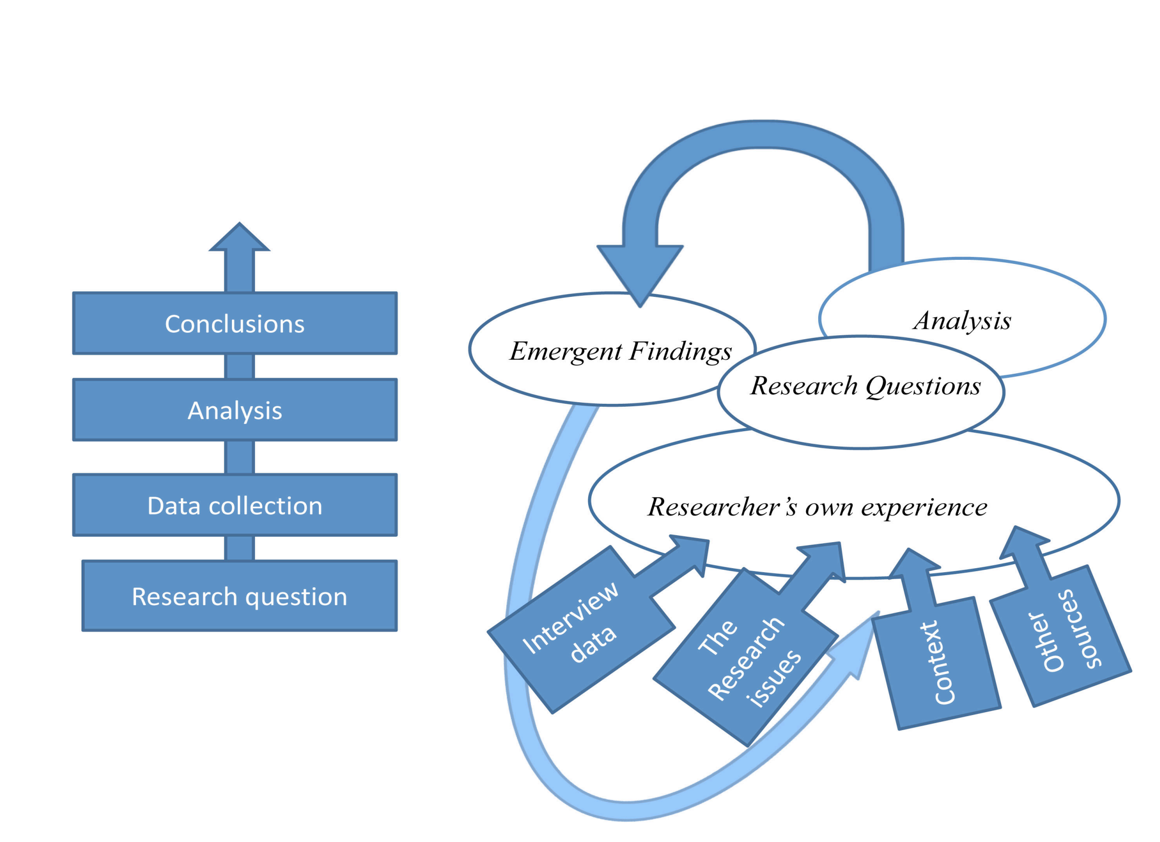


Figure 32: Research Question relationship to data: linear (left) and iterative model (right).

A more constructivist approach envisages the researcher following a much less linear path. Taking account of 'gathering' and 'fractionality', the researcher would be part of the enactment of a situation, attempting to describe and account for the hinterland and paradigm of the actors, the material reality in which they operate and how they create new realities which resonate with and elucidate patterns of behaviour. Allowing yourself to be open to what is present, absent and othered, how there may be multiple realities that require accounts from different sites or groups of players, asking what's been constructed in the reality and in the account of it and, finally, how best to represent these multiple accounts, while being tolerant of possible non-coherence.

This raises, for example, the possibility of considering objects as a metaphor for phenomena (Neil Brownsword used broken and salvaged ceramics within his PhD research on the decline of the pottery industries in Stoke-on -Trent) (Brownsword, 2006). The impact on possible methods in this case is that the researcher was open to a range of data that could be examined including data, lack of data, representations, narrative accounts, objects and events. In the event, as detailed in Section 4.2 and above, a variety of data sources and sites was considered as well as the researcher's own personal experience as a practitioner. The researcher's own reflection on events and interviews and subsequent reworking of texts and analysis form part of this process of interpretation. The cases were treated as a series of individual accounts that could be compared and contrasted, looking for different approaches and meanings, rather than trying to simplify and minimise differences by treating the Making it Digital programme as a single case study.

3.3.2: Case study methods

Chapter 4, Making it Digital, is treated as being a 'practice-led' account, using direct data gathered from a knowledge transfer project. By practice-led, the researcher means that this was a series of case studies that constitutes research *into* practice, attitudes and outcomes within a specific research-related context and programme. The primary focus is to advance knowledge about emergent practice. The recent AHRC review of practice-led research in the field of art and design makes clear how this type of research *into* practice is just one possible practice-led methodology, explaining that the term 'practice-led' does not describe a single set of ideas about research. '*Its meaning varies with discipline, location and person and it varies with the questions that are investigated'* (Rust et al., 2007:10). They go on to assert that the central issue is how the researcher '*can best resolve the research problem that they have taken on*' not whether, for example, an analytical text or an artefact results from the research. The research problem in this case is the potential impact on designer-maker practice of the use of digital technologies. The opportunity to research directly into this type of emergent practice in a specific group undertaking a knowledge transfer project was therefore an extremely timely and valuable one. The definition that the researcher is using for 'practice-based' work, the reflection on the artefacts and outcomes of her own experimental digital making practice, is discussed under Section 3.5 below. The Making it Digital scheme itself, the data collected and analysis are discussed in Chapter 4.

Traditional case study methods have a historical link to pragmatism and narrative accounts. Hamel, Dufour and Fortin (Hamel et al., 1994) explains how the ideas of John Dewey and George Herbert Mead were influential within the Chicago School of qualitative research, early 20th century journalistic narrative accounts of immigrant urban populations in Chicago, which led to field studies and eventually to case study methods. For example, the work of HS Becker which echoes Law's contemporary concerns with understanding meanings and establishing the context from the actor's viewpoint.

'*To understand an individual's behaviour, we must know how he perceives the situation, the obstacles he believed he had to face, the alternatives he saw opening up to him*'. (Becker, 1970a:64 in Hamel et al., 1994:17).

In '*The Art of Case Study Research*' Stake similarly emphasises the strength of a case study being its uniqueness. The point is to emphasise '*episodes of nuance, the sequentiality of happenings in context, the wholeness of the individual'* (Stake, 1995:pxii). Again, this is reflected in the subject under study. Uncommonness in craft process and skills, the uniqueness of situated practice, is a key area of craft value (Section 2.4).

How the Making it Digital scheme was setup, its aims and process are therefore relevant to understanding the individual cases, and these are described in Section 4.2. Stake points out the need to define the boundaries of your case at the outset, is it the programme itself or an individual, is it being studied for 'intrinsic' or 'instrumental' reasons, i.e. for the case itself, to understand the complexity and motivations within the case or because it is applicable to other situations and the need to make generalisations. In this case the researcher considers that the Making it Digital cases were primarily considered as 'intrinsic' isolated examples of individual engagement, particularly because they represent practice that is emergent and undertaken in a particular research context and therefore uncommon. That is why a series of case studies was undertaken (rather than perhaps a survey that could address concepts and language that are already well established). However, the insight generated from these cases has been used as the basis for further inquiry, in Chapters 5 and 6. Stake considers the researcher's main obligation is to 'know the case well', change mid-way if necessary and re-focus. This advice was taken on board in research decisions such as to run additional focus groups and collect additional data through participant review of transcripts. Stake suggests looking at the programme's own goal statements for initial ideas about issues of concern, to ask what is the programme attempting to address and then to consider the constraints and problems encountered to create *issue statements*. For this reason, a description of the Making it Digital scheme and its context are included in Section 4.2 and Appendix 1.2, followed by a discussion of what issues were identified at the outset in questions and how, as issues emerged, these were further interrogated.

The question of whether issues to look into can be decided at the outset or emerge later, is explored through the distinction between Etic and Emic issues. The first are the researcher's questions and may come from the researcher's own knowledge and experience, from talking to other participants and from initial interviews; these are distinguished from Emic issues, ones that emerge from the cases themselves.

'*These are the issues of the actors, the people who belong to the case. These are issues from the inside. Ethnographers have traditionally taken great satisfaction in developing emic issues, departing in the field from the conventional views as to what is important, but ultimately relating the emic to the etic issues of their discipline*' (Stake, 1995:20).

Stake considers that research should begin with initial issues and what data would be needed to talk about them and move on to how to get it, where could it be observed. The most important job is to try and understand and describe the actors and their goals and motivations.

'The function of research is not necessarily to map and conquer the world but to sophisticate the beholding of it. "Thick description", "experiential understanding" and "multiple realities" are expected in qualitative case studies…an ongoing interpretative role of the researcher is prominent in qualitative case study.' (Stake, 1995:43).

Narrative description is paramount for Stake:

'Our accounts need to be personal, describing the things of our sensory experiences, not failing to attend to matters that personal curiosity dictates. A narrative account, a story, a chronological presentation, personalistic description, emphasis on time and place provide rich ingredients for vicarious experience. Emphasizing time, place and person are the first three major steps' (Stake, 1995:86).

Stake gives full weight to acknowledgement of the subjectivity of qualitative research, saying that research is not helped by making it appear value-free when it is not, it will be shaped by '*the mood, experience and intention of the researcher*' and it is better to acknowledge this (Stake, 1995:95). Within this research, the researcher's own point of view as a craft practitioner and the inclusion of first-hand practice bring etic issues to the inquiry and give the researcher a situated viewpoint that can be used to compare with and corroborate against data gathered. The question of identifying emic issues, issues that spring from the research participants, was addressed by employing the techniques of coding transcripts through grounded theory. The researcher believes that an integrated perspective and recognition of herself as a research participant means that the distinction between etic and emic issues acts as a tool for awareness and discussion rather than as a meaningful categorisation device. In practice, issues were raised by both the researcher and participants and were often found to be shared, overlapping, added to or uncovered (although at times there were also differences in perspective) *together with* the research participants.

Beyond establishing the context, identifying issues and their source and acknowledging personal research agendas there were many practical considerations and decisions that have to be made about conducting case study research. Specific methods have been used that required the researcher to learn about a large range of necessary techniques, each one a small stepping stone within the research which needed specialist advice. These include advice on interviewing techniques, recruiting participants and obtaining consent, framing and asking open questions, developing rapport and using recording equipment. The list continues with advice sought on dealing with ethics, such as participant confidentiality and anonymity, keeping records, developing transcription protocols and categorisation devices. Similarly, more advice was needed for later methods such as setting up, facilitating and understanding focus groups, organising data, learning and using analysis software and writing up the results. This kind of advice was gained from a number of sources, including supervisors and training opportunities but mainly from published case study literature including: (Riley, 1990), (Keats, 2000), (Gillham, 2000), (Wengraf, 2001), (Eisenhart, 2002), (Yin, 2003), (Macnaghten and Myers, 2004) , (Wilkinson, 2004), (Dey, 2004), (Silverman, 2004), (Silverman, 2006), (Seale, 2007) (Flyvbjerg, 2007), (Holliday, 2007), (Breslin and Buchanan, 2008). These specific contributions are discussed where appropriate within Sections 4.3 and 4.4.

3.3.3: Analysis and Verification - The Grounded Theory Method

The version of grounded theory used was taken from Strauss and Corbin (1998) and Corbin and Strauss (2008) *The Basics of Qualitative Research* which explains in detail the analytical tools used within this particular qualitative method. Essentially, primary documents such as interview transcripts and observation records are micro analysed for concept words (open coding), the researcher then uses a variety of techniques, particularly memo writing - speculative written questioning of possible interpretations of phrases and ideas - to interrogate those concepts for properties and how those properties vary along dimensions. Emphasis is laid on asking questions and making comparisons, building up a process and interplay between primary documents and analysis so that the strongest concepts emerge, rising to the top through the data. Further rounds of linking concepts (axial coding) and linking dimensions (selective coding) are undergone alongside more data gathering to test emerging theory.

As the authors explain:

'our sampling procedures are designed to look at how concepts vary along dimensional ranges (how their properties vary), not to measure the distribution of persons along some dimension of a concept' (Strauss and Corbin, 1998:280).

So, rather than putting up a concept (e.g. designer-maker) and asking participants to measure themselves against it, it seeks to gather broad conversational and interview evidence among other sources and then derive participants' and the researcher's interpretation of concepts. It is this basic assertion that qualitative research can offer something quite different from quantitative research in actual findings in this way, by both defining and bringing into focus concepts not yet fully explored, that makes it attractive for emergent practice.

Digital technology generally is well established and quantitative survey questions could be envisaged that worked on a shared understanding of concepts by the researcher and respondents. However, 3D digital production for makers is relatively new (and was more so in 2008), and research aimed at defining concepts to be used in later survey questions was considered helpful. How do makers themselves understand or identify with concepts such as 'designer', 'designer-maker', 'craftsperson', what are the properties of these concepts and how do they vary and relate to each other? How does this relate to the concept of 'physical involvement' with making and where do the boundaries of variation in this lie? How far are digital technologies able to be accommodated within the properties of the concept 'hand-made'? These kinds of issues are crucial in any attempt to define how (and which) makers might be more (or less) inclined to use digital technologies. Concepts from detailed transcripts of interviews with Making it Digital participants were analysed, compared and related to an overarching narrative as described in Section 4.4.

Corbin and Strauss are keen that quantitative and qualitative methods are viewed as complementary and, in particular, that there is an interplay between them; as new concepts emerge, flexible research design can take account of findings, for example building concepts into survey questionnaires, or further interviewing protocols. Again, this sense of an iterative process was retained.

Grounded theory, with its rigorous procedures of memo taking, micro and macro matrixes and theoretical sampling (concept-driven cumulative sampling to build upon previous data collection and analysis) (Corbin and Strauss,2008:145) could be taken as a rigid approach. Strauss and Corbin are extremely generous on this front, whilst laying out their procedures they encourage novice researchers not to follow them too dogmatically, always pointing out that a descriptive account or conceptual ordering rather than full-blown academic theorising could be the outcome. They encourage researchers to be flexible and indeed suggest it is acceptable to only use part of their methods. They make clear the depth and saturation of categories that would be required for theory generation but advise students not to:

'*get caught up in worrying about what is the right or wrong way. The important thing is to trust oneself and the process. Students should stay within the general guidelines outlined in this book and use the procedures and techniques flexibly according to their abilities and the realities of their studies'* (Strauss and Corbin, 1998:295).

Many of the general comments in Strauss and Corbin's book resonate with the previously described issues from the texts outlined above, for example concern with

'*taking with great seriousness the words and actions of the people studied' and 'that phenomena are complex and their meanings are not easily fathomed or just taken for granted'* (Strauss and Corbin, 1998:6).

In particular their repeated insistence on complexity is apparent, both in the research process, with its audit trail of primary documents, memos and diagrams and in the depth of engagement with the details of the phenomena, its chronological processes and its web of interactions, on a micro to macro level. They also share the view that the '*flexibility and openness are linked with having to sustain a fair amount of ambiguity*' (Strauss and Corbin, 1998:5).

Within grounded theory, then, data is all important. As Cohen, Manion and Morrison explain:

'*Grounded theory starts with the data, which are then analysed and reviewed to enable the theory to be generated from them; it is rooted in the data and little else. Here the theory drives from the data – it is grounded in the data and emerges from it'* (Cohen et al., 2007:492).

They go on to explain that being as open as possible to discovery rather than starting with preconceived ideas, that are then tested, requires the researcher to have 'certain abilities', including:

'*tolerance of confusion and regression (feeling stupid when the theory does not become immediately obvious), resistance to premature formulation of theory, ability to pay close attention to data, willingness to engage in the process of theory generation rather than theory* *testing; it is an emergent methodology, ability to work with emergent categories rather than preconceived or received categories'* (Cohen et al., 2007:492).

Grounded theory analysis follows a particular process, involving pulling out concepts from interviews and then mentally theorising about the meaning of those concepts in 'memos' to yourself, then going back to the data to look for related information and ideas. This is why it is particularly suited to emergent practice, it aims to take a fresh look from actual data and is particularly suited to areas where some flexibility and difference in opinions and interpretations is likely between participants. This was found to be the case in this research. In this study, computer software Nvivo 8 was used for this process. This procedure is aimed at continuously comparing categories and properties across data and is the key tool of data verification. As Cohen et al point out *'The process resonates with the methodological notion of triangulation'* (Cohen et al., 2007:493).

There are many versions and interpretations of grounded theory; Robson explains differences in protocol between Strauss and Corbin (1998) and Glaser (1992) and explains how a series of stages result in selecting one aspect as a 'core category', around which the categories arising from axial coding are integrated. Robson continues; *'Srauss and Corbin approach this task via the storyline. This starts as a description of what axial coding has produced. You have to move from this descriptive account to a conceptualization of the storyline'* (Robson, 2002:494). Further details about how this was done within this research are in Section 4.4.

The idea of triangulation stems from an analogy with navigation (Seale, 2007:53) in which a position can be established by drawing intersecting lines from bearings on two landmarks. Stake's discussion of triangulation assesses its usefulness in substantiating points that are most likely to be contentious and examines a number of triangulation protocols identified by Denzin in his book 'The Research Act' (1984). He believes that methodological triangulation '*principally of observation, interview and document review*' is the one most recognised, but comments that '*triangulation regularly sends us back to the drawing board*' (Stake, 1995:114). He relates this to the researcher's philosophical perspectives in a clear interpretation of how scepticism about the data and findings is likely to be influenced by the researcher's epistemological stance:

'*The stronger one's belief in constructed reality, the more difficult it is to believe that any complex observation or interpretation can be triangulated. For Denzin and many qualitative researchers, the protocols of triangulation have come to be the search for additional interpretations more than the confirmation of a single meaning*' (Flick 1992) (Stake, 1995:4).

The researcher feels that she has used triangulation as a way to add complexity and depth to the conclusions presented, rather than as a way to simplify and narrow them. Stake also advises that texts are shown to respondents to check meaning but reports that it is common to get no response, nevertheless, he feels it is important to go through that process. All of the participants in the *Making it Digital* series of cases were sent the detailed transcripts of interviews, they were also shown an introduction to the analysis and the conclusions drawn, and were asked for comments and asked if they would like to see the completed text. Two made comments or corrections to transcripts, one asked to see the completed chapter.

Grounded theory is not immune from questions about validity and subjectivity and the strength of the researcher's pre-conceptions. After an interesting grounded theory analysis of a transcribed classroom text that concluded that the 'core variable' exhibited in the data was *power*, Cohen et al question how far the researcher's own experiences of power and authority may have led her to *'projecting too much of herself onto the data interpretation'* and point out that a transcript cannot convey any more of the contextual situation than the spoken word, the selection of what is taking place has been made on what is transcribable. They go on to make a general point about analysis and interpretation:

'*In qualitative research, analysis and interpretation frequently merge. This raises the issues of validity and reliability. What we have here is a problem of the 'double hermeneutic' – as researchers we are members of the world we are researching, so we cannot be neutral; we live in an already interpreted world*' (Cohen et al., 2007:500).

As a craft practitioner herself, the researcher acknowledges a generally positive attitude towards the use of digital tools which were successfully brought into play within the researcher's degree work (see Section 1.2). This is a positive benefit in being able to empathise and communicate well with other practitioners but this also requires an awareness of personal agendas. All researchers bring their own narrative to their research, so this is not an unusual or problematic situation. The researcher would not expect to be an 'objective unbiased' observer, but it does require an acknowledgement that this is the starting viewpoint from which the research was conducted, and allows for a discussion of how the researcher's understanding and attitudes have altered during the course of the research. This impact is recounted as part of the conclusion in Section 7.2.

The constraints of interview data, of capturing only what is transcribable, are also well described in case study literature. Interviews can only reflect one, possibly rather remote, view of the participants. The limitations on information include participants' awareness of being recorded, possible inability to remember, to want to share, or to verbalise their views. In this research, supplementing interview data with other ways to capture information, such as observations and notes, informal chats, photographs and exhibition attendance, as well as reflection on the objects created, and the researcher's own practice, formed part of the deliberate mixed methods strategy for this study, designed to gather multiple data.

This could be seen as another form of triangulation. Whatever the data consists of and however it is analysed, essentially you are looking for patterns and comparisons as well as holding onto and reflecting differences from a range of information. Gray and Malins consider that using *'triangulation: the use of two or more methods of gathering information on an issue'* and the use of multiple media is characteristic of research in the sector. The use of multiple methods and multiple media, which include different kinds of sensory information (film, photos, and objects) *'is more likely to give us a comprehensive and rich perspective on the research issue being explored'* (Gray and Malins, 2004:32). They advise researchers to 'play' with data, organising it and re-organising it through different 'filters' and 'sieves' to draw out meaning. Again, in this research, successive iterations, diagrams, conversations and written accounts prepared in stages and re-visited and revised, are designed to achieve this end. The detailed analysis conducted for the Making it Digital chapter is described in Section 4.4, and it draws on the general case study methods outlined above.

Section 3.4: Practice-based work

Chapter 5, *Moving Boulders*, considers the ‘practice-based’ element of this research. This was undertaken by the researcher during September and October 2009. Practice-based research was envisaged as making a 20 per cent contribution to the overall PhD project, it was included as a way to triangulate research with a different engaged perspective, and was carried out in two phases. This section considers the methodology related to the researcher’s practice, the context and rationale for the practice work, its aims and objectives and the action research methods employed.

3.4.1: Rationale for practice

The rationale for practice-based research, as a building block of the researcher’s PhD, was discussed and agreed at an early stage. The objective of the practice-based element was established within the RF3 (the University of Arts London PhD registration document) and reviewed during confirmation after the initial case study work was completed. This is re-stated as the ‘***Rationale for Practice***’.

‘*To enhance the researcher's understanding of the process of moving towards a digital practice through exploratory practice-based research. This will provide rigorous documented insight on a personal level of the barriers, rewards and collaboration inherent in new technology adoption and thereby provide examples of technique and process, highlighting relevant issues and empathizing with makers’*.

This confirmation document, developed after the completion of the Making it Digital study, also makes clear the researcher's intention that:

‘*The practice element will act as a way to present a documented example of the degree of collaborative interaction and embedded knowledge accessed during the process of creative engagement in digital craft. As a way to quantify the contribution of knowledge from sources outside the researcher’s traditional resources and test the proposition that digital engagement challenges traditional notions of personal autonomy in craft practice.*’

And that:

‘*The intention is to produce quality work, however, in this case it is not intended that the specific techniques involved in the work itself, or the final outcomes of the work will be the primary research aim*’ (Rationale for Practice).

The first point to make is that the researcher’s own practice-based element, in chronologically following the practice-led series of case studies, was designed to draw on the preliminary observations made from the first element, namely to investigate *‘collaboration inherent in* *technology adoption'.* The researcher's methodology specifically calls for flexibility in adapting research to new concerns as they arise, and this was done in this case. Although a practice-based element was always planned, its form, direction and issues of concern arose from the initial findings of the series of case studies.

The practice element, and in particular an examination of process, is therefore the ***subject*** of research but as this practice was undertaken for this research, it is also in part a method, certainly to the extent of providing evidence and data within an action research method. Within art and design research there has been much debate and a lack of clarity over the terms practice-based and practice-led. Much of the discussion has centred on whether, and how, art works themselves can constitute research. A recent review, funded by the AHRC, considers the whole landscape of practice-led research in detail (Rust et al., 2007). Among many other commentators it draws on the work of Scrivener. Scrivener, writing in a paper that followed from the 2007 Helsinki Conference: *The Roles of Art and Design Process and Objects in Research*, identified six conditions as a working definition of research: intention, subject, method, justification, communication and goal:

An activity is research if, and only if, it is 1) a systematic investigation, 2) conducted intentionally, 3) to acquire new knowledge, understanding, insights, etc., that is 4) justified and 5) communicated 6) about a subject (Scrivener, October 2007:71).

Scrivener goes on to argue that research where creative production is the subject (rather than the method of inquiry) requires no separate categorisation as practice-based research because it is consistent with non-art and design research (Scrivener, October 2007:75). His view is that the terms practice-based and practice-led *'should only be applied to research where creative production is a mode of knowledge acquisition'.*

The recent AHRC report adopts a wider definition of practice-led as:

'*Research in which the professional and/or creative practices of art, design or architecture play an instrumental part in an inquiry*' (Rust et al., 2007:11).

Within this thesis, the term practice-led would therefore cover every aspect of the research, including the researcher's own practice. However the term 'practice-based' is used to identify and distinguish the element of the researcher's inquiry relating to her own practice, one strand of the mixed methods used, providing one source of evidence. The use of the term is not an indication that the actual objects produced are intended as the contribution to knowledge or that the wider research methodology is exclusively a practice-based approach. The researcher acknowledges that greater clarity in the sector would result from adoption of Scrivener's call for a more exclusive categorisation, and that her own research is not practice-based or practice-led in a profound methodological sense (that the creative objects themselves are new knowledge), it is a hybrid social science-based methodology with a practice-based element. This was the most appropriate choice for the research problem. It is the textual analysis of the researcher's own *experiences* and *reflection* in relation to her practice work and thesis, which is the research outcome of the practice documented in Chapter 5. The overall research is a systematic investigation into how digital processes and capabilities may be able to alter craft practice, meanings and potentialities. In this context the researcher's own practice, as a novice digital craft practitioner, was deemed appropriate as an additional element and alternative focus for detailed investigation, potentially able to yield evidence not accessible from other case studies conducted.

A detailed practice investigation is used as evidence to test against the researcher's theoretical understanding of digital craft practice. Commentators on practice-based research have emphasised the need for methods to be acknowledged by, and appropriate for, the community at which the research is aimed. An element of the attraction of practice-based research is its usefulness as an easily communicable source of knowledge for the wider craft community. Descriptions of practice and analysis in relation to specific objects and images are likely to communicate and resonate better with craft practitioners and craft researchers than theoretical analysis alone. The practice-based work was created for a public exhibition, it has been exhibited elsewhere and used within presentations, for example by Autonomatic and to UCF contemporary crafts students. In this way, it has become part of the shared discourse with practitioners (Section 5.4.1).

The approach taken here is similarly consistent with a broad tradition of art and design research, for example 'Research *into* art and design' - a category which Frayling describes as the most straightforward and common of his three putative categories of art and design research (Frayling, 1993/4:2). It also has an element of Frayling's second category 'Research *through* art and design' one focus of which Frayling identifies as:

'*action research – where a research diary tells, in a step-by-step way, of a practical experiment in the studios, and the resulting report aims to contextualise it. Both the diary and the report are there to communicate the results, which is what separates research from the gathering of reference materials'* (Frayling, 1993/4:5) .

The researcher accepts the viewpoint that artefacts and practices need to be explained and communicated to render them transparent as research (Friedman, 2009). Section 5.2, the description of practice, attempts to 'render explicit' the extent to which analysis of the researcher's own fledgling digital craft engagement is capable of revealing insight and testing theory regarding the modes of engagement that are emerging in digital craft practice. The researcher acknowledges that *practice* is capable of fulfilling or part-fulfilling the six research conditions listed above in a number of complex variations (Scrivener *Table 1. Condition of research and claims for creative production in knowledge acquisition*: 78). For example, it would be possible for objects and process to embody knowledge. It would also be possible for practice to act as an overall methodology, a framework for inquiry and understanding. Within the context of this research, however, explicit contextualisation and narrative text-based analysis of practice follows from the researcher's overall methodological approach (discussed under Section 3.5 and broadly characterised as a pragmatist philosophy using social science, practice and other mixed methods and experiential understanding of the phenomenon under discussion using case studies) and acknowledges the unique value of an element of engaged personal practice as one source of triangulation. Practice meets the subject condition and is used as a tool within the method and communication conditions.

3.4.2: Action Research method

An action research method was employed (Herr and Anderson, 2005, McKernan, 1996, Cohen et al., 2007). A mixed method approach to collection of data was followed:

This took four forms:

- Practice notebooks detailing technical notes and training, documenting sources of inspiration and creative exploration, development and reflection, primarily in hand-drawn sketches alongside secondary data collected.
- A detailed reflective personal log of the researcher's experiences and questions in relation to the impact of using digital tools and changing working practices, recorded within Nvivo 8 database software. Archived photographs of test pieces and progress.
- A public practice narrative blog, briefly detailing the researcher's experiences, designed and implemented from July 2009 and hosted within the researcher's www.technepractice.org.uk website, which invited comment and discussion.
- Reflection and summarising of data was carried out through conversations with colleagues, mind mapping (Buzan and Buzan, 2000), and analysis of the researcher log. An initial written analysis was conducted in November 2009, subsequent interactions and further consideration resulted in a more detailed analysis presented under Section 5.2 below. The researcher emphasises that data was analysed in the light of contextual resources previously examined and through discussion with craft and digital making experts. Access to experts and informed opinion (through project supervisors and other colleagues, conferences and seminars) and contextual reading provided a cycle of ongoing critical examination, in dialogue with the wider field of research.

This framework is based on one outlined in Gray and Malins*:*

'*a dynamic and recursive reflection process, which relates to David Kolb's experiential learning cycle (Kolb, 1984). Briefly, Kolb proposes four stages of learning from experience: do, reflect, summarize, test*' (Gray and Malins, 2004:57).

This text goes on to discuss work by McAleese that proposes '*two main tools to enable and externalise reflection-on-action are concept mapping and reflection journals*' (Gray and Malins, 2004:58).

Within Gray and Malins, recognition is given to the value of 'off-loading' into a reflective journal in moving ahead with work, but equally tinged with a fear of losing or damaging creativity by speaking or writing about it. This informed the researcher's decision to keep a private log separate from a public blog. The private log acted as a space for relatively unmediated personal narrative and formed the main data used for analysis.

The notebooks were primarily seen as a method for reflection 'in' action, at the time of making, for quick notes and training reminders. The private Nvivo log and public blog centred on reflection 'on' and 'for' action and enabled the researcher to summarise, assimilate and plan action. However, after some time the researcher felt that a public blog required too much input at the level of carefully worded and self-censored overview to act as source of rich research data for analysis, and would have required much more promotion work to stimulate meaningful debate. This was therefore discontinued in favour of the more subjective and contentious issues noted, and questions posed, reflectively within the private log.

This method also relates more broadly to action research methodology, (Robson, 2002, McKernan, 1996) where '*rigorous and systematic methods for data collection*' (McKernan, 1996:57) are combined with reflection and action, in a cyclical process. Action research encourages the inclusion of a wide variety of data types suited to the purpose of the inquiry. The approach taken by the researcher was informed by her case study methodological approach, and the principles of 'flexible' design, mixed methods and triangulation are further discussed under case study methodology Section 3.1.5. In particular, the practice element emphasised the role of a personal case study in looking at a phenomenon with a narrow focus, in its real-life context, combining subjective and objective data (Cohen et al., 2007:254). The researcher also believes that being, as she was, an 'insider researcher' can significantly aid understanding of a phenomenon, Cohen explains:

'*In rejecting the viewpoint of the detached objective observer – a mandatory feature of traditional research, anti-positivists would argue that individuals' behaviour can only be understood by individuals sharing their frame of reference: understanding of individuals' interpretations of the world around them has to come from the inside, not the outside'* (Cohen et al., 2007:19).

The practice element therefore formed a vital part of the researcher's ability to understand the wider case study data.

Herr and Anderson quote a variety of definitions of *Action Research,* adding that while they '*prefer to remain as eclectic as possible with regard to a definition of action research*' (Herr and Anderson, 2005:5), researchers themselves should be explicit about their own definition because this will inform the epistemological, ethical and political decisions made throughout the study. The following working definition and understanding of action research has been developed and used by this researcher in the investigation of the phenomenon of digital craft: A systematic reflective process of creative intervention, evidenced through personal practice, objects and reflection, producing data and exhibited craft work. This work was analysed in dialogue with contextual resources and informed opinion from the field of research, resulting in a text and image based articulation of practice, aimed at a better theoretical understanding and critically examined through dissemination of findings. The researcher is an insider researcher, a craft practitioner herself, taking an experimental approach to developing innovative techniques and exploring digital potentialities through practice recorded through personal narrative text and analysed using case study methods.

Section 3.5: Professional Views

The third evidence element, Chapter 6 Professional Views, concerns interviews undertaken at the end of of 2010 and early 2011, towards the end of the research, after the conclusion of the series of case studies and the researcher's own practice-based enquiry. These were deliberately conducted among a selected group of digital technology professional users as a method of theoretical sampling (Section 3.3.3) to provide a perspective on the researcher's thesis, as it had emerged from the first two elements of evidence gathering.

These interviews were transcribed and analysed for similarities and differences in the range of views, particularly focusing on how processes and technical assistance employed within participants' practice were understood and explained by interviewees. Interviews were conducted among a small number of practitioners who were all experienced in the use of digital technologies. How participants were selected and interviewed is covered in Section 6.2 and Appendix 3. These interviews sought to gather evidence and interrogate this evidence in the light of the researcher's ideas about the extent of reliance and support on technical experts and the range of collaborative encounters reported. They are therefore another mixed method of data gathering, another iteration of evidence. Conducted after other elements were completed, they draw on the insights and emergent findings from research already conducted, they act both to add to the data gathered and as an initial reflection on emergent theory. By reflecting back to professional users the idea of 'collective' engagement in making, expressed as the concept of 'team effort' (Section 6.3) and exploring questions about how far practice relies on technical support, or is in some way collaborative, this element was employed to explore questions raised in earlier parts of the study.

Section 3.6: Summary of Methodology

In order to address the research question, this chapter presents evidence of an understanding of the broad philosophical questions and relates why choices resulting in the particular hybrid methodology adopted were made (and other possibilities excluded). The researcher identified an approach that was appropriate within the specific research context. The study is one of *emergent, technological practice* from which tentative conclusions (*generalisations*) about the nature of new opportunities and *change* were envisaged. The approach is one of pragmatism but this is informed by other philosophical perspectives. It rejects strict paradigmatic exclusivity, that ideas within paradigms cannot overlap or that methods cannot be shared, in favour of adopting appropriate means for the type of research being undertaken, the point in the research process and the nature of the evolving research questions. Nevertheless, a pragmatic philosophy is adhered to, emphasising actions and interactions in the world, intersubjectivity, which assumes there is value in identifying and developing shared understandings of concepts, that findings may not be generalisable in a scientific sense but may be transferable or amenable to 'fuzzy' prediction. It is research that looks for a wide range of data within a narrow subject focus – the 3D digital making experiences and views of research participants and the implications of these experiences. It looks for what is absent as well as what is present, and what is present but not necessarily in the form of words. It embraces mixed methods, cross-disciplinary understanding, a wide variety of information sources, practice-led as well as practice-based data, the use of triangulation and iterative reflection followed by further research to add to understanding. It concludes with tentative results that suggest that what has been found in these cases *may* prove to be the case in other similar circumstances. How does this dictate the practical stance towards the enquiry itself?

With regard to the three following evidence-based chapters, the common themes within the social science and philosophical literature that forms the basis of the approach taken are summarised below:

- Acknowledgment of, and attempt to account for, subjectivity within the research context. Relishing complexity and respecting non-coherence.
- Sensitivity to the direct voice and experience of participants, including the researcher's own.
- Not claiming too much for your findings but being open to the possibilities of findings being transferable, if found to be so.
- Allowing creativity and freedom in specific methods of collecting and recording data, being open to new possibilities, both for what counts as data and how it is recorded. Looking for absence.
- Using data verification methods such as triangulation and respondent checking but acknowledging the limitations.
- Telling a detailed story, backed up by good detailed primary documentation, 'thick' description, 'rich' research in order to substantiate the context.
- To be flexible, allowing interplay between ideas and concepts that emerge and your own ideas, re-focusing, changing and adapting to research as it progresses.

This research takes a pragmatic philosophical approach, which mirrors both the concerns of the participants (their practical embodied enquiry and physical way of being in the world) and the practice being studied (physical object creation through iterative and creative use of technology-based tools), and is carried through to the methods approach, one of continual inquiry and interplay between action and reflection, as well as an inclusive attitude towards what constitutes data. This does not imply a cavalier attitude toward paradigm shifts, a lack of understanding of how fundamentally a paradigm influences outlook, or inconsistencies in the use of data, but rather a direct approach that continually refers back to the data gathered and the data gatherer and the lived experience of participants. Whilst emphasising contingency and flexibility, all of the case study methods considered call for detailed evidenced audit trails and transparency linked with interpretation. Pragmatism and grounded theory provide a framework for such detailed engagement with the phenomena under consideration, and present a good research strategy to best resolve the research problem taken on, augmented by the practice-based and interview methods described.

Additional bibliographic listings: authors are listed here, and full references appear in the bibliography, although these texts have not been specifically cited they inform the background reading of the chapter.

(Biggs and Büchler, 2007), (Cooley, 1980), (David, 2006), (Dewey, 1929), (Friedman, 2000), (Fry, 2008), (Hague, 1993), (Heidegger and Krell, 1993, Heidegger and Lovitt, 1977), (Hickman, 2007), (Latour, 1999, 2008), (Pink, 2001), (Pulman, 2009), (Riessman, 1993), (Read, 1944), (Rothenberg, 1993), (Scharff and Dusek, 2003), (Schön, 1983), (Seale, 1999), (Strauss and Corbin, 1997), (Sullivan, 2005), (Walker, 1995), (Wormald and Pedgley, 2007).

Chapter 4: Case studies

'*...and then you have those few moments that make the whole thing worthwhile of like 'oh my god, I love it, I love it I love it, I love it' and for me that's what makes me live, that's what makes me want to be alive*' (Participant 1).

Section 4.0: Introduction

Making it Digital (MiD) was advertised as an opportunity for designer-makers to access digital manufacturing facilities and mentoring to develop an innovative new product. Support, including £250 project-related expenses, was made available through a structured programme run by *Hidden Art* and *Hidden Art Cornwall* [1] with *Autonomatic*, University College Falmouth's (UCF) *3D Digital Production Research Group*. It was co-funded by *Arts Council England* and *UCF* and part of Hidden Art's wider *Innovative Routes to Market Programme*, designed to address the difficulties that designer-makers face to develop and get a new product to market. After a competitive selection process, eight projects involving 11 makers, including three collaborative groups, were accepted onto the scheme. Each was allocated a 'mentor' from the Autonomatic team to help facilitate their work. These mentors worked intensively with makers on realising project proposals, from preparing digital files to machining materials.

The researcher was closely involved with the programme from the outset, for example, participating as an observer at introductory events such as the '*Launch and Demonstration Day'* where makers discussed ideas and were introduced to the digital equipment available. The researcher attended project proposal meetings and assisted in setting-up and documenting workshops and exhibitions, and attended presentations by makers. As well as extensive informal contact with all the participants on the programme, eight of the participants agreed to act as research informants and took part in more formal semi-structured interviews and a focus group as part of this research. A series of case studies was conducted by the researcher among these participants, involving extensive collection of data through, for example, observations and interviews. This chapter presents evidence and analysis that is the result of this series of case studies. Appendix 1 contains background documents and contextual information regarding the MiD programme. It gives further detailed descriptions of the programme timetable, the researcher's data collection strategies, sampling design and the interview protocols. MiD ran from March to June 2008 and, in addition, a series of exhibitions was held later that year.

[1] *Hidden Art Cornwall*, operated during this period as a not for profit membership organisation that promoted and supported designer-makers who lived or worked in Cornwall and the Isles of Scilly, in association with UCF, it was a social franchise of *Hidden Art* (London).

Making It Digital

One of a number of launch events held:

- 18 Designer Makers
- Tour of Tremough facilities
- Introduction to research participation

Figure 33: Making it Digital Launch Day, UCF, March 2008.

Section 4.1: First Impressions

The main intention, in line with grounded theory and the case studies methodology set out above (Section 3.3.2), was to allow the data to generate issues, concepts and questions to be further explored so that findings emerge from the study. However, some issues were identified at the outset, drawn from the researcher's experience, interest and reflection on the purpose of the research; these do not amount to a 'theory' but were issues the researcher wished to explore. The researcher carried out initial discussions with one or two makers and supervisors and from this developed a five page questionnaire. The intention was to broadly understand the benefits and difficulties potential participants in the scheme foresaw and their level of computing expertise. The questionnaire is reproduced in Appendix 1.1. At a Launch Day held at Tremough Campus, Cornwall on 13th March 2008, the researcher completed eight questionnaires through face-to-face discussion with potential participants. This was done as part of a 'speed networking' session, the main intention of which was that makers could meet each other and discuss possible collaboration. A question and discussion (Appendix 1.2) session among all the makers, programme organisers and Autonomatic also provided data. The main concerns arising from these initial discussions, questionnaires and field notes are detailed below.

4.1.2: Business-minded

The researcher formed the impression that these designer-makers were intensely practically minded, the focus of their concern was on what they could and couldn't do with the equipment, on costs and on moving their businesses forward. This underlined the appropriateness of taking a pragmatic philosophical approach and the benefits of being able to follow case studies within the institution where the researcher was based. It seemed likely that a close relationship to the site of the project and being on-site for much of the time would enable the researcher to keep up-to-date with developments and adapt to changing plans.

Discussion of the economic viability of designer-maker practice, for example, the input in time and money of new (or existing) product development were key issues. The potential participants seemed aware of the substantial investment needed and discussion around the difficulty of making time to '*experiment and play'* to develop products, whilst running a business, were noted. Questions around machine capabilities re-occurred throughout the day, particularly in relation to materials that makers already had extensive knowledge of. The natural point of departure for many makers was to ask questions about the machine capability in terms of an extension of existing practice. For example, there were questions about working on slate, metal, glass, in wood and mixed media, underlining a keen sense of material engagement.

The eight potential participants who filled out a questionnaire were asked to rate the importance of the following elements in attracting them to apply for the project, on a scale of 1 to 5, where **1: Not important at all**, to **5: Very important.**

The table shows how the eight respondents rated the following factors:

	Not important at all	2	3	4	Very important
Developing a new product		1	1	2	4
Gaining new computing skills		1	1	3	3
Gaining new business skills	1	1	1	1	4
Working with other makers	1	2	3	2	
Funding available for materials/expenses			3	1	4
Access to 3D equipment				2	6

'*Access to the 3D equipment*' was rated as an important or very important benefit of the scheme by all eight, '*Developing a new product'* and '*Gaining new computing skills*' by six participants, while '*Gaining new business skills*' and '*funding available for materials/expenses*' was very important for half of this small sample. None felt that '*Working with other makers'* was very important. When asked to pick one aspect that attracted them '**most**', seven of the eight, indicated that the '*opportunity for new product development*' was what attracted them '**most**' about the MiD project, with the eighth citing '*opportunity to learn new business skills'*, suggesting that these makers were perhaps centrally focused on the business opportunity, rather than the less specific benefit of '*opportunity to access to 3D equipment'*. The MiD programme was intended and advertised as a new product development opportunity, and the researcher concluded that the programme had indeed attracted serious designer-makers, intent on pushing forward their businesses. The main concerns, reported from the questionnaires, were possible lack of time and availability of additional funding. This questionnaire was not subject to further analysis, it was viewed by the researcher as an initial introduction to the views and most important issues for one group of potential participants.

It does, however, underline the fundamental issue that '*access to digital equipment'*, available within the facilities at UCF, was a key part of the programme and ranked highly in potential participants' minds. The practical and financial difficulties of access to large scale, expensive, specialist digital equipment such as laser cutters and milling machines designed for industry, requires potential users to find accessible equipment and skilled intermediaries. This can be done through a variety of possible routes such as commercial operators, manufacturers, online bureaux and specialist facilities such as those made available to design students, and commercially, through participatory and workshop schemes. From the outset, then, it was apparent that access to equipment within MiD was seen as a major benefit. The opportunity was clearly presented as mediated access within a University research setting, it was a programme designed to offer '*a tailored and flexible programme of training and support from design idea through to production'* [2] enabling makers to work closely with skilled technicians and intermediaries, such as the programme mentors.

The question of creative collaboration between makers (rather than with mentors and technicians) was raised at this initial stage, as applications were actively encouraged from designer-makers '*collaborating in groups of 2-4'* (Appendix 1.2). Two makers during questionnaire discussions suggested that this would be a positive benefit of the scheme, however during the general discussion, others were concerned about collaboration. Specific doubts were raised about the difficulty of negotiating collaborative outcomes that fitted with makers' existing ranges and about practical aspects of collaboration such as negotiating meetings and travelling. The most common concern mentioned overall was about makers' time constraints.

From these initial discussions and reflection a list of questions and issue statements was developed which contributed to the areas the researcher explored further, for example, in one-to-one interviews. It was expected that these would change as more 'emic' (Section 3.3.2) issues emerged.

[2] Making it Digital Information Sheet and Project timetable

Section 4.2: Data Collection and Interpretation Issues

Appendix 1 contains details of the MiD Programme including: a full timetable (Appendix 1.2), details of recruitment and data collection protocol (Appendix 1.4 and 1.5), interview questions (Appendix 1.6) and focus group questions (Appendix 1.7). The most important data sources were a series of transcripts of interviews conducted with eight MiD participants, between May and July 2008, and a transcript of a focus group conducted in October 2008. These were analysed alongside other data such as field notes of conversations and workshop observations, project documents and photographs.

The formal interviews were conversations with individuals, some of whom were using digital technologies within their making practice for the first time. They were engaged and motivated subjects, who considered the researcher as a potential colleague, certainly as an '*insider researcher'* (Section 3.4.2) to the group that they were working with on the Making it Digital programme. The relationship of the researcher to the interviewees was one of a degree of trust and ongoing involvement, the interviewees accepted the researcher as an integral member of the UCF research team within which the MiD programme was being jointly run.

4.2.1: Categorisation

Textual analysis was conducted on the transcripts of the one-to-one interviews and focus group discussion. This raised issues regarding how phrases and comments from makers should be categorised. Dey (2004) discusses the crucial interpretative transformation that occurs when categorisation of data takes place. He takes issue with the idea of an '*insistence that categories should be fitted to data rather than the other way round*' (Dey, 2004:87) that forms the basis of a simplistic reading of grounded theory methodology. Dey regards the idea that you can attribute a value-free category, which essentially just describes your data: the '*concept-indicator model'* as assuming a positivist epistemology. He argues that linguistic categories play a more active role, they are '*approximate and provisional and relative to the vagaries of experience*' (Dey, 2004:87) but nevertheless attach meaning to observations, by nature of being dependent '*on an underlying cognitive context that informs category judgement*'. Dey argues that studies of categorisation in other fields show how our own experiences, the role of metaphor and associations, make categorisation a personal and adaptable skill. In essence, you choose what to group together, under what concept and in doing so define what seems both similar to you, and what seems to be particular. Dey concludes:

'*In short, we are not detached observers who discover meaning through observation. Rather, we attach meanings to observations, in terms of specific contexts and particular purposes. Meaning is created, not 'discovered*' (Dey, 2004:88).

The researcher agrees with this account and recognises the interpretive nature of this analysis is from her own personal perspective as a craft practitioner. The researcher is also herself a cautious advocate of the use of new technologies and clearly this has a bearing on the research findings. The initial coding structure was developed as one the researcher found meaningful and useful, reflecting narratives she identified as emerging from data. It equally reflects the researcher's own interpretation of that data, from experiences and a perspective as an '*insider researcher'* within University College Falmouth. The researcher was concerned to return to the data as often as possible and give due prominence to the words from the participants themselves, but also acknowledges the active interpretive role she has played. This was through analysis of data by category creation, comparing categories, generating connections between categories and the generation of insight that seems to her meaningful and made sense of the available data. Dey discusses the role of abduction (in contrast to deduction - starting with a theory, making an observation and inferring a result - or induction - setting out a generalisable theory inferred from data). Abduction (first described by American pragmatist philosopher Charles Peirce) (Dey, 2004:91) can begin with either theory or data, it offers a 'plausible interpretation' rather than a 'logical conclusion'. Theory is used together with observation to produce a plausible new interpretation of a specific circumstance within a frame of reference, privileging neither data or theory. Dey describes this approach, of using your own perspective in concert with a close reading of the data, to reveal a way to look at a phenomenon, as 'recontextualization'.

'*In terms of 'grounded theory'…the process of 'coding' data can also be usefully considered as a process of recontextualization….For what is 'discovered' is not so much new facts as new ways of connecting them. Rather like the 'discovery' of America, what is discovered through recontextualization is not so much a new phenomenon per se as new meaning or interpretation*' (Dey, 2004:91).

The researcher aimed to reveal the specific narratives of this engagement with technology through a combination of textual analysis informed by grounded theory and by bringing to bear her own understanding of the issues, for example, gained from research conducted for the Critical and Contextual Review (Chapter 2) and her own making experiences. This is consistent with contemporary social science methodologies. Flyvbjerg, for example, considers that: '*Social science has not succeeded in producing general, context-independent theory and has thus in the final instance nothing else to offer than concrete, context-dependent knowledge. The case study is especially well suited to produce this knowledge*'. He goes on to quote Hans Eysenck as encouraging researchers to look at individual cases '*not in the hope of proving anything, but rather in the hope of learning something*' (Seale, 2007:392). This analysis is therefore specific to the programme under study and the researcher undertaking it, it is an attempt at a plausible explanation of the available data, as one element towards a better understanding of digital practice.

4.2.2: Transcription

A transcription protocol was followed based on advice that considers interviews to be a shared construction of an account (Silverman, 2006:109). Silverman believes that interviews should be seen as a '*local accomplishment'* (Silverman, 2006:138), that respondents tend to construct a coherent view which reflects the way that:

'*interviewees invoke a sense of social structure in order to assemble recognizably 'sensible' accounts which are adequate for the practical purposes at hand*' (Silverman, 2006:143).

The interview, then, is the 'reality', it is the 'topic' of the research and transcription must reflect this as closely as possible, for example, by including all the normal conversational errors which are not edited out or smoothed over. The researcher felt it was important to try and pick up the 'form' of the interview through a high level of transcription detail such as pauses, repetitions, turn-taking and repair strategies (Silverman, 2006:192) which emphasise the importance of the context of a quote, what was being said before, or asked, which are part of the actual occurrence and may reveal insight into content. Whilst the researcher was not concerned to conduct either Conversational or Discourse analysis, she recognises the specific methods employed in these techniques and was concerned to undertake all transcription herself, as accurately as possible. An established transcribing protocol was followed for denoting pauses, stresses, overlapping speech, placing words not clearly heard in brackets and so forth. (Silverman, 2006:399). Notes were also taken during the interview and referred to later, however, recorded and transcribed records were the primary source. Due to a technical failure one interview recording was lost before transcription. The researcher excluded this participant as it was felt that the notes taken did not offer substantial enough data collected in a similar way, to be comparable with other interviews. The researcher agrees with the viewpoint that the method of data collection fundamentally alters the data available for analysis, so much so that '*comparison reveals that tape recording and note taking emerge not simply as alternative techniques for achieving similar ends, but as really quite different ways of going about research*' (Murphy and Torrance, 1987:234).

4.2.3: Ethics and anonymity

Grounded theory studies are generally carried out on the basis of complete participant confidentiality. Participants are identified by numbers or made-up names. This posed a particular problem for this study because the participants were engaged in small-scale public programme aimed at producing new products that would attract publicity. Two issues quickly emerged: protecting participants' copyright and making sure they had the opportunity for feedback on their input and how it had been used.

The University of Arts London Research Ethics sub-Committee reviewed the researcher's consent forms and arrangements for gaining participants' consent. It was agreed that once transcripts had been made, participants would be sent the transcript and contact sheet of photos of their work and given the opportunity to amend any comments, be made aware of ways in which the research and photographs of their work may be used and published, and given the opportunity to comment or withdraw from the study. Participants were contacted in 2010 for their consent to use interview data as part of the final research. Seven of the eight participants agreed to the use of the interview data straight away, one asked for more details of the research. At this stage participants were asked about how MiD had impacted in the longer term on their practice, but no detailed information was received and longer-term follow-up falls outside the scope of this research.

Section 4.3: First coding scheme: emerging issues

Following a general grounded theory approach (Section 3.3.3) the first two interview transcripts were 'coded', quotes and phrases were assigned to category headings organised under themes. This initial coding scheme identified four 'themes' - large areas that data seemed to cover, and a fifth for reflection on what was absent in data. These themes emerged from trial and error in coding the first two interviews and other materials, but clearly follow the broad areas of questions in the interview template and focus group questions (Appendix 1.9). The scheme, at the thematic level, looked like this:

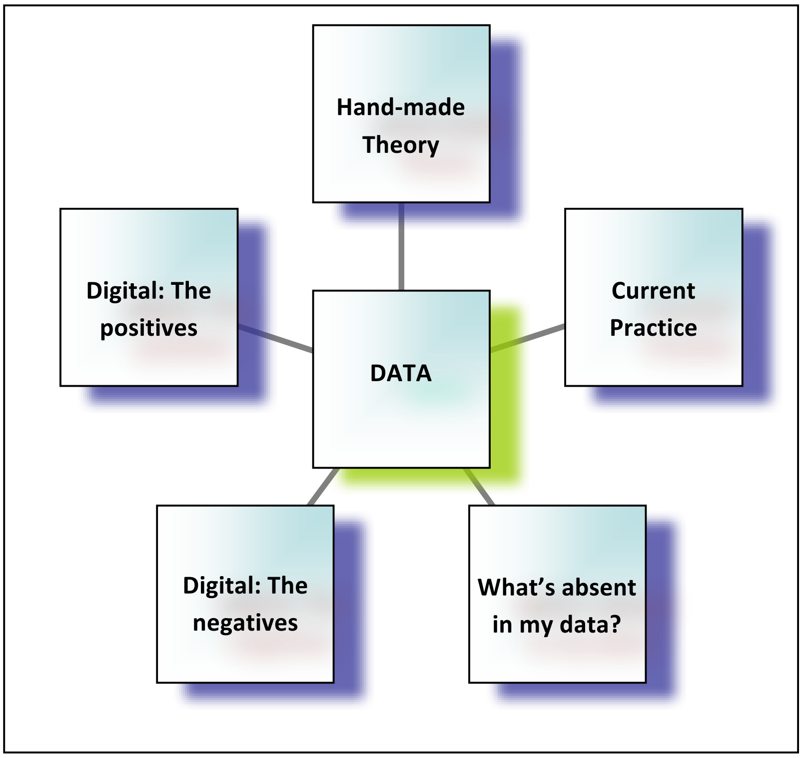


Figure 34: Early themes from data

This stage involved creating categories within these themes, as deposits for discrete quotes from transcribed interviews or a note of what was possibly felt to be missing. Analysis of the first two interviews and reflection on the emerging themes resulted in an initial ten categories, described below, included here as an indication of the process of coding and reflection entered into. This also demonstrates how the researcher's views interacted with data as some categories were created in anticipation of data and issues, as the comments below indicate. The figure next to each of the category headings below represents how many quotes (or other pieces of data) had been attributed to each category after the analysis. Quotes can be placed in more than one heading, and the number of quotes in each category demonstrates the multiplicity of data that can be generated from interviews, as a single comment often pertains to a number of issues. Each of these categories contained many subheadings which flexibly merged and emerged as coding took place. Analysis was aided by use of Nvivo8 software. It was selected as one of the leading software programs available for case study research, and is designed specifically to enable easy tracking of data and flexible analysis. The researcher was able to access it from within the resources of University College Falmouth. Each category below has a brief introductory comment on narratives the researcher felt were beginning to emerge from the data or she wished to explore, very much the kind of initial ideas that formed the basis of memos. These initial ten categories were:

4.3.1: Theme 1 – Current practice

Hard graft (20 quotes)

This category concerns comments made about the difficulty of making a living from craft and design micro business. Some of these makers are sole traders trying to conduct their business full-time but some are also engaged in a number of different part-time occupations, so called portfolio careers including four who are 'insiders' to UCF as currently or previously have had some involvement in teaching, administrative work or as a student. This would seem to reflect industry surveys that have identified part-time work and mixed careers (Section 2.1) (McAuley and Fillis, 2004, Creative & Cultural Skills, 2008).

Bricoleurs (24 quotes)

The idea of the Bricoleurs category is that evidence emerged that these makers are an innovative, flexible and resourceful group with a high level of commitment to their practice. This label was created for evidence that broadly related to their entrepreneurship, range of background and training, a sense of diversity and commitment to do what it takes. This is perhaps in opposition to the stereotype image of an esoteric, rather isolated figure, of a traditional craftsperson. This maybe a characteristic of these particular makers who have signed up for an innovative scheme. Bricolage, bricoleurs: '*A person (esp. an artist, writer, etc.) who constructs or creates something from a diverse range of materials or sources; the creator of a bricolage*' (OED, 2011b). This was an early indication of the sense of diversity of practice encountered even within a small group and the affinity of these makers with innovation and change.

Type of Current practice (six quotes)

A further category was created to record the titles with which interviewees described themselves and their practice, leading to a discussion of practice definitions and whether these makers saw themselves as 'designers' 'craftspeople' 'designer-makers' or in some other way.

4.3.2: Theme 2 – Digital: the positives

Digital nirvana, the promised dream (20 quotes)

This category holds quotes from interviews that in any way describe broadly positive comments about the use of digital tools for making. It was quickly subdivided into two areas that seemed distinct, the myth and the reality (both still positive). On the whole, these comments seem to be aspirational and a bit vague (less concrete than the negative comments) but this, in part, may reflect the early stage of the MiD programme of these two interviews. There is enormous enthusiasm for the potential, and a sense of freedom from everyday work pressures.

Real digital: what are its strengths (nine quotes)

This category holds evidence of specific advantages that makers identified with digital working practices and was subdivided into four categories of advantages that emerged for objects, people, process and businesses. If a maker identified a particular advantage that using a technology had given them, it was coded here. There seemed to be an early emphasis on the new object possibilities and the speed of design development made possible by these technologies.

4.3.3: Theme 3 – Digital: the negatives

Disappointed expectations (17 quotes)

This category aims to identify disappointments and frustrations. The difficulty of negotiating a coding scheme that hovers between what is in the data directly in front of you and what you know to be in the data as a whole (and your own ideas) is apparent here. Some sub-categories were created in advance of data because the researcher was looking for evidence around an issue, such as access, for example. A dynamic and flexible approach meant that initial categories were merged, renamed, deleted or moved as coding progressed. The makers' disappointments seem to the researcher to be expressed in concrete and tangible form and about specific problems they have encountered.

Access: the big issue (0)

The separate category of 'access - the big issue' was created because the researcher anticipated a lot of data relating to this, based on the initial informal launch day discussions and her own practice research. The eventual wording of the category came from a later focus group comment, issues around access tended to come to the fore towards the end of the programme.

4.3.4: Theme 4 – Hand-made theory

Craft values, design processes (15 quotes)

This category represented emerging ideas about the relative merits of hand and machine made objects, a sense of what machines were good at and what humans were good at, which for these makers depends on a pragmatic judgment in context of the specific piece of work. There was an emphasis on the appropriateness of the technology for the desired outcome (reflected in later professional interviews Section 6.0). An initial reading of some data would appear to suggest that the space that this project offers makers is one between craft and design, for example, bringing craft values, such as customisation, identity of the maker in the object, fine detail and creative product differentiation, to the slow process of design product prototyping. Some makers want to develop a product design (that could then be taken on by a manufacturer) or are thinking about developing a way to manufacture parts (that can be assembled by hand).

What counts as 'hand-made' (18 quotes)

This category contains comments about what makers think about the concept of hand-made work and what they think their customers think. The two initial interviews pointed towards a degree of lack of coherence on this subject and some confusion about customers' expectations. For some customers, hand-made value may be embodied in work and nature of the object-making process, while makers may be more concerned with issues such as how well the object reflects their design ideas, identity and a good quality of finish. The researcher noted a question to herself regarding the meaning of 'hand-made'.

4.3.5: Theme 5 – What's absent in my data?

What's been othered: the literal loss of concern for the hand. (one quote)

This last category represented the researcher's concern to think about, from the outset, what's not emerging from data, important issues that seemed absent. From initial reflection, one area appeared to be a lack of concern for the loss of the physicality of making, of repeated craft process. These were makers who had chosen this programme and many regarded themselves, in some contexts, as designers rather than craftspeople. However, they still engaged in a lot of hand-making for design prototypes. The researcher was surprised, however, that no one seems to voice concern that machines may not be for them, that they have found they don't like working that way, or to regret that the technology separates them somewhat from materials. These makers seem able to maintain that sense of close engagement with making from design, machine experiment, handling and inspecting material outcomes, discussing options and so forth, rather than needing an absolutely focused physical involvement with repeated process.

This was an initial scheme and, as was expected, it changed as more interviews were transcribed and coded. As the additional interviews and the focus group were coded, the above scheme was re-designed. The researcher was able to reflect on how makers' concerns linked together and what patterns were emerging between issues. A strong sense of issues around types of collective engagement emerged, a theme and categories for '*types of working with'* were created to chart, from existing practice and the MiD programme, different types of collaborations from working with retailers, manufacturers and external organisations to creative and technology partnerships.

A series of analytical techniques was employed, such as writing up a digest of the main issues in each case and what aspects seemed to strike the researcher as important. Cases were looked at in pairs to consider similarities, but particularly differences. Quotes were re-assigned to new categories, tables and diagrams were made to identify and develop ideas. The point of cross-case searching tactics is to attempt to reveal a theory that is a good fit with data but goes beyond initial assumptions (Huberman and Miles, 2002:19). The aim is the constant comparison of theory with data, as theory emerges. A number of simple techniques, made easier through the Nvivo8 software, were employed to identify patterns. These included: using the text search facility and word frequency queries; looking for key words such as collaboration or comparing the frequency of references to craft and design; interrogating cross-coding patterns; highlighting text; annotating interviews; writing speculative memos and the diagrammatic re-working of codes. These are all methods that are common ways to organise data within qualitative analysis, whether or not a computer is employed (Riley, 1990:29-72). They resulted, for example, in the 'word clouds' shown in Section 4.6.3:172-173.

The researcher found that a combination of computer-based coding and hand written analysis on printed transcripts and card summaries was necessary to gain an overall picture. For example, a word search for the term 'access' was accurate in that it picked up five interviews in which this term was specifically mentioned in discussion, but not another case where a discussion of the desire to use a specific piece of equipment as part of the motivation for joining the programme didn't happen to use this word. Some terms that the researcher has used as central explanations were not the wording used by respondents, the term hybrid, for example, only appears once in interviews, but many terms indicating hybridity such as collaboration, crossover, combination, mix, relationship and layering are common in the interviews.

4.3.6: Final coding scheme: developing an overall narrative

The coding scheme was adapted as further interviews were coded and analysed. It resolved into a mixture of original categories and a new set of categories that described connections that emerged between respondents' interviews and common digital potentials identified. These new categories included: 'types of 'working with', hybrid practice, hybrid objects, engagement/dis-engagement, bespoke, prototyping, data transfer, traditional/digital crossovers and skill leverage'. The core category of 'negotiated collective engagement' emerged from a further reflection on, and distillation of, the evidence based on working through thinking about the common themes in some of the biggest categories of quotes such as 'change', 'digital potentials' and 'craft values'. The researcher felt that the common narrative to emerge from data collected about these individuals engaged in this knowledge transfer project was one of *taking an opportunity for change to their practice by working in creative and technical partnerships aimed towards hybrid object and practice outcomes*.

Section 4.4: Further Analysis: Overview

The diagram below was developed as a visual map of the overall pattern of data. It suggests a movement from entrepreneurial, engaged 'intelligent making' through collective engagement with digital technologies, knowledge networks and skills towards outcomes in the five key areas of digital potential identified by these makers: creating digital bespoke objects, craft prototyping for manufacture, using digital data creatively, the creative potential of digital and craft crossover objects, and leveraging skills through technology use. This dynamic of digital practice, in relation to craft values and the areas of digital potential identified, is explored in more detail in the Further Analysis below (Sections 4.4 to 4.6).

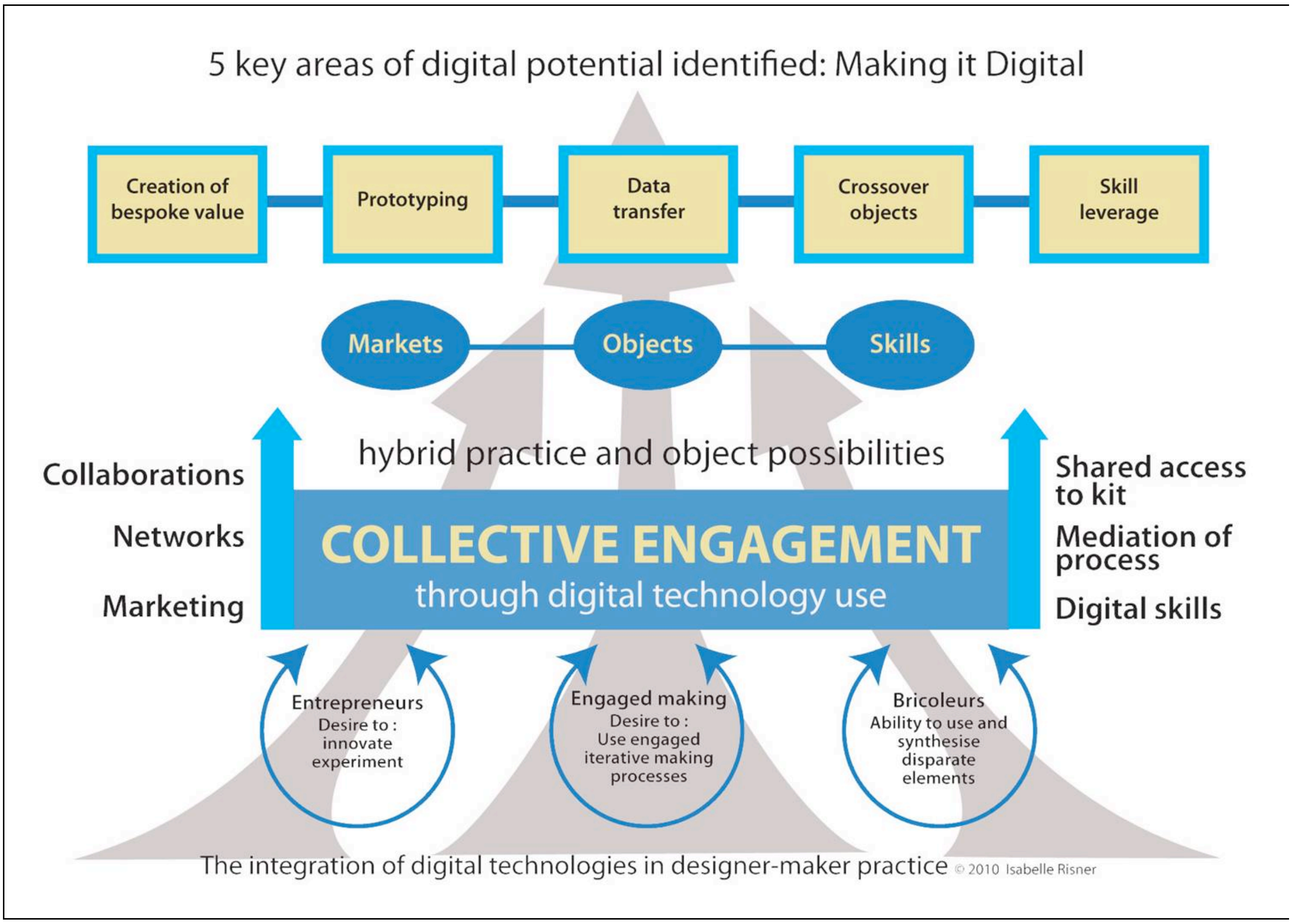


Figure 35: Collective engagement as the central dynamic of the Making it Digital project.

Section 4.5: Further Analysis: Existing Practice

4.5.1: Practice definitions

After an initial discussion about their background and training, each participant was asked how, in terms of their own practice, they would describe themselves to someone who didn't know much about their work. No two participants gave exactly the same response, although two did have 'product designer' as at least one part of their self description. In total, 13 different titles were mentioned. In all eight cases the word 'design' or 'designer' figured as part of the description, in half, the word 'maker' figured in some way. The most common approach was a specific product, process or material-related two-part description such as jewellery maker, product designer, embroidery designer, furniture designer-maker, textile designer, surface designer. The specificity and multiplicity of terms in itself suggests a clearly differentiated identity in each case, but an identity that can be altered depending on context. The prevalence of 'designer' may relate to the MiD programme being a new product design opportunity, and may also reflect 'designer' having a higher cultural status than 'maker' (Section 2.1). Only one participant described themselves as a 'craft' maker, and this was in conjunction with an alternative description as product designer for some areas of his work. One person suggested 'artist', again in conjunction with more specific terms. The generic term 'designer-maker' was used by one person and when suggested by the researcher as a possible term was deemed somewhat appropriate in three other cases, but also received several lukewarm responses. At the product design end of the spectrum the term was unnecessary, two participants saw themselves clearly as 'product designer' and 'designer' with no alternative titles offered, whilst another participant, whose work mainly involved bespoke commissioned pieces, saw 'designer-maker' as too product-orientated:

'No, I wouldn't say I'm a designer-maker… even though I design and make, for me I think a designer-maker is someone who does more of the product in a way, so he is a maker that makes product...' (Participant 8).

For another participant, designer-maker was just a bit old fashioned:

'I find that a bit of a sort of, I don't know... it's a bit nineties or whatever or 2000, I don't know, it's like 'partner' it's the equivalent of partner, (laughs) you know what I mean? slightly cheesy but probably appropriate you know' (Participant 1).

The diversity of practice represented, and the way that many of the participants use more than one term, and terms having a dual element, suggests a pre-existing cross-disciplinary and flexible approach to titles based on context rather than fixed definitions. It reflects some traditional specialisms but is also one indication of the hybrid nature of practice that has been established within a particular niche (for most participants there are at least two elements involved, one of which is design), it is testament to an adaptable attitude and a breadth of experience amongst this group. In terms of title, they are held together most strongly by 'design' but there is no clearly agreed generic term for what they do. This sense of self-determination extended to a strong sense of self-direction and multiple roles:

'pretty much everything I do is self-directed' (Participant 2).

'some making that I do is very craft orientated and it's all about hand-making and then other things that I do are very much about me making one object as a prototype and then finding... manufacturing processes, batch production processes that make it for me' (Participant 6).

Despite 'design' figuring more prominently than 'making' in self-descriptions, all of the participants were actively involved in making and selling work for a part or all of their income. Again they ranged from sole traders working in their practice full-time and selling through retail outlets, craft fairs and galleries to participants who undertook bespoke commissions alongside other employment. The self professed product designers tended to see the actual manufacture of finished goods for sale as a rather separate concern, a valued activity carried out by those more skilled at making than themselves:

'*I'm a designer... I wouldn't describe myself as a maker umm.. I do make things but I also outsource other makers to do certain things that I wouldn't tend to spend... because I feel that if I was going to be a maker I'd have to spend a lot of time building those skills in that thing and that's not what I want to do... I like the designing part I'm not so keen on the making part'* (Participant 3).

'anything that I do make I find that I can get somebody else to make for me much cheaper and much better…so that's generally what I do' (Participant 2).

4.5.2: Engagement in making

Despite the most design-orientated participants standing aside from the physical construction of their goods to some degree, all the participants were involved in hand-making, even if only for specific products where it was felt appropriate, or for models and prototypes. A sense of engagement with making and with materials and skills was very apparent in most cases, with discussions often slightly sidetracked by detailed descriptions of processes, products or materials that individuals were currently using in their practice. This ranged from enthusiasm voiced for tools (jacquard loom) techniques (stitch, dovetailing and illustration) or materials (wood, resin). The term 'engagement' was used several times and there was abundant evidence of participants being knowledgeable and closely involved with process and materials:

'I understand my materials, I understand my yarns, I understand the fabric construction and I understand…its potential' (Participant 8).

'if it's lovingly handcrafted dovetails and it's got that finish line down on the edge of the dovetails and it's crafted in... either oak or a contrasting timber that's structurally sound... and

it runs just beautifully and it's got the minimum of gap around it and it push it shut and there's just this little (hssh)... you're there... do you know what I mean?' (Participant 5).

Most participants possessed a depth of making skill associated with a main material or tool they used in their current practice that had been gained over a number of years of formal and informal training and workshop experience. This high level of training and experience included three who had studied at the Royal College of Art to a postgraduate level while others had pursued specialist training through other routes. However, half this group had chosen to pursue projects that were not in the main material they usually worked with, perhaps as part of a collaborative experiment. Some brought their traditional expert making skills to bear on the project work directly, by making a hybrid object. Most, however, chose to bring material and artistic sensibilities and knowledge to the project from their previous experience, but not draw directly on their core expert making specialism, whether this was resin casting, ceramics, wood turning, weaving or embroidery. This underlines the sense of working with digital technologies being seen as an opportunity to try out new possibilities and move participants' practice forward.

4.5.3: Repetition: Over and Over again

The sense of engagement, commitment to and expertise in making was tempered by the degree to which these makers were generally concerned not to find themselves solely working within a repetitive narrow making practice. This was a common sentiment and was expressed by almost all participants in strikingly similar ways:

'whether I am actually interested in repeating this thing over and over again.. .no, I don't actually...so that's a clear limitation... in terms of growth' (Participant 6).

'I also...the other thing is I don't like too much repetition.... so I don't want to be actually... making the same thing over and over again because for me the interest is the imagery' (Participant 7).

The space that this programme seemed to offer them was, to some extent, about providing an area within participants' practice for more experimental design-based exploration. Many participants were very comfortable with a 'portfolio' working arrangement where several elements were combined and a series of time-limited projects and opportunities pursued. The MiD programme fitted within that framework.

4.5.4: Innovation

A dislike of repetitive practice was matched by a desire to be involved in new initiatives. These are, of course, individuals that were attracted to an innovative project using digital tools, so they are clearly entrepreneurial. It is striking that they seem drawn to high quality engaged making processes (which may traditionally be associated with craft and repetitive practice) which was apparent from the conversations around material sensitivity and quality (Section 4.4.3), however, they are also drawn to innovation in practice and products:

'I'm fascinated by new techniques I'm fascinated by materials, I'm fascinated by new stuff… (that is) part of me getting as far as I have done' (Participant 1).

'So, I don't want to be doing the same thing, I want to be doing different things, I like building up my skills and taking things from different directions and just seeing what is possible …getting that sorted and then moving on to something else' (Participant 2).

Section 4.6: Further Analysis: Hand-made value

4.6.1: The value of the one-off

The meaning of craft values in relation to digital technologies is a central concern of this study (Section 2.2) and the researcher took the opportunity to explore this theme with the makers interviewed. The researcher particularly wanted to explore how participants' views on making processes co-related to their views of the 'hand-made' or 'crafted' object. All the participants were asked about the value they saw in hand-made objects and particularly a discussion around what counts as 'crafted' was engendered through presenting an image of a bowl made by craft theorist and practitioner David Pye, apparently crafted, that nevertheless had been made through assistance by a guided tool system, rather than completely free hand. The participants were asked if their view of the piece altered with the knowledge that it was made via Pye's 'fluting engine'. All the participants initial reaction was no, it didn't affect their view of the piece, which was generally positive, it was a piece they liked. There was a general sense that hand-made was not a literal term, that *appropriate* machine-use was fine and didn't compromise the craft status of an object. When asked what they thought 'crafted' meant, particularly for customers, all eight suggested that 'uncommonness' in some form, expressed as uniqueness, exclusivity, one-offs or small numbers, played a fundamental role (see conclusion Section 4.6.3).

[Researcher: Would you consider that was a crafted piece?]
'It depends... if I saw five of them next to each other then I wouldn't' (Participant 3).

'I think.... it's sheer numbers of object that were made.... I think that's a clear component of a crafted object that there's a uniqueness about it ... um... it's not a mass produced object there aren't ten thousand of them… there's a limited number of them' (Participant 6).

This small sample of makers suggested that a combination of qualities constituted a crafted object, and 'uncommonness' expressed in many ways, was one crucial element. Issues such as quality, identity of the maker, time invested in the piece, maker's skills or the complexity of the object, were also part of the mix (see conclusion below: Section 4.6.3). Some issues were mentioned but qualified as not being enough on their own. For example, one participant felt that time taken to make work didn't automatically confer value. Other issues were not always reliable indicators, quality was a word that recurred frequently throughout the interviews but wasn't considered exclusive to crafted objects:

'quality is always appropriate... always... that's a constant....there is no reason why anything shouldn't be good quality but quality doesn't necessarily mean craft as well' (Participant 3).

'well, you know, my things are laser cut ...it's much higher quality than it would be if I'd cut it by hand and what would be the point of cutting it by hand?' (Participant 2).

The judgement seemed to be about a detailed assessment of a range of elements and associations that the object may possess. Ultimately, the use of machinery or digital tools would not necessarily rule a product out from being considered crafted or even hand-made but equally the kind of qualities needed might be hard to get from a machine aesthetic.

'quality I think is one thing... it's got to be... you know it isn't mass manufactured... it is considered and it's still kind of made with passion and it's made with curiosity... whether that's from how you are using the digital technologies or how you are making something by hand' (Participant 4).

'I do believe that you know... using the tools… using the digital tools is also doing it by hand... I suppose... you know… craft has just moved on' (Participant 7).

'you know any of the digital stuff even if I'm assembling it here it's still.. it would go in a hand-made show, it's still part of hand-made' (Participant 1).

One participant felt that complexity was easier to achieve by hand:

'usually it can have more complexity, more layers, more thought, more this, more that, it's not that it reflects our personality it's just that humans as machines are more sophisticated machines than machines are a lot of the time' (Participant 1).

Though machined products could be 'craft', there was a difference if a product had been designed to be rationalised for manufacturing. The participants with experience in industrial design saw a clear distinction in products that had been specifically designed for efficient manufacture in their use of materials or processes, rather than something lovingly created with a hand-crafted character and detail in mind.

'*I also outsource to manufacturers, so I get things machined and a lot of my products are designed for machine really... to be machined rather than to be hand-made... I go hand-made when I want the piece to have a certain quality'* (Participant 3).

'Because it's one thing that an industrial process tends to... there's a rationalisation (for) material... not a love of material I think....' (Participant 6).

Craft, for participants then, generally meant unique or small numbers of 'considered' objects that demonstrated a complex mix of qualities ranging from makers' identity to skill, time and knowledge, 'special' objects in the sense that they were uncommon in many ways but that could certainly be made through the use of appropriate technology and machines.

4.6.2: Customer expectations

These makers all had experience of direct selling of their products, whether manufactured or hand-made, and were asked whether their customers '*asked if pieces were hand-made or* *crafted'*. The general response suggested that some customers showed knowledge and interest while for others the making process was less important. Customer expectations of craft and hand-made objects were often viewed as diverse, and several makers expressed some degree of uncertainty about what customers thought, it appears there was no clear single expectation.

'it's a double thing...some people are very excited that what they are getting is done digitally…it's a one-off even though it could be mass produced.. they're interested in that digital process... others are thinking well if it's done by the machine it's not really....so you've got to gauge it' (Participant 8).

''is it hand-made?'...there's a confusion in my own mind...but I attempt to find the actual meaning of what they are trying to say by 'is it hand-made?'... if there's only one, if I was standing there as it was being made, if I was controlling what it is as an object then in some senses it is hand-made because it was made by my head...the root of the question is about how connected you were to the object during its making' (Participant 6).

'I don't know actually... I think it varies from person to person.... I think if you said handcrafted to somebody, to one individual they are going to think that you have painstakingly sat there with a plane and planed every piece whereas if you said handcrafted to another person... they are going to think yeah... he's done exactly what I've just spoken about...he's used his machinery... he's a craftsman .. he's designed and made it... it's a one-off piece' (Participant 5).

Makers generally agreed that hand-made was not interpreted literally by their customers, as it was not by themselves, commonly the most important element for customers seemed to be a close association of the product with an individual maker. This was expressed by a number of participants:

'the people..that came said that what they just enjoyed was seeing the person that has made their work' (Participant 7).

The research seemed to suggest that customers were looking for a sense of the maker's identity vested in the object, but that this 'authorship' could be provided in a number of ways, ranging from the object having been physically entirely made by hand to its making having been controlled and orchestrated by the maker.

4.6.3: Conclusion to hand-made value

The diagrams below are a visual representation of the frequency of individual words and phrases, that makers used in interviews when talking about what they saw as craft values, both for the meaning of craft for themselves and for customers. The bolder the word, the more times it was mentioned, the word 'quality' for example was mentioned most frequently.

Figure 36: Word frequency: skill and material, quality, time and effort.

These 'word clouds' have been categorised into seven groups: skill and material, quality, time and effort (above) craft aesthetics, maker's identity and uncommonness (next page). There is also a diagram for phrases that were used to describe craft 'in distinction to', (for example, in distinction to mass production: '*not run of the mill'*), underlying the persistence of craft seen in distinction to industrialisation (Section 2.4). For the researcher, these word clouds demonstrate the wide variety of terms that are associated with craft and the breadth of ideas contained within the concept, even among eight individual makers. Key elements of craft for these makers are: a skilled, engaged, difficult process, uncommon objects, maker's identity and beauty.

In terms of the indicators of skill within digital craft work that the researcher has chosen to highlight (Section 2.3.4), as ways to gauge the retention of craft value, these concepts map well onto the three indicators chosen. The retention of the '*risk of failure'* is reflected in terms that refer to process, such as: quality; complexity; effort; time; detail and '*not easily achieved'*. '*Uncommonness*' is reflected in the terms associated with uniqueness. The '*creative use of skills*' is present in the sense of authorship, reflected in the terms associated with the maker's identity, and development of an individual skilled process and beauty. Innovation and newness doesn't appear in the craft associations listed above but is fundamental to the digital proposition, to the ability to leverage skills and to the 'otherwise unobtainable' creative impulse that is one source of attraction of digital practice for makers (Section 2.3.2).

Figure 37: Word frequency; aesthetics, maker's identity and uncommonness

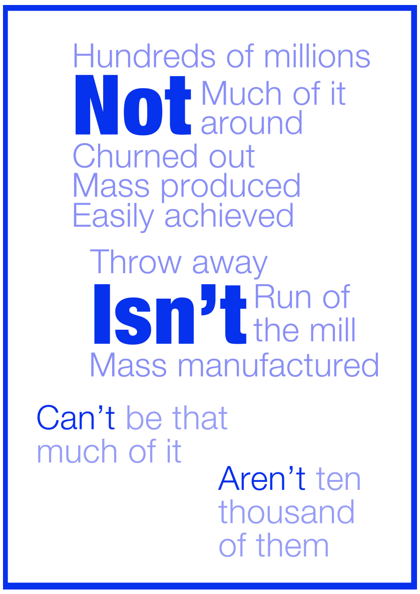


Figure 38: Word frequency, craft isn't...

For these makers, then, there is a recognition of added value for customers, for example, of 'uncommonness', in a variety of forms, and the maker's identity being vested in the object. One possible motivation for the use of digital tools would seem to be finding a way to provide customers with value (whether design or craft value) that doesn't require the maker's practice to be restricted to repeatedly making a variation of the same object. Traditional hand-making craft practices would seek to provide the value of uniqueness through very small variations within a depth of hand-making practice that is narrowly focused. The value of the hand-made would rest in uniqueness but also in the years of skill built-up continually honing a particular process, resulting in finely tuned products that demonstrate the making skill of the individual maker (Section 2.2). The MiD participants, however, were from a variety of backgrounds, often cross-disciplinary practice or design and were keen to pursue a number of options within their making. On the whole, they did not want to have a narrowly focused making practice, at least not for all of their work. Most of these makers do possess a high level of specialist making skills but in the context of the MiD programme and their practice, other values, such as 'innovation' and 'creativity', are also a focus. Digital practice offers the possibility of providing high quality objects and uniqueness to the customer in other ways, for example, through bespoke objects and customised variations. This may offer customers personalised objects that are partly achieved through digital file changes and this was an aspiration for some makers. A business model that prototyped products for licence by manufacturers, as an element of practice, was also a popular possibility among this group; this offers makers the engagement of making a high quality prototype, that can then be taken forward in collaboration with business. In a sense, by taking a desire for customers to have values such as 'uncommonness' and 'maker's identity' closely associated with craft objects and 'innovation in product' and 'prototyping' more associated with design, makers can forge a new, perhaps small part of their practice that has hybridised desirable elements for customers and makers from both disciplines. The researcher concluded that one element of exploration for makers provided by this project was exploring a space between craft and design (Risner, 2010). In relation to the research question; *what is the impact of using digital technologies on designer-maker practice?*, this research element demonstrated that digital technology use can broaden the practice options open to makers. This is further explored below.

Section 4.7: Further Analysis: Digital practice

All of the participants were asked about their aspirations and the potential they foresaw for their practice in using digital tools. The researcher analysed and compared results and developed five categories of digital potential identified by makers. Each is an expression of hybridity - the bringing together of different elements - either hybrid business opportunities, hybrid objects or combining skills.

4.7.1: Digital possibilities: 1. Digital Bespoke

The possibility for this type of business model, in which a high quality object could be developed and then personalised through digital manufacture, was fairly widely seen as part of a range of digital affordances by a number of respondents, even with very limited digital experience. The possibilities for bespoke objects were mentioned by a number of participants. Several projects were aimed at exploring this possibility.

'I think it's the possibilities for unique objects…a kind of mass customisation... you know it will run it ten thousand times or it will run it one time.... it doesn't really matter to the piece of equipment so that's a really kind of engaging and interesting component of what the equipment is' (Participant 6).

'I think it allows people to have something that's personal to them' (Participant 3).

'that's it… if we can get the process down then it can be offered as a bespoke service' (Participant 5).

4.7.2: Digital possibilities: 2. Crafting Prototypes

Prototyping and licensing was also a popular possibility, mentioned by a number of participants, in many different guises, and was often associated with a desire for a new element of practice. At the focus group, conducted in October 2008, during a progress day held towards the end of the programme, there was a discussion on the possibilities for prototyping and the degree of engagement in process required to make it work. For several of the participants, the promise of an element of practice that was capable of producing high quality individual designed objects, work they were proud of and identified with but were not individually made, was an attractive prospect.

'it's about having a relationship with suppliers... basically that means you're having a relationship with the machine that those suppliers are using' (Focus group discussion).

*'you **are** part of the process and then once you've got it right you can stand away and you know that's it's gonna be doing exactly what you want every single time... but you have to know the (limitations) of the machine before you get what you want'* (Focus group discussion).

'If I could have a process where my design ideas...I could spend more time designing and less time as the machine...if the machine could be the machine and I could be the designer and then someone else assembles and then we sell' (Participant 1).

'you could make work that is less in a designer-maker way and more in a designer way so that's very interesting. It also means that you could send the work off to manufacturers and get it mass produced so you detach yourself which is again good because that could become something else a different line of work to what you would do' (Participant 8).

4.7.3: Digital possibilities: 3. Data Transfer

Hybrid object possibilities were also an apparent and exciting opportunity for participants. Many of the projects undertaken were made possible by the ease of digital data manipulation such as rescaling, image manipulation and the incorporation of novel data (Section 2.4.6). These makers understood that the inherent potential of digital tools, for data transfer and file sharing, opened up possibilities for incorporating digital information sources into design, working via email and the potential, for example, for remote manufacture. There was also a sense that as new possibilities came into view, this could lead to further work.

'again using…information and transferring it.... not transferring it exactly .. but what I was trying to do was use… design data and combine it with the milling machine but create a relief surface' (Participant 8).

'things you might not have thought of in the first place…it takes you with it…it feeds itself…' (Focus group discussion).

4.7.4: Digital possibilities: 4. Crossover objects

Creative combinations playing on a traditional aesthetic (often a craft aesthetic) but giving an object contemporary relevance through a digital technique are a particular observed strength of the objects created. The potential to give objects a direct contemporary relevance by exposing the *idea-space* (Section 2.4.6) of a craft (weaving, furniture making, jewellery making) to a digital re-working through laser cutting, engraving or CNC milling, perhaps from data transferred into a machineable form, is an approach evident in several of the projects.

'it combines your existing skills… with a different element that transforms it from something into something else... you haven't lost the original skills that you've got'
' That's it .. it's a complete cross over isn't it…' (Focus group discussion).

'but it's still about how best to get the kind of narrative on furniture, because there's... to try and do something …it's kind of a mix really of both.' (Participant 7).

4.7.5: Digital possibilities: 5. Skill leverage

The final sense of hybrid practice that emerged as a strong positive for participants was in the skill leverage potential of digital machines. This digital equipment was made available through project mentors and skilled operators. 3D CAD modeling was a skill possessed by two of the participants, and these same two participants had fairly extensive experience with relevant software programs and technical machine capabilities. They were able to operate machinery with the advice and guidance of technical staff. However, for most participants access to equipment was only possible in the company, and under the direct control, of a skilled operator (usually their project mentor) who had extensive experience and carried out machining tasks alongside the maker, taking on board decisions and possibilities suggested as work was undertaken. Mentors, for example, took a substantial role in preparing files for machining. The question of access to digital equipment is therefore bound up with the question of access to the skills needed to operate it. The digital equipment has embedded knowledge and skill and skilled technical support and help was available. Together these provide accessibility to making skills that considerably extended, in combination, the skill available to each individual maker, from their own resources. The ability to leverage these skills for the benefit of their project was a clear area of interest for makers, and particularly appreciated in relation to their knowledge of the difficulty of building-up hand-making skills.

'when you see something working...you think, God, it's not actually that difficult to engrave an illustration on wood - you know...' (Focus group discussion).

'I think we have all made stuff that's just not possible without the machinery... that bowl unless I was like a master craftsman with a wood chisel I would never have made that design and your engraving and etching unless you are master with a little... tool... I mean you can do things that are not possible otherwise...' (Focus group discussion).

Section 4.8: Further Analysis: The Central Dynamic

4.8.1: Negotiated collective engagement

'the collaboration part is very important because when I do my own work I would normally not think about product or would think about my work in a very specific way but collaborating with people means that you get a different sense of perspective' (Participant 8).

The core category which the researcher developed to integrate and offer some explanation of how making and digital processes knit together and extended practice, within the analysis of the MiD programme, was named by the researcher as 'negotiated collective engagement'. This category permeates the MiD programme. It describes how participants, both in the digital technology making experiences they had before MiD, within the programme and in their aspirations for their future work, orchestrated collective engagement. This means initiating, developing and nurturing collective working arrangements that enabled them to enlarge and re-define a new hybrid practice space to occupy. The working arrangements that makers had negotiated for themselves were both individual and diverse, but at least ten different types of collaborative partnerships were identified in the interview data. One type, for example, is an equal creative collaboration between two makers in the same or similar fields, based on mutual respect for work and sharing ideas, there were examples of this type of collaboration. There were also collaborative partnerships based on cross-disciplinary working, for example, an illustrator collaborating with two designers and thereby gaining access to a design understanding of prototyping:

'at the end of the day when you do furniture you know... because they are from a design background and I'm not....you know on my course you're encouraged to make everything... but they're from a background where you know you make the first one at least...or you do a prototype…and then it's manufactured out...' (Participant 7)

Other participants were ostensibly working as individual makers but were, in essence, in some degree of collaborative partnership with technical staff and project mentors, and there was a recognition that access to making capabilities meant more than just access to equipment, it depended on good working relationships.

'my first prototype would have to be through a working relationship with A (technician),or somebody.... he knows me, I know him, he knows the files I email them over and he cuts them... you know that's my first step of manufacturing....[yeah, I think that's doable]…and then in the future see how that works' (Focus group discussion).

The extension to practice, through negotiated collective engagement, included partnerships that were also envisaged with external organisations, clients and customers, bureaux and retailers or craft support organisations. Makers were thinking about the creation of collaborative value chains, a key part of the digital creative industry proposition outlined above (Section 2.5). Participation in the MiD scheme had followed from an opportunity put forward by the designer-maker support organisation Hidden Art, and participants talked about many ways that they had extended their practice by taking up such opportunities and working with other parties in the past. Their experience of working in a collaborative way was brought to bear on the digital making collaborative possibilities. One, for example, had experience of working with customers on bespoke furniture and was interested in doing a bespoke range using digital manufacturing technologies. Another took their experience of a previous marketing and licensing collaboration with a major retailer, and experience of using a bureau for manufacturing elements of work, forward into their thinking about the type of remote digital manufacture, licensing and marketing agreements that might be possible. Some participants were well used to sourcing materials and even making processes remotely.

'an online database of manufacturers in the UK and you just put in what you are looking for' (Participant 2).

In relation to the research question, what is the impact of using digital technologies on designer-maker practice? the researcher concluded that broadening of practice options was accompanied by the need to invest in building new relationships and professional development of the skills needed to work collaboratively. The use of digital technologies means investing time and money in complex and sometimes difficult to negotiate working practices that involve extra-studio skills, partnerships and equipment.

4.8.2: Participant feedback

A central discussion within the focus group concerned the extent to which there was a gap between the perception of what digital tools could do and the reality of using them. There was general agreement within the focus group that the process was going to be quicker and easier than it had actually turned out to be. There were a variety of reasons for this, for example process problems with materials warping or being unsuitable, refinements of tooling and digital programme limitations. Some participants voiced the idea that, in the end, mistakes and problems had helped them to engage and learn. However, when the researcher asked for a show of hands '*if the reality didn't quite meet your expectations*'; three makers agreed.

'I thought it was going to be a smoother and easier process... I didn't realise it was going to have that whole archaic 'but this file isn't compatible with that file and that won't do…' (Participant 1).

Concerns and problems with the difficulties of accessing equipment that is in high demand and not dedicated solely for their use, even within this well supported programme, were common:

'the accessibility...how easy it is to get on and off the site and use the machinery and the technology when you need to... that for me that was a really big issue ...' (Focus group discussion).

'because for prototyping you need several goes…[yeah] …and even with access... working round the students and all that... just on that, that has been difficult...' (Focus group discussion).

On the whole this group was enthusiastic, and particular positive impressions discussed included the immediacy of results and the space for reflection and learning created within very busy practice lives. In general, the enthusiasm for the speed of results could be partly accounted for by the separation of 'design time' spent on creating digital machining files on computer from actual machining time, which perhaps meant there was a stronger impression of speed of process, than reality. Several participants, however, voiced the opinion that the process was gratifyingly quick compared to their normal making process, so for engaged craft makers there was an apparent speed. There was also a sense from several participants that valuable experience could be taken forward into their practice.

'actually it's the immediacy of it … in the normal way of working it might take weeks before you've got … the way I design I'd do sketches and then I'd do lots of kind of really painstaking model making and it takes a long time…from that to a tangible object' (Focus group comment).

'Yeah, definitely. I'd certainly use it again in my practice - I would set out to design something using digital technology...' (Focus group discussion).

'the next time I need some routing done that is just a little bit more specific than just 2D cutting I'll be able to understand how it works, therefore I'll be able to describe what I want better you know... so that's...initially that's fantastic' (Participant 3).

These makers, however, commented on how access within a university setting was different from a purely commercial relationship.

'Yeah it's like being back at college in a sense... it's taking me back and making me think about how I can produce… as a business person you don't have time to do that...' (Participant 5).

Not all the data revealed positive feedback. There were many more specific disadvantages and problems mentioned. Particularly within the focus group session at the end of the programme where participants were asked to write down a series of good and bad impressions. On the negative side, which is where the discussion began, specific problems mentioned concerned the difficulty in transferring the experience gained from the programme, carried out within a research environment, forward into a business context. Particular points raised concerned the lack of comparability of pricing structures, technology access, and the gap between expectation and reality, particularly in terms of machine limitations.

'This programme has been pretty divorced from the real world... I mean I have no idea what their costs are here but if I was going to do this with an outside manufacturer then I'd always (increase) what their costs are anyway' (Focus group discussion).

More general concerns included incompatible software programs, difficulty in finding time away from their own business, having to book machine time and lose continuity, having to spend money on product development, difficulties in communication with technicians and mentors. The general concerns, while not surprising in themselves, imply a recognition among these makers that the impact of using digital tools is in line with it being an engaged and difficult process, requiring significant time and input into developing and negotiating skills, resources and relationships.

Section 4.9: Making it Digital: Conclusion

The chapter offers an interpretation of the data gathered based on a version of grounded theory analysis (Section 3.3.3). Issues emerged from data and resolved into an understanding of the core category of ‘negotiated collective engagement’, and a narrative of practice and object ‘hybridity’. It describes how participants talked about practice and made work that both gave expression to and de-lineated a negotiated space between craft and design, between object and product, between the one-off and the mass produced. The data pointed to the key impact on these makers of using digital tools in this series of cases as being a need to negotiate and animate ‘collective engagement’, requiring an extension of practice significantly beyond the individual’s immediate resources but to which these self-directed, independent makers, some of whom came from a strong design background, were well suited. They were already working in ways that often integrated different roles and were engaged in practice that depended on their personal drive and vision, this was extended by the collaborative value afforded through digital working practices.

This concept of ‘collective engagement’ applied to a wide variety of ways in which the maker’s reach was extended through continually ‘working with’ other people and resources; from accessing kit; to types of creative collaboration and peer interaction including joint authorship; technical collaborations that extended skill; mentoring; aspirations for new business partnerships and models. Being able to reach beyond their current practice to integrate disparate elements and create something new extended to the creation of hybrid objects that can effectively combine the ‘idea-spaces’ of both craft and digital technologies (Section 2.4.6). The interpretation examines a perceived narrative of engagement and dis-engagement in making practices, the sense in which these makers are, on the whole, passionate and determined to produce objects of outstanding quality and deeply engaged with making processes, but are also creatively driven to continually innovate and move on.

A central question that emerged was how continual innovation can be reconciled with depth of making skills. This question is discussed in Chapter 5 in relation to the researcher’s craft practice. For the researcher, definitions of practice and the question of ‘craft’ values and meanings that emerged from this work were broadly concerned with ‘quality’ and ‘skill’, ‘uncommonness’, and ‘maker’s identity’. A large range of descriptors were used, each of which explains a small part of craft value, as it is understood by these participants. This work informed the researcher’s focus on three elements of craft practice as indicators of skill in digital practice, the retention of risk of failure, uncommonness and the creative use of skills (Section 2.3.4).

‘Collective engagement’, in this series of cases, enabled makers to operate in and create their own negotiated space between the hand-made and the manufactured, between working alone and with others, between engagement and dis-engagement, directing partnerships that leveraged skills and orchestrated making. The case studies demonstrate the integration of some skills that might describe as 're-skilled' or 'immaterial skills' (Roberts, 2007:6) (Section 2.3.7) (Section 2.2.5) alongside more traditional artisanal elements of practice. A range of authorship strategies; from the hand-made, to elements of remote orchestration of making - 'authorship at a distance' - was apparent.

The research identifies five key areas of potential in digital practice that emerge from the case studies. These overlap and are often present in combination, they are relevant to practice that integrates elements of craft, design and art.

These are:

- The potential creation of **bespoke** value in objects through the use of digital data.
- The potential for engaged **prototyping** leading into licence agreements or remote manufacture via digital file transfer.
- The potential for **'data transfer'**: file sharing and the inclusion of digital data opening up object and manufacturing possibilities.
- The potential for **'crossover objects':** the combination of a traditional object or skill made contemporary by digital input or vice versa, a contemporary object given a traditional craft persona.
- The potential for **'skill leverage'**: makers having access via collaborations, technology, mentors and technicians to making skills and knowledge they do not possess themselves.

Each of these five areas is explained as an expression of 'hybridity' that is digitally enabled. The first two are about digital enabling of hybrid business practice options. The second two are about hybrid objects and the last about hybrid making skills. This interpretation identifies and describes a making dynamic that inherently involves working with elements contributed or resourced from beyond the maker themselves, whether this is with customers, manufacturers and retailers, other data sources, embedded knowledge, another field, discipline or aesthetic.

This echoes the sense of 'collaborative value chains' described as a digital trend in Section 2.5.1. The researcher concludes that these makers using digital tools could be described as acting as *impresarios of concerted effort*, a term the researcher feels expresses the role of orchestration of a complex and disparate combination of elements that spans concerns with materials, skills, the physicality of making, and leveraging the potential of technology towards a considered and uncommon outcome. In the researcher's view these makers, coming from design and craft backgrounds, were exploring forms of hybrid practice between craft and design. For these makers, digital practice, holds out the promise of forging an area of their work which could potentially combine some of the most prized aspects of both craft and design, the engaged depth of practice from making unique 'crafted' objects alongside product development and innovation, without necessarily being constrained by narrowly focused repetitive practice, for at least part of their practice. This aspiration was described by one participant as '*making creativity tangible in the marketplace'* (Focus group comment) which, for the researcher, expresses an aspiration to achieve better market access for innovative, small-scale creative projects and products.

All participants described ways in which they were working with others. It could be argued that in a modern connected world it is impossible to operate effectively without being deeply involved in working with other people, in any form of production. However, the researcher feels that digital practice presents a proposition that invites, and in some cases demands, collective engagement, encourages collaborative aspects of working practice and facilitates creative collaborations. At the very least this is necessary to access large scale industrial equipment and technical help and to animate skill leverage. Pursuing the hybrid digital potentials identified in this study, such as bespoke and prototype models, promotes collaborative value chains and business models where value can be added by users and audiences, clients, manufacturers and through other retail agreements (Section 2.5). Hybrid collaborative cross-disciplinary object possibilities, like the potential for customisation, are potentially enabled by digital capabilities such as file sharing, data transfer and converged systems.

The definition of 'intelligent making' developed by Cusworth and Press (Section 2.2.1.) emphasises the synthesis of elements involved in practice. It is '*a mix of formal knowledge, tacit knowledge, physical and mental skill, contextual awareness, innovation and personal creative autonomy. These are applied to practice that involves a skilful achievement of relevance in identifying an objectified focus for the craft process*' (Cusworth and Press, 1996:4). The researcher contends that 'intelligent making' is a good description of the elements involved in digital practice. However, she believes that digital practice would be better described by the addition of an added component to explicitly reflect the sense of constant collective engagement (in addition to the knowledge and skills described which may relate to the individual). Animating, orchestrating and negotiating collective engagement and collective knowledge and skills is, in the researcher's opinion, required to access and make use of the hybrid digital opportunities on offer. For the researcher, digital craft in this way has a semi-public character. It is because makers are used to pulling together elements from many different sources that they may be able to adapt to working in a digital way. The researcher has described this kind of practice applied to craft (rather than product design) as technology enabled networked practice – *technepractice* – which is intended to convey this pervasive sense of inter-connectivity and collective engagement (Section 2.3.8). Some sense of this emerged from the MiD programme, within which the impact on makers' practice was, in part, a broadening of potential practice options, although it was found that this required considerable investment in constantly defining and wrangling involvement with the skills, resources and help of others, synthesising practice. Part of the impact on practice of using digital technologies, within this time limited knowledge transfer programme, was the opportunity for makers to re-evaluate and reflect on their practice and find new ways of doing things.

'I respect tradition and I think that's got to be something that's got to be encouraged and extended and updated but I do see the real value in how you can use these digital technologies to push your practice forward ... and to kind of open up new ways of working..... getting people to ask questions really' (Participant 4).

Chapter 5: Practice-based enquiry

Section 5.0: Introduction

The researcher is a graduate of a Contemporary Crafts B.A. (Hons) degree, (awarded July 2007) and her personal experience of making ceramics, as an undergraduate student, informs her perspective as a craft practitioner and researcher. Practice-based research involving making ceramic objects and subsequent analysis of the researcher's own practice, was considered from the outset an important element within the overall PhD project. The reasons for the inclusion of a practice-based element are defined and justified within *The Rationale for Practice* (Section 3.4.1). The practice element acts as a personal case study. It is distinct from the case studies examined in Chapter 4: Making it Digital. As a single case study it was not analysed using grounded theory but through personal reflection within an action research methodology (Section 3.4.2). The practice element followed chronologically from the research undertaken for the previous chapter and benefited from the insight gained in undertaking the previous case studies. It was also used to inform the approach taken towards the following chapter, which is concerned with the views of makers with extensive experience of using digital tools (Chapter 6: Professional Views).

In essence, the aim of this element was to provide '*documentation, communication and assessment of process… in relation to the researcher's thesis'*. The practice element, in the event, proved a great advantage, benefiting both the study as a whole and providing direct evidence for the researcher's thesis. Being a practitioner herself enabled the researcher to better understand, empathise and talk on more equal terms as an 'insider researcher' (Section 3.4.2) with other case study participants. It also gave the researcher first-hand experience of practice that could be investigated in-depth. Unlike other case studies, the details of the researcher's own working practices and day-to-day concerns were directly accessible and able to be documented in detail. Despite having insightful and productive discussions with other case study participants, the researcher considers that working practices, particularly problems and barriers, were more readily accessible within her own practice. This is partly as a consequence of her situation as a novice practitioner and as a student, allowing a relatively greater freedom to experiment and, at times, fail. A second, personal perspective was therefore obtained on the use of University College Falmouth's digital workshops in developing and making new work.

What emerged during analysis of the researcher's personal practice, was a focus on reflection and examination of the question of '*depth*' of craft skill (in orchestrating and animating making) in digital craft, a question that was raised in the previous chapter (Section 4.9). Practice, in this way, served to integrate emerging questions and provided evidence on which analysis was undertaken. The previous chapter establishes the role of digital tools in enabling *'breadth'* of hybrid practice possibilities. This chapter interrogates the researcher's own practice and goes on to focus on practice work undertaken as a demonstration of how collaborative engagement and the use of collective imagery are facilitated by digital practice (Section 5.4). The practice element was envisaged as making a 20 per cent contribution to the overall PhD project.

This chapter, then, briefly describes practice work undertaken (Section 5.1), and identifies the main evidence and questions that emerged from analysis of the researcher's practice log (Section 5.2). A central question from this analysis, and in relation to the study of earlier cases within the Making it Digital project, concerns the location and validity of *craft skill* within digital processes. It then relates the framework for craft skill in digital practice outlined in the Critical and Contextual Review (Section 2.3.4 to Section 2.3.8) to the researcher's process (Section 5.3). The question examined is: what is the difference between a process that is classified as digital *making* to one classified as digital *craft?* It concludes (Section 5.3.9) with a discussion of whether the researcher's enquiry demonstrates *craft* skill in digital practice. It then goes on to describe a ceramic installation prepared for exhibition in June 2010 (Section 5.4) that was designed to exemplify and build on ideas developed through practice and case studies, specifically an examination of the potential for collective engagement through 'data transfer' and 'skill leverage' in the researcher's own work. The conclusion (Section 5.4.5) is an analysis of how the '*Moving Boulders'* project demonstrated the facilitation of collective authorship and the extent of collaboration within this practice-based enquiry.

Section 5.1: Description of practice

As a novice practitioner, the researcher is in a situation where her practice is inherently experimental and open to new processes and requires continual learning and re-assessment of techniques. This means that the researcher is using digital tools without set craft processes - traditional processes at which she has already become expert - in mind. This practice was not, for example, an attempt to perform an established making process in a quicker, cheaper or more efficient way. This was an open-ended exploration undertaken without a set outcome in mind. The level of practice achieved with these experiments is therefore at an early stage, but still exhibits characteristics that can be interrogated in relation to wider digital craft practice, bearing in mind the context of the practice work undertaken.

The main interests that the researcher carried with her from previous studio work were a fascination and concern to further explore the translucent properties of porcelain (a deep and abiding vein of ceramic tradition) and a personal interest in how issues of contemporary relevance (for example popular political and environmental concerns) could be reflected in craft practice. Two months were set aside for the researcher to focus on the first practice element of the work, which was mainly carried out in September and October 2009. A series of tests was carried out over a number of weeks, aimed, for example, at producing three dimensional box forms, slip cast moulds, laser engraving of digitally manipulated imagery, press moulding from engraved plywood and a variety of other materials. Early results included square vessels and slip cast objects. Eventually, after around six weeks, one fairly self-contained and simplified process emerged as a test process for obtaining high resolution relief imagery, in flat press moulded, porcelain panels. This process is described in detail in Appendix 2.1.

The initial content of the work, the subject matter dealt with, was chosen by the researcher as *MPs' expenses*. The media and public interest in the lack of transparency in the political expenses system, a prominent news story during the time that the practice research work was being carried out, resonated with the researcher's interest in working with the translucency of porcelain. The researcher felt there was a parallel between the way that an aspect of the working of the institution of the House of Commons had been put under a spotlight and a new narrative exposed, to the way in which porcelain in strong light can be made to reveal imagery contained in subtle relief. Text from newspaper cuttings and hand drawn sketches from photos were used, among other materials, as sources of imagery for a series of process experiments. The researcher had some previous experience of incorporating relief surfaces into porcelain (See Figure 2) and wanted to experiment with the potential of using laser engraving techniques to create relief surfaces and press moulds for ceramic relief.

The basic process involved using computer controlled machine engraving (see Appendix 2.1 for process description and Appendix 2.3 for further information regarding the Trotec Engraver : health and safety notice) of imagery to create press moulds that combined text and relief imagery and resulted in fired pieces of flat porcelain. Like many making processes, it has a number of stages that correspond to imagery, material and data transformations that take place. The Oxford English Dictionary lists one definition of '*transformation*' as: '*The action of changing in form, shape, or appearance; metamorphosis'* (OED, 1989). The process described in Appendix 2.1 involves a series of transformations, where the imagery is moved from one form to another, or from one material to another (from lino to plaster or clay), some are transformations of the form of the information (perhaps from analogue to digital and back), and others are in scale or appearance. Some transformations are enabled by a digital process or machine intervention; others are accomplished through a physical or hand-making process. Together they amount to a complex set of interactions which have been deconstructed and described in Appendix 2.1. The researcher considers that *data transfer* - the transformation of imagery or other data from a diverse range of formats to standard digital formats and the possibilities for digital output – is one important aspect of digital potential for designer-makers that emerged from contextual and case study research (Sections 2.4.2 and 4.7.3), and she therefore chose to explore this aspect within practice.

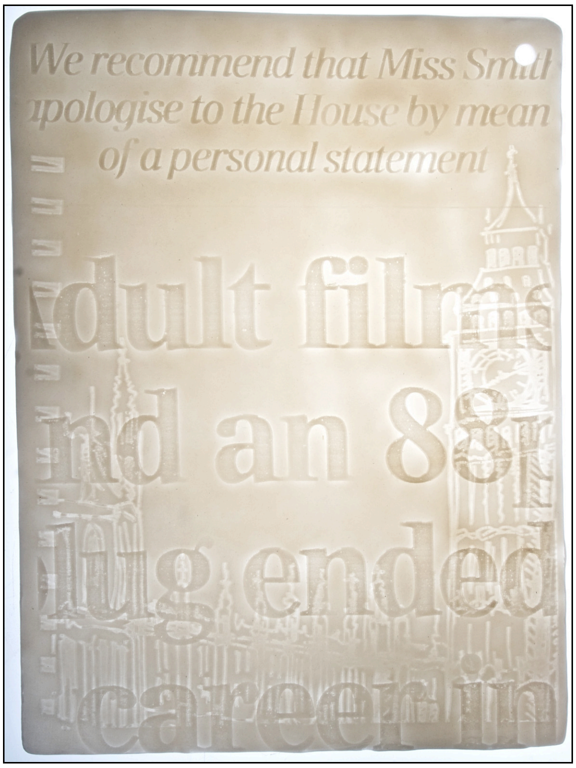


Figure 39: Figure 9: Fired Porcelain test, approx 13.3 cms x 17.7cms, I.Risner

Section 5.2: Analysis of practice Log

Appendix 2.2 details a numerical categorisation of problems and issues that the researcher encountered and noted in a practice log kept between July and November 2009, throughout the time the researcher was engaged in process and equipment tests, working on practice-based research full-time in September and October. Further practice work was undertaken in 2010, resulting in exhibited work in June and September 2010 (Section 5.4). The commentary below (Sections 5.2.1 to 5.2.6) explores evidence from the practice log that points towards the impact of digital tool-use on the researcher's practice, particularly where the evidence signals a departure from the researcher's previous experience with non-digital techniques.

5.2.1: General issues: costs, access, time and health and safety

Concerns the researcher noted in her log about issues of costs, access to technology, lack of time and health and safety were not very numerous (only 16 in total) and covered both traditional and digital areas, from direct materials costs to inductions needed to use equipment. The small number of comments about costs and access compared to greater prevalence of these issues within the *Making it Digital* cases is, the researcher feels, due to the privileged position of working as a research student based within the University. Access to equipment was provided at no direct cost to the researcher and facilitated by the researcher being on site as a full-time student. One piece of equipment was an inexpensive scanner/printer the researcher bought privately for home use for less than £50, an example of digital technology that has progressively come within the reach of individuals. In the case of access, most comments (four) concerned gaining access to the Trotec Speedy 500 laser engraver (see Appendix 2.3 for Health and Safety notice) which is a large, expensive, sophisticated piece of equipment, popular with students and researchers, located within the UCF workshops and central to the researcher's work. It was made available through the mediation of trained technicians and the researcher's supervisor, individuals with a good understanding and experience of the integration of digital equipment and creative practice, (who had also worked with the Making it Digital participants) so that the researcher's work benefited from substantial technical support and help being provided in the context of creative craft practice. The benefit and importance of developing close technical working relationships is reflected in the relationships with technical experts described in Chapter 6 (Section 6.6) among some professional digital craft practitioners. The researcher feels that the issue of access is more than just the ability to pay to use a piece of equipment (costs in any case were covered by the researcher's course fees). Productive progress was made by the researcher by being able to have supported access to try out many settings and programmes, within health and safety requirements and within an environment of considerable expertise. This digital practice work was made possible because the researcher had supported access to skills and equipment, including help with software and file manipulation.

5.2.2: Noting and overcoming problems

The proportion of problems noted with digital processes to problems with traditional ones was (3/10), so the overwhelming majority of problems, noted in the log, were with traditional craft issues. These were generally with the very real physicality of making, for example things breaking, spilling, being cast too thin or drying unevenly. The problems and mistakes categorised as 'digital' within this category concerned digital equipment but had a similar character, for example, positioning material incorrectly or selecting the wrong digital file so that a section was engraved twice on one panel. In the researcher's experience, digital processes do not always run more smoothly than analogue ones. There is a sense in which mistakes within the digital stages may be wrong decisions rather than related to a lack of manual skill, they are, however, still capable of disrupting production or ruining work. All of these mistakes concerned the commonplace learning-by-experience that is necessary as part of the development of any technique unfamiliar to a maker. The traditional and digital issues were not only similar to each other but similar to other problems the maker has encountered in previous practice. It reinforced the researcher's experience of making as a slow, incremental, but often non-linear development process, where a sudden insight can rapidly change the pace of progress; this was unchanged despite the large digital element to the current practice. The ratio of time between developmental work and arriving at a process that seemed to be yielding useful results was also familiar from previous practice. Five times as much time was spent experimenting and pursuing routes that were not ultimately followed (although they yielded useful results, techniques and creative insights) compared to the time spent producing the final test pieces. This sense of resolving issues through time invested in making, often without successful results but building experience and options which were used in some way later, felt familiar to the researcher's previous practice. For example, an early decision to pursue hand-drawn sketched imagery was the result of looking at many different types of line quality achievable. Another round of tests and experiments resulted in comparisons of the different light quality from raised or relief marks. The availability of digital tools in no way negated the need to generate physical tests and results, to follow an iterative craft process, well known to the researcher.

Technical difficulties were categorised separately, and here the split between digital and traditional was more even (8/13) though there were still more traditional technical issues. Typical issues included: consistency of slip, pint weights, pouring times, kiln heat work and temperatures, thinness of rolled porcelain and warping during drying. The digital technical issues concerned matters of file preparation, software incompatibility, file resolution, file transfer problems and machine crashes. All the technical issues - traditional or digital - are characterised by a need to seek help and advice. In the case of the traditional problems, this is sought from a large variety of sources including advice from colleagues with more ceramics experience, technicians, other students, and a specialist pottery supplies business. A few words of verbal advice on an appropriate material or technique generally sufficed to enable a renewed attempt by the researcher at a particular technique, perhaps using a new material.

For the digital problems, specialist technical help was sought from technicians and digital experts, who, on a number of occasions, stepped in and helped prepare or alter files, or manipulate software. This dependence on a degree of sophisticated digital technical expertise that, apart from learning about fairly simple digital technical issues, remained outside the researcher's knowledge (it was knowledge that was not assimilated during the process but remained 'bought in') did seem to be a distinctly digital characteristic within this practice. Within this relatively short practice element the researcher did not become a CADCAM expert herself. The work was accomplished through engaging with others who could provide specialist help. The sense of a collective endeavour where other intelligences and sources of knowledge were at work (judgements were being made about qualities that were based on a range of options presented within software, or through mediation by a digital expert) was more apparent than with the traditional side of the work. This technical help was not all the same, it covered a fairly broad spectrum from knowledge-based advice and help that the researcher relied on to fix immediate technical problems, to much more broadly-based digital expertise that enabled new possibilities and opportunities to be understood and explored, within the researcher's overall aesthetic judgement and control. The digital expert role is analogous to the mentoring and facilitating role of the Autonomatic team and technical support identified within the *Making it Digital* project. Requiring specialist help and knowledge, that was not assimilated during the process of development, may be an effect of novice practice, that is, the investment of time required to learn particular software to an expert level was not justified within a short practice experiment. However, developing close technical relationships was also a feature of relationships with technical experts described in Chapter 6 (Section 6.6) among some professional digital craft practitioners. The researcher suggests that the level of expertise with software she was able to access far exceeded the level she would have been able to acquire herself.

As the work continued, it was clear that technical assistance with setting up files, image manipulation and software-use resulted in decisions that had a collaborative element, in the sense that creative decisions were taken by the researcher but often from suggested opportunities and possibilities previously unknown to her. This was of enormous positive benefit to the work. A simple example would be the opportunity to set up large digital files so that it was easy to move imagery across from one panel to another and accurately split images to be engraved in consecutive panels. This was beyond the technical expertise with Adobe Illustrator of the researcher and made possible through expert help. It is an important aesthetic element in the visual narrative created across ten panels in the final exhibition work discussed (Section 5.4). Digital technical help, then, was important, mostly positive and extended the project. However, as a maker it was more complex to manage the range of inputs, from sourcing the specific digital technical help needed to accessing machine timeslots and technical support. Although it overstates the case to imagine an abrupt divide, some degree of shift from direct making to directing making (or perhaps managing, organising or animating making) can be detected in the digital processes. The terms 'choreograph' or 'orchestrate' have been suggested, though both terms imply a 'performance'. The researcher has previously suggested the idea of the maker as *'an impresario of concerted effort'* (Section 4.9). Whatever term is used, the specific digital advantages and constraints identified highlighted for the researcher the enhanced assisted element apparent within the process due to the required technical support, even within a test practice project not specifically intended as a collaboration.

A degree of frustration at this dependence is also apparent, particularly because it can be the source of introducing new errors. For example, at one stage, a file prepared by an outside expert was found to be unusable, for reasons including software compatibility problems, on three occasions. The evident frustration expressed in the log is with digital dependence *'having to rely on someone else' (log, p.19)* and this comment is reflected in a similar sense of having to 'rely' on others from some comments made in Chapter 6 (Section 6.6). Relying on others, for example, caused delays as time-slots booked on equipment might be lost. Using technical help had overwhelmingly positive effects but occasionally negative effects were noted from entering into this type of negotiated outcome and giving up some control. A certain amount of ambiguity can be detected about conflicting technical and aesthetic priorities: An early comment from the researcher's log concerns impatience with the amount of time needed to be invested in software training in order to improve results and says *' I'm obviously extremely lucky to have help (to learn software programs)but what matters to me at the moment is that it starts to look good' (log, p.19).* The researcher's concern is to prioritise agency above productive autonomy, and this begins to emerge from practice.

The researcher found that the volume of work was fairly evenly split between traditional ceramic and digital processes. This suggests that the greater number of mistakes, problems and technical issues noted above with traditional processes was not simply because more time was spent on traditional techniques but that, for example, the researcher found it more difficult to slip cast well than to achieve a good quality simple digital engraving. One reason appeared to be that because the digital processes tend to be mediated through a great deal of embedded knowledge in software choices and machine presets and are additionally mediated, by qualified technicians or digital experts, fewer problems are encountered in the final execution of the work itself, the machining stage, as problems are resolved at the digital image manipulation and file preparation stage. In the case of this practice the actual machining stage was a relatively speedy part of a much longer and more complicated, engaged and iterative process.

5.2.3: Comments regarding help asked for /given

A large number of comments concerned help asked for, or given (33) and the number of times first names were mentioned, in total, was high (78). Again, the greater number concerned help with traditional techniques rather than digital (21/12) but as noted above, whilst the traditional help was often just a few words of technical advice from more experienced makers, the digital help did involve specialist file interventions and a more participatory involvement in actual outcomes. The vast majority of comments about help were positive (29) as opposed to (four) that were concerned with negative impacts, such as help or advice that turned out to be not useful or incorrect. In the course of the whole project, all the help or advice received was given freely and was overwhelmingly positive for the outcome of the work. There was a large spread of sources of help, including from people in supervisory roles within the University, and from technicians but also knowledgeable outside contacts (with software expertise), other students, colleagues, visitors to the University and books consulted, often in a very quick and informal way. This gives a strong picture of the collaborative environment within which this work was carried out, in a University workshop and studio setting.

5.2.4: Concerns regarding work outcomes

This category contains reflective judgements made by the researcher on the progress and quality of the work. These have been given a separate category because they reflect persistent questions that emerged regarding the impact on the *quality* of the work from using digital tools. These comments have been split into three groups, quality of outcomes (14), use of digital imagery (nine) and direct questions about digital impact (seven). The first group is characterised by comments such as *'looking for more complexity, layering and depth' (log, p12)* in the work. Concerns over imagery tended to relate to whether the collaged effect of layered text, from secondary sources, is *'superficial' (log, p15)*. Digital impact refers to whether the particular equipment chosen dictates outcomes, such as working on flat panels rather than in 3D.

A recurring theme is a fear that the work does not amount to the complex and engaged crafted outcome sought. Should the work be seen as craft or, as the (perhaps superficial) application of machine capabilities? Is there a lack of skill that disqualifies it from being defined as craft, should it be described in some other way? The central question and persistent anxiety then, raised by the researcher throughout the log, is about whether a perceived lack of depth (both literally and metaphorically in flat pieces and in collaged imagery) is commensurate to the use of digital tools. To some extent the researcher felt this was the case within a short and novice practice exploration. However, the log does contain many positive comments as well as negative ones. A more positive tone with regard to outcomes is particularly evident after some pieces have been engraved more than once and the 'interference pattern' described in Appendix 2.1 is developed. This level of image complexity and the positive incorporation of an effect previously unknown (to the researcher) into the work appears to engender outcomes judged as more interesting and satisfying by the researcher and a sense of ownership of process that somewhat assuages the concerns. For the researcher, the development of an individual approach within making is a validation of craft.

5.2.5: Positive comments

There were (22) positive comments categorised. These mainly concern issues such as enjoyment of practice work or the impressive resolution and accuracy achievable with digital engraving. The question arises whether the researcher's aesthetic judgements regarding the work were made using familiar 'artistic' or 'craft' criteria, as would be the case with previous practice, or something new and perhaps more applicable to digital work? The researcher asked the question: Was this work valued for its novel digital content? The evidence here suggests that, in the main, old criteria are used. At times work is described as having *'interesting textured refinement' (log, p18)* or having *'fantastic light translucency' (log, p17).* The judgements, then, tend to be expressed in terms of the visually pleasing aspects of the outcomes, as has been the case with the researcher's traditional work, rather than any new criteria regarding the use of digital process or content. Ultimately, the process becomes less apparent and, to some extent, invisible in the final pieces.

5.2.6: Distractions

Many comments concerned distractions from practice due to family events or other work, including a two-day conference and other research work. It serves to underline the importance of acknowledging that this log is an attempt to capture the integration of day-to-day concerns and the stop-start nature of making in an informal and naturalistic way. The description and analysis of practice provides insight into the researcher's limited experience but is not intended as a generalisable experiment from which conclusions can be drawn in isolation, rather as an element of personal evidence that advanced the researcher's understanding. In line with the researcher's overall methodology, it is a situated narrative account that returns to, and comments on, the specific data collected.

5.2.7: Conclusion to practice log

In summary, within this practice, the digital and traditional problems encountered in making were often similar in character, they tended to be about the material and physical capabilities and restrictions of process. There were more traditional than digital problems and more traditional mistakes and technical issues than digital ones. Digital technical issues tended to need more expertise and outside help to fix. The researcher experienced the sense in which technology takes some control away from the maker. This is an effect that has been noted by many commentators. Peter Dormer, for example, *'to claim that one possesses a craft is to claim that one has autonomy in a field of knowledge: craft is something one can do for oneself….the* *power and attraction of technology is that it enables you to do things without understanding how they are done. The price you pay is a loss of autonomy: you are in the hands of the engineers, programmers and designers who give you the means but not the knowledge to perform certain acts'* (Dormer, 1997: 102) (Section 2.2.3). The researcher expressed concern in the log that the form and content of the work was being driven by digital equipment capabilities and constraints, but decided this was outweighed by the attraction of enhanced capabilities provided by digital equipment. The question this research poses is whether the '*loss of autonomy'* Dormer notes is actually '*paying a price'* or indeed, a positive development. Indeed, does one actually lose autonomy if authorship is retained? The researcher certainly felt that the loss of productive autonomy in this case was a gateway to a more productive, self-directed but assisted, use of stored knowledge and capabilities. Dormer complains that, unlike craft where the craftsperson remains master or mistress of the craft '*with technology, the craft of a process is diffused into the tools and into the systems of manufacture'* (Dormer, 1997: 102). The researcher acknowledges this fact; she didn't for example, learn the craft of traditional manual engraving, but felt that a process of craft was brought to bear on how the engraving technology was used. This relates to the researcher's adoption of the pragmatic view of technology in craft outlined by Marshall (1999), as neither enframing experience or as a value-free-tool, but as an active evolving encounter, a dynamic extension to practice an 'active counterpart'(Section 3.2.1). Ultimately, the spectre of digital determinism was overcome through development of relatively complex practice work which the researcher felt established some ownership and conferred a sense of crafted process. The authorship implied by the development of an individual approach (the creative use of skills) alongside the retention of the risk of failure and uncommonness is examined below (Section 5.3).

The researcher did not feel, within this practice-based enquiry, that productive autonomy was a desirable or even realistic condition in itself and certainly not if the price for autonomy is a rejection of technology's capabilities. A positive and inclusive attitude towards shared knowledge, whether codified within technology or contributed by experts (for example through software modifications), was the basis on which this practice was able to progress and, in the researcher's view, did not preclude a craft process emerging.

It is clear that, from analysis of this making experiment, whilst there were important areas of distinction between the researcher's perceived traditional and digital working practices, as recorded during this enquiry, not least in the degree of collaborative digital working, there were also large areas of practice in common. Some central tenets of craft practice, such as an iterative, material-based experimentation aimed towards a considered, high quality outcome, remained the objective in both digital and traditional spheres.

Analysis of the practice-based enquiry (through the practice log and mind mapping – Appendix 2.4) therefore confirmed two central issues to emerge from practice, the first was the researcher's reflection on the validity of her practice in terms of craft skill, the second was the extent to which digital working practices imply and facilitate a collaborative element. Section 5.4 attempts to answer the first question by discussing craft theory explored in Section 2.3.4 with regard to the status and validity of the researcher's practice, asking: at what point and why in craft theory terms does this practice move from digital *making* to digital *craft*? The second question regarding collaboration is returned to in Section 5.4.

Section 5.3: Examining the researcher's current practice for craft 'skill'

The researcher's test process can be examined in relation to the chosen criteria: creative use of skill, retention of the risk of failure and uncommonness, discussed as indicators or craft skill in digital practice in Chapter 2 (Section 2.3.4). The test process is an example of a combination of a series of simple hand and machine stages of production that result in a composite process and object. It seeks to integrate hand and machine processes through digital data transfer, in that sense it is characteristic of one type of craft approach to the use of digital tools. It could be said to have retained craft through an element of 'hand-made'. However, can a craft process also be detected in the digital stages or the composite process, does it amount to digital *craft* practice?

The diagram below attributes a rating of high, medium or low to each stage of the process described (Appendix 2.1) and for each of the three skill-related issues described above - creative use of skill, retention of the risk of failure and uncommonness. It attempts to interrogate the researcher's test process by the yardsticks of traditional craft values as derived from Woolley (Section 2.3.4) and from the craft values identified from the Making it Digital analysis (Section 4.6.3) and re-stated by the researcher in order to be relevant to digital practice (Section 2.3.8). The researcher believes this is just one set of craft values (the intrinsic value of material, the poetics of meaning and beauty are examples of possible alternative descriptors of value), however, these three elements, as a reflection of craft skill, have been explored in relation to digital craft (Section 2.3.3) because it is the supposed lack of, or replacement of, makers' skill, that is one central objection to seeing craft value in digital processes.

What is meant by the attribution of a high, medium or low rating for each category is defined below; the researcher believes that each scale is in fact a continuum but has defined the extremes in order to create a relative scale. Mid-points of high to medium and medium to low are also indicated, as a five point scale enables more flexibility over judgements. By forcing processes into approximate categories, the researcher recognises that there is a degree of false clarity and that a very wide medium category is clearly where most processes will be placed. However, the researcher believes it is still useful to think about these issues within these terms. The rationale for the rating attributed to each stage is discussed below.

5.3.1: Level of skill and creative use of skill expressed in process:

High - Outcome demonstrates both highly skilled process and creative use of skills.

Medium - Some creative use of skills and variability of outcome working with and within constraints - such as arise from material, machine, medium or traditional design.

Low - Outcome is pre-determined by simple process with little or no creative use of skill.

Risk of Failure:

High - constant, imminent risk of failure, very difficult to repeat, if process goes wrong

Medium - could go wrong but be repeated with similar outcome, with medium effort.

Low - error eliminated, repeatable, predictable outcome, easily achieved.

Uncommonness of process/outcome:

High - unique, one-off outcome/process that could not be imitated effectively.

Medium - individual outcome/process, object could be within series or batch.

Low - simple process/identical objects that could be mass produced easily.

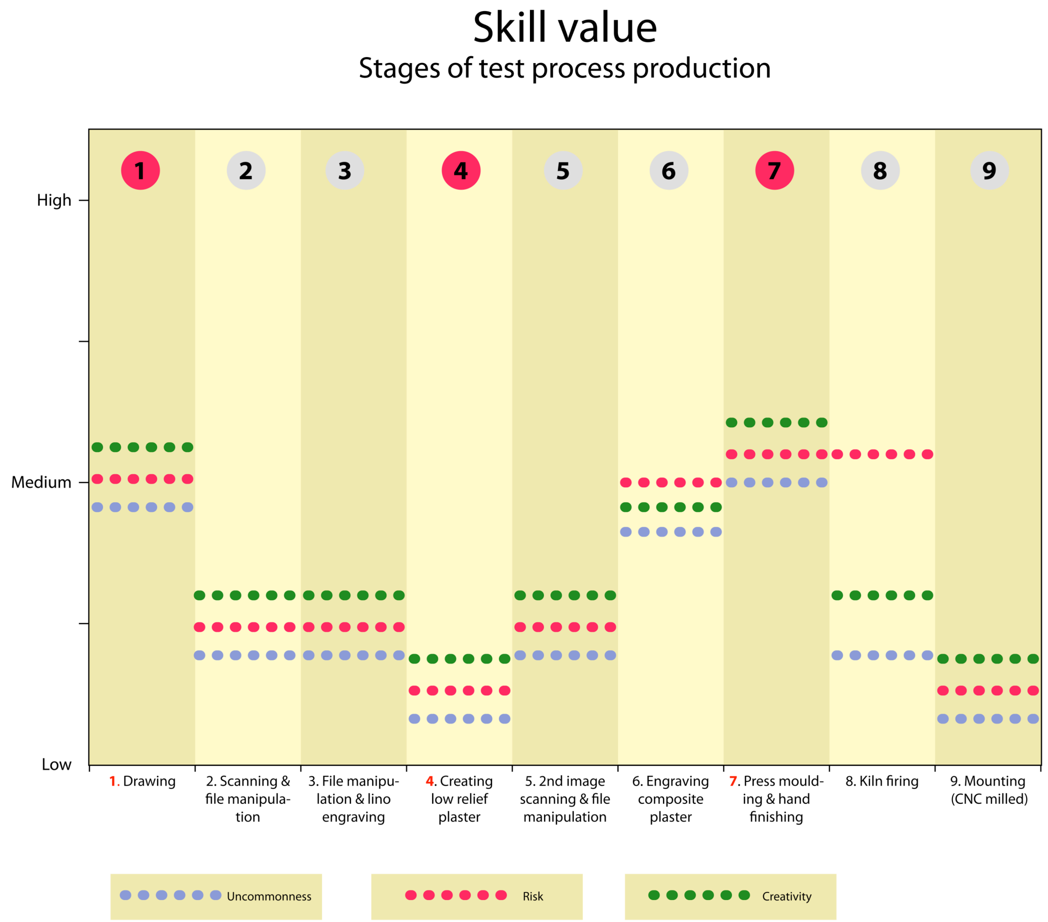


Figure 40: Craft skill value, stages of test process production.

5.3.2: Risk of failure

Initially, it is apparent that the original drawing, creating a plaster relief and clay moulding (columns 1, 4, and 7 highlighted in red) are ‘hand’ processes, whilst the two sets of laser engraving and various file manipulations are ‘machine’ and ‘digital’ processes (as well as kiln firing) – but how far does this categorisation help to identify any common or different qualities to ‘hand’ or ‘digital’ work?. The higher risk of failure profile, for example, does not attach only to hand processes.

The risk of failure, or making a mistake (related to cost, time and effort of replacement) was a building and cumulative quality, the risk was higher when a number of stages had been completed and increased with the complexity of the work. There is also risk of failure associated with the sense that the work was not pre-determined. It was a live evolving project, shown for example, in the constant scrutiny, adjustment, reflection on and re-iterations of work, changes to software models or machine parameters to get exactly what the researcher wanted, and because this was a succession of one-off pieces in an evolving series. It is not a pre-determined plan, or a designed outcome, that is executed through running specific operations, but an exploration of capabilities and effects in interaction with the maker's experience and live decision making, drawing on expert advice. The level of individual skill and immediate risk of failure at the moment of material transformation, e.g. for machine engraving, may be less than in a manual craft such as throwing a pot. However, the general level of skills brought to bear from all of the collectively animated sources (in complex software manipulation or in directing machine operation), and a cumulative risk of failure is identifiable and, for the researcher, comparable to a manual craft.

5.3.3: Digital dilution

Column 3, the lino engraving, resulted in an extremely accurately machine engraved image but is categorised as low to medium risk of failure. Had this process been completed by hand the researcher would have categorised it as higher risk – because the level of lino cutting skill required of the maker, the time and effort involved and the difficulty of replacing the object if a mistake was made at a late stage would have resulted, in the researcher's view, in more risk of failure, than the machined version of this process. Creative skill and aesthetic judgement was required in composing digital images and tests to get the required effect from machine engraving, but in the researcher's view, in this case, it was more easily repeatable than a hand process. The researcher concluded that the replacement of a skilled hand process by simple machine operation may be appropriate as a making strategy but can dilute the craft skill in comparison to a hand process. The researcher felt that a process that may result in an object that looks like craft, but is actually a simple machined replacement for highly skilled and high risk-of-failure engagement, does not add enough value (complexity of process, layering and depth) to be a digital *craft* process.

5.3.4: Building craft complexity

The activities shown as high to medium risk of failure include the kiln firing, column 8, (an unrepeatable and to some extent unpredictable stage) and the second stage of composite engraving, (column 6). Neither is dependent on the individual manual skill of the maker. In each case, however, more has been invested to get the work to that stage. Risk of failure is related to time, effort, complexity and repeatability, rather than to a hand or machine process distinction.

5.3.5: Traditional craft skill and risk

The two main hand processes - columns 1 and 7, the drawing at the beginning and the clay moulding towards the end – are traditional artistic, high to medium risk ‘in the moment’ creative events, they have a ‘performance’ and ‘flow’ aspect, even when carried out to fairly average quality. They conform to a traditional view of artistic or craft skill, individually ‘owned’ by the maker (Section 2.2.1). They are medium to high risk of failure, they could go wrong at any moment and cannot be exactly repeated. They depend on the creative use of skill, for example an individual style and approach to drawing, based on individual experience.

5.3.6: Traditional low risk

Creating a low relief plaster mould (column 4) is a hand process but low risk of failure. It has been categorised as low risk of failure because it is easily repeatable, if it goes wrong you can mix some more plaster and use the same lino to make a new version. It is also a process where the maker has little creative control, in the sense that there are very few variables to alter and the outcome is a fixed intention of a standard quality. In this case a ‘hand’ process has a fairly low craft skill value.

5.3.7: Extending craft

The composite engraving is a digital/machine stage but categorised as medium to high risk of failure. It has been categorised as higher risk of failure because the composite engraving created a more complex effect and, should a mistake occur at this later stage, it is more difficult to correct – more is invested in the piece, several stages would need to be repeated to recover the lost ground. The researcher contends more risk of failure attaches to any process (kiln or engraver in this case) which is a complex pivotal activity for a successful outcome. The complexity of the machine process, the importance of its role and the creative application of technology, in the researcher’s view, created craft value, in a traditional sense of skill value, but divorced from individual hand processes. The researcher believes that there is the possibility of craft skill value transferring to the object, having been created by a complex interaction, between the maker’s intention, technical help and machine operation, even though a specific part of the process is largely automated.

5.3.8: Creativity and uncommonness

Creative use of skills and uncommonness have not been separately considered for each process because, on the whole, they correspond to the judgements made about risk of failure and are closely inter-linked. The kiln firing stage is the only exception, which was judged as low for creativity or uncommonness but was rated as higher risk of failure, for reasons explained above.

5.3.9: Conclusion to digital process and skill discussion

The researcher believes that the evidence supports the idea that the three elements of craft process examined in relation to digital technology within this practice - creative use of skill, risk of failure and uncommonness – are demonstrated in some parts of the practice examined and not in other parts. Overall, the researcher judges that her practice does amount to a digital craft process (rather than digital making) but only in complex interaction with hand elements. The researcher seeks to replace the opposition of hand versus machine, (hand - by implication highly skilled, valued and difficult, against machined - implying easy, superficial and unskilled) with descriptions of evolving hand and machined, integrated outcomes where the presence of creative use of skill, risk of failure and uncommonness can be used to identify craft in any making process, whether traditional, digital, hand or machine.

The concept of authorship, a *creative individual* animating and directing collective skills, knowledge and resources, working *with* technology and specialists in the interests of the outcome of the work, is at the heart of the researcher's claim for understanding the possibility of digital technologies contributing to a rich, integrated, engaged form of craft. Technologies (designed in some cases, in part, to replace skill, remove error and make copies) can become instruments of extending craft. Digital technologies are capable of building and extending craft skill into the value of the objects created.

Craft value is a variable, capable of being demonstrated and present in variable quantity. The researcher does not believe that either 'dilution' or 'extension' of craft are the inevitable outcomes of the use of digital technologies, as mutually distinct categories. The craft skill value of a digital or machine operation only accrues to the craft object when it is, to some extent, part of a creative use of skill, workmanship of risk and uncommon process, and not when it is a simple machine replacement of skill. Interpretations of value in digital craft objects need to go beyond dualistic over-simplifications - the 'either/ or' determination of an object as either hand or machine, either unique or mass produced, either one-off or repeatable, either the result of maker controlled operation or automated processes. Forcing objects into mutually exclusive categories cannot describe digital practice (often a hybrid or composite process) adequately. The oppositions of risk to certainty, unique to mass produced, creative maker to machine-operative, skilled to unskilled, are part of a pervasive narrative of contrasting categorisation which fails to do justice to the complex interactions that are synthesised by makers in shifting formations, depending on the problem and context they are faced with. A rejection of dualisms is reflected in pragmatic philosophy (Section 3.2).

Press, in attempting to bridge the historically influential but overly simplistic divide setup by Pye, between the *workmanship of risk* and *the workmanship of certainty* has theorised new technology-based craft practice through the idea of '*connected craft'* in which the tacit craft knowledge of individuals (seen as analogous to the workmanship of risk) is brought to bear on distributed knowledge, contained in machinery and systems (workmanship of certainty) (Press, 2007:265). The researcher believes that this is a useful integration but that for craft to be retained in digital practice, the contribution from tacit knowledge needs to extend to a broader range of craft values; summarised, for the researcher, as the creative use of skill, risk of failure and uncommonness. Equally, for digital craft, the digital technology element extends beyond the distributed knowledge in 'tools, systems and opportunities' it extends, for example, to the potentials inherent in *digital* capabilities and trends, such as collaboration, convergence and customisation through the use of digital data and digital marketing, examined in Section 2.5. Digital craft is a wider and more variably constructed proposition than an elision between a maker's tacit knowledge and the knowledge embedded in technology.

Hand-made objects of pre-industrial design from individual craftspeople can meet this criteria (creative use of skill, risk of failure and uncommonness) as well as collective, machined and contemporary ones. Craft value can be provided in many different guises and to different extents. An important reason for identifying craft value in products is that, if successfully communicated, it can accrue to the object as added value. For example, finding a balance between *depth* of craft making and a *breadth* of object reach possibilities, enabled through digital technologies, is one possible customisation strategy identified as a potential of technology use within *Making it Digital* (Chapter 4).

Cardoso argues that the new paradigm replacing mass production is the 'individuation of experience' (Cardoso, 2010:331) and that craft has a role to play in providing a model of individuation based on community and shared interaction. He cites a community of producers, as envisaged by the Arts and Crafts enthusiasts, as craft's collective heritage and sees a possible new role for craft, as part of a change towards emphasis on the user's experience of a product and its adaptation over longer life-cycles. This suggests that a pre-industrial collective craft heritage (seen, for example, in vernacular forms and local workshops (Section 2.2.1)) may re-emerge in contemporary forms. This is clearly a vision beyond the researcher's current field of enquiry (although it relates to developments such as Fablabs, Section 2.5.7). However, the potential of digital technologies to facilitate collective engagement, for example through digital communication and organisational strategies, may mean that it has a role to play in new ways of providing local access to craft skills and product, that adds value. The logic of using collective skills, knowledge and resources in an identifiable craft process (creative use of skill, risk of failure and uncommonness) to provide experience and meaning, in relation to products, in flexible ways, is understood. How the potential of technology is taken up by makers' in responding to future social or environmental needs cannot be predicted. However, the potential; the 'digital proposition', for craft and digital technology combined to provide a vehicle of collective engagement, is explored in the second element of practice.

Section 5.4: Practice as a vehicle for collective engagement:

5.4.1: Description of Appledore project

In December 2009 the researcher was invited, as an alumnus of University College Falmouth Contemporary Crafts degree course, to submit a proposal to exhibit work as part of an exhibition to be held in June 2010 at The Glove Factory in Appledore, on the North Devon coast. The theme of the exhibition 'Coastlines' was set by the organizers as part of a wider Appledore Visual Arts Festival. The invitation asked for proposals for self-funded site-specific work and stated that *'The work can be two or three dimensional interpretations loosely connected to the theme of coastlines'.* A selection panel met to consider proposals in January 2010.

It was agreed that this opportunity would enable the researcher to produce a new piece of digital craft work that extended the practice work already undertaken, both by further exploring technique and as an opportunity to explore the theme of how digital technologies facilitated collaboration, a theme that had emerged from previous research and practice. The researcher felt that the possibility and ease of data transfer and accurate representation of data in high fired porcelain explored in the first practice element had potential to be used to communicate information and present visual data in a way that embedded craft within a wider collaborative context.

The researcher submitted a proposal that stated:

'*I intend, if possible, to research and make use of data relevant to coastal erosion, obtained through collaborative engagement … to represent the data in a way that reflects and communicates my understanding of the conflicting narratives of change and knock-on effects in coastal management*.'

The proposal was accepted by the selection panel at the beginning of February 2010. The practice work was undertaken during April and May 2010 for exhibition 3-6 June 2010.

5.4.2: Description of content collaboration

Initial research was carried out to identify policy issues and documents such as a recently published coastal management strategy from the National Trust*: Shifting Shores in the South West, Living with a Changing Coastline* (The National Trust, 2008). At this time, the researcher was fortunate to be put in touch, through a contact made by her Director of Studies, with a scientist from the University of Exeter, School of Geography, Dr. Larissa Naylor.

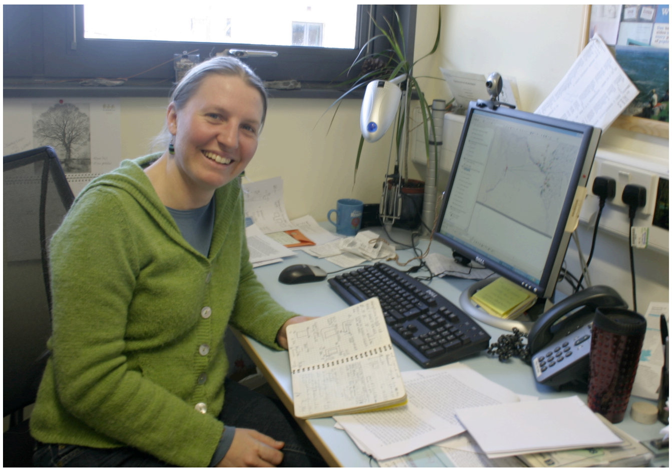


Figure 41: Dr Naylor, 2010, Uni. of Exeter, Sch. of Geography, photograph: I.Risner.

Figure 40 shows Dr. Naylor in her office at the University of Exeter, Cornwall Campus. Dr. Naylor is a geomorphologist and has a research interest in coastal erosion on shore platforms. An initial discussion concerning the possibility for collaboration was held on 23rd March 2010. Dr. Naylor agreed to make available data she had collected. After a broad discussion of several possibilities it was agreed that one data set, that might provide a suitable vehicle, was of measurements taken of boulder movements across a rocky shore platform in Wales in 2008. This data forms part of Dr. Naylor's study of the effect of a storm event on a Welsh shore platform from the 9th to 13th March 2008. The data consisted of Excel Spreadsheet files that recorded the GPS position of marked rocks at intervals over the five days, and a series of scientific data maps which plotted the movement of the rocks across different levels of the shore platform. These are very large boulders, up to ¾ of a tonne in weight and 1.5 metres in length. Dr. Naylor's work has revealed the dynamism, surprising mobility and pace of change in these types of rock configurations, in particular conditions.

The researcher was delighted to have access to scientific data on which to base her work. This data was freely given with very few preconditions on use, a level of trust and understanding was established by open communication and by the researcher making available the written proposal for the work and samples of previous porcelain. The researcher considers that she was very fortunate to be able to collaborate with a scientist whose attitude to craft was very positive and who had a genuine interest in exploring new ways to communicate scientific findings. In this case the attraction of collaborating across disciplinary boundaries was equally apparent from both sides. From the researcher's point of view, collaboration with a discipline where so much was new and of significant interest and an expert willing to take time to explain it, felt much more challenging and rewarding than sourcing imagery from within her own artistic practice. The term 'exciting' was one that was used on both sides (see Appendix 2.5 for email exchange).

The researcher felt a sense of vitality and mutual interest in cross-disciplinary collaboration and relates this to ideas about creativity being engendered by unusual combinations. From craft theory, Sennett has expressed this in the idea of active borders, sites of resistance that are also porous active edges encouraging exchange and interactivity, in opposition to fixed *boundaries* that do not allow interchange (Sennett, 2008:227). Cross-fertilisation is also the basis of a broader approach to understanding creativity examined by Ogle (2008).

The data was received in early April and the researcher worked over the next two weeks to create a composite map in Adobe Illustrator representing the boulder movement by adapting, tracing and re-drawing the maps provided and cross-checking data. The process of getting the map right involved several draft versions. In Appendix 2.6, *Figures 13 - 16* show stages of preparation and the final version. The email excerpts reproduced in Appendix 2.5 give an indication of the level of scientific accuracy and clarity of representation that both parties to the collaboration were concerned to achieve. *Figures 17 and 18* show the map detail from Panel 9, The Boulder Trap, a lower area, identified through textured shading, from which the boulders have difficulty escaping.

5.4.3: Use of circles imagery

The researcher aimed to increase the complexity of the piece by introducing layered imagery and multiple engraving processes in a similar way to the test piece process described in Appendix 2.1. The intention here was to experiment with transferring into porcelain a large variety of coastal-related imagery that represented the complexity of environmental pressures, human uses and policy initiatives that coastal management considers. The scope for additional imagery was designed to maintain consistency across the piece by containing new imagery within a standard format and size of circle, like oculi focusing in on particular points, whilst allowing for huge diversity of actual images and experimentation with a range of digitised source materials. There are around 20 circles imposed over the background map and they are split into two groups. Around half were sourced from original artwork by the researcher or from objects and imagery chosen by the researcher. They are diverse in character, from a piece of common bladderack seaweed, picked up from a local beach, dried, scanned and altered in Adobe Photoshop to the researcher's own photographs and ink drawings. Many sources of imagery were tested and a number rejected.

Figure 42:Photograph of surfer, Conor McMahon, 2009. Plaster, artwork and porcelain shown.

The ability to convert an image to a digital format through scanning or photography, and then alter and transfer the altered digital imagery from one source of output to another, is one area of digital capability explored by this work. The development of imagery and its manipulation into a desired scale and format and the variety of options for relief output in a range of media were explored. This was as a small indication of the huge potential in possible 3D applications of data that originate in one format but can be digitised and made available for output in alternative formats. 3D scanning and other data collection methods mean that the original source does not need to be 2D imagery. Within this work, data collected by GPS or 3D objects (such as the seaweed) are examples of the huge variety of data sources available. Jorgensen, for example, is a craftsperson working with hand movement data (Section 2.4.2). Recorded sounds, memories or emotional responses are the basis of work by other practitioners. The common ground of 'data' as digital phenomena provides a platform for cross-disciplinary language and communication.

5.4.4: Description of collective authorship

The researcher had been considering for some time making a piece which included imagery from a number of other makers as a further illustration of data and imagery transfer potential, that is facilitated by digital technology. The researcher is particularly interested in the potential for alternative viewpoints or perhaps collective consciousness to be directly represented in craft objects. The researcher offered the opportunity to contribute imagery that might be used as a circle image within the piece to a small group of family and colleagues who were closest to the work being carried out at the time. The researcher made it clear that overall editorial control would be retained by herself. Two of the researcher's immediate family members, two of her supervisors and two colleagues were approached and asked if they would like to contribute an image. This resulted in a very interesting and surprising diversity of images, four of which are shown in *Figures 20 to 23,* Appendix 2.7. The request was made to a very tight timescale, just a few days, and was couched in terms of an entirely voluntary contribution, yet everyone who was asked, responded positively. Only one of the contributed images was turned down, because the researcher felt that another similar image (a surfing related image) had already been included. The majority of the images 'donated' were quite unexpected. The researcher's Director of Studies contributed a photograph of a pestle and mortar (*Figure 20*) which initially was perplexing, until a personal association of experience of the grinding movement of rocks eroding on the Welsh coast was explained. A second supervisor offered the use of a number of alternative images including digital seaweed imagery previously developed in collaboration with another artist (*Figure 21*) bringing high quality digital artwork into the mix. The researcher's teenage son contributed a drawing of a boat in which the sail is a handwritten pattern of words describing the mathematical formula for measuring coastlines (*Figure 22*). The last contributed image shown (*Figure 23*) is the GPS trail from a recent kayak trip the researcher had undertaken, this was superimposed on a map and altered to give texture to the sea and land. An extraordinary richness of imagery and associations was therefore conferred on the work, facilitated by the transferability of digital data and a shared understanding of the diverse associations that imagery can convey.

The way in which this donated imagery hugely contributed value to the work, in the researcher's opinion, can be seen in the generation of interest in, and comment on, the finished and exhibited piece. A short video of the private view was made and captured something of the flavor of conversation and explanation that was directly generated by the collaborative content. A number of the contributors, including Dr. Naylor, attended the private view. A sense that there was a very direct interest and reason to talk about the content of the work was apparent. This sense of wider involvement and ownership was very noticeably at odds with the researcher's previous experience of exhibitions where work might engender aesthetic admiration but rarely gets discussed in an animated fashion. This discussion was directly related to the collaborative approach and that a number of contributors were on hand and interested in the piece. The researcher felt there was a sense of collective authorship and communication of content, *a collaborative value chain*. The lack of wall-mounted accompanying information (the artists statement – shown in Appendix 2.8 - was in the exhibition booklet) meant the narrative in the map data needed active explanation. For the second exhibition of the work an information panel that made the data more explicit was developed in collaboration with Dr.Naylor (see Appendix 2.9). Experience, then, led to this development in enhancing the communication value of the work, in this way the first exhibition acted as a pilot and the project continued to evolve. The researcher believes that this sense of interaction being facilitated by collaborative involvement is part of the *digital* potential in digital craft practice (Section 2.5). The use of a variety of sources of imagery and the greater sense of participation observed, is a small indication of how value can be added by a collaborative value chain (Section 2.5).

5.4.5: Conclusion to practice

The finished ceramic installation was exhibited in Appledore in June 2010. *Figure 26* Appendix 2.10 shows the poster advertising the Appledore exhibition. *Figures 27 and 28* are images from the exhibition itself. This piece was additionally exhibited at the University College Falmouth MA Design show in September 2010.

Figure 43: Detail of Panel 9, fired porcelain, 'Moving Boulders' May 2010.I.Risner

Figure 44: Moving Boulders exhibit, MA show, Falmouth, Sept. 2010,photograph K.McMahon

The researcher contends that the craft value of the piece was extended through the use of digital technology processes. Craft value was created in the risk of failure, uncommonness of process and outcome and the creative use of skills. This was done through a craft process being followed involving a traditional iterative and reflective progression of the work. The risk of failure is shown in process: increased time, effort, complexity and difficulty built into the work as it progressed, a successful outcome was not easily achieved. In addition, uncommonness is demonstrated in the innovative methods (including digital techniques and imagery) and unique outcome. However, the researcher believes that it is in the creative use of skills, the development of an individual approach that harnessed the digital potential of data transfer, leveraged skills and collaborative engagement that the craft value was extended through digital technology use. The researcher feels that the piece was better crafted in terms of *quality* of outcome because digital technologies had been used as well as considerable added value being derived from the use of digital technologies and digital data as a conduit for collaboration and collective authorship.

This practice element provides dual evidence of the way in which employing digital processes can extend material object outcomes in terms of both physical attributes and conceptual content. It demonstrates that craft is apparent and identifiable in complex processes that include digital elements. In this case digital manipulation of imagery enabled complex layering and composite visual construction resulting in a sense of depth in the finished pieces. However, a designation of craft is not inevitable, or equally the case with all the processes described (or synonymous with hand making). Where a digital or machined process is a simple replacement of skill with a pre-determined outcome, and not integrated within a wider craft process, it is termed by the researcher as ‘digital making’ rather than craft. Within this practice using digital technologies tended towards the use of knowledge and resources beyond the immediate capacity of the maker, such as involving greater technical expertise and embedded knowledge, in an extension to traditional making processes. In showing the ease of transferability of digital data it demonstrates collaboration across disciplines and how collective authorship is facilitated by digital means. It has provided a vehicle to interrogate the meaning of craft skill within digital practice, concluding that traditional definitions of individual skill need to be expanded to accommodate the ‘negotiated collective engagement’ identified in digital practice, but not stretched wholly beyond the traditional tenets of craft that focus on the production process of engaged complex practice and the role of authorship and experience in risk of failure and uncommonness and the creative use of skills.

The researcher believes that this practice-based enquiry can in this way be identified clearly as craft but not as autonomous, individual, anti-industrial craft. It is collective, machined and contemporary craft. The researcher believes this is a type of craft that depends on positively embracing the help, knowledge and expertise of others, particularly technical software help. It also recognises the cross-disciplinary potential of placing craft through digital means in a direct conversation with other fields. The use of digital data is ubiquitous, and potential cross disciplinary sources of data almost unlimited.

The opportunity exists for craft to make connections to audiences, acting, for example, as a conduit for interaction, communication, or for education, adding value through collaborative value chains. Some makers who are exploring the potential of new connections to audiences are examined in Section 2.4.4. Again, this is part of the digital potential across creative industries identified in Section 2.5., described by the expression: collaborative value chains. The researcher believes that a new craft genre can be identified (Section 2.4), a type of craft that looks outward to other sectors for opportunities and sees digital technology as providing common platforms. Potentially, a type of craft that sees digital technology use a way to bridge disciplinary divides and seek collaborative roles for craft. It is digital craft rather than digital making by virtue of its complexity (retention of the risk of failure), uncommonness (in object and process) and authorship (creative use of skills), a complex synthesis of knowledge from many sources, so that the skill content is effectively enlarged, rather than replaced, as it might be in a simple instrumental carrying-out of linear machine capabilities.

Having recognised this sense of leveraging skills within the researcher’s practice, it was felt to be worthwhile to attempt to establish whether this type of practice was recognised by more experienced professionals. In the following chapter the researcher interviewed a number of experienced practitioners to assess the professional viewpoint. These are working practitioners who have been drawn to make increasing use of digital technologies. The aim is to arrive at a sense of how practitioners with extensive experience of digital tool-use see the benefits and problems, and whether their views correspond with the researcher’s thesis.

Chapter 6: Professional Views

Section 6.0: Introduction

At the end of the previous chapter, the researcher suggested that a shift in the location of some elements of productive skill, and a need to source skills from a wider ambit, was a phenomenon identified within her digital practice. The researcher found that, within her overall authorship, she was willing to give up parts of the process of making, in order to reap the potential rewards of a broader toolset and broader narrative platform, which can result from being in a position to exploit the opportunities presented by digital manufacturing processes and the availability of digital data sets. The intention of the research carried out for this chapter was to discover if this dispersion (in order to gain extension) of some degree of the productive skill and a loss of absolute productive autonomy, was recognised as a way of working with digital technologies, by more experienced practitioners and what were the perceived implications of working in these ways. A small group of professional makers was approached in order to gain an insight into whether working through dispersed digital production models, accessing remote production facilities or digital skills and software expertise, for example, were working practices recognised by other makers. The researcher was keen to gather evidence regarding how the problems and opportunities of these ways of working were experienced and negotiated by professional practitioners, and whether practitioners using digital tools had become, for example, more involved in collaborations.

Section 6.1: Practitioners selected for interview

For this chapter the researcher contacted a number of practitioners by email, requesting an interview and providing an outline of questions to be asked. After exchanging emails and arranging times convenient to interviewees, a small number of experienced practitioners, who were all using digital technologies in their work, agreed to a take part in a full recorded interview. Some were carried out in person, some by video link via Skype, and in one case a telephone interview was conducted. Appendix 3.1 includes details of interview protocol and questions. Among this group of six practitioners, the level of engagement with digital technologies varied. (Participants are referred to as Participant No.10 to No.16 to make a clear distinction from numbers used in earlier chapters.) Four are very experienced in the field, that is working professional makers or designers whose level of engagement with digital technology and digital data and manufacturing methods is a significant part of their professional identity, perhaps working across several material specialisms and a variety of outsourced processes. All four of these practitioners have, for example, been included in recent Crafts Council exhibitions featuring digital production methods, three were included in the *Lab Craft* exhibition *(Fraser, 2010)*, which specifically focused on digital craft. This was a national touring exhibition including work from 26 makers, titled: '*Lab Craft: Digital Adventures in Contemporary Craft'* (Section 2.4.5). The two other interviewees are SouthWest based makers. One, Participant 11, was using digital technologies (including preparing digital artwork and buying-in services such as photo etching and laser cutting) for specific applications within their practice. This maker was contacted because they had expressed an interest in joining the *Making it Digital* scheme (Chapter 4) but ultimately decided not to apply. The researcher was keen to interview a variety of practitioners, including a professional who had perhaps considered wider digital tool-use but come to a decision about the limitations of technology and its current applicability within their practice. A final interviewee (Participant 16) is a recent graduate of the University College Falmouth Contemporary Crafts Degree and was known to be making extensive use of technology in her practice. In this case the researcher was keen to discuss how access to digital technologies during training, and how potential difficulties with access after graduation, had impacted on practice.

These interviewees are therefore a varied group, both in terms of depth of digital practice experience and type of practice. (A brief anonymised outline of each interviewee's practice is included in Appendix 3.) However, these were all working practitioners who have been drawn to consider or make increased use of digital technologies and can realistically be viewed as having moved in the direction of greater digital technology use, within the past few years. They represent a range of attitudes from a generation of makers which has directly experienced the opportunity to access a wider range of outsourced and digital manufacturing processes, the use of digital tools for design and artwork as well as communications and marketing.

This research is therefore timely, in the sense that it is able to capture these individuals' views both on, and in, potential transition from a pre-digital to a post-digital engagement, within a broad variety of practitioners who have a differing extent of digital involvement. Several were trained before these techniques were widespread, or got a first taste of technology use during their training but have gone on to develop their practice by exploring and pursuing digital technology-based solutions. They are in a position to comment on, and help establish what, the day-to-day impact of this kind of change means for them. They have practices originating in a wide variety of materials and specialisms including jewellery, furniture making, glass making, ceramics and general craft and design.

Section 6.2: Interpretation of findings

As identified in Appendix 3.1, three broad themes were identified by the researcher from the interview data. They are detailed below and each is discussed in turn within the following three sections.

1. Role of technology and definitions of practice (Section 6.3).

2. Technical relationships and access to technology (Section 6.4).

3. Authorship, collaboration and a sense of collective engagement (Section 6.5).

Illustrative statements from the interviews are included as examples of the points the researcher wishes to make. This chapter describes practice as it is reflected on through a single interview between the researcher and each of these individuals (unlike Making it Digital, where the researcher had extensive participation in the programme or her own practice-based enquiry where extensive data, collected over time, was available). However, these interviewees have extensive experience over a number of years of working with technology and provide a valuable ‘real-world’ professional perspective. Each practitioner’s experience is individual and cannot be generalised, however they broadly represent a range of makers negotiating with the possibilities that digital technology affords. The researcher was keen to try and identify both common themes and differences amongst this small group who share the experience of working as makers engaging with digital technologies. Other makers, however, will have a different perspective. The researcher considers that this commentary, then, is an interpretation of the evidence of these individuals’ practice, based on interview data and the contextual and research evidence she had previously gathered and the issues that had previously emerged. It adds some evidence from a professional perspective to the researcher’s emerging thesis of digital practice, and is viewed by the researcher as a way to see whether issues identified correspond with the researcher’s thesis. It can be considered as a method of theoretical sampling (Section 3.3.3) within a grounded theory approach, in the sense that the researcher at this stage was looking to probe previously identified issues, such as the contention that there is a predisposition within digital technology working practices towards collective engagement and the facility for collaborative practice.

Section 6.3: Role of technology and definitions of practice

The researcher began by asking what role digital technology played in the interviewees' work. The researcher understood that these interviewees, in general, expressed the relevance of digital technology in their practice in terms of what it allowed them to do, the potential of specific capabilities. These reflected the potentials previously identified by the researcher, earlier in this research (Section 2.4.6 and Section 4. 7). For example, specific affordances were mentioned several times that fell into the categories, as the researcher considered them, of data manipulation, data transfer and making connections to audiences. One interviewee explained that she felt technology played a central role in her work, mentioning one important aspect as the ability to design and make on a much larger scale than was previously possible (Participant 16). Another said it was particularly useful because it was quicker, faster and more efficient for repetitive tasks (Participant 11), allowing them more time to be creative. Another commented that it afforded an immediacy of 'connection', a potential to make connections (between people and places for example) that was difficult to achieve with other mediums (Participant 14). The role of manipulating and changing designs and generating variations '*so you can cover so much territory so much quicker'* (Participant 12) and the materialisation of concepts were also mentioned (Participant 13). More general benefits were also highlighted, for example, that technology could spark or communicate an idea.

Generally, the researcher felt there was a practical approach towards the role of technology, as an appropriate 'tool' to convey the makers' vision and the narrative of the work. For one interviewee who was most closely associated with design (as with the MiD participants who identified strongly with design) there was a natural assumption that, as a good designer, you would know what digital equipment was available and use it when you needed to (Participant 12). This focus on the usefulness of technology, in contexts, seemed to the researcher to place digital technologies within a continuum of tool-use, rather than place an emphasis on a particular range of affordances by virtue of being *digital*. One interviewee described digital as a 'medium' or 'material' (Participant 14) but, for most, the language used suggested the concept of 'tools'. The general view of technology as useful in particular contexts was reflected, the researcher felt, by a concern among interviewees that the technology wasn't too pervasive in their work. There was a determination not to be, and a desire not to be seen to be, 'technology-led'. For example, two of the makers expressed the idea that work shouldn't be '*a showcase of the technology*' (Participant 13) or was less interesting if it was '*an expression of what the machine can do rather than having an inherent language*' (Participant 12). Emphasis was often placed on the narrative content of work, or the relatively greater importance of the ideas expressed and the maker's creative vision rather than the technology itself.

'*it's not that we've got some wizzy tools and I'm dying to use them…you've got to use them appropriately…in order to communicate an idea. To tell a story… there is so much story-telling potential…*' (Participant 10)

There was a strong sense that of technology as a 'tool' among a range of possible tools alongside an understanding of the 'potential' of digital engagement. Not being 'technology-led' was apparent in many comments about how the technologies used needed to be *appropriate* to the task, not just a question of exploiting technology for its own sake. One interviewee described how the idea for work, knowing what you wanted to make and why, came first, before choosing an appropriate tool, otherwise it was putting '*the cart before the horse'* (Participant 11). For the researcher, the language of 'tools' and 'control', and the sense that that the 'tools' used should be limited, appropriate and under the makers' 'control' signaled a view of technology, to some degree, as neutral and content free (Section 3.2.1) under the control of the practitioner. This suggests a characterisation of technology in which tools are seen largely as a means to an end (Marshall, 2002:3). Equally, the interviewees rejected technological determinism. They did not want the technology to determine the results achieved. One participant, for example, said he was '*a little bit wary about technology in that sense because it can limit you as well because then you start designing to the limitations of the machine and particularly where the machines are very expensive and time consuming and you need a technician to operate them'* (Participant 11).

This relates to the researcher's own concern to avoid '*the spectre'* of determinism (Section 5.2.7) in her own practice work, through the development of a relatively complex process and imagery. These interviewees, then, tended to emphasise authorship, ideas and narrative and the development of an individual approach and visual language.

Several interviewees expressed the idea that a stereotypically digital visual aesthetic language would be at odds with, or unsympathetic to, their work. For example, one interviewee commented that she hand finishes pieces after a digital manufacturing process because if they were left '*very, very crisp…it would look a bit clinical and cold*' (Participant 16). Several expressed dissatisfaction with other work that spoke too loudly of its digital or technological inception. Part of the reason for this, the researcher felt, was a desire that their own final work was not too closely identified visually with the process used, that the maker's intention and vision is not subsumed under interest in how it was achieved.

'*a design that happens to use digital... some people use it as a full-on language in what they do...yet...I guess...I think of it just as another tool.... some objects use it some objects don't.... I don't design explicitly for it... that would defeat the object of what I do*' (Participant 12).

Interviewees, then, were generally keen to ascribe an important but limited role to digital technology use and to re-assert the importance of the maker's vision and their own visual language. That sense of having developed an individual approach, a strong sense of deliberate autonomous authorship, having made individual decisions in the interests of how the visual or communicative value of the work was best served, was very apparent. The researcher felt that the affordances of *digital* technology, as a set of potentialities, the digital 'proposition' (Section 2.5.9) was less well recognised, or perhaps not expressed by interviewees, and was not explicitly explored by the researcher.

There was agreement among several interviewees that the use of digital technologies had changed their practice. A cross-disciplinary outlook was reflected by some interviewees in the terms used to describe their practice and possible titles they used. One described his practice as being in a grey area between art, craft, design and technology '*taking from where I need and bringing together elements of all those disciplines*' (Participant 10). Another suggested they had become more of a 'hybrid designer' and added that the title they used to describe their work may depend on the audience they were talking to (Participant 14), an approach that was common to a number of participants in Chapter 4. A third said he had been through a number of possible titles and definitions of his practice and eventually decided on 'Creative Director' (Participant 13), potentially echoing the role of orchestration in digital practice, described by the researcher in Section 2.2.2 and Section 4.9.

Section 6.4: Technical relationships and access to technology

The researcher was keen to explore the extent and types of technical relationships with individuals that had been developed by interviewees. The main part of each interview was devoted to this theme. What emerged was a complex range of different types of relationships, and sources of technical help. There was a wide variety of arrangements, from one-off, technically specified and out-sourced production contracts for elements of practice, to an individual working in a full-time collaborative research working environment, predominantly a computer science department, with access to programmers and electronics engineers (Participant 14).

Despite the variety of these technical relationships, they were an important (and readily acknowledged) element of practice for all the interviewees. Interviewees commonly expressed a sense of gratitude towards technical partners, valuing others' expertise and contribution.

'it's fantastic to work with... Gxxx... has to deal with my gargled data...absolutely crucial...without Gxxx I would struggle and I did struggle with another company' (Participant 10).

Many talked about how they had developed particularly valued working relationships over a number of years, resulting in innovative individual processes. Almost always they were on first name terms with individuals who made important contributions to their work and with whom they had developed bespoke solutions to process issues.

'Yeah, he knows what I'm doing ... and when I was developing it he used to say... Oh…I don't know if that's going to work and if there was problems with it... it was something that I had to think about and work around and work out how to do it myself but now that we have done that and he has seen me doing it and he trusts my method…' (Participant 16).

Good communication with those making a technical contribution was identified by several interviewees as being vitally important, to the extent that there were several comments concerned with how successful outcomes were based in good understanding, and the development of shared language and meaning.

'So, when you start working with people from such a different discipline… four years ago it was about finding words that meant what we wanted them to mean between us…learning what the other one means and what we are talking about and sometimes that happening through heated discussion, where you are coming from very different perspectives' (Participant 14).

There was a sense that a number of interviewees recognised that part of the progress of their practice was in developing skills in the language and communication they needed to put forward their intentions, and precisely arrive at options and solutions that they wanted. Interviewees identified this sense of skill in language as important in different ways one interviewee, for example, felt that he was better able to approach and communicate with specialist companies because he understood the language needed to discuss process.

' at the RCA I did make myself… but I was supported by amazing technicians.. these guys helped me so much...I can never thank them enough… but that way I understood a process, the language of what was going on… and I think it has added a tool, it's added a skill.. it's added a language' (Participant 13).

Another interviewee, with extensive experience of using CNC routing machines, expressed the need to work closely with the machine operator to, in effect, translate his intentions into machine instructions that would achieve the right quality of outcome:

'the same kind of things you would do by hand…so you are asking the machine to slow down..and take a little bit more care…not to chop off as much every time… but you just have to communicate that digitally to the machine through the operator' (Participant 12).

Several interviewees related stories of previous relationships, sometimes with companies they had outsourced work to, which had been problematic because of a failure to appreciate what really mattered to the maker. Two interviewees detailed how past projects had suffered from poor communication, for example, the standards and language of a technical company, used to dealing with demanding technical specifications, were mismatched to the maker's priorities.

'because they came from an engineering background they didn't have the same vision of what I was trying to achieve as me... and also like the tolerances of things... they were overly worried about certain things that wouldn't have mattered to me and some things that did matter they really messed up some times because they didn't know that it mattered…' (Participant 16)

Another participant had experience of a problem arising from a similar misunderstanding of the maker's intention:

'*I sent them the data that needed refining but in refining it they omitted a whole chunk of this design… it was completely integral to the story... and went ahead and printed it… because it was simpler to do it without the interior structure…just a lack of communication'* (Participant 10).

There was a strong sense that makers had had to work hard at finding the right relationships, communicating their vision and ideas, and hugely valued the technical relationships that they had invested in. One interviewee, for example, described how she had learnt to appreciate programming as a craft skill.

'Sitting with them and watching how they work… it's very much a craft and there are a lot of parallels I could draw…no two programmers will do something the same way… if they work on the same task and they will do it differently...and it's a lot about playful ways of trying to do something… Building up your own specialisms…and beautiful bits of coding that you want to

use again and change to fit into different contexts… and thinking about them as craftspeople is a really good way in for me to be able to talk with them' (Participant 14).

Developing and using specialist shared language and a depth of effective communication was sometimes expressed as a way to maintain very close engagement and control over process, which had, to some degree, been relinquished in order to get the required results.

'although a lot of my work is outsourced I can't just let it go away... I have to understand what's going on... there's that control element which I think the majority of craftspeople have... even if they are not doing it physically...actually using their hands let's say in a very direct sense... they need to know... for me that means being a facilitator understanding the language of what's going on' (Participant 13).

The researcher felt that, for the majority of these makers, coming from a background of traditional hand making techniques, gave them a very strong grounding in process and were used to having total control over process, they were willing to give this up to some degree, in order to gain specific benefits of using digital technologies or outsourcing but expressed the importance of maintaining their creative control. One interviewee, for example, expressed a degree of separation from their work and a regret that, at times, they were not able to be more involved in some processes.

'I really, really wanted to just get in there and look over their shoulders and do the computer thing with them and get the mask cut,.. I wanted to be in there with them doing it and of course I couldn't...they just take work and take it away and you come back when it is done and I felt very separated from it…' (Participant 16).

Another placed clear limits on the role of outsourced technical contributions, saying:

'I'm not expecting them to be creative…I don't want them to be creative…because that's…from a selfish point of view what we do…they are technicians who know their stuff back to front…they want to get everything correct…to do the perfect job for you' (Participant 11)

The above comment was one of a range of responses when the researcher asked whether their practice had become 'a bit more of a team effort'. None of the interviewees totally rejected the characterisation of practice as a 'team effort'. Some form of collective engagement was seen as necessary and a positive advantage, but was clearly something that had taken time and patience to arrive at, developing working methods that suited both parties. Sometimes a discrete area of the process had been extended through specialist intervention.

'It is more of a team effort in that a lot of the software and hardware is extremely complicated and I can't pretend to have mastered the technology so I do rely on people who are more expert and specialised than me' (Participant 10).

This sense of reliance was mentioned by another interviewee and reflects the researcher's experience of reliance on technical expertise (Section 5.2.2). Asked about the appropriateness of 'team effort' this interviewee responded:

'*that's' exactly how I would describe it because it is about the reliance on people*' (Participant 13) and described, at another point in the interview, how reliance on a large company from whom he needed a specialised process, for a small one-off job, was challenging:

'You rely on people and this relying is… it's probably more stressful than making it yourself...I am literally...I am in their hands...and it's a very... that's when my negotiation skills have to come out as well... that's part of the art form as well and perhaps a lot of my practice is actually emailing and talking to people in that sense and it's weird... it's a weird craft form.. I can't really describe what it would actually be…' (Participant 13).

For the researcher, this sense of a new form of craft, that depends on good communication being used to animate the skills of others, within a complex iterative process that brings craft sensibilities to bear on digital processes, is reflected in findings from earlier elements of the research (Section 5.4.5). The development of skills such as orchestration, communication and curation relates to the concept of '*re-skilling*' in artistic practice, discussed in Section 2.2.2. Another interviewee asked whether their practice was '*a bit more of a team effort than working in a traditional way'* highlighted a sense of an enlarged and extended collaborative space, enriched by both craft and digital expertise, bringing experience from both fields together, for the researcher this related to the discussion of creativity in hybrid practice (Section 2.4.6).

'I think it certainly is and I think it's about bringing sensibilities from the background that you come from into that mix...and what you have got to bring to the party really.. it is quite a democratised process when you are collaborating with somebody but I think there is potential to influence one another' (Participant 14).

Another way in which working with digital technologies tended towards more collective engagement was highlighted by an interviewee who suggested that perhaps there was a growing sense of a group of people engaged in similar explorations. For the researcher, this implies the establishment of a genre (Section 2.4). The interviewee suggested that:

'a body of people start working and using these machines in this way.. then people come together and it does create a little bit more of a movement ... that's what's different between 1996 and 2010….that body of exploration filters through and encourages other people' (Participant 12).

During the course of the interviews a number of familiar problems with working with digital production facilities surfaced among comments from interviewees. Access to technology was particularly a concern for Participant 16, who as a recent college graduate was adjusting to sourcing machinery and commercial facilities outside of an educational establishment.

'tooling companies often have the kind of machinery that I could be using but they use it in their own way and they don't understand how I would use it' (Participant 16).

She had considered many different options to gain the access she required:

'I thought that I might be able to outsource things but obviously that costs so much more... they all cost like ten times the price... it's been really hard I've actually ended up developing another way of inlaying that doesn't use digital technology' (Participant 16).

At the time of the interview, this interviewee was making long trips back to University College Falmouth facilities, to enable work to be made.

Time constraints and the need to be always learning new skills were also commonly cited as problems, both in the general sense of self-employed practice being time pressured and because the technologies required new skills to be learnt.

'because when you are self-employed time is always of the essence so I just had to focus in on exactly what we needed to do the artwork' (Participant 11).

'Alongside all the creative developments of the work there is also a need to be learning the technology, learning the software, learning the manufacturing processes in order to realise their potential... to be able to draw them as you imagine them.......complex pieces... quite a high proportion of the time is ***still*** *learning how to use the software efficiently'* (Participant 10).

Several participants talked about how working with craftspeople, or on artistic projects, could offer advantages to the other partners, such as technical experts, commercial machine operators or project collaborators. One mentioned that the opportunity to work on something a bit less rigid than most of their regular manufacturing work was welcome *'for people that operate a CNC machine there's quite a lot of monotony in a commercial situation for them'* (Participant 12). Another suggested that collaborators were interested in challenging their own practice and working on difficult projects that explored their processes *'you have to get them interested… the majority of people I approach their first response is 'that can't be made that's almost impossible' because it hasn't been made before*' (Participant 13).

There was an awareness that, in projects that could be described as creative collaborations, both parties may have their own experimental agenda:

'*I am always aware of them being able to go where they want to with it as well… so if there are things they want to experiment with and try out ...if it's only a bog standard bit of code... sometimes that happens... but I am conscious of wanting to make things we are both proud of in terms of having extended our practice'* (Participant 14).

Section 6.5: Authorship, collaboration and a sense of collective engagement

Following on from the makers' reaction to the idea of 'team effort', the researcher was keen to explore how this related to any sense of a shift from productive autonomy to a greater emphasis on autonomy of authorship (Section 2.2.3). How did working with others impact on a separation of creative vision from physical making? For example, did these interviewees feel that their sense of authorship and ownership was more closely identified with ideas and design than might be the case in previous craft practice focusing on process? As these interviewees covered quite a range of types of practice the researcher expected that attitudes would vary. Participant 12, for example, from a design background, suggested that there was no major change in practice '*the machine is just an extension of your own arm… or the machine that I have been using is an extension of my own arm and even the computers are…'* (Participant 12). Other interviewees also emphasised themselves as the source of creative ideas and narrative in their work, so that there was some evidence that a relatively greater importance was being placed on pushing through the makers' creative vision, and that the process didn't come first. One interviewee located her sense of ownership in ideas and in the designing and commissioning process: *'a lot of the work I do ...because they haven't had any input in the design stage of the work, meeting the client and finding the work so that makes me feel like I have ownership over the project…because the ideas come from me'* (Participant 16). For another interviewee, being explicit in language alongside being very closely engaged in process, with the input (and output) of others, was seen as one way to ensure results that were what the interviewee wanted. *'…it makes you focus in on what you want to achieve and learn to articulate it because you are not the only one producing the objects you've got to articulate it in lots of different ways and be clear about the texture or pace of the digital thing you want to happen… and before… those conversations were there at the back of your mind but now they are a lot more explicit'* (Participant 14). Another participant said the major impact of working in this way on their practice was that they spend '*most of the day staring at the screen.. rather than out in the workshop with all the physical activity*' suggesting a fundamental shift in process, this interviewee added that although the work involved more people than previously, the creative side still felt very personal: '*in practical terms I'm dealing with more people…this work takes a lot more thought and it's looking out into the world more….the work has become more public in some ways*' (Participant 10).

Several interviewees talked about the excitement and interest generated from the conceptual possibilities opened out by the availability of digital data and new digital themes in their work emphasising awareness of digital potential. Generally, the researcher sensed that for some participants a bigger canvas and new opportunities had resulted from digital engagement, whether through new ways to connect and engage with audiences or new ways to think about presenting and incorporating meaning within their work

'but for me the most exciting areas are not in the manufacturing but in the software of the thinking behind mobile phone or satellite communication' (Participant 12).

However, the proportion of time that interviewees could devote to developing work was also an issue for some participants. There was a sense that practice was constantly under pressure, and that participants had to be able to develop skills in many different areas, including the orchestration of practice and negotiation of competing claims on their time. This was expressed by Participant 13, among others.

'I have got five projects on the go just now...and that's the way I work.......so I am always juggling… but they are all over the world... so I am kind of controlling this and then I have got different exhibitions coming up ... a sustainable practice isn't just about making work… work is just about ..I don't know…15 per cent of my practice...' (Participant 13).

Section 6.6: Conclusions: Impact on practice

Many interviewees recognised the researcher's central thesis that they were operating in a more collective way, but the nature of these collaborations, the quality and texture of the relationships vary very considerably with the nature of the work undertaken. The term 'collaboration' should perhaps be reserved for those partnerships that involved a long term personal relationship built on good communication and an understanding of the developing visual language of the particular maker. Collaborative relationships involve the interchange of expertise and options that extend and add to the practice of both parties. Developing a collaborative partnership wasn't the intention of using technical help for all of the interviewees, some had a more limited role in mind. Almost all of the makers talked about how they didn't want their work to be defined by technology use. Several interviewees, at the start of the interview, pointed out that they were not 'seduced by technology', 'geeks' or 'technology-led . What mattered most to participants appeared to be the ideas, narrative, design or personal visual language. Several were concerned that the final outcome didn't have a technological aesthetic, that it didn't speak too loudly of the particular process used. At the same time they had enormous fascination for the potential that digital working methods gave them and respect for the expertise and crafts skills of their collaborators. They have to maintain a balance between retaining a strong sense of it being their own work, emanating from their personal vision and under their control, and yet having to animate extensive specialist help and use of specialized tools to realise that vision.

Alongside an assertion of the pre-eminent role of the maker, there was also a recognition, by some, of a shift in practice away from material specialisms and direct hands-on control towards more amorphous and shifting practice definitions. The control that they may once have had over the physicality of making at every stage of production seems, in some cases, to have been displaced somewhat to a communicative sphere, where ideas and intentions have to be fully thought through, discussed and made explicit in language to be able to be realised, following the true intentions of the practitioner. Collaborative relationships, where collaborators are also experimenting on behalf of practitioners and extending their own practice, were a feature of some of the practice described. That slow experiential process of craft production is carried on in communication and the building of a shared language and understanding. Other interviewees had developed practice through elements of outsourcing that delivered closely monitored required results, and such specific arrangements were very varied and changed with specific projects.

One participant explained that during the production process, of final exhibition versions of work, he was often physically separated from the process of making:

'the first time I saw the work was the day before the private view.... I do this all the time now...this is how I work....I've worked this way probably for the last three years…a lot of my work I don't see until perhaps… as the audience sees it… and I like that' (Participant 13).

So there is a sense that a number of interviewees have come to (and ultimately welcome) the realization, over a period of time, that some particularly large projects have a specialist production process, need very specialist skills or complex digital processes, for example, which mean they can't make everything themselves. They have developed ways of working that still give them control over their own work and ownership, but the degree and type of control that each requires is different and may vary with different projects, they have negotiated collective engagements, through a variety of means. '*I think that when I left the Royal College.... the biggest...I still class it as the biggest turning point in my career when I stepped back and went 'I can't make everything I want to make'* (Participant 13).

Another interviewee who expressed satisfaction with this way of working was content to have given up some control:

'I do understand some of it but I am not a programmer and for me it is a collaboration... I don't want to have complete control over it...that kind of relinquishing of control... giving something that somebody else completes...it's quite daunting to begin with but I wouldn't want to work in any other way now. It's actually about the way that you can build up relationships.... bringing your sensibilities and learning to be a good communicator...'(Participant 14).

The quality and nature of communication, the relationships and understanding created in collaborative partnerships, are described as particular to the project undertaken and contribute to the character of the work. As Participant 14 explains:

'It's not this generic collaboration....I think that's a flawed conception... it's actually finding the right people to collaborate with ...it's not just any old programmer as it wouldn't be any designer...and each participant that I work with gives the project a different flavour' (Participant 14)

The question posed at the beginning of the chapter asked how practitioners accommodate the need for greater dispersion of skill in digital practice. The evidence from these interviews, although very limited, suggests that where physical control over making is somewhat relinquished makers are keen to animate the skills of others and negotiate collective engagements that enable them to retain enough control over outcomes to be absolutely confident that the work is an expression of their creative vision. Keeping a level of control over production that they are happy with may require them to be very clear about the limitations of what others do for them and keep it within a limited sphere. Another approach is to build close individual relationships of trust so that they can be confident collaborators will understand and stick to the remit and negotiate any creative contribution; a third solution is to return to a trusted productive environment, such as a university research and production facility. They are particularly wary of being technology-led. The essence of an experiential, closely monitored and engaged 'craft' process is retained through complex interactions and communication mingled with genuine interest in, and respect for, collaborators.

'through their expertise… and what they can think of the digital being able to do they will introduce things to me that I couldn't possibly have thought of beforehand.... you know the sort of nuances of something and that I find really fascinating… you are working with experts and they are so talented at what they do' (Participant 14).

Interviewees sought to stress the *application* of technology to *their* projects rather than influence being exerted the other way round. This was expressed by Participant 13:

'as long as we start understanding it's just a tool... and we don't stress that it instantly creates innovative and exciting objects… it doesn't.. .it's the application of this which is important… so I hope the application is stressed more than the innovation of the technology itself...' (Participant 13).

The researcher acknowledges the fundamental role of authorship in practice and has reflected this in the criteria she has used to identify and value craft skill within digital practice (examined in Section 2.3.4) by placing emphasis on the '*creative use of skills'* – explained as authorship and innovation in developing an individual approach, that may include the use of leveraged and embedded skills. However, the researcher contends that *digital* technologies, by virtue of being digital, present a range of affordances and trends in digital tool-use (identified in Section 2.5) which are identifiable and applicable across creative industries. The broad canvas of the 'digital proposition' for craft presents opportunities to makers in particular spheres, such as the manipulation of 2D imagery, data transfer and manipulation, 3D materialisation of data, the facilitation of new connections to audiences and collaborations, as outlined in Section 2.4. The researcher has put forward her adoption of a pragmatic view of technology (Section 3.2.1) which sees technology as an 'active counterpart' in the creative process, part of an iterative cycle that cannot separate ends and means. Within this view, digital technology presents an agenda and proposition but the outcome is not determined. Every individual practitioner may make innovative and unpredictable uses of digital technologies by exploring and experimenting, in rich, surprising and individual ways, through animating specialist help and expertise. However, the affordances inherent in digital technologies will be a part of the process that influences practice development. The researcher believes that this interplay allows for the identification of a genre (Section 2.4). In this way, the researcher contends, digital technology is not a neutral tool, it brings with it agendas and potentialities, which are exploited individually. Several interviewees did mention digital potential and digital affordances, suggesting that the influence of the technology in offering possibilities in particular areas was understood and a part of their practice, however, ultimately the emphasis was placed on not being technology-*led* and a view of digital technology as providing tools under makers' control: technology-*enabled.* This suggests that digital technologies were valued for specific project applications rather than seen as part of a broader interaction, bringing properties and characteristics that present a general 'digital proposition' (Section 2.5.9), '*teeming with values and potentialities'* (Hickman 1990:13) (Section 3.2.1).

In conclusion, the researcher feels that this element of research provided some evidence of corroboration of several elements of her thesis. For example: a move towards authorial autonomy and away from direct productive autonomy; the development of new immaterial skills; a degree of identification with a new type of cross-disciplinary practice and 'team effort' – collective engagement; and the facilitation of collaboration within digital practice. However, for the researcher, the most important insight from this element of research is not in the similarities between interviewees' practice but in describing the differences in working practices. Digital practice does not inevitably imply particular working methods such as creative collaboration. As these interviewees' responses show, each maker has to negotiate collective engagement appropriate to their current practice and the project on hand. A wide range of sources and degrees of technical help, digital expertise and production from specialist facilities was apparent.

Chapter 7: Analysis

Section 7.0: Introduction

This thesis has considered existing research and scholarship in the field of UK designer-maker practice in relation to craft values and digital tools and presented new observations, research and discussion regarding the impact of digital tool-use on practice. This chapter concludes the thesis and presents the researcher's reflections. It brings together the existing knowledge, the contextual research, the case studies, practice-based work and practitioner interviews and presents findings and conclusions that answer the stated research aim: *'to produce and evaluate evidence and formulate knowledge with regard to the impact of cutting-edge technology adoption on design and craft micro businesses. The research will focus on the process of change and whether it can extend practice'.*

The methodology, Chapter 3 deals at length with the philosophical and practical approach adopted towards the research question: *What is the impact of using digital technologies on designer-maker practice?* The methodology emphasises the lived experience and engagement with makers, projects and personal practice, findings which are reflected upon and interpreted in conjunction with contextual reading and theoretical texts. The research question was approached from several directions: in part from large scale abstractions – the theoretical understanding of the context of change in the global digital economy, other creative industries and extensive reading, for instance, of craft theoretical texts. The research question was also approached from very small scale concrete experiences – the researcher's own practice as a maker and that of other makers engaged in a knowledge transfer programme or professional practice. This approach was the best fit to the research question. The investigation of emergent practices of technological change within the broad context of digital developments, required enquiry from a variety of perspectives, from the macro-level of the global digital economy to the micro-level of enquiry into individual practice.

Chapter 4 details research into a knowledge transfer programme, within which makers experimented with digital technologies to develop a new product, called *Making it Digital* (Section 4.0). This practice-led enquiry, based on grounded theory, set the agenda for later investigations. The crucial insight that there was a need to 'negotiate collective engagement' to make effective use of digital tools emerged from the analysis of case study data. This led to the understanding of the 'digital proposition', the agenda and potentialities presented by the use of digital tools. Most notably for craft, the researcher recognised the relevance of *collaborative value chains* (Section 2.5.1), the idea that users and customers are, through the mediation of digital technologies, better able to contribute to the value of artefacts. For the researcher, the potential of collaborative value chains also applied to digital craft production. The need to negotiate access to equipment and digital expertise and the capabilities of digital data transfer encouraged collective engagement which may take many forms, from limited technical assistance to thoroughgoing creative collaborations (Section 6.6). This early case study work was a study of a situated mentored knowledge transfer programme (Making it Digital), so a finding of collective engagement was not surprising, however, a digital facility for shared engagement and collaboration in production (and in some cases in authorship) was later corroborated through the researcher's own practice, professional interviews and in the contextual evidence of other digital creative industries. Early case study work was in this way subjected to triangulation from other sources and, in an on-going and dynamic enquiry, this knowledge came to be understood within a contextual understanding of the concept of autonomy and the researcher's analysis of the meaning and value of craft skill.

The conclusions in this analysis section have been made by integrating the knowledge and experience gathered and continually referring back to the data gathered and the data gatherer. The researcher's philosophical understanding of how change occurs in emergent practice, through experience (Section 3.2:117), meant that actual situated practice was the only viable locus of enquiry. A study of emergent practice also suggested that grounded theory was the most appropriate method because the research concerned concepts that were not fully articulated and formed but could, through this method, be identified, brought into focus and explored. The advantage that grounded theory presented to the researcher was the opportunity to develop theory rather than testing against an existing theory.

The inquiry undertaken by the researcher into philosophies of technology, following from the work of Marshall (1999) (2002) alongside her own practice experience, have led to a view of technology as '*as an active counterpart in new possibilities, a sense that technologies bring potentialities and agendas but that the experience of makers brings into existence new outcomes and uses*' (Section 3.2.1:122). This analysis seeks to make explicit the agenda and potentialities of digital craft, both from the top-down work on digital trends and from the bottom-up work on makers' practice. What makers do with that agenda and potentiality can only be forged in experience and has been shown to be full of surprises (Review of Practice 2.4). This analysis is essentially a summary and integration of observations, reflections and conclusions that have been previously discussed in detail, in the body of the thesis.

Section 7.1: UK designer-makers

The Contextual Review Section 2.1 began by asserting that the terms ‘craft’ and ‘designer-maker’ were not popular among interview participants; ‘designer-maker’ tended to lose out to more descriptively focused terms such as ‘jewellery-maker’ or ‘furniture-maker’ and ‘craft’ to ‘design’ and ‘art’ (Section 2.1:19). The use of the term designer-maker within this research was defended on the grounds that it had been used in previous research and there was some evidence of its gaining in popularity as a generic term, such as its use by organisations representing groups of makers and in exhibition reviews. However, the researcher recognised that it appeared to be unpopular as a self-identifier for individual makers, for example within the London Design Week Festival. Associated from the 1990s onwards with a design career path designing and manufacturing ‘*limited edition, one-off or bespoke products for retail’* (Design Council, 2012) the term has been used in a broader context within this research and is intended to be inclusive of the multiplicity of specialisms, materials and processes used by people that design and make objects on a relatively small scale within the design, craft and art sectors, with a particular focus on contemporary craft.

Industry statistics for the craft sector reveal difficulties with both definitions and comparable statistics for the numbers of makers engaged in the field. Economic estimates are complicated by factors such as many makers working part-time, for example, engaging in making as part of a portfolio career. One 2004 Crafts Council survey estimates 32,000 makers (Section 2.2) , the more recent Creative and Cultural Skills report estimates 88,250 makers, on a more inclusive basis (Section 2.2). There is general agreement that estimates are likely to be under-reporting activity and further research on economic impact of the sector is needed. The South West is highlighted as a hotspot for craft activity. Previous research into the designer-maker industry sector establishes historically strong links with innovation and with adaptable and varied working arrangements, the term *bricoleur* is used by the researcher to describe a professional approach that constantly seeks to define and redefine ways to combine elements of traditional and innovative practice. This view of makers was borne out by interview participants both among those interviewed for Chapter 4: Making it Digital and those interviewed for Chapter 6: Professional Views. They were from a variety of sectors and experienced in many different materials and processes. What seemed to unite the makers interviewed was a self-directed entrepreneurial outlook that often spanned multiple roles and job titles. Most identified with some element of design as well as craft; they were highly skilled practitioners, often with a depth of experience and practice in a particular field. The sense of working between and across sectors was prevalent. For example, an interviewee who had previously located his practice in a material specialism, described digital practice as more diverse:

'*I do like being in this gray area...somewhere between craft, art design, technology…sort of taking from where I need, bringing together elements from those disciplines...'* (Participant 10) (Section 6.3).

Despite the lack of a strong personal association with 'craft' by many makers, the researcher argued that one-off and small scale production is viewed in a craft context and that positive value does attach to the objects of craft practice. In Section 2.2.1 the researcher examined the complex and somewhat contradictory characterisation of craft, which can seem unattractively backward-looking for innovative designers or artists, yet can also be usefully associated with positive aspects of highly skilled specialisms. This is explored through the work of theorists including Sennett (2008), Adamson (2007) and others. The researcher concluded that some of the attributes associated with craft are: engagement, experience, time invested and creativity grounded in practice. Alternative views of craft as rooted in the ancient practices of hand-making functional objects, and therefore brimming with relevance in distinction to industrial production - Risatti (2007) - were explored. Craft's material sensitivity and the role of tacit knowledge in integrating theory and practice, resulting in a holistic activity, were emphasised. The researcher argued that craft has a conceptual role and image as a form of production in distinction to large-scale industrial production. This has tended to result in one view of craft being centred on the merging of vernacular forms with pastoral idylls and a restricted permissible '*idea-space'* (Ogle, 2008) for craft that relies on the '*constructed authenticity'* (Journal of Modern Craft, 2008b:179) of traditional studio practice within which an emphasis is placed on productive autonomy. In conclusion, the researcher argues for a view of craft that sees it as a loose assembly of a range of elements that can be configured to produce objects imbued with values that range from materiality and individual skill to authenticity, uniqueness and creative expression. Whilst many elements, from political associations to environmental concerns, may shift and be more or less present or altogether absent, in particular craft expressions, for the researcher, craft (in the sense of craft object making) always means one-off or small scale creative production and always brings together skill and intentional cultural meaning (Section 2.2.1). The idea that creativity results from immersive work in a dedicated field being understood and transferred to an adjacent context, where it can lead to innovative solutions, is also discussed. This relates strongly to the creative potential of two unlike domains, digital and craft, being in close proximity.

The view of craft values from the group of makers interviewed for Chapter 4 (MiD) was also a complex one. Most were themselves designers or makers with a depth of skill in a particular narrow field and they certainly expressed some reverence for highly skilled craftsmanship and an understanding of a sense of engagement. A number of interviews were occasionally sidetracked by a descriptive discussion of much-loved materials and processes. However, there was also a strong desire to innovate and move beyond the perceived narrow groove of repeated craft practice. There was a general sense that 'hand-made' need not be a literal term and that appropriate digital technology and machine use was acceptable. The definition of craft for these makers tended to depend in some way on engaged, skilled making of unique, one-off or uncommon objects. The meanings of craft value for these makers are explored through a series of 'word clouds' developed from interview data (Section 4.6.3:172). Customer expectations of the hand-made were also explored, and the authorship of a known maker was stressed as important to customers, rather than the knowledge of literal hand processes.

'... if there's only one, if I was standing there as it was being made, if I was controlling what it is as an object then in some senses it is hand-made because it was made by my head...the root of the question is about how connected you were to the object during its making' (Participant 6).

Section 7.2: Craft values and the constructed authenticity of productive autonomy

The issue of moving beyond artisanal skill was examined theoretically in Section 2.2.2. Several versions of craft skill are described, from Sennett's '*trained practice'* (Sennett, 2008:52) based on personal experience and repetition, to a more straightforward knowledge of process and the phrase '*judgement, dexterity and care'* used by Pye (1995). The way in which the demonstration of skill is linked to cultural meaning emphasises that skill cannot be seen in isolation. The work of Roberts (2007) is examined in detail, particularly his analysis of the dialectical relationship between productive and artistic labour. Roberts explores skill in art after the readymade. He evaluates the presence of immaterial, non-artisanal skill alongside manual skill in relation to artistic autonomy and in artistic practices incorporating diverse studio and extra-studio work. He examines this, for example, within the work of Duchamp, as in a relationship to changes in the organisation of productive labour.

As the researcher comments in Section 2.2.2:35 '*Roberts puts forward a view of artistic skill that takes a number of forms beyond artisanal skill, for example, the displacement of skill into immaterial labour, into the organisation and manipulation of pre-existent objects, (such as readymades), or executive roles such as orchestration'*. The researcher proposes that digital craft can also be seen as moving away from artisanal skill, perhaps, in part, to maintain productive relevance. The researcher believes that immaterial skills are particularly relevant to digital practice, in order to organise and effectively co-create or outsource elements of production - skills such as orchestration, communication and negotiation are required, a new set of skills for a new type of production (perhaps used in concert with more traditional artisanal and interpretive skills). The question raised is whether these skills are, in fact, capable of being manifested and understood as *craft* skills.

The use and development of these types of skills appeared to the researcher to be apparent from the interviews undertaken with a small number of digital 'professionals' (Section 6.4). A picture emerges of some parts of practice being concerned with negotiated relationships with technical experts, outsourced production facilities and creative collaborators, that strike a balance between keeping and relinquishing control over process and building confidence in collaborative partnerships. An emphasis on verbal communication of the makers' vision tends to corroborate a shift in practice towards authorial autonomy and away from direct productive autonomy.

'You rely on people and this relying is…it's probably more stressful than making it yourself…I am literally…I am in their hands… and it's a very... that's when my negotiation skills have to come out as well... that's part of the art form as well and perhaps a lot of my practice is actually

emailing and talking to people in that sense and its weird... it's a weird craft form..' (Participant 13).

Among interview participants taking part in the *Making it Digital* scheme there was a clear sense that they wanted (or indeed had) moved beyond artisanal skill (in the sense of practice that centres on repeated iterations of very similar products) for at least part of their practice. They wanted to experiment and innovate. There was a strong interest in new possibilities and how these might be achieved digitally (developing a new product was part of the intention of the programme). The researcher concludes that digital tools may be attractive to makers who understand quality and engagement (depth of practice), and have achieved this but also want a breadth of practice. These interviewees saw no contradiction in working in a number of distinct ways for part of their time, moving between design and craft, digital tools and hand-making, organisational and material skills in a fluid and highly adaptable way.

Section 2.2.3 discusses the concept of autonomy. A distinction is drawn between productive and authorial autonomy, a distinction the researcher introduces in recognition that it is a device to aid the description of a perceived shift in practice. Whilst both types are concerned for the researcher with skills and process, productive autonomy refers to the physicality of making, close involvement of the maker in all elements of their productive process, such as control over their time and making activity, materials, tools and working practices. Authorial autonomy is concerned with the maker's control over the ideas and content and a contribution to the authorship of process and outcomes of work, described as '*skilled intention and freedom in developing an individual approach*' (Section 2.2.3:37). The researcher argues that productive autonomy is part of the appeal of craft practice, particularly in relation to a conceptualisation of craft in opposition to industrial production. Within an 'intelligent making' (Cusworth and Press, 1996:4) model of craft – bringing together various forms of knowledge, contextual awareness and personal creative autonomy – both productive and authorial autonomy are combined and described as 'creative autonomy' in keeping with the integration of designing and making in craft. However, the researcher contends that digital craft tends to require knowledge and equipment beyond the immediate personal resources of the maker and, in common with digital modes of production in the creative industries generally, requires collective engagement and lends itself to collaborative process (Section 2.5) thus moving craft away from a personal productive autonomy model. Makers retain creative autonomy, but by describing elements of creative autonomy separately, as authorial and productive, the researcher can focus on authorship and identify the potential loss of an element of productive autonomy, the physicality of hand-making.

The opportunities *Making it Digital* participants interviewed saw in the use of digital technologies were not obviously centred on collaboration or collective engagement. They tended to be about the business potential of making bespoke products or prototypes for manufacture.

'there's a clear route in our minds to where it can become a marketable object and we no longer make it... that's the point at which our engagement with it kind of [stops] ...I think that would be fantastic... as a point to get to' (Participant 6).

Equally, participants were keen on combining digital and traditional aesthetics (bringing together two unlike domains) and in making the best use of skills embedded in digital tools, expertise and the use of digital data.

'unless I was like a master craftsman with a wood chisel I would never have made that design and your engraving and etching unless you are master with a little... tool... I mean you can do things that are not possible otherwise...' (Focus group discussion).

Analysis of the interview and other data collected did, however, highlight the importance of the way in which participants were able, and needed, to work together in groups or with project mentors. The analysis of data suggested that 'negotiated collective engagement' was the core category to emerge from this small practice study of digital tool-use. Working with others was facilitated, encouraged and often necessitated to get the results required. The researcher concludes that digital practice offers a direct challenge to the supposition of productive autonomy in traditional practice.

In reviewing how autonomy has been accounted for among a number of theorists, the researcher argues that craft can fulfil the conditions for a number of types of autonomy and to varying degrees, so that productive autonomy, authorial autonomy or the autonomy of object may be emphasised in different craft practices. Digital craft, depending as it does on digital modes of production which provide a framework that enable greater collective authorship and collaborative practice, tends to move making towards practices that include a range of skills, knowledges and expert contributions. Authorship may rest with a primary instigating maker driven by an idea, an individual who orchestrates production and has ownership of the object, but objects are often realised through a division of labour and incorporate many areas of expertise and knowledge. There was some evidence, however, that makers were still concerned to ensure that the process was of a craft quality and character even if they were not directly undertaking it themselves. For example, one of the professional interviewees commented:

'Sitting with them and watching how they work… it's very much a craft and there are a lot of parallels I could draw…no two programmers will do something the same way… if they work on the same task they will do it differently...and it's a lot about playful ways of trying to do something… Building up your own specialisms…and beautiful bits of coding' (Participant 14)

Within the researcher's practice-based work and analysis of her detailed practice log, the retention of craft skill was questioned, for example, when machine engraving was used to replace a hand skill. There was an acknowledged increase in sources and extent of help, such as the digital expertise required for successful outcomes in areas such as file manipulation compared to the researcher's previous non-digital practice. This raised the question of the implications of a consequent loss of productive autonomy. Close scrutiny of what is at stake in the relinquishing of some productive control, and the use of converged and democratised tools, led to the conclusion that retention of craft skill depends on retention of key craft values.

The development of a relatively complex multi-stage making process that integrated ideas, digital and hand work, was judged to have enabled the researcher's practice to go beyond machine determinism (Section 5.2.7). This finding was demonstrated through the analysis of skill within the final work produced, which ultimately justified a definition of the work as craft. An apparent greater division of labour within this work demonstrated the added value derived from technical help. Skill leverage, (Section 4.9) gaining access to skills beyond the researcher's own skills base, was necessary for the successful outcome of the work. A second practice element demonstrated the rich complexity of imagery that resulted from the use of digital technologies as a conduit for collaboration and collective authorship. The common ground of 'data' and 'data transfer' within the digital convergence of systems and the creation of collaborative value chains, as digital phenomena, provided a platform for cross-disciplinary language and communication.

For the researcher, personal productive autonomy was found to be less important than the potential for expression of *creative collective agency* - the ability for makers to harness and create work by bringing together many areas of knowledge and expertise, some of which is embedded in machinery, by outsourcing elements of production, by using collectively held digital data and so on. The interplay between agency and productive autonomy - what you can do and what you can do alone - was found to be a crucial trade-off within her own practice experiments and, the researcher believes, may be typical of early stages of digital practice. *Making it Digital* was, for example, designed as a mentored scheme in an implicit recognition of the need to provide a high level of support and technical expertise. Digital expertise can be part of the maker's skills. One example of this is being able to write and transform machine code to get a complex outcome (Masterton, 2007). The interviews in Chapter 6 demonstrated the opportunities from, and need to, integrate their own expertise with specialists and outsourced production.

The importance of the challenge presented by a division of labour within craft practice is examined in Section 2.2.4 which reviews scholarship that links the importance of productive autonomy within craft to the constructed authenticity of studio crafts practice, the view of craft as a foil for the alienation and division of labour implied by industrialisation. Both the myth and the reality of this position are explored through the work of Harrod (1999), Cardoso (2010), Sennett (2008), Shales (2008), Greenhalgh (1997b) and others. For example, Sennett's account of shared craft practices and positive engagement with machinery during the Enlightenment is contrasted to an ideology-based anti-technology stance associated with the Arts and Crafts movement. The researcher examined examples where writers have been able to document how craft and industry have been, in fact, inter-dependent, or where the perception of a practice or process has shifted over time from an industrial to a craft category.

The researcher concludes that recent scholarship sees craft in relation to industry as moving into a new, more unified relationship. A post-industrial view of craft, (echoing the pre-industrial view), is emerging, in which small-scale and bespoke production have the potential to re-unite craft and industry and break down the image of the craftsperson as the '*idealisation of the individual atelier as a bulwark against 'alienated labour'* (Shales, 2008:78). Digital craft is seen as a standard bearer for this new reconciliation between craft and industry, sitting comfortably within a longer tradition of technological innovation and collective creative agency (but somewhat at odds with the image of productive autonomy within traditional studio practice). The research evidence certainly identified an interest from makers in hybrid practice possibilities and a lack of concern for the loss of 'pure' hand-making, at least among participants, who were, in any case, seeking to engage with digital tools.

'I respect tradition and I think that's got to be something that's has got to be encouraged and extended and updated but I do see the real value in how you can use these digital technologies to push your practice forward ... and to kind of open up new ways of working' (Participant 4).

Section 7.3: Digital craft business opportunities and threats reviewed

Section 2.3 identifies and describes previous scholarship in the digital craft field. For example, Bunnell's (1998) examination of how digital technologies can extend craft through techniques such as pattern and image storage, the fast flow of ideas, capabilities such as changing scale and repeating tasks. Early indications of the impact on designer-maker business led Bunnell, writing in the 1990s, to speculate on the possibilities for an enhanced role of designer-makers and new hybrid forms of business. Bunnell called for further research on the impact on digital technology integration in real-world situations. Marshall (1999) theorised craft makers' active participation and reciprocal relationship to technology with reference to pragmatic philosophy and raised questions about access to, and costs of, technology. John Marshall examined the trans-disciplinary nature of digital practice across craft, architecture, product design and sculpture, presenting the case for shared creative technology platforms. Other PhD research was examined, including work from Wallace (2007), Yair (2001), Wood (2006), Treadaway (2006) and Harris (2000).

This research began, then, with the knowledge from previous research that had identified creative potential in extensions to practice, possible business opportunities, the theoretical influence of technology and converged systems as well as some suggestions that collaborative practices such as file sharing were facilitated. The researcher concluded that a gap in knowledge existed in the examination of the day-to-day impact of digital technologies on working practices in the context of a fast developing digital economy. Within the wider review of writing on digital craft, particular emphasis is laid on the work of McCullough (1998) who examines how computing can be accommodated and understood as a craft activity, particularly through advances in the user's experience of computer interfaces. The concern with the design of better interfaces was certainly echoed by research participants whose frustration with issues from file incompatibility to inflexible outcomes was documented. The evidence gathered suggested that practical problems with access, costs and difficulty with software and machine limitations were among the main concerns from the initial case study data. (Section 4.8.2:179). However, the strongest impression was that digital possibilities abound. Many of the research participants echoed this sense of attraction to the possibilities discovered through practice. The way in which the 'otherwise unobtainable' has entered the digital craft canon was reflected in the positive experience of makers. In chapter 6, professional interviewees were keen not to be 'technology-led', they tended to view the technology as a tool for the pursuit of narrative and communication of the maker's ideas and this, in itself, suggests a shift towards authorial autonomy and autonomy of the object over a concern with the demonstration of process within work. This was expressed by one participant as:

'I'm not using it for its own sake…it's not that we've got some wizzy new tools and I'm dying to use them…you've got to use them appropriately make appropriate choices in order to communicate an idea. To tell a story..(there is) so much story telling potential' (Participant 10).

The researcher concludes that whilst an emphasis on the maker's authorship and ideas is important, craft also requires a re-affirmation of craft value; she goes on to examine how this might be achieved through evaluation of craft skill, as an enlarged concept that can accommodate collective and immaterial skills, rather than through literal individual productive autonomy.

Section 7.4: Valuing skill in digital practice

Section 2.3.4 looked at the central issue of defining and describing craft skill and the 'leveraging' of skills within digital work. Leveraging skills implies adding value to craft work by inclusion of a wider range of skills and knowledge than is within the personal resources of an individual maker. The researcher developed the argument that the embedded knowledge in digital processes, and the skill of technical professionals mediating digital manufacturing processes, are a central part of the opportunity that digital craft presents. '*This ability to use digital technologies to enhance skill to improve the quality of result through a division of labour, is a key quality that attracts makers' attention. You can do things you can't do by hand or do things to a better quality than you can do by hand*' (Section 2.3.4:60). The question then arises: how do we locate and value skill in craft work if it does not necessarily emanate solely from the maker, and if the process may not be apparent from an examination of the object? Does this possible contribution of skill from machinery or an expert mediator matter in an evaluation of digitally enhanced work in relation to craft values?

It is acknowledged that technology has the potential to dilute or extend craft skill but that neither outcome is inevitable. Using evidence from her own practice, the researcher concluded that '*an initial dilution of craft (as technology took over the role of engraving) became a pathway to extension as the work progressed in complexity'.* An analysis of whether a particular application has indeed diluted or extended the craft content of a process depends on a detailed examination of the location of skill. Using a distillation of indicators of skill in relation to the craft process from Woolley, the researcher proposes criteria for an examination of craft skill in digital work, namely the *retention of risk of failure, uncommonness and the creative use of skill.* Each of these concepts is defined in a contemporary digital context. *Retention of risk of failure* refers to the outcome of a process not being determined, the level of *difficulty in the process* and whether it is easily repeatable and refers back to the seminal work of Pye. Perhaps the most central criticism of digital craft is the idea of the maker degraded to the role of machine operator, simply putting in motion a pre-determined software and machine parameter-driven outcome.

The researcher believes that evidence from the research shows that, in fact, risk of failure is still a live and relevant concern, indeed mistakes and failure still occurred within digital work and were apparent from her own practice log, which noted the similarities in traditional and digital making spheres (Section 5.2.2). Digital mistakes tended to involve wrong decisions rather than failure of manual skill but were still disruptive: '*It reinforced the researcher's experience of making as a slow, incremental but often non-linear development process, where a sudden insight can rapidly change the pace of progress, this was unchanged despite the large digital element to the current practice, though messy spillages and breakages were confined to traditional making spheres.*' It is argued that risk of failure is a variable quality and can be particularly relevant in digital work in the final stages of machining when the cumulative time and complexity invested in the work can be very substantial. It is argued that the complexity and level of possibilities of multiple interventions, alongside makers' authorship and desire to develop an uncommon outcome, in practice prevent pre-determined machine outcomes, although similarities from software programs or in early stage work can be apparent.

Alongside an examination of the retention of risk of failure, a related indicator of craft skill is a discussion of the one-off or small scale process and outcome, the quality of craft that makes the object *unique* or at least *special* (these were key words used by participants to describe craft values, Section 4.6.3:172), and grouped together by the researcher, following Woolley's (2007) lead, as *uncommonness.* This relates to a sense of open-endedness, a decision-making journey that has been followed and engaged with by a maker and to the historical appropriation of technology and its re-interpretation in craft applications. A craft value is associated to uncommon making skills, processes or tools. This is seen, for example, in the use of industrial technologies designed to make copies, like print technologies, but applied in craft or art practice for one-off and bespoke outcomes. Finally, the *creative use of skill*, (perhaps the instigation of a new application of skill or a new way to combine skills within a process) is discussed as an alternative to the outright ownership of physical making skill by the individual maker at the point of production. This allows for the contribution of skill from other sources and does not restrict skill to the field of artisanal skill within a 'traditional' productive autonomy model of craft. The creative use of skills is therefore inclusive of the maker's knowledge and skills, knowledge and skills sourced from technical help and embedded in software and machinery and immaterial skills.

The question of whether digital technologies dilute or extend craft practice can be answered by '*examining process against the yardsticks of retention of risk of failure, uncommonness and the creative use of skill, by identifying the depth of skill and engagement in process from both the primary maker and other contributions. Without a significant element of these qualities within making processes, digital making fails to become digital craft'* (Section 2.3.7:65). The analysis of the *Making it Digital* project concludes that practice is extended through negotiated collective engagement (Section 4.8.1:178). This animates hybrid potential for new business models in bespoke and prototyping products, through the potential for data transfer, for hybrid objects that combine digital and craft associations and through skill leverage.

Section 7.5: Thesis conclusion

In Section 2.3.8:68, the researcher describes how the researcher's term: *technepractice* is intended to describe a networked type of digital craft practice, identified through this research. The term has been chosen to express a connection between ancient craft traditions (technē is usually translated from Greek as craft and is also the root of the word technology) and the collective networked character of the practice identified. The intention is that this term expresses the idea of craft and digital technology combined in digital practice that extends beyond the individual maker and brings together a significant integration of aspects of a digital approach. The table on the next page, *Aspects of digital practice: exhibited within technepractice* (Figure 45), identifies and summarises a large number of aspects of digital practice, which have been identified and explored within this research, either from within contextual sources such as previous research or from first-hand evidence. Aspects of digital practice will be apparent in digital making (where a digital process is used simply to replace a hand skill) and in digital craft. For the researcher, an assignment of digital making or digital craft would depend on an examination of the craft skill value of the work according to the criteria of creative use of skills, retention of the risk of failure and uncommonness (Section 2.3.4). In Section 2.4 the researcher puts forward a range of characteristics that she believes help to identify an emerging digital craft genre, based on a review of work.

However, the researcher reserves the term *technepractice* for digital craft practice that integrates many aspects. It describes practice that is networked (achieved through the employment of a communication, knowledge, production or other digital network), integrated (between craft and digital technologies or aesthetics) and re-skilled (achieved through a process of orchestrating collective engagement). This is the type of practice which exhibits a significant integration of aspects of digital practice identified in Figure 45 below, across all five '*Areas of Impact*': from enhancing objects, managing data, and collaborative value chains to innovation in production and effects on working methods.

Figure 46 below is also reproduced here, as it contains the five key digital potentials identified from research in Chapter 4: Making it Digital and summarises the findings from this research element. The central category of 'negotiated collective engagement', which emerged through grounded theory, explains the researcher's core understanding of the driving dynamic of digital craft practice. This diagram can also be cross-referenced to the *Aspects of digital practice*, the relative position of the five key potentials identified during *Making it Digital*, which fall across the spectrum of Areas of Impact, have been highlighted in bold, to enable better identification of common themes across the research.

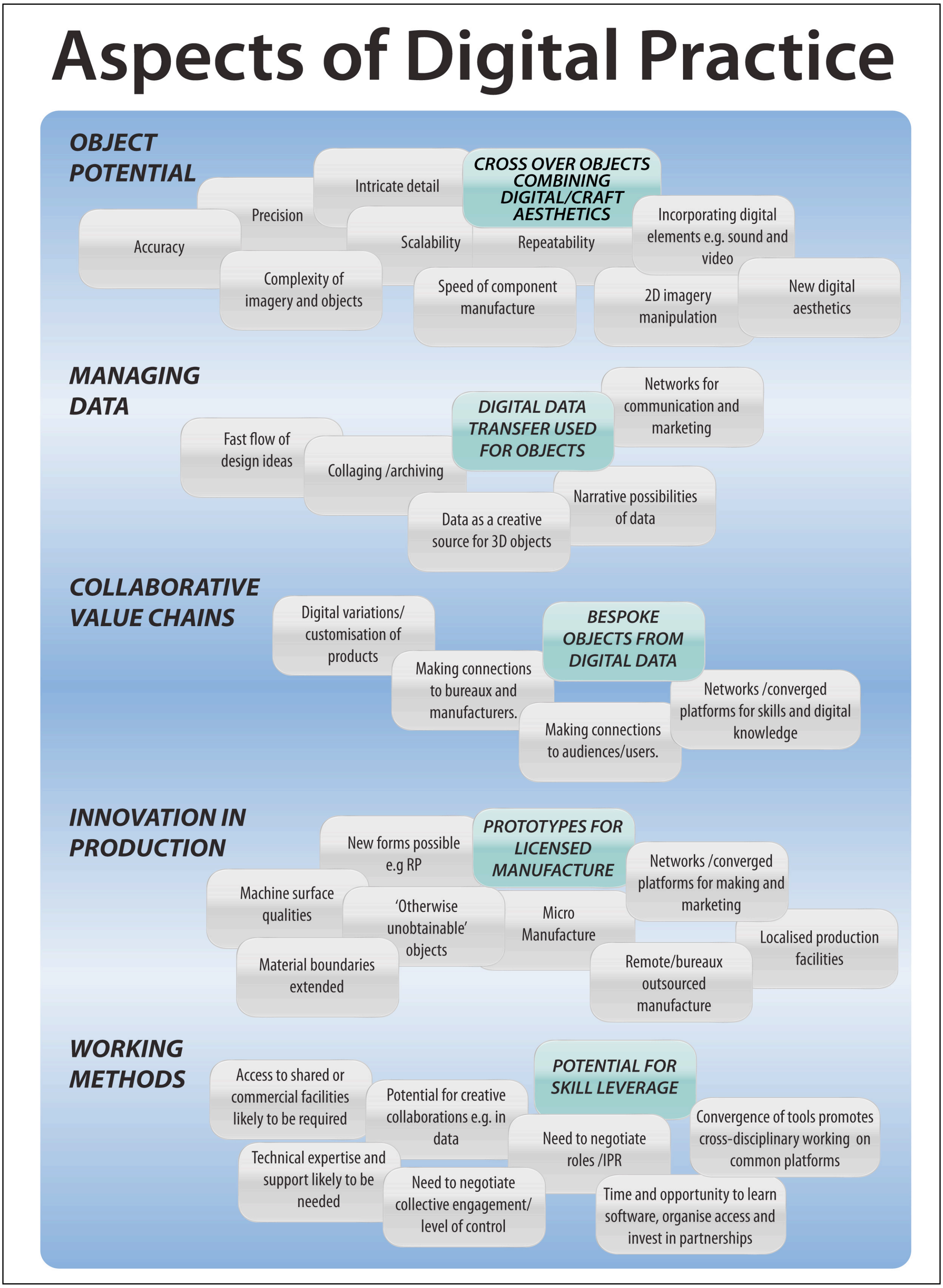


Figure 45: Aspects of digital practice: exhibited in technepractice in five areas of impact

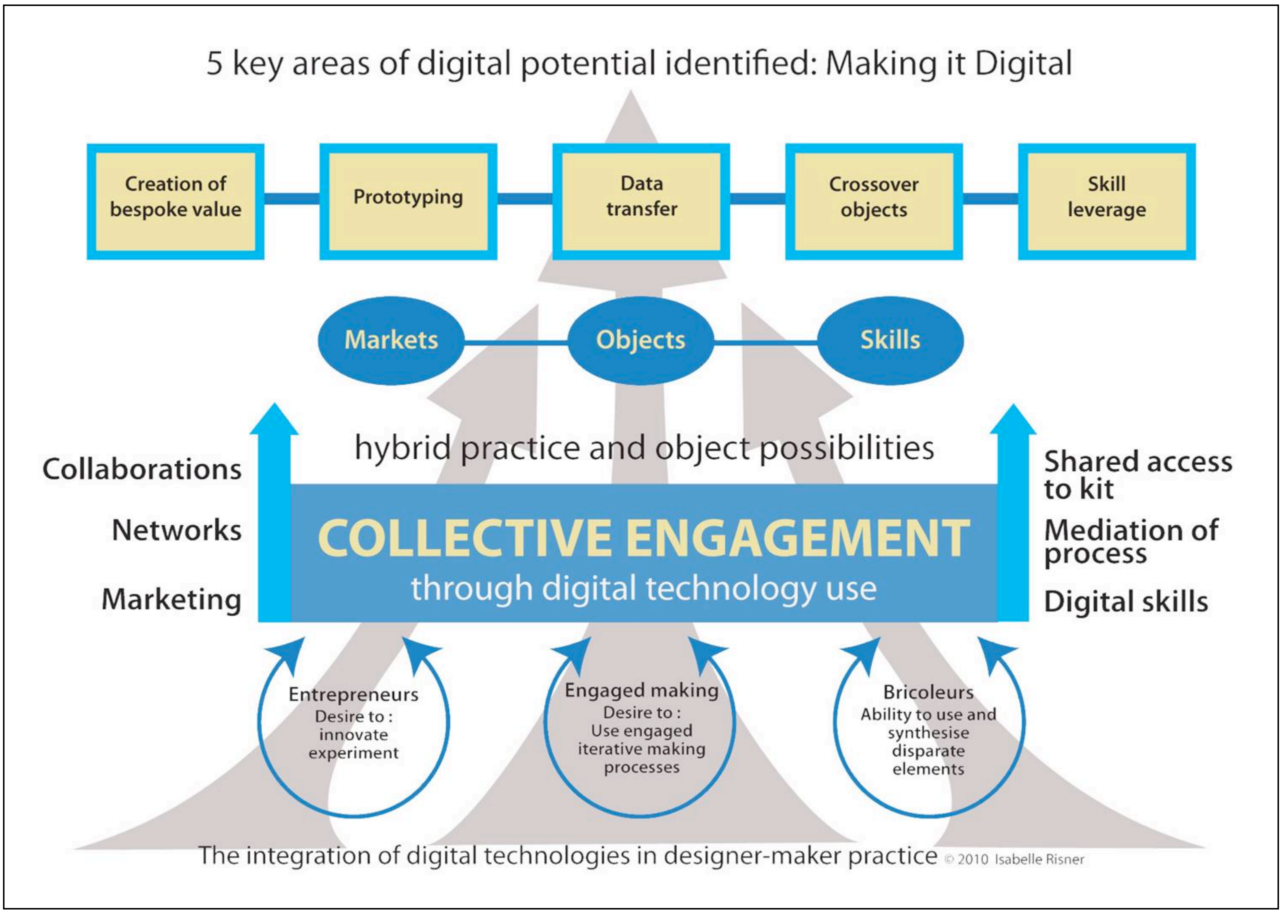


Figure 46: Collective Engagement as the central dynamic of the Making it Digital project

The researcher argues that, in this way, there is a type of practice that goes beyond bringing craft to a digital arena, that takes on the organisational and emergent creative practices of digital creative industries, such as the '*discovery and animation of diverse skills, facilities and entrepreneurship'* (Section 2.3.8:67) and a tendency towards the creation of added value through collaborative value chains. *Technepractice* is not an inevitable working scenario, but is seen as a likely progression for makers who choose to make extensive use of digital tools. A review of work in Section 2.4 examined the public face of digital craft through websites of a number of contemporary practitioners. It was organised under five themes and the progression towards an identifiable genre was outlined. It is argued that an emergent genre with particular characteristics is being brought into view, signs of a genre include extensive exploration of 2D and 3D digital imagery and data manipulation in craft, digital technology used to facilitate audience participation and the existence of digital craft exhibitions, conferences and research groups. The majority of projects described highlight a collaborative element to the work or the desire to create something not possible through traditional techniques. Among the characteristics of the genre explored are its hybrid nature and the creative cross-fertilisation from other disciplines (such as design or programming). Again, this sense of cross-disciplinary practice is echoed in the research evidence. '*it's a huge change, you become more of a hybrid designer really...*'(Participant 14).

The final section of the Critical and Contextual Review, 2.5, discusses the extent to which craft practitioners using digital tools are facing the same issues, around digital technology trends and developments in tool-use, as people engaged in other creative industries. The researcher identifies and discusses major changes in creative industry practices reported from Government funded research, such as the rise of collaborative value chains, the spread of converged systems and customised and localised manufacture. Having examined the democratisation and convergence of digital tools and the applicability of general digital trends to craft practice, the researcher concludes that trends in digital tool-use are relevant and a good fit with digital practices observed. From data driven creativity to creative collaborations, many creative industries are engaging with the same agenda, evidence for this can be seen in the potentials explored in the research practice work, described and summarised in Figure 45, above. For example, a discussion of new business models in Section 2.5.1 explores customised and made-to-order trends citing a number of examples from rapid prototyping advances to generative software applications in furniture design. Several participants in *Making it Digital* were similarly interested in the potential for customisation. The researcher concludes that broad digital technology trends and developments in tool-use amount to a 'digital proposition' for craft (Section 2.5.9).

The researcher suggests that some accounts of product design appear to be moving towards craft, for example, in the acceptance of an agenda of bespoke and localised production; therefore it is possible that distinctions between craft and design may narrow, given the use of common digital frameworks. For example, the researcher concludes, after reflecting on the research findings from the *Making It Digital* project, that the space explored by these makers is between craft and design and that movement for practitioners between disciplinary boundaries may be more fluid within a digital design and production framework. However, the researcher contends that craft objects retain a distinct character, even for practitioners who span craft and design boundaries. This can be seen in the way that craft values are described (Section 4.6.3:172). The use of converged tools and systems between craft and design is all the more reason to develop ways to identify, distinguish and protect *craft* value in objects resulting from digital craft practice.

Craft audience research suggests a growing desire for personalised and 'special' objects that have a narrative content. This could be provided, for example, through digital imagery or data incorporated in objects that embody the craft values examined in (Section 4.6.3:172), such as beauty and exclusivity, but enabled through the collaboration, convergence and customisation trends within digital tool-use. The researcher concludes that for craft '*there is a sense of an open, collaborative global playing field, open to the influence of very small scale, specific individual projects, companies and collaborations that can potentially impact on a global scale'* (Section 2.5.9:107). An interest in marrying craft quality to digital capabilities in collaborative, converged and customised ways is clearly reflected in many of the comments and observations from the first-hand research evidence. Creative collaboration, for example, was encouraged within the *Making it Digital* project, was notable within the researcher's practice-based enquiry and within some elements of the professional views.

'I do understand some of it but I am not a programmer and for me it is a collaboration... I don't want to have complete control over it...that kind of relinquishing of control... giving something that somebody else completes...it's quite daunting to begin with but I wouldn't want to work in any other way now.' **(**Participant 14).

The image of traditional studio craft practice relates strongly to productive autonomy; even though this has been described as more of a myth than a reality, there persists an element of attraction to craft that is about individual practice for makers and about individual makers for customers. Craft practice which makes extensive use of digital technologies brings makers into a direct conversation with the digital proposition for creative industries, namely greater collaborative value chains, convergence of tools and customisation. For craft practice, the strongest challenge presented by these three elements comes from collaborative value chains, which tend to involve new working practices, although ones that flexible and entrepreneurial designer-makers appear well able to adapt to. Convergence of tools and customisation are more familiar territory. Convergence because craft tools and practices have often been in the hands of amateurs, and customisation because it is part of the normative ground of craft. All three, however, present both threats and opportunities for craft practice. The threats are in the possible dilution or replacement of skill value, questions raised over the role of craft practice as tools become democratised and converged, and in the possible loss of the unique selling point of customisation to general design practice. The opportunities are in the practical advantages of efficiency and digital capabilities that lend themselves to data transfer and manipulation, to hybrid object and business opportunities, to skill leverage and to the opportunities of 'otherwise unobtainable' possibilities presented by digital tool-use.

There is, the researcher argues, a need to protect and enhance the craft value by re-interpreting craft skill for the contemporary digital context. For the researcher, this means examining provenance through an assessment of the retention of the risk of failure, uncommonness and creative use of skills. The researcher argues for an interpretation of skill that is not simply vested in a single maker's process, or even in single authorial intent, but in the collective creative agency, the diverse contributions of skills and expertise, brought to bear in a distinct craft process in the realisation of successful craft work. It allows for highly skilled orchestration, communication, team work, engagement and subtlety of interpretation, for example, to be valued alongside the skilful physical manipulation of materials in the realisation of one-off or small scale objects of cultural relevance. The researcher believes that in this way craft characteristics and quality can be detected in processes and objects that are not the result of the productive autonomy of a single maker. A general move towards greater authorial autonomy in digital practice is noted in the research and this is linked to a move beyond artisanal skill to maintain the relevance of craft in relation to others' productive skills, employing the organisational and authorial skills required of many modern workers. The prevalence of portfolio working noted in research by Schwarz and Yair (2010:3) and their conclusion that '*craft is increasingly understood as a distinctive set of knowledges, skills and aptitudes, centred round a process of reflective engagement with the material and digital worlds…across industry sectors and community and education settings'* (Schwarz and Yair, 2010:8) re-inforces the relevance of immaterial skills within digital practice. The researcher believes that in her own practice she is willing to trade some degree of productive autonomy for creative agency, but for each maker engaging with digital tools a different balance will be forged.

The emphasis should be placed on understanding the digital proposition, the propensity of technologies to engender ways of working, a proposition that can be taken up in many different ways by makers, as this research demonstrates. Rather than seeing digital craft as technology-led, the researcher conceptualises digital craft as a genre, with a group of propensities and characteristics that can be identified (Figure 45), in its most integrated and extensive expression the researcher considers it as *technepractice*. Whilst a propensity towards collective engagement and collaborations has been identified, the quality and depth of such relationships varies in practice and according to the needs of the project and the maker. Within this research there was an apparent concern from professional makers to invest in relationships that can deliver craft outcomes (shown in the close engagement and communication within process). The researcher's own view of digital craft has moved from a willingness to focus solely on the possibilities for extending practice to a more measured support, that emphasises understanding digital technology engagement as a two-way process. Makers do make a shift in practice in return for digital capabilities, and, given the researcher's view of technology as an active counterpart, it follows that they take on board a digital agenda even though this is open to expression in a thoroughly crafted way.

Throughout this research the voice of participants, including the researcher's, have echoed with persistent acknowledgement of the difficulties and problems associated with digital practice. *Making it Digital* participants expressed the difficulties with access to equipment (Section 4.8.2:179), with gaining technical proficiency (in part, to communicate intentions) and the investment of time needed. Concerns that were repeated among professional views. The researcher's practice revealed a concern about the '*reliance*' on sources of technical help, a desire not to make work that was determined by the technology and that was appreciated within a craft aesthetic context, again these concerns were echoed in later research interviews. The sense that this shift requires more investment in communication, organizational and collaborative working practices may also be off-putting for some practitioners.

This thesis has focused on the potential for collaboration and collective engagement, particularly in the areas of bespoke objects, prototyping for small scale manufacture, data transfer, crossover objects and skill leverage because these five areas were identified from the initial case study research. The collaborative theme arose from case study research, but further investigation has enabled the researcher to identify this as a major theme of digitisation within creative industries more generally, and to explore it as a digital modus operandi. In identifying and examining digital craft as a distinct digital genre, a type of craft with digital as well as craft characteristics, the researcher acknowledges the immense creative potential of bringing two unlike domains together. It is not inevitable that every individual maker making use of digital tools will work in a networked way or shift the focus of their practice towards creative collaboration. However, negotiated collective engagement beyond the individual maker has been shown to be a likely outcome of digital technology and digital economy engagement, not least because leveraging distributed skills, knowledge and networks represents a major gain for makers.

Section 7.6: Contribution to knowledge

The objectives of this research were: (as set out in Section 1.2:10).

- To identify individuals and micro businesses in the object design and craft markets who are engaging with CADCAM technologies in innovative ways, describing examples of best practice.
- To research and consider the implications of access models for digital object making and selling from online bureaux to local access initiatives such as technology workshops.
- To critically map the emerging theoretical basis for distributed making and technology adoption.
- To develop a new theoretical and practical understanding of the mechanisms and implications of designer-makers adopting new technologies and working practices, including following the process of change with a number of South West case studies. Are new definitions of practice needed or justified?
- To enhance the researcher's understanding of the process of moving towards a digital practice through exploratory practice-based research. This will provide rigorous documented insight on a personal level of the barriers, rewards and collaboration inherent in new technology adoption, and thereby provide examples of technique and process, highlighting relevant issues and empathising with makers.

7.6.1: Findings

The contribution to knowledge gained by meeting these objectives lies in the theoretical and practical examination and exploration of digital craft practice presented within the body of the thesis. This focuses on developing understanding and knowledge in three areas:

7.6.2: The digital 'proposition' for craft.

This research has examined technology adoption among craft practitioners from a methodological position that considers technology to be an '*active counterpart*' in the making of work (Section 3.2.1:122). This implies characteristics and potentialities that are inherent within a digital agenda but are nonetheless open to specific and individual application by practitioners. This viewpoint is explained and developed within the methodology Chapter 3 and is consistent with the evidence presented. This research has therefore drawn on work that identifies broader digital tool-use trends, such as converged systems, collaborative value chains and customized production (Section 2.5.1) and has reflected upon the relevance of these trends for craft, with regard to the first-hand research evidence. Chapter 4, for example, highlights the potential uses of digital technology identified by makers and looks at impacts on working practices, finding that '*negotiated collective engagement*' was a core category that emerged as a description of the overall dynamic within this small scale knowledge transfer project , titled *Making it Digital*. Chapter 5 presents practice-based evidence of the researcher's own exploration of the potential for collaborative digital practice. Chapter 6 uses interview data to make an initial examination of the importance and practical implications of collaborative partnerships, their varied nature and the importance of the effective communication of the maker's vision. The term a digital *'proposition'* for craft is intended to convey an understanding that working with digital tools has been found, within several elements of this research, to show a strong correlation to broader digital tool-use trends and, in particular, a tendency to mean working in a collaborative way. An important part of the proposition presented to makers is of establishing collaborative working partnerships and arrangements in order to access technology, skills embedded in technology and expertise, both in person and virtually. This enables successful use of technology and maximizes the potential for successful outcomes based on digital capabilities ranging from file and data transfer to digital interaction with customers and audiences. Figure 47 in Annex 4 maps collaborative elements of digital practice. The research is therefore an affirmation of previous research work in the field (Section 2.3.1) and further description of the opportunities that designer-makers see in digital practice. It places these opportunities in the context of similar shifts in practice in other digital creative industries.

7.6.3: A new genre – technepractice.

The research makes the case for a theoretical understanding and description of digital craft as a genre. Within the review of digital craft work, in Chapter 2.4, the researcher explores characteristics of work and argues that a genre is emerging. Characteristics identified range from data driven innovation in 3D object making to new ways to make connections to audiences (Section 2.4.6). As well as characteristics and trends demonstrated within objects, the research explores trends within working practices and potentially within business models. Chapter 4 outlines business potential identified within the case studies, such as digital bespoke object making or craft prototyping (Section 4.7). Chapter 2.5 examines examples and future trends in creative industry models of commerce. The researcher's term *technepractice* is intended as shorthand to represent a set of conditions and elements that this research has identified (or recognised and validated) that are characteristic of a type of digital craft practice. The concluding Chapter 7 explores and develops the researcher's view of what would constitute *technepractice* and an overview of these elements is presented in Figure 45. The research concludes that aspects of networked, data-driven and collaborative craft practice are discernible as a pattern of potential practice, elements which have been identified through the research, and that this type of digital craft represents a new departure.

7.6.4: A re-evaluation of craft skill in the digital context.

Within this research an understanding of the theoretical and practical nature of the digital *'proposition'* for craft leads on to an understanding and description of the challenge to sole productive autonomy presented by digital working practices. The research examines why this is important within the historical context of the idealisation of studio craft. The implication of this research is recognition that, in some digital craft practice, a broader division of labour is appropriate and presents opportunities for makers to do new things, for example by outsourcing elements of production and leveraging the skills of others. A further implication is that this raises questions about the location and meaning of skill in craft production. This research examines the question of skill, concluding that the use of a particular digital technology does not inevitably dilute or extend the skill value of work. This can only be assessed through an examination of particular process and provenance. The researcher goes on to suggest a framework for the evaluation of skill in digital craft work based on an assessment of the retention of risk of failure, uncommonness and creative use of skill within her own practice-based work (Section 5.3). Drawing on the work of Roberts (2007) in theorising the importance of authorship and immaterial skills within contemporary art and its relationship to productive labour the researcher reflects on parallels within digital craft work (Section 2.2.2:34). The researcher argues the case for craft skill to be recognised in the inception, orchestration, direction and realisation of digitally-produced craft work. The researcher argues that digital practice implies a degree of movement away from sole productive autonomy.

Section 7.7: Identification of further research and recommendations

7.7.1: Implications and further research needed:

Makers within the research have been documented as engaging in a variety of types of collaborative practice in order to access the technical help, expertise and equipment that can extend their practice. This research has outlined the digital '*proposition*' for craft, assessed the potential which makers see in digital craft and given a description of *technepractice*, as an expression of a digital craft genre. In particular it has highlighted the potential for forming '*collaborative value chains'* that enable new approaches to creating craft value in partnership with audiences, customers and other stakeholders. Collaborative practice can take many forms - as Chapter 7 highlights - however, in practice based on *'negotiating collective engagement'*, there are a number of common issues that could form the basis of further research and policy initiatives.

In general, the implication of this research is that, for those makers who want to go down a digital route, priority should be given to providing research and support in accessing information and training regarding how technology adoption can best be accomplished. There are many fast-changing commercial digital options and makers within this study expressed concern at the time and financial commitment needed to explore possibilities. Two areas of research that might help practitioners are:

- Research into new business models and the variety of on-line selling platforms. An investigation of networked funding and marketing strategies may provide a clearer range of options, costs and benefits for makers. This could provide comparative analysis of the alternative routes being explored to access new markets.
- Research into examples of collaborative projects and business models may reveal innovative partnerships, for example with customers, and common problems that are encountered, issues are likely to include, for example, the negotiation of joint authorship models for copyright protection.

7.7.2: Recommendations:

7.7.3: Access to facilities, skills and training that supports digital practice

Digital technology applications are increasingly popular options within craft and design undergraduate degree courses and among the maker community generally. A recent Crafts Council report *Craft in the Age of Change* (2012) recognized the importance of digital in the current and future practice strategies of makers. '*While such technologies are not necessarily widely used by the craft-making population as a whole (though some mid-career makers have*

embraced them), they are used in universities and colleges, and are therefore shaping the next generation of craft-makers.' (Crafts Council, 2012:18). In particular survey data recognized the higher proportion of 'craft careerists' - a group within the data identified as makers committed to the idea of craft as a career who have moved to start their business shortly after finishing a craft related degree – as being more likely to be using digital technology for making and designing than other groups (42.7%) and '*more willing to adjust their practice in response to changes in the wider culture'* (Crafts Council, 2012:17). A series of recent Crafts Council reports and briefing notes have recognised the importance of emergent digital practice and looked at developments and exemplars of digital practice, reporting, for example, on '*the trend towards hybrid manufactured and handmaking – enabled by digital technology*' (YAIR, 2012). Digital practice is highlighted within two recent Crafts Council briefings, in particular: *Crafting Capital: New Technologies, New Economies* (YAIR, 2011) which reviews the craft contribution to collaborative innovation, for example within scientific, manufacturing, engineering and construction collaborative projects and *Craft and Enterprise* (YAIR, March 2012) which assesses the potential for economic growth, discussing both opportunities and challenges, including digital potentials.
Crafting Capital makes a series of detailed recommendations including: the need for flexible and accessible knowledge transfer programmes, advocacy and brokerage services bringing together makers and companies and the promotion of cross-curricular learning in schools. *Craft and Enterprise* discusses the need for access to digital manufacturing facilities alongside recommendations concerned with the promotion of online sales, export strategies, improved access to finance and to innovation and growth schemes. The researcher considers that over the period in which this research has been carried out (2008 – 2012) there has been a growing awareness of the role and potential of digital technologies and policy recommendations are in place aimed at promoting digital practice.

This research suggests that, for students and craft practitioners who want to make extensive use of digital technologies, access to specialist equipment and technical support provided within a university setting (or increasingly through fab labs, specialist bureaux and online manufacturing platforms) needs to be matched by support and training in the skills and working practices implied by digital practice. In particular, this research recommends that within educational settings, for example undergraduate and post graduate courses and professional development initiatives, priority is given to fostering a positive attitude to collaboration and gaining skills and experience in using digital applications and tools within supported collaborative projects and partnerships. For example, the opportunity to take part in inter-disciplinary creative projects, as part of broader teams, could be given priority and recognised as providing experience in the kind of negotiating and orchestrating skills important for digital practice. An emphasis placed on projects and training that demand collaborative working, helping practitioners to gain experience in the wide spectrum of skills and issues needed to work in a collaborative and networked way, may also support a diversity of options open to graduates. Previous research has considered the nature of the distinctive contribution to the wider economy (Press & Cusworth, 1998. Schwarz and Yair, 2010), that craft makers can bring, emphasizing, for example, the importance of transferable skills and portfolio working. Inter-disciplinary skills developed through training in collaborative authorial and digital practices will continue to support this contribution and may enable more craftspeople with digital experience to exploit wider opportunities.

Section 7.8: Closing remarks

This research project has developed into an exploration of the ‘digital proposition’ for craft. The researcher began with limited experience of the use of digital tools within her own practice and a generally positive attitude towards both the extension of practice and the potential for new business models. It asked a research question about the impact of digital tools on practice. As the research has progressed, the researcher’s own views have been modified, a degree of change that has been brought about by a need to focus on the exact nature of the digital proposition. Whilst the researcher believes there is clear evidence to suggest an extension of practice is possible, it also comes with a latent digital agenda which certainly requires caution. A greater degree of collaboration and collective authorship can be a very powerful and creative force, but could also dilute the identification of work with an individual maker which is so important to the public view of work (Section 4.6.3). Convergence of tools may deliver shared working practices, and the democratisation of tools may deliver ease of use and possible inter-disciplinary working, but may also undermine the professional standing of highly skilled craftspeople by diluting practice. Customisation could become an inexpensive norm for products rather than the domain of craft. Opportunities and threats are contained within the general digital proposition. This research suggests that there are ways of recognising the opportunities and protecting against the threats (to quality and craft standing) by focusing on what we value most in craft objects and how to extend rather than dilute practice through digital means. For the researcher, this means focusing on the creation of craft value in the creative use of digital data and tools, through the making of small scale and one-off objects of cultural significance, that exhibit the kinds of qualities that make a crafted object special.

Bibliography

3D SYSTEMS (2011) Press release: May 12, 2011. *3D Systems Acquires Freedom Of Creation*, Available at: http://blog.3dsystems.com/2011_05_01_archive.html, [accessed 26.9.2011].

3D SYSTEMS (2011) *Rapid Manufacturing SLS Design Guide - Plastics*, Version 1.0. Available at: http://production3dprinters.com/sites/production3dprinters.com/files/SLS-Sintering-Plastics-Design-Guide-V1-R5.pdf [accessed 26.9.2011].

ADAMSON, G. (2007) *Thinking Through Craft,* Oxford; New York, Berg.

ADAMSON, G. (2010) *The Benefits of Hindsight.* Crafts, No. 227. pp34-39. London, Crafts Council.

ADAMSON, G. (Ed.) (2010) *The Craft Reader,* Oxford, Berg.

ADAMSON, G. (2010) *Once More With Feeling.* Crafts, No. 223. pp.42-46. London, Crafts Council.

ADAMSON, G. (2010) *Sleight of hand: craft, design and the fine art of manipulation.* Design and craft: a history of convergences and divergences. 7th Conference of the International Committee of Design History and Design Studies (ICDHS).pp.26-33. IN GIMENO-MARTINEZ, J., FLORE, F. (Ed.). Brussels, Koninklijke Vlaamse Academie van Belgie voor Wetenschappen en Kunsten.

ADAMSON, G. (2011) *Firm Following*. Crafts May/June 2011. pp 43-47. London, Crafts Council.

ALDERSEY-WILLIAMS, H. (2007) *A Perfect Fit?* Crafts, 204, pp.36-41. London, Crafts Council.

ALDERSEY-WILLIAMS, H. (2011) *The New Tin Ear: Manufacturing, Materials and the Rise of the User-Maker.* Available at: http://www.thersa.org/__data/assets/pdf_file/0003/391467/RSA-The-New-Tin-Ear-pamphlet.pdf [accessed 2.4.2012]. London, RSA Projects, Royal Society for the encouragement of Arts, Manufactures & Commerce.

ALFOLDY, S. (2007) *NeoCraft: Modernity and the Crafts,* Halifax, N.S., Nova Scotia College of Art and Design.

ANARKIK 3D (N.d.) Homepage for Annarkik3D. *Cloud 9: 3D touch-modelling software*. Available at: http://anarkik3d.co.uk/ [accessed 26.02.2011].

ARTQUEST (Ferbruary 2009) *Ex-Machina: Exploring digital manufacturing in fine art, crafts and design practice.*Ex-Machina one day conference audio recording. Available at: http://www.artquest.org.uk/articles/view/ex-machina [accessed 4.5.2011]. RIBA, London, Artquest.

ASHCROFT, S. (2006) *Metropolitan Works Digital Manufacturing and Workspace Centre - Works and Play Creative Review,* 26**,** 42-44.

ASHUACH, A. (N.d) Homepage for *Assa Ashuach studio*. Available at: http://www.assaashuach.com/ [accessed 12.10.11]. Osteon chair. Available at: http://www.assaashuach.com/osteonchair.php [accessed 10.4.12].

ATKINSON, P. (2004) *Post Industrial Manufacturing Systems: the impact of emerging technologies on design, craft and engineering processes.* Challenging Craft Conference paper. Available at: http://www2.rgu.ac.uk/challengingcraft/ChallengingCraft/papers/paulatkinson/patkinsonabstract.htm [accessed 2.4.2012]. Aberdeen, Gray's School of Art, The Robert Gordon University.

ATKINSON, P. (2010) *All that glitters is not gold: craft jewellery and digital manufacturing.* Design and craft: a history of convergences and divergences. 7th Conference of the International Committee of Design History and Design Studies (ICDHS).pp.454-462. IN GIMENO-MARTINEZ, J., FLORE, F. (Ed.). Koninklijke Vlaamse Academie van Belgie voor Wetenschappen en Kunsten.

ATKINSON, P. (2011) First chapter of *Open Design Now* : *Orchestral Manoeuvres In Design*. Available at: http://opendesignnow.org/index.php/article/orchestral-manoeuvres-in-design-paul-atkinson/ [accessed 15.10.11]. Open Design Now is a collaborative effort of Creative Commons Netherlands, Premsela, the Netherlands Institute for Design and Fashion and Waag Society.

ATKINSON, P., MARSHALL, J. & DEAN, L. (2008) *Automake/Future Factories* Sleaford, Lincolnshire, Hub: National Centre for Craft and Design.

ATTFIELD, J. (2000) *Wild things: the material culture of everyday life,* Oxford, Berg.

AUTOMAKE (N.d.) Homepage for *Automake* project. Available at: http://www.automake.co.uk/about/index.html [accessed 16.10.11].

AUTONOMATIC (N.d.) Drummond Masterton, *Project Terraincup.* Available at: http://www.autonomatic.org.uk/team/dm/terrain.html [accessed 5.10.11].

AUTONOMATIC (N.d.) Homepage for Autonomatic: 3D Digital Production Research Group. Available at: http://air.falmouth.ac.uk/research-groups/autonomatic#home [accessed 18.3.12] University College Falmouth.

BAIER, F. (N.d.) *Fred Baier* homepage. Available at: http://www.fredbaier.com/ [accessed 16.10.11].

BANDOOKWALA, F. (N.d.) Homepage for *Farah Bandookwala*. Available at: http://farahb.com/ [accessed 15.3.12].

BARSEGHIAN, T. (November 2008) *Embracing the Green*. Craft: transforming traditional crafts. No.9. p.10. Homepage Available at: http://craftzine.com/ [accessed 2.4.2012]. Sebastopol, Canada, O'Reilly Media.

BASSEY, M. (2001) *A Solution to the Problem of Generalisation in Educational Research: Fuzzy prediction.* Oxford Review of Education. 27:1, 5-22.

BECHTOLD, J. (N.d) Homepage Jeroen Bechtold: *31 years of working in porcelain, designing and playing with computers*. Available at: http://www.jeroenbechtold.nl/ [accessed 5.10.11].

BECKER, H. S. (1982) *Art Worlds,* Berkeley; London, University of California Press.

BEEGAN, G. & ATKINSON, P. (2008) *Professionalism, Amateurism and the Boundaries of Design. Journal of Design History Vol. 21 No. 4, pp.305-313.*

BEHANCE (N.d.) Homepage for Behance Network. *Showcase and Discover Creative Work.* Available at: http://www.behance.net/ [accessed 2.4.2012].

BENJAMIN, W. & UNDERWOOD, J. A. (2008) *The work of art in the age of mechanical reproduction,* London, Penguin.

BENKLER, Y. (2006) *The Wealth of Networks: how social production transforms markets and freedom,* New Haven, Conn. ; London, Yale University Press.

BH (2001) *Working to Order,* Crafts, No.169, p.15. London, Crafts Council.

BIGGS, M., A.R. & BüCHLER, (2007), *Rigor and Practice-based Research*. *Design Issues,* 23**,** 62-69.

BLACKBURN, S. (2008) "*pragmatism*" The Oxford Dictionary of Philosophy. Oxford Reference Online. Oxford University Press. University College Falmouth. <http://www.oxfordreference.com/views/ENTRY.html?subview=Main&entry=t98.e2466> [accessed 3.4.12].

BONANNI, L., PARKES, A. & ISHII, H. (2008) *Future Craft : How Digital Media is Transforming Product Design. MIT Media lab*. *CHI 2008.* Florence, Italy.

BOSWORTH, J. (2006) *Ceramics with Mixed Media,* London, A. & C. Black; Philadelphia PA.: University of Pennsylvania Press.

BOTSMAN, R. & ROGERS, R. (2011) *What's mine is yours: the rise of collaborative consumption,* New York, Harper Business.

BRANDEIS, S. (Summer 2004) *Post-Digital Textiles:Rediscovering the Hand*. *Surface Design Journal,* 28 no.4**,** 44-51.

BRAVERMAN, H. (1998) *Labor and monopoly capital: the degradation of work in the twentieth century,* New York, Monthly Review Press.

BRESLIN, M. & BUCHANAN, R. (2008) *On the Case Study Method of Research in Teaching and Design*. *Design Issues,* 24**,** 36-40.

BRIAN ADAMS CERAMICS (N.d.) *Ripple Platter*. Available at: http://www.brianadamsceramics.co.uk/pages/products_ripple_dish.htm [accessed 21.9.2011].

BRITTON, A. (1991) *The Manipulation of Skill on the Outer Limits of Function*. IN FRAYLING, C. (Ed.) *Beyond the Dovetail: Craft Skill and Imagination.* London, Crafts Council.

BRITTON NEWELL, L. (2007) *Out of the Ordinary: Spectacular Craft,* London, V& A Publications and the Crafts Council.

BROUN, J. (April 2005) *History Of Designer Makers*, Available at: http://www.designermakers.org.uk/HistoryOfDesignerMakers.html [accessed 15.6.2011].

BROWNSWORD, N. (2006) *Action/Reflection: a creative response to transition and change in British ceramic manufacture*. High Wycombe, Buckinghamshire Chilterns University College; Uxbridge : Brunel University.

BRYAN-WILSON, J. (2008) *The Politics of Craft*. *Modern Painters,* 20, no.1**,** 78-83.

BUNNELL, K. (1998) *Re:Presenting Making. The Integration of New Technology into Ceramic Designer-Maker Practice.*CRiAD, Gray's School of Art. Aberdeen, The Robert Gordon University.

BUNNELL, K. (2004) *Craft and Digital Technology.*Keynote lecture: World Crafts Council 40th Anniversary Conference, Metsovo, Greece. Available at: http://www.autonomatic.org.uk/team/kb/craft%20and%20digital%20technology.pdf [accessed 7.5.2011].

BUNNELL, K. (2010) *Crafting Collaboration: the role of digital technology in creating a public artwork.* Design and craft: a history of convergences and divergences. 7th Conference of the International Committee of Design History and Design Studies (ICDHS). IN GIMENO-MARTINEZ, J., FLORE, F. (Ed.). Brussels, Koninklijke Vlaamse Academie van Belgie voor Wetenschappen en Kunsten.

BUNNELL, K. & MARSHALL, J. (2010) *Developments in post industrial manufacturing systems and the implications for craft and sustainability.* Making Futures Conference. Plymouth, Plymouth College of Art.

BURLET, P. D. (2006) *Interface. A Devon Guild of Craftsmen Touring Exhibition.* Education Officer, supporting notes.

BUSZEK, M. E. (Ed.) (2011) *Extra/ordinary: craft and contemporary art,* Durham, N.C. ; London, Duke University Press.

BUZAN, T. & BUZAN, B. (2000) *The Mind Map book,* London, BBC Books.

CARDOSO, R. (2010) *Craft versus Design: Moving Beyond a Tired Dichotomy*. IN ADAMSON, G. (Ed.) *The Craft Reader.* Oxford, Berg.

CATLING, B. (2009) *Steampunk. A calibration of longing* in Broadsheet. No.9., Museum of History of Science, Oxford.

CECULA, M. (2011) Homepage for Marek Cecula Available at: http://www.marekcecula.com/index.php [accessed 5.10.11].

CENTRE FOR FINE PRINT RESEARCH (2009) Symposium proceedings: *3D Print Technologies and their Creative Application in the Arts and Crafts.* Available at: http://www.uwe.ac.uk/sca/research/cfpr/research/3D/research_projects/2009_symposium.html [accessed 2.4.12]. Bristol, Centre for Fine Print Research, University of the West of England.

CHARNY, D. (Ed.) (2011) *Power of Making: the Importance of Being Skilled,* London, V&A Publishing and the Crafts Council.

COCHRANE, G. (August 2008) *Crafts and design: making and thinking in the intersection.*Craft Victoria. Available at: http://craftvic.org.au/resources/craft-culture/2008/crafts-and-design-making-and-thinking-in-the-intersection [accessed 2.4.2012].

COHEN, L., MANION, L. & MORRISON, K. (2007) *Research Methods in Education,* London, Routledge.

COLEMAN, M. (1976) *Archive:Wood and Workmanship, Interview with David Pye.* Crafts. March/April 2009. pp.82-84. London, Crafts Council.

COLLECT (2011) Homepage for *Collect: The International Art Fair for Contemporary Objects.* Available at: http://www.craftscouncil.org.uk/collect/ [accessed 15.10.11]. Crafts Council.

COOLEY, M. (1980) *Architect or bee?:the human/technology relationship,* Slough, England, Langley Technical Services.

CORBIN, J. M. & STRAUSS, A. L. (2008) *Basics of Qualitative Research: techniques and procedures for developing grounded theory, 3rd edition,* Thousand Oaks, Calif., Sage Publications, Inc.

CRAFTS COUNCIL UK (2008) *Crafts Council Strategy and Plans, 2007-2008 Overview, 2008-2012 Outline Strategy.* London, Crafts Council.

CRAFTS COUNCIL UK (2009) *Collect exhibition catalogue: the International Art Fair for Contemporary Objects,* Saatchi Gallery, London, Crafts Council.

CRAFTS COUNCIL UK (2010) *Crafts Council/Craft Matters* booklet. London, Crafts Council.

CRAFTS COUNCIL UK (2011) Homepage for *Craft Cube:Research:Jayne Wallace*. Available at: http://www.craftscouncil.org.uk/collection-and-exhibitions/exhibitions/craftcubes/view/craftcube-research-jayne-wallace [accessed 17.10.11].

CRAFTS COUNCIL UK (2011) *LabCraft. Digital Adventures in Contemporary Craft.* exhibition homepage. Available at: http://labcraft.org.uk/ [accessed 7.10.11].

CRAFTS COUNCIL UK (N.d.) *National Register of Makers*, Available at: http://www.craftscouncil.org.uk/explore-craft/national-register-of-makers/ [accessed 15.6.2011].

CRAFTS COUNCIL, UK (2012). *Craft in an Age of Change: Summary Report.* Available at: http://www.craftscouncil.org.uk/professional-development/research-and-information/research-reports/ [accessed 29.11.12].

CRAWFORD, M. B. (2009) *The Case for Working With Your Hands*, article in NewYork Times, 21 May 2009. Available at: http://www.nytimes.com/2009/05/24/magazine/24labor-t.html?pagewanted=1&_r=2&adxnnlx=1285264989-RQhVNcwU7gQfRM%20oovL4gg [accessed 22.11.10]. New York Times Company.

CREATIVE & CULTURAL SKILLS (2008) *Craft Impact and Footprint.* The Creative and Cultural Industries Economic & Demographic Footprint. Available at: http://www.ccskills.org.uk/LinkClick.aspx?fileticket=SYP66OfTigE%3d&tabid=600 [accessed 8.5.2011]. Creative and Cultural Skills.

CREATIVE AND CULTURAL SKILLS (2009) *The Craft Blueprint, A workforce development plan for craft in the UK*. Available at: http://www.ccskills.org.uk/Research/Publications/tabid/81/Default.aspx [accessed 9.5.2011]. Creative and Cultural Skills.

CREATIVE INDUSTRIES KNOWLEDGE TRANSFER NETWORK (2010) *Digital Tools Beacon Scenarios Report*. Available at :https://connect.innovateuk.org/c/document_library/get_file?p_l_id=801321&folderId=1447494&name=DLFE-16116.pdf [accessed 26.10.11].

CREATIVE INDUSTRIES KNOWLEDGE TRANSFER NETWORK (2011) Creative Industries KTN homepage: *Outcomes from Beacon Projects.* Available at: https://connect.innovateuk.org/web/creativektn [accessed 9.11.11].

CREATIVE INDUSTRIES KTN (2011) Creative Industries KTN, Beacon Project - *Phase 1. Baseline Report*. *Bridging the Digital and Physical Worlds.* Prepared for CIKTN by Alloy, Geoff McCormick, Available at: https://connect.innovateuk.org/c/document_library/get_file?p_l_id=1342482&folderId=2479701&name=DLFE-23715.pdf [accessed 22.2.12].

CROW, D. (2008) *Magic Box. Craft and the Computer.* Eye Magazine: The International Review of Graphic Design, Winter 2008, 70, pp.20-25. Available at: http://www.eyemagazine.com/feature.php?id=161&fid=732 [accessed 8.5.2011]. Eye magazine.

CSIKSZENTMIHALYI, M. (1992) *Flow:the psychology of happiness,* London, Rider.

CURTIS, L. (2004) *TACTiCS: Toward Applying Computer Technology in Craft*, Scotland, Challenging Craft Conference paper. Available at: http://www2.rgu.ac.uk/challengingcraft/ChallengingCraft/papers/tactics/lcurtisabstract.htm, [accessed 8.2.2012]. Aberdeen Gray's School of Art, Rober Gordon University.

CUSWORTH, A. & PRESS, M. (1996) *A New Vision in the Making: exploring the value of craft education in the information age.* Working Paper. Crafts Council Learning Through Making Project. Sheffield, Art and Design Research Centre, Sheffield Hallam University

DAVID, M. (2006) *Case study research,* London, SAGE.

DAW, D. (2010) *The 3D Printer Revolution Countdown:Print Your Own PC Coming Shortly.* 6 Dec 2010. PCWorld online. Available at: http://www.pcworld.com/article/212440/the_3d_printer_revolution_countdown_print_your_own_pc_coming_shortly.html, [accessed 26.9.2011]. PC World Communications.

DAWSON, R. (N.d.) *Robert Dawson Aesthetic Sabotage* homepage. Available at: www.aestheticsabotage.com [accessed 10.10.11].

DEBOOS, J. (2007) *Industry, Design and Studio Ceramics Ceramic Review,* 226, July/August 2007**,** 28-31.

DECLAN, M. (September 2010) Keynote lecture: *From the Vertical to the Horizontal: rethinking Models of Practice and Distributio.* Critical Creative Connections Event. Exeter, University of Exeter.

DENZIN, N. K. & LINCOLN, Y. S. (2005) *The SAGE Handbook of Qualitative Research,* Thousand Oaks ; London, Sage Publications.

DENZIN, N. K. & LINCOLN, Y. S. (2008) *Collecting and Interpreting Qualitative Materials,* London, SAGE.

DEPARTMENT FOR CULTURE MEDIA AND SPORT (2008) *Creative Britain. New Talents for the New Economy*. London, UK, Department for Culture, Media and Sport.

DESIGN COUNCIL (2012) *Design Council, Careers in design: Craftsperson/designer-maker*. Available at: http://www.designcouncil.org.uk/about-design/Design-as-a-profession/Careers-in-design/Designer-maker/ [accessed 15.6.2011]. Design Council.

DEVON GUILD OF CRAFTSMEN (2011) Homepage for: *The Contemporary Craft Festival*, Bovey Tracey. Devon. Available at: http://craftsatboveytracey.co.uk/ [accessed 16.10.11].

DEWEY, J. (1917) *The Need for a Recovery of Philosophy*. *Creative Intelligence: Essays in the Pragmatic Attitude.* New York, pp. iv. 467. H. Holt & Co.: New York.

DEWEY, J. (1929) *The Quest for Certainty: a study of the relation of knowledge and action.* Gifford Lectures 1929 New York, Minton, Balch & Company 1929

DEY, I. (2004) *Grounded Theory*. IN SEALE, C., GOBO, G., GUBRIUM, J., F & SILVERMAN, D. (Eds.) *Qualitative Research Practice.* London, Sage.

DIGITAL FORMING (N.d) Homepage for Digital Forming, Available at: http://www.digitalforming.com/technology.html [accessed 17.4.12].

DIXON, S. (2007) *Digital performance: a history of new media in theater, dance, performance art, and installation,* Cambridge, Mass. ; London, MIT.

DODS, R. (July 2008) *Jerwood Contemporary Makers,* Exhibition Catalogue Introduction, p.1, London, Jerwood Space.

DORMER, P. (1990) *The Meanings of Modern Design: Towards the Twenty-first Century,* London, Thames and Hudson, 1991.

DORMER, P. (Ed.) (1997) *The Culture of Craft: Status and Future,* Manchester, Manchester University Press.

DR JOHNSON'S GARRET PROJECT (2011) Homepage for *Dr Johnson's Garret. Interactive Work-table and Escritoire.* Available at: http://www.drjohnsonsgarret.net/about [accessed 16.10.11].

EASTWOOD-BLOOM, Z. (N.d.) Homepage for *Zachary Eastwood-Bloom.* Available at: http://www.zacharyeastwood-bloom.co.uk/section314203.html [accessed 3.4.2012].

EDEN, M. (N.d.) Homepage for Micheal Eden. Available at: http://www.edenceramics.co.uk/default.html [accessed 29.9.2011].

EISENHART, K. M. (2002) *Building Theories from Case Study Research*. IN HUBERMAN, A. M. & MILES, M. B. (Eds.) *The Qualitative Researcher's Companion.* Thousand Oaks ; London, Sage Publications.

ETSY (N.d) Homepage for *Etsy -Your Place to Buy and Sell all things, handmade, vintage and supplies.* UK. Available at: www.etsy.com [accessed 18.11.2011].

FAST COMPANY (2012) *3d printing*. Available at: http://www.fastcompany.com/tag/3d-printing, [accessed 26.9.2011]. New York, Mansueto Ventures LLC.

FLUID FORMS (2011) Homepage for *Fluid Forms:Your Unique Designs. Earth Bowl Pinstripe*. Available at :http://www.fluid-forms.com/design-your-own/Fluid-Earth-Pinstripe-Bowl [accessed 17.10.11].

FLYVBJERG, B. (2007) *Five misunderstandings about case-study research*. IN SEALE, C., GOBO, G., GUBRIUM, J., F & SILVERMAN, D. (Eds.) *Qualitative Research Practice.* London, Sage.

FORTESCUE, D. (2010) *Digital Craft: The use of digital technologies in contemporary craft in the US*. Review of US exhibition, The New Materiality - Digital Dialogues at the Boundaries of Contemporary Craft. Craft Australia. Available at: http://www.craftaustralia.org.au/library/review.php?id=digital_craft [accessed 5.5.2011].

FOSTER, K. & LORIMER, H. (2007) *Cultural Geographies in practice. Some reflections on art-geography as collaboration. Cultural Geographies, Sage Publications,* 14 (3)**,** 425-432.

FRASER, M. (2010) *Lab Craft: Digital adventures in contemporary craft*. Exhibition catalogue. London, Crafts Council.

FRAYLING, C. (1991) *Beyond the Dovetail: Craft, Skill and Imagination,* London, Crafts Council.

FRAYLING, C. (1993/4) *Research in Art and Design*. *Royal College of Art Research Papers,* Vol.1 No.1**,** p.1-5.

FRAYLING, C. & SNOWDON, H. (1982) *The Myth of the Happy Artisan*, Crafts, No. 54, pp.16-17. London, Crafts Council.

FREEDOM OF CREATION (2012) Homepage for *Freedom of Creation.* Available at: http://www.freedomofcreation.com/ [accessed 26.9.2011]. Press release re. de Bijenkorf. Available at: http://www.freedomofcreation.com/wp-content/uploads/2010/02/2011-09_3D-Systems-Printers-Anchor-Dutch-Department-Store-Annual-Sales-Event.pdf [accessed 11.4.12]. Press release re:3D systems.

Available at: http://www.freedomofcreation.com/wp-content/uploads/2010/02/2011-05_FOC_3D-Systems-acquisition_des-arch.pdf [accessed 11.4.12].

FREITAG (2011) Homepage for *Freitag bag*. Available at: http://www.freitag.ch/ [accessed 17.10.11].

FRENCH, N. (1997) *CADCAM and the British ceramic tableware industry*. IN DORMER, P. (Ed.) *The Culture of Craft.* Manchester, Manchester University Press.

FREYER, C., NOEL, S. & RUCKI, E. (2008) *Digital by Design:Crafting technology for products and environments. TROIKA,* London, Thames & Hudson.

FRIEDMAN, K. (2000) *Creating Design Knowledge: from research into practice*. Available at: http://hdl.handle.net/2134/1360 [accessed 3.4.2012]. *IDATER 2000 Conference* Loughborough, Loughborough University, UK.

FRY, T. (1992) Green Hands Against Dead Knowledge. IN IANNOU, N. E. (Ed.) *Craft in society: an anthology of perspectives.* South Fremantle, SA, Fremantle Arts Centre Press.

FRY, T. (2008) *Design futuring: sustainability, ethics and new practice,* Oxford, Berg.

FULLER MUSEUM OF CRAFT (2010) *The New Materiality - Digital Dialogues at the Boundaries of Contemporary Craft*, press release. Available at: http://www.fullercraft.org/_assets/FCM_The%20New%20Materiality.pdf [accessed 17.2.2012].

FUTURE FACTORIES (N.d.) Homepage for Future Factories *Digital Creativity by Product Artist Lionel Theodore Dean*. Available at: www.futurefactories.com [accessed 28.9.11].

GAY, P. (1995) *The enlightenment: an interpretation: the rise of modern paganism,* London, Norton.

GEDENRYD, H. (1998) *How Designers Work - Making Sense of Design as a Cognitive Activity.* Lund University Cognitive Studies 75. Lund, Sweden.

GERSHENFELD, N. A. (2005) *Fab: the coming revolution on your desktop - from personal computers to personal fabrication,* New York, Basic Books.

GILLHAM, B. (2000) *Case Study Research Methods,* London and New York, Continuum.

GIMENO-MARTINEZ, J., FLORE, F. (ED.) (2010) Conference Proceedings. IN GIMENO-MARTINEZ, J., FLORE, F. (ED.) (Ed.) *Design and craft: a history of convergences and divergences.7th Conference of the International Committee of Design History and Design Studies (ICDHS).* Brussels, Koninklijke Vlaamse Academie van Belgie voor Wetenschappen en Kunsten.

GLANCEY, J. (2011) *London design festival shows the world in a new light.* Guardian online article 14.9.2011.Available at: http://www.guardian.co.uk/artanddesign/2011/sep/14/london-design-festival-review [accessed 26.9.2011]. London, The Guardian News and Media Ltd.

GRAY, C. & MALINS, J. (2004) *Visualizing Research: a guide to the research process in art and design,* Aldershot, Ashgate.

GREENHALGH, P. (1997) The History of Craft. IN DORMER, P. (Ed.) *The Culture of Craft.* Manchester, Manchester University Press.

GREENHALGH, P. (1997) The Progress of Captain Ludd. IN DORMER, P. (Ed.) *The Culture of Craft: Status and Future.* Manchester University Press.

GROSS, M. D. & YI-LUEN DO, E. (2009) *Educating the New Makers:Cross-Disciplinary Creativity.* Leonardo, Volume 42, Number 3, pp. 210-215.

HAGUE, P. N. (1993) *Questionnaire design,* London, Kogan Page.

HAMEL, J., DUFOUR, W. S. & FORTIN, A. D. (1994) *Case Study Methods*, Sage Publications.

HARRIS, J. (2000) *Surface tension - the aesthetic fabrication of digital textiles: the design and construction of 3D computer graphic animation* London, Royal College of Art.

HARRIS, J. (2005) *"Crafting" Computer Graphics—A Convergence of Traditional and "New" Media*. *Textile,* 3**,** 20-35.

HARRISON, C. & WOOD, P. (1992) *Art in theory, 1900-1990: an anthology of changing ideas,* Oxford, Blackwell.

HARROD, T. (1999) *The Crafts in Britain in the 20th century,* New Haven ; London, The Bard Graduate Center for Studies in the Decorative Arts, Yale University Press.

HARROD, T. (2007) *Otherwise Unobtainable: The Applied Arts and Politics and Poetics of Digital Technology*. IN ALFOLDY, S. (Ed.) *NeoCraft Modernity and the Crafts.* Halifax, Nova Scotia, The Press of the Nova Scotia College of Art and Design.

HARROD, T. (2008) *Thinking Out Loud*, Crafts, No.213, p.23. London, Crafts Council.

HEIDEGGER, M. & KRELL, D. F. (1993) *Basic writings from "Being and time" (1927) to "The Task of thinking" (1964),* London, Routledge.

HEIDEGGER, M. & LOVITT, W. (1977) *The question concerning technology, and other essays,* New York ; London, Harper and Row.

HERR, K. & ANDERSON, G. L. (2005) *The Action Research Dissertation: a guide for students and faculty,* London, SAGE.

HICKEY, G. A. (1997) *Craft within a consuming society*. IN DORMER, P. (Ed.) *The Culture of Craft : Status and Future.* Manchester, Manchester University Press.

HICKEY, G. A. (1999) *Common ground: contemporary craft, architecture, and the decorative arts,* Hull, Quebec, Canadian Museum of Civilization with the Institute for Contemporary Canadian Craft.

HICKMAN, L. A. (1990) *John Dewey's Pragmatic Technology,* Bloomington, Indiana University Press.

HICKMAN, L. A. (2007) *Pragmatism as post-postmodernism: lessons from John Dewey,* Ashland, Ohio, Fordham University Press ; New York: Eurospan [distributor].

HIDDEN ART (N.d) Homepage for Hidden Art. Available at: http://hiddenart.com/ [accessed 5.2.11].

HOLLIDAY, A. (2007) *Doing and Writing Qualitative Research,* London, SAGE.

HOOKWAY, C. (2008) "Pragmatism". The Stanford Encyclopedia of Philosophy (Spring 2010 Edition), Edward N. Zalta (ed.) Available at: <http://plato.stanford.edu/archives/spr2010/entries/pragmatism/> [accessed 7.6.2011].

HOOPER, R. (N.d.) Homepage for Richard Hooper. Available at: http://www.richard-hooper.co.uk/ [accessed 5.10.11].

INSTITUTE FOR THE FUTURE (2008) *The Future of Making Map*. Available at: http://www.iftf.org/FutureofMakingMap [accessed 2.4.2012]. Palo Alto, CA, The Institute For the Future.

INSTRUCTABLES (N.d.) Homepage for *Instructables - Make, How to and DIY.* Available at: www.instructables.com [accessed 2.4.2012].

INTRONA, L. (2011) *Phenomenological Approaches to Ethics and Information Technology*, The Stanford Encyclopedia of Philosophy (Summer 2011 Edition), Edward N. Zalta (ed.), Available at: <http://plato.stanford.edu/archives/sum2011/entries/ethics-it-phenomenology/> [accessed 20.5.2011].

JACKSON, L. (2007) *Editorial introduction: Autonomatic, the 3D Digital Research Cluster,* Falmouth, University College Falmouth.

JACOB, S. (2008) *Lemon Squeezy: Contemporary Design Tendencies After the Juicy Salif*, Art Review, April 08, No. 21. London.

JERWOOD CONTEMPORARY MAKERS (2010) Jerwood Contemporary Makers exhibition catalogue 2010. Available at: http://jerwoodvisualarts.org/page/3220/Jerwood+Contemporary+Makers+2010/110 [accessed 16.10.11]. London, Jerwood Charitable Foundation.

JONES, P. (June 2008) *Artists Talking: Fred Baier,* in a-n online. Available at: http://www.a-n.co.uk/artists_talking/artists_stories/single/435585 [accessed 22.9.2011]. a-n. The Artists Information Company.

JÖNSSON, L. (2007) *Research futures in craft*, presentation from NeoCraft Conference available at: www.neocraft.ca [accessed 3.05.11]. *NeoCraft Conference, An International Conference on the Crafts and Modernity* Nova Scotia, The Nova Scotia College of Art and Design (NSCAD University).

JORGENSEN, T. (2004) *Binary Tools*, research paper. Available at: http://www.autonomatic.org.uk/team/tj/binary_tools.pdf [accessed 7.5.2011]. University College Falmouth.

JORGENSEN, T. (N.d.) Homepage for Tavs Jorgensen. Available at: http://www.oktavius.co.uk/ [accessed 16.10.11].

JOURNAL OF MODERN CRAFT (2008) *Editorial Introduction*. *The Journal of Modern Craft, Berg,* Volume 1, Issue 1, March 2008**,** 5-12.

JOURNAL OF MODERN CRAFT (2008) *Editorial Introduction. The Journal of Modern Craft, Berg,* Volume 1, Issue 2, July 2008**,** 179-180.

KAYSER, M. (2011) *Sun cutter* project video. *Solar Sinter*. Available at: http://vimeo.com/25361014 [accessed 26.9.2011].

KEATS, D. M. (2000) *Interviewing: a Practical Guide for Students and Professionals,* Buckingham, Open University Press.

KELION, L. (2012) *CES 2012: 3D printer makers' rival visions of future,* BBC News online 11.1.2012, Las Vegas. Available at: http://www.bbc.co.uk/news/technology-16503443 [accessed 11.1.2012]. BBC.

KICKSTARTER (N.d.) Homepage for *Kickstarter*: *A New Way to Fund & Follow Creativity.* Available at: www.kickstarter.com [accessed 19.11.2011].

KRISTAL, M. (2008) *The Hand Meets Hign Tech*. *American Craft,* 68, no 2**,** 64-71.

KUYKEN-SCHNEIDER, D. U. (1995) *Bodil Manz, Cylinders, catalogue introduction,* DK, Bodil Manz.

LABROOY, C. (N.d.) *Crossfire 3D modeling* project page Available at: http://www.chrislabrooy.com/crossfire.html [accessed 16.10.11].

LATOUR, B. (1999) *Pandora's hope: essays on the reality of science studies,* Cambridge, Mass. ; London, Harvard University Press.

LATOUR, B. (2008) *A Cautious Promethea? A Few Steps Towards a Philosophy of Design.* Keynote Lecture for Networks of Design, September 2008, Annual International Design History Society Conference. Falmouth, UK.

LAW, J. (2004) *After Method: Mess in Social Science Research,* London, Routledge.

LEIGH, M. (2002) *Chronomanual Craft, Time Investment as a Value in Contemporary Western Craft. Journal of Design History,* 15 (1)**,** pp.33-45.

LEVINE, F. & HEIMERL, C. (2008) *Handmade nation: the rise of DIY, art, craft, and design,* New York, Princeton Architectural ; Enfield : Publishers Group UK

LINCOLN, Y. S. & GUBA, E. G. (1985) *Naturalistic inquiry,* Beverly Hills, Calif., Sage Publications.

LONDON DESIGN FESTIVAL (2011) Homepage for *London Design Festival*. Available at: www.londondesignfestival.com [accessed 12.12.2011]. Industrial Revolution 2.0. Available at: http://www.londondesignfestival.com/events/industrial-revolution-20-murray-moss [accessed 12.4.12].

LOUGHBOROUGH UNIVERSITY (2012) Additive Manufacturing Research Group *Our Facilities* page. Available at: http://www.lboro.ac.uk/research/amrg/about/facilities.html [accessed 29.3.12].

LOUGHBOROUGH UNIVERSITY (November, 2009) *Cutting Edge: Lasers and Creativity Symposium.* Presentations Available at: http://cuttingedgesymposium.com/ [accessed 2.4.12]. Loughborough University School of Art and Design.

MACNAGHTEN, P. & MYERS, G. (2004) *Focus Groups*. IN SEARLE, C. (Ed.) *Qualitative Research Practice.* London, Sage.

MADE.COM (N.d) Homepage for *Made.com: Designer furniture straight from the makers to your home.* Available at: http://www.made.com/ [accessed 26.20.11]. Made.com.

MAKERBOT INDUSTRIES (N.d) Homepage for *MakerBot Industries*. Available at: http://www.makerbot.com/ [accessed 26.10.11]. Brooklyn,NY.

MANCHESTER FABLAB (2011) Homepage for Manchester fablab. Available at: http://www.fablabmanchester.org/ [accessed 26.10.11]. Link to: *Neil Gershenfeld talks about FabLabs coming to Manchester.* http://www.fablabmanchester.org/p3/About-Us.html [accessed 3.4.2012].

MANN, G. (2011) *Studio Mrmann* homepage. Available at: http://www.mrmann.co.uk/about-studiomrmann [accessed 28.9.2011].

MARSHALL, J. (1999) *The role and significance of CAD/CAM technologies in craft and designer-maker practice: with an emphasis on architectural ceramics*. Cardiff, University of Wales Institute, Open University.

MARSHALL, J. (2002) *Craft and Technology.* Paper presented at: Craft in the 21st Century Conference, November 2002, Edinburgh. Available at: http://www.autonomatic.org.uk/team/jm/JMcraft-techpaper.pdf [accessed 27.2.12].

MARSHALL, J. J. (2008) *An Exploration of Hybrid Art and Design Practice Using Computer-Based Design and Fabrication Tools.* Aberdeen, The Robert Gordon University.

MASTERTON, D. (2007) *Deconstructing the Digital*, pp.9-23. IN FOLLETT, G. & VALENTINE, L. (Eds.) *New Craft - Future Voices.* Dundee, Duncan Jordanstone College of Art.

MCAULEY, A. & FILLIS, I. (2004) *Making it in the 21st century: a socio-economic survey of crafts activity in England and Wales, 2002-03,* London, Crafts Council.

MCAULEY, A. & FILLIS, I. (2005) *Careers and lifestyles of craft makers in the 21st century. Cultural Trends*, Vol.14: 2, No.54. 139-156.

MCCARTHY, J. & WRIGHT, P. (2004) *Technology as Experience,* Cambridge, Mass. ; London, MIT Press.

MCCULLOUGH, M. (1998) *Abstracting Craft: the Practiced Digital Hand,* Cambridge, Mass. London, MIT Press.

MCCULLOUGH, M. (2004) *Digital Ground: Architecture, Pervasive Computing, and Environmental Knowing,* Cambridge, Mass. ; London, MIT.

MCGUIRK, J. (July, 2009) Fabbers, Dabblers and Microstars. The technology is in place for everyone to become a designer. *Icon Magazine, 073.* Loughton, Essex, Media 10 Limited.

MCINTYRE, K. (2004) *Crafting the Future- Review of PixelRaiders 2 Conference, Sheffield Hallam University.* Crafts, No.189, p.63. London, Crafts Council.

MCKERNAN, J. (1996) *Curriculum Action Research: a handbook of methods and resources for the reflective practitioner,* London, Kogan Page.

MEAD, G. H. (1917) Scientific Method and Individual Thinker. *Creative Intelligence, Essays in the Pragmatic Attitude.* New York, Henry Holt and Company.

METROPOLITAN WORKS (N.d.) Metropolitan Works, Creative Industries Centre, *Assa Achuach page.* Available at: http://www.metropolitanworks.org/research/assa/ [accessed 12.10.11]. London Metropolitan University.

MGX (N.d.) Homepage for *MGX by Materialise.* Available at: http://www.mgxbymaterialise.com/ [accessed 17.10.11]. .MGX at the V&A Museum. Available at: http://www.mgxbymaterialise.com/news/exhibitions/a-very-special-exhibition-mgx-at-the-vaa-museum [accessed 11.4.12].

MORGAN, D. L. (2007) Paradigms Lost and Pragmatism Regained: Methodological Implications of Combining Qualitative and Quantitative Methods. *Journal of Mixed Methods Research,* January 2007, 1;48**,** 48-76.

MORRIS, HARGREAVES & MCINTYRE (2010) *Consuming Craft: the Contemporary Craft Market in a Changing Economy*. Executive summary. London, Crafts Council.

MOSKVITCH, K. (2011) BBC News online, 2.9.2011: *Individuality drive and 3D tech make firms go bespoke.* Available at: http://www.bbc.co.uk/news/business-14748924 [accessed 26.9.2011]. BBC.

MURPHY, R. & TORRANCE, H. (1987) *Evaluating education: issues and methods: an Open University reader,* London, Harper and Row.

MURRAY, R. (2006) *How to write a thesis,* Maidenhead, Open University Press.

MUSEUM OF ARTS AND DESIGN (2011) Archive homepage for *Object Factory: The Art of Industrial Ceramics,* May-September 2009. Available at: http://collections.madmuseum.org/html/exhibitions/472.html [accessed 16.10.11]. New York.

MYERSON, J. (2010) *The Designer as Collaborator*, talk given at London Design Week, V&A, 2010. Available at: http://www.vam.ac.uk/content/videos/t/video-the-designer-as-collaborator-jeremy-myerson/ [accessed 17.10.11].

NERVOUS SYSTEM (N.d) Homepage for *Nervous System Generative Design Studio*. Available at: http://www.n-e-r-v-o-u-s.com/ [accessed 17.10.11].

NEW CRAFT - FUTURE VOICES (July 2007) *New Craft Future Voices Proceedings of the Dundee Conference*. IN FOLLETT, G. & VALENTINE, L. (Eds.). Dundee, Duncan of Jordanstone College of Art & Design. Past, Present and Future Craft Practice Research. University of Dundee.

NEW DESIGNERS (2011) Homepage for *New Designers Exhibition*. Available at: http://www.newdesigners.com/ [accessed 15.10.11]. Upper Street Events Ltd.

NIKE INC (N.d.) Customise with *NIKEiD*. Available at: http://store.nike.com/gb/en_gb/?l=shop,nikeid/t-CUSTOMISE_WITH_NIKEiD [accessed 17.10.11].

NIMKULRAT, N. & O'REILLY, T. (Eds.) (2009) *Reflections and Connections. On the relationship between creative production and academic research*, University of Art and Design, Helsinki.

OBERHEIM, E. & HOYNINGEN-HUENE, P. (2009) *The Incommensurability of Scientific Theories*, The Stanford Encyclopedia of Philosophy (Fall 2010 Edition), Edward N. Zalta (ed.), Available at: <http://plato.stanford.edu/archives/fall2010/entries/incommensurability/> [accessed 7.6.2011].

OED (1989) *transformation, n.* Second edition, 1989; online version December 2011. <http://www.oed.com.ezproxy.falmouth.ac.uk:2048/view/Entry/204743>; [accessed 05.3.2012]. Earlier version first published in New English Dictionary, 1914.

OED (2009) *social science, n.*Third edition, September 2009; online version March 2012. <http://www.oed.com.ezproxy.falmouth.ac.uk/view/Entry/183756>; [accessed 4.4.2012]. An entry for this word was first included in A Supplement to the OED IV, 1986. *Oxford English Dictionary.* Oxford University Press.

OED (2011) *autonomy, n.*Third edition, June 2011; online version June 2011. <http://www.oed.com.ezproxy.falmouth.ac.uk:2048/view/Entry/13500>; [accessed 19.7. 2011]. An entry for this word was first included in New English Dictionary, 1885.

OED (2011) *bricoleur, n.* Third edition, March 2005; online version December 2011. <http://www.oed.com.ezproxy.falmouth.ac.uk:2048/view/Entry/263245>; [accessed 1.3.2012].

OED (2011) *genre, n.* Second edition, 1989; online version September 2011. <http://www.oed.com.ezproxy.falmouth.ac.uk:2048/view/Entry/77629>; [accessed 18.10.2011]. Earlier version first published in New English Dictionary, 1898.

OED (2012) *design, n.* Third edition, January 2012; online version March 2012. <http://www.oed.com.ezproxy.falmouth.ac.uk/view/Entry/50840>; [accessed 29.3.2012]. An entry for this word was first included in New English Dictionary, 1895.

OGLE, R. (2008) *Smart world: breakthrough creativity and the new science of ideas,* London, Marshall Cavendish.

OLDING, S. (2009) *Looking Backwards at the Future*, paper given at seminar: Digital Technology and Contemporary Craft Practice: Currents in Conversation. June 2009 Farnham, University for the Creative Arts.

PAST PRESENT AND FUTURE CRAFT (2011) Homepage of *Past, Present and Future Craft Practice*, AHRC funded research project. Available at: http://www.futurecraft.dundee.ac.uk/ [accessed 11.10.11]. Dundee, Duncan of Jordanstone College of Art and Design.

PERRY, G., BOSTRIDGE, I., WARNER, M. & SENNETT, R. (2008) *Amateurism, Art and Absorption: Edited extract of talk at London Literature Festival 2008.* Crafts, September/October 2008, pp.52-55. London, Crafts Council.

PHILLIPS, E. & PUGH, D. S. (1994) *How to get a Ph.D: a handbook for students and their supervisors,* Buckingham, Open University Press.

PINK, S. (2001) *Doing visual ethnography: images, media and representation in research,* London, SAGE.

PLYMOUTH COLLEGE OF ART (September 2009) *Making Futures. The crafts in the context of emerging global sustainability agendas*. Conference Abstracts. Available at: http://online.plymouthart.ac.uk/micro-sites/conference/index.php?page=Abstracts&pag_id=6 [accessed 2.4.12]. Mount Edgcumbe House, Plymouth.

PONOKO (N.d) Homepage for *Ponoko: the world's easiest making system*, Available at: http://www.ponoko.com/about/the-big-idea [accessed 26.9.2011]. Ponoko.

PRESS, M. (1999) *A working craft hero is something to be? Reassessing the dominant culture of crafts education through an examination of long-term patterns of employment*.Third Conference: Design Cultures Vol 2, 2, pp161-188. Sheffield, Sheffield Hallam University, University of Salford.

PRESS, M. (2007) *Handmade Futures: The Emerging Role of Craft Knowledge in our Digital Culture*. IN ALFOLDY, S. (Ed.) *NeoCraft Modernity and the Crafts.* Halifax, N.S., Nova Scotia College of Art and Design.

PRESS, M. (April 1995) *It's research Jim.... but not as we know it.* Design Interfaces Conference. Salford,UK, European Academy of Design.

PRESS, M. (November, 2007) Podcast: Handmade futures: The emerging role of craft knowledge in our digital culture. *NeoCraft Conference, An International Conference on the Crafts and Modernity.* Halifax, Nova Scotia, The Nova Scotia College of Art and Design (NSCAD University), Available at: www.neocraft.ca [accessed 27.04.11].

PRESS, M. & CUSWORTH, A. (1998) *New Lives in the Making. The Value of Craft Education in the Information Age. Executive Summary. ,* Sheffield, Learing Through Making Research Programme, Crafts Council. Art and Design Research Centre, Sheffield Hallam University.

PULMAN, A. (2009) *Blogs Wikis Podcasts & More,* Hampshire, England, Palgrave Macmillan.

PYE, D. (1986) *David Pye: Wood Carver and Turner,* London, Crafts Council in association with the Crafts Study Centre, Bath.

PYE, D. (1995) *The Nature and Art of Workmanship,* London, Herbert.

RAMLJAK, S. (2009) *Richard Sennett on Making*. *American Craft, 69, no.5*, 46-9.

RAZOR LAB (2011) Homepage for *RazorLAB, Laser Cutting & Engraving*, UK. Available at: http://www.razorlab.co.uk/ [accessed 3.4.2012].

READ, H. (1944) *Art and Industry, etc. (Second edition.),* London, Faber & Faber.

REES, H. (1997) *Patterns of making: thinking and making in industrial design*. IN DORMER, P. (Ed.) *The Culture of Craft: Status and Future.* Manchester, Manchester University Press.

RIELDELBAUCH, G. (2011) Blog post re Ponoko 13.3.2011, *CAD to gold-plated stainless steel*. Available at: http://virtualterritory.wordpress.com/2011/03/13/cad-to-goldplated-stainless-steel/ [accessed 15.10.11]. .

RIESSMAN, C. K. (1993) *Narrative Analysis,* Newbury Park, Calif. ; London, Sage Publications.

RILEY, J. (1990) *Getting the Most from your Data: a handbook of practical ideas on how to analyse qualitative data,* Bristol, Technical and Educational Services.

RISATTI, H. A. (2007) *A theory of craft: function and aesthetic expression,* Chapel Hill, University of North Carolina Press.

RISNER, I. (2010) *Craft + digital technology = design?* IN GIMENO-MARTINEZ, J., FLORE, F. (Ed.) *Design and craft: a history of convergences and divergences. 7th Conference of the International Committee of Design History and Design Studies (ICDHS) Vol1,1 pp.486-490.* Brussels, Koninklijke Vlaamse Academie van Belgie voor Wetenschappen en Kunsten.

ROBERTS, B. (2007) Introduction to Bernard Stiegler. *Parallax, 13: 4, 26 — 28.*

ROBERTS, J. (2007) *The Intangibilities of Form: Skill and Deskilling in Art after the Readymade,* London, Verso.

ROBSON, C. (2002) *Real World Research: a resource for social scientists and practitioner-researchers,* Oxford, UK; Madden, Mass., Blackwell Publishers.

ROTHENBERG, D. (1993) *Hand's end: technology and the limits of nature,* Berkeley; London, University of California Press.

RSA (2009) RSA Design and Society. IN CAMPBELL, E. (Ed.) *Resourcefulness: why and how.* London, The Royal Society for the encouragement of Arts, Manufactures and Commerce.

RUST, P. C., MOTTRAM, P. J. & TILL, P. J. (2007) *AHRC Research Review. Practice-Led Research in Art, Design and Architecture*. Arts and Humanities Research Council, Sheffield Hallam University, Nottingham Trent University, University of Sheffield.

SÁNCHEZ-DEL-VALLE, C. (2011) Digital Craft, Design and the Work of Lawrence Sass. *Int Rev Afr Am Art 23 no3 2011 p. 37-40.*

SCHARFF, R. C. & DUSEK, V. (2003) *Philosophy of Technology: the technological condition: an anthology,* Malden, MA ; Oxford, Blackwell.

SCHÖN, D. A. (1983) *The Reflective Practitioner: How Professionals Think In Action*, New York: Basic Books, c1983(1991).

SCHWABSKY, B. (2008) Making is Thinking. *American Craft 68,* 5, October/November**,** 84-86.

SCHWARZ, M. & YAIR, K.(2010) *Making Value: craft & the economic and social contribution of makers*. Executive summary. Available at:

http://www.craftscouncil.org.uk/files/file/7cec2fd1e3bdbe39/making_value_executive_summary.pdf [accessed 5.5.2011]. London, Crafts Council.

SCOTT, D. (2010) *The democratization of digital design tools and the impact on contemporary craft.* pp.492-495. IN GIMENO-MARTINEZ, J., FLORE, F. (Ed.) *Design and craft: a history of convergences and divergences. 7th Conference of the International Committee of Design History and Design Studies (ICDHS).* Brussels, Koninklijke Vlaamse Academie van Belgie voor Wetenschappen en Kunsten.

SCOTT, P. (2002) *Ceramics and print,* London, A&C Black.

SCOTT, P. C. (2010) *Ceramics and Landscape, Remediation and Confection - A Theory of Surface.* Department of Contemporary Arts. Manchester, Manchester Institute for Research and Innovation in Art and Design.

SCRIVENER, S., A.R. (October 2007) *The Roles of Art and Design Process and Object In Research*. IN NIMKULRAT, N. O. R., TIM (EDS.) (Ed.) *Reflections and Connections an anthology following discussions at: The Art of Research, an international seminar held at the University of Art and Design, Helsinki.*

SEALE, C. (1999) *The Quality of Qualitative Research,* London, SAGE.

SEALE, C. (2007) *Quality in Qualitative Research*. IN SEALE, C., GOBO, G., GUBRIUM, J., F & SILVERMAN, D. (Eds.) *Qualitative Research Practice.* London, Sage.

SENNETT, R. (2008) *The Craftsman,* London, Allen Lane.

SHALES, E. (2008) Technophilic Craft. *American Craft,* 68**,** 78-80.

SHAPEWAYS (2011) *Shapeways Adds Ceramic 3D Printing*, press release 12.5.2011. Available at: http://www.shapeways.com/presscorner [accessed 26.9.2011].

SILVE, S. (2006) *Changeable context of the new technology artefact and the chageable research outcomes.* Available at: :http://www.herts.ac.uk/artdes/research/papers/wpades/vol4/ssfull.html [accessed18.10.07]. Research into Practice Conference, University of Hertfordshire. *Working papers in Art and Design, Volume 4.*

SILVERMAN, D. (Ed.) (2004) *Qualitative Research: theory, method and practice,* London, SAGE.

SILVERMAN, D. (2006) *Interpreting Qualitative Data: methods for analysing talk, text and interaction,* London, SAGE.

STAKE, R. E. (1995) *The Art of Case Study Research: perspectives on practice,* Thousand Oaks, Calif. ; London, Sage.

STERLING, B. (2005) *Shaping things,* Cambridge, Mass. ; London, MIT.

STIFF, A. (2008) Ten Key Issues in Digital Arts. IN OSBORNE, R. (Ed.) *Philosophy in art.* London, Zidane Press.

STINSON, L. (2012) *Protein OS Breifing on Digital Craft*, Submitted by Liz Stinson on Fri, 17.2.2012: Avaliable at: http://prote.in/briefings/2012/02/digital-craft [accessed 20.2.12].

STRAUSS, A. L. & CORBIN, J. M. (1997) *Grounded theory in practice,* Thousand Oaks, [Calif.] ; London, Sage publications.

STRAUSS, A. L. & CORBIN, J. M. (1998) *Basics of Qualitative Research: techniques and procedures for developing grounded theory,* Thousand Oaks, Calif., Sage Publications.

STUDIO LUDENS (2011) Homepage for *Studio Ludens*. *We create design tools because we love to see how creative you can be!*. Available at: http://www.studioludens.com/ [accessed 26.9.11].

STUFF.CO.NZ (2011) *Wellington firm lures top tech guru*. Available at: http://www.stuff.co.nz/technology/digital-living/5008871/Wellington-firm-lures-top-tech-guru [accessed 16.5.2011]. Fairfax Digital Media, New Zealand.

SUGRU (N.d.) Homepage for: *Sugru. Hack Things Better.* Available at: https://sugru.com/buy [accessed 26.10.11].

SULLIVAN, G. (2005) *Art Practice as Research: inquiry in the visual arts,* Thousand Oaks, Calif. ; London, Sage Publications.

SYJUCO, S. (N.d.) Homepage for Stephanie Syjuco. Available at: www.StephanieSyjuco.com [accessed 19.11.2011]. .

TAPSCOTT, D. & WILLIAMS, A. D. (2006) *Wikinomics: how mass collaboration changes everything,* New York, N.Y., Portfolio; London : Penguin.

TECHNOLOGY STRATEGY BOARD (N.d.) Homepage for Technology Strategy Board. Available at: http://www.innovateuk.org/ [accessed 20.10.11].

TFRC (N.d.) Homepage for the Textile Futures Research Group. Available at: http://www.arts.ac.uk/tfrg/ [accessed 17.10.11]. University of the Arts London.

THE MUSEUM OF MODERN ART (2008) *Design and the Elastic Mind. Exhibition catalogue, Design and the Elastic Mind, Feb-May 2008.,* New York, Museum of Modern Art ; [London : Thames & Hudson, distributor].

THE NATIONAL TRUST (2008) *Shifting Shores in the South West : Living with a Changing Coastline.* Available at: http://www.nationaltrust.org.uk/servlet/file/store5/item349149/version1/shiftingshores%20-%20sw.pdf [accessed 21.3.12].

THINGIVERSE (2012) Homepage for *Thingiverse:Digital designs for real, physical objects. A Universe of Things!* Available at: http://www.thingiverse.com/about [accessed 3.4.2012]. New York, MakerBot Industries inc.

TOLSTRUP, N. (N.d.) Studiomama homepage for Nina Tolstrup. Available at: http://www.studiomama.com/press.html [accessed 12.10.11].

TORD BOONTJE (N.d) Homepage for studio Tord Boontje. Available at: http://tordboontje.com/ [accessed 17.10.11]. Studio Tord Boontje.

TREADAWAY, C. (2006) Digital Crafting and Crafting the Digital. *The Design Journal,* 10,2**,** 35-47.

TREADAWAY, C. (2006) *Digital imaging: Its current and future influence upon the creative practice of textile and surface pattern designers*. University of Wales Institute, Cardiff.

TUFTE, E. R. (2006) *Beautiful Evidence,* Cheshire, Conn., Graphics Press.

TYZLIK-CARVER, M. (2009) *Interactive Work-table and Escritoire*. Tremough Exhibition Leaflet. University College Falmouth.

ULLRICH, P. (1998) The Workmanship of Risk: The Re-emergence of Handcraft in Postmodern Art. *New Art Examiner,* 25**,** 24-29.

UNIVERSITY FOR THE CREATIVE ARTS (June, 2009) *Digital Technology in Contemporary Craft Practice: Currents in Conversation*, half-day seminar chaired by Colin Webster. Farnham, University for the Creative Arts.

UNTO THIS LAST (N.d) Homepage for *Unto This Last. Made in Bricklane* Available at: http://www.untothislast.co.uk/index.html, [accessed 21.9.2011].

VERHOEVEN, A. G. (2007) *The Identity of craft: Craft is dead, long live Craft.* pp.184 -196. IN FOLLETT, G. & VALENTINE, L. (Eds.) *New Craft - Future Voices.* Duncan of Jordanstone Collage of Art and Design, University of Dundee, Scotland, Duncan of Jordanstone Collage of Art and Design.

VON BUSCH, O. (2011) Exploring net political craft: From collective to connective. *Craft Research,* Volume 1**,** pp.113-124.

VON HIPPEL, E. (2006) *Democratizing Innovation,* Cambridge, MA ; London, MIT Press.

WALKER, D. (1995) The Case for Cases. *Co-design Journal,* s1,02**,** p.29-33.

WALLACE, J. (2007) *Emotionally charged: a practice-centred enquiry of digital jewellery and personal emotional significance*. Sheffield Hallam University.

WALLACE, J. (N.d.) Homepage for: *Jayne Wallace Digital Jewellery*. Available at: http://www.digitaljewellery.com/ [accessed 5.10.11]. .

WALLACE, J. & PRESS, M. (2004) All This Useless Beauty. *The Design Journal,* No. 7, pt.2**,** pp.42-53.

WALTERS, P. & THIRKELL, P. (2007) New Technologies for 3D Realization in Art and Design Practice. *Artifact,* Volume 1;Issue 4**,** 232 - 245.

WALTERS, P. J. (2005) *Knowledge in the making: prototyping and human-centred design practice*. Sheffield, Sheffield Hallam University.

WARDELL, S. (2004) *Porcelain and bone china,* Marlborough, Crowood Press.

WARDELL, S. (2007) *Slipcasting,* London, A. & C. Black.

WENGRAF, T. (2001) *Qualitative Research Interviewing: biographic narrative and semi-structured methods,* Thousand Oaks, Calif. ; London, SAGE.

WILKINSON, S. (2004) *Focus Group Research*. IN SILVERMAN, D. (Ed.) *Qualitative Research.* London, Sage.

WILLIAMS, G. (2009) *Telling Tales: fantasy and fear in contemporary design,* London, V & A Publishing.

WOOD, N. (2006) *Transmitting craft knowledge : designing interactive media to support tacit skills learning*. Sheffield, Sheffield Hallam University, 2006.

WOOLGAR, S. (2005) *Perspectives on Technology and Society.*Science, Technology, and Society. Ed. Sal Restivo. Oxford University Press 2005. Oxford Reference Online.Available at: <http://www.oxfordreference.com/views/ENTRY.html?subview=Main&entry=t210.e78 > [accessed via University College Falmouth 15.2.2010]. Oxford University Press. .

WOOLLEY, M. (2007) *The Making - Value and Values in the Craft Object.* pp.169-185. IN FOLLETT, G. & VALENTINE, L. (Eds.) *New Craft - Future Voices.* Duncan Jordanstone College of Art & Design, Dundee.

WOOLNER, M. & ADAMS, B. (1994) *The Application of Computer Technology in Designer Maker Practice. A survey of the nature and extent of computer usage by designer/maker craft practitioners*. University of Plymouth and The Crafts Council.

WOOLNER, M. & WYNNE, S. (Eds.) (2006) *Interface exhibition catalogue,* Exeter, Devon Guild of Craftsmen.

WORMALD, P. & PEDGLEY, O. (2007) Integration of Design Projects within a Ph.D. *Design Issues,* 23**,** 70-85.

YAIR, K. (2001) *Craft and industry: investigating the nature and value of collaboration between crafts practitioners and manufacturers within the new product development process*. PhD.Sheffield, Sheffield Hallam University.

YAIR, K. (August 2010) *Contemporary Craft Sector Profile and Analysis.* Briefing Note. Available at: http://www.craftscouncil.org.uk/files/file/76df15d439c56f74/craft-sector-profile-and-analysis.pdf [accessed 4.5.2011].Crafts Council.

YAIR, K., PRESS, M. & TOMES, A. (1999) Crafting Competitive Advantage: Crafts Knowledge as a Strategic Resource. *Design Cultures, Proceedings of the Third European Academy of Design Conference.* Sheffield Hallam University.

YAIR, K. (May 2011) *Craft & the Digital World*. Crafts Council research briefing. Available at: http://www.craftscouncil.org.uk/professional-development/research-and-information/research-briefings/ [accessed 29.11.12].

YAIR, K. (Nov.2011) *Crafting Capital: New technologies, New Economies*. Crafts Council research briefing. Available at: http://www.craftscouncil.org.uk/professional-development/research-and-information/research-briefings/ [accessed 29.11.12].

YAIR, K. (March 2012) *Craft & Enterprise*. Crafts Council research briefing. Available at: http://www.craftscouncil.org.uk/professional-development/research-and-information/research-briefings/ [accessed 29.11.12].

YIN, R. K. (2003) *Case Study Research: design and methods,* Thousand Oaks, Calif. ; London, SAGE.

ZAZZLE (N.d.) Homepage for Zazzle. *Custom T-Shirts, Personalised Gifts, Posters, Art and More...* Available at: www.zazzle.com [accessed 18.10.11].

Appendices

The Integration of Digital Technologies into Designer-Maker Practice: a Study of Access, Attitudes and Implications.

Isabelle Risner

A thesis submitted in partial fulfilment of the requirements of

University of the Arts London for the degree of Doctor of Philosophy

May 2012

University College Falmouth

Appendices Contents

Keywords: DIGITAL, DESIGNER-MAKER, COLLABORATION, CRAFT, DESIGN, HYBRID, SKILL, TECHNOLOGY.

These questionnaires were completed by the researcher, in conversation with eight makers, in March 2008. For commentary see: Section 4.1.2.

Appendix 1.1: Launch Day Questionnaire

Making it Digital

Launch Day Pilot Questionnaire

Please answer the following questions and return the questionnaire.

1. About You:
1a) Your sex: (please circle)

Male **Female**

1b) Your age: (please circle)

20 or under **21-30** **31-40** **41-50** **51-60** **Over 60**

2. Your Practice
2a) Which of the following do you consider yourself to be? (please tick all that apply)

Full-time designer-maker/craftsperson

Part-time designer-maker/craftsperson

Just starting out (first 2 years of practice)

…………………………………………………………………………………..

2b) Can you briefly describe your practice? e.g. ceramicist, textile designer, (main material/objects?)

………………………………………………………………………………………

……………………………………………………………………………………..

3. Making it Digital
3a) How did you hear about the Making it Digital project? (please tick all that apply)

Newsletter

Hidden Art Cornwall email

Friend

Other (please specify) ………………………………………………………………………………………

4. Your Computing Experience

4a) How would you rate your level of computing experience (in terms of using computers across the range of everyday home and work uses), on a scale of 1 to 5, where 1 is very little experience and 5 is very extensive experience: (please circle one number)

very little experience				very extensive experience
1	2	3	4	5

4b) Which of the following types of software package have you used before?

Please circle your level of experience with each type on a scale of 0 to 4, where 0 is never used and 4 is very frequent use.

	I have never used this type of software				Very frequent use
Word processing e.g. Microsoft Word	0	1	2	3	4
Internet/Email	0	1	2	3	4
Image manipulation e.g. Adobe Photoshop Paint Shop Pro	0	1	2	3	4
2D graphics/CAD e.g. Adobe Illustrator Corel Draw	0	1	2	3	4
3D CAD modelling e.g. 3D Studio Max Rhino, AutoCad	0	1	2	3	4

Are there other software types/programs you use very regularly? (please specify)

………..

4c) Which of the following 2D/3D digital input or output technologies have you used before?

Please circle your level of experience with each technology on a scale of 0 to 4, where 0 is never used and 4 is very frequent use.

	I have never used this type of equipment		occasional use		Very frequent use
Digital input devices e.g. Scanner, Microscribe	0……………......1	………………2	…………………..3	………………..4	
2D digital output devices e.g.plotter cutter, laser cutter, laser engraver	0……………......1	………………2	…………………..3	………………..4	
3D substractive output e.g. CNC Milling	0……………......1	………………2	…………………..3	………………..4	
3D additive output e.g. rapid prototyping	0……………......1	………………2	…………………..3	………………..4	

4d) Is there any other digital manufacturing equipment / service you have experience of?

(please specify)

……………………………………………………………………………………………………..

4e) Had you considered the use of digital design or production technologies in your work before you became aware of the Making it Digital project?

YES **NO**

If yes, please describe briefly

……

……..

5. Making it Digital – the benefits

5a) On a scale of 1 to 5 please rate the importance of the following elements in ATTRACTING you to apply for the Making it Digital project? Please circle ONE number where 1 is: not important at all and 5 is: very important.

	Not Important at all				Very important
Developing a new product	1……………......2………………3…………………..4………………..5				
Gaining new computing skills	1……………......2………………3…………………..4………………..5				
Gaining new Business skills	1……………......2………………3…………………..4………………..5				
Working with other makers	1……………......2………………3…………………..4………………..5				
Funding available for materials/expenses	1……………......2………………3…………………..4………………..5				
Access to 3D equipment	1……………......2………………3…………………..4………………..5				

Can you think of anything else that particularly ATTRACTS you to the project?

……

5b) What attracts you MOST about the Making it Digital project, please tick ONE only

Opportunity for new product development

Opportunity to learn new computing skills

Opportunity to learn new business skills

Opportunity to work with other makers

Funding for materials/expenses

Opportunity to Access 3D digital equipment

Other, (please specify)

…………………………………………………………………………………………………

6. Making it Digital – the challenges
6a) What, if anything, CONCERNS you about taking part in the Making it Digital project?

On a scale of 1 to 5 please rate how concerned you are about the following elements of the Making it Digital project? Please circle ONE number where 1 is: not concerned at all and 5 is: very concerned.

	Not concerned at all				Very concerned
Collaborative working	1	2	3	4	5
Lack of time	1	2	3	4	5
Difficulty with computer skills	1	2	3	4	5
Not enough funding	1	2	3	4	5
Not enough access to staff help	1	2	3	4	5
Not enough access to 3D equip.	1	2	3	4	5

Can you think of anything else that particularly concerns you about the project?

……

……

6b) What, if anything, concerns you MOST about the Making it Digital project, please tick ONE only

Difficulty in collaborative working

Difficulty in finding time to take part

Difficulty in learning new computing skills

Not having enough funding for project

Not having enough access to equipment

Not having enough access to staff help

Other, (please specify)

…………………………………………………………………………………………………

…………………………………………………………………………………………………..

6c) Given what you NOW KNOW about the technologies available within the Making it Digital project, are you more or less interested in applying digital techniques to your work, than you were at the start of the day?

Less interested	**About the same**	**More interested**

1…………………………2………………………..3……………………….4…………………………5

6d) Is there any other comment you would like to make about digital technology and your practice?

…………………………………………………………………………………………………

If you have any questions about this research contact Isabelle Risner, Design Centre, Tremough.

Appendix 1.2: MiD Demonstration Day timetable

Making it Digital introduction and demonstration day: Schedule for the day

9.30 - 10.00	**Registration and tea/coffee** Business room meeting room, Design Centre
10.00- 11.00	**Introduction to Making it Digital** 3D Digital Research Cluster room, Design Centre Tamsin Godfrey (Hidden Art Cornwall) and Justin Marshall (Autonomatic, 3D Digital Production Research Cluster at UCF) will introduce the project, what it includes and what the opportunities are for members.
11.00-11.30	**Tea and coffee break** Business Room meeting room, Design Centre
11.30-12.00	**Demonstrations of equipment- Session 1** Group 1 with Justin Marshall demonstrating laser cutting, laser engraving and rapid prototyping. Group 2 with Drummond Masterton on CNC milling machine Group 3 with Adam Stringer (Research Production Co-ordinator) demonstrating cutter plotter and the microscribe.
12.00-12.30	**Demonstrations of equipment- Session 2** Group 2 with Justin Marshall: laser cutting, laser engraving and rapid prototyping. Group 3 with Drummond Masterton: CNC milling machine. Group 1 with Adam Stringer: demonstrating cutter plotter and the microscribe.
12.30- 1.30	**Lunch in the Stannary** All participants will receive £5 worth of lunch vouchers to purchase food in the Stannary. An area near the window has been allocated for participants.
1.30 – 2.00	**Demonstrations of equipment- Session 3** Participants meet back in 3D Digital research cluster room after lunch. Group 3 with Justin Marshall: Laser cutting, laser engraving, rapid prototyping

	Group 1 with Drummond Masterton: CNC milling Group 2 with Adam Stringer: Cutter plotter and microscribe
2.00 – 2.45	**Questions and discussion session** Following demonstration sessions, groups return to the 3D Digital research cluster room for questions about the equipment and the project. In general.
2.45- 4.30	**Structured speed- networking session- led by Miranda Adams** (Project Coordinator, Cornwall Film) All participants go to the allocated area in the bar on the upper floor of the Stannary for a structured speed-networking session, which will help them to meet potential collaborators. Tea and Coffee will be available

MAKING IT DIGITAL: PROJECT TIMETABLE

Making it Digital will be launched in March 2008 and will run until November 2008. **The project comprises:**

Date of event	Event/ Activity
Thursday 13 March 9.30am-4.30pm (Enrol by 7 March) University College Falmouth **Please note date change (was 6 March)**	**Making it Digital introductory and demonstration day at University College Falmouth** which will involve: • An introductory presentation by members of the Autonomatic team about how digital design and production technologies have been employed by designer-makers, including the work of some Hidden Art Cormwall members. • The competition brief will be issued with a chance for initial queries and questions to be addressed. • Live demonstrations of the digital equipment at UCF, including laser cutter and laser engraver, vinyl cutter, CNC desktop mill and large scale mill, FDM rapid prototyping and jacquard digital loom. A microscribe arm (which allows physical movement to be captured digitally) will be demonstrated and information and samples of digital textile printing and the production of ceramic decals will also be available. • The day will conclude with a speed networking workshop, which will provide an opportunity for you to make initial connections with potential collaborators.
Monday 17 March 6-8pm University College Falmouth (Enrol by 12 March)	**Developing your project proposal:** Small group mentoring session led by Gary Allson This will provide an opportunity to discuss and gain feedback on your proposal, and to develop and improve it prior to the Making it Digital application deadline.
Wednesday 19 March 6-8pm University College Falmouth (Enrol by 12 March)	**Developing your project proposal:** Small group mentoring session led by Gary Allson This will provide an opportunity to discuss and gain feedback on your proposal, and to develop and improve it prior to the Making it Digital application deadline.
Wednesday 20 March 6-8pm University College Falmouth (Enrol by 10 March)	**Collaborative working practice:** Led by Karin Rucker (open to all members) The Making it Digital project is keen for as many people as possible to access the project resources. The preferred approach is for participants to collaborate in groups of 2 to 4. Individuals will still be able to participate in the project however their access to resources will be less than those applying as a group. The project recognizes that effective collaboration is crucial to the project success. This workshop will help practitioners to develop productive collaborations. It aims to: o Help participants to reflect on how collaboration could benefit them

- Highlight some of the pitfalls of collaboration
- Highlight the key elements of effective collaboration
- Provide some tips on developing collaboration agreements
- Offer an opportunity to develop a set of agreements for group collaboration

Thursday 3 April 5pm	**Competition deadline** for designer-makers to submit a proposal responding to the Making it Digital competition project brief.
Wednesday 9 April	**Competition results announced**. Hidden Art Cornwall will notify designer-makers of the outcome. Successful applicants will be asked to develop a structured project plan which will be presented at the forum on 25 April.
Wednesday 9 April 10am-4.30pm (Enrol by 14 March) Design Centre, University College Falmouth	**Software training**: Photoshop for beginners (Max 10 places) Led by Kate Knapp
Thursday - Friday 10-11 April **10-4.30** (Enrol by 14 March)	**Software training**: Two day course for beginners in Illustrator to Laser-cutter. (Max 10 places) Led by Kate Knapp
Thursday - Friday 10-11 April (times tbc between 4-5.30pm)	**Feedback and planning meetings for participants with their allocated Autonomatic team mentor**
Monday 14 April 6-8pm Venue tbc	**Developing project plans for Making it Digital led by Adele Oakes and Geoff Thorndyke (Truro College Business Centre)** This session will give participants support with developing each section of their project plan
Thursday 17 April 6-8pm Venue tbc	**Resources planning for Making it Digital led by Adele Oakes and Geoff Thorndyke (Truro College Business Centre)** This session will focus on planning out the activities needed to reach production, assigning resources to each task i.e. budget and people, ensuring the product can be delivered within the budget/resource allocation provided within the project (including time each partner has available)
Friday 25 April 9.30am-4.30pm Media Centre, University College Falmouth (Enrol by 11 April)	**Making it Digital Forum** 9.30-12.30 (For Making it Digital participants only) Making it Digital participants will give 15 minute presentations about their projects to the group. Written feedback from invited speakers from the pool of specialists and peers will be taken and fed back to the groups following the forum.

	1.30-4.30 (For all members registered on the IRTM programme wishing to attend) The session will include talks by members of the pool of specialists, focusing on the innovative uses of digital technologies, product development and the process from design idea through to production. It will also look at case studies of designer-makers who have taken part in similar projects.
Monday 28 April - Friday 2 May (times to be scheduled)	Following the Forum, each group will have a 1-2-1 mentoring session with a Business Advisor with feedback from their presentation.
1 May to mid June	**Product development:** A timetable of sessions will be set up in order for participants to work through the first product development stage with support from the Automatic team. This will focus predominantly on developing CAD files. Access to the computer lab at University College Falmouth will be available.
Mid June - end July	**Access to 3D digital production equipment** will be available. A timetable will be set up for participants to have access to the equipment, with support from the Autonomatic team and technician.
Thursday 19 June 10-12am University College Falmouth	**Group feedback meeting for Making it Digital participants** to discuss progress so far and decide what material to include in the Making it Digital showcase at the Hidden Art Cornwall Design Fair.
Thursday 17 July 10-12am University College Falmouth	**Group meeting for Making it Digital participants** to finalise details for Making it Digital showcase at Hidden Art Cornwall Design Fair.
22-25 August 11am-6pm (8pm Sunday)	**Making it Digital showcase at the Hidden Art Cornwall Design Fair** Work developed through the project so far will be showcased at the Hidden Art Cornwall Design Fair at Godolphin House. Participants will assist with the set up and invigilation of the exhibition.
3-7 September	**Showcase** will then be transferred to The Poly for the Networks of Design Conference. Participants will assist with set up and invigilation.
Monday 29 September Media Centre, University College Falmouth (Enrol by 14 September)	**Making it Digital second forum** The first part of the day will be for participants to feedback and get advice from the pool of specialists. The second form will be open to all members and will focus on developing marketing strategies, getting work into the press and issues associated with protecting your designs.
Early November (tbc)	Meeting to resolve final showcase.
October - November	Participants will complete their product and finalise marketing strategy etc.
Mid November – Dec.	**Touring showcase of finished work** at venues in Cornwall, the wider region and London.

Appendix 1.4: Explanation of MiD Timetable

Making it digital (MiD) ran from March to December 2008. Launch events in London and Cornwall, training exercises, including sessions on collaborative working and developing proposals and the formal written selection process took place during March and early April 2008. On 25th April 2008 successful applicants presented their finalised project proposals, and consent from them to act as participants within this research was sought. Nine participants agreed to take part in the research. Support with making and use of digital equipment ran through the Summer 2008, concentrated from mid-June until the end of July. The first showcase of work took place at the Hidden Art Cornwall Design Fair: 22-25th August 2008 at Godolphin House, with final exhibitions in London (Broadway Market) and Cornwall (Royal Corwall Museum) in December 2008.

1.4.1: Recruitment: Making it Digital

Around 30 makers attended a London launch day. A launch day for MiD was held at the UCF Tremough campus on 13th March 2008 (Appendix 1.2). The scheme was widely advertised within the Hidden Art Cornwall (HAC) member network by email, word of mouth and telephone canvassing. HAC staff reported that raising interest in Cornwall had been difficult with many members *'seeing the word digital and thinking it didn't apply to them'*. (Personal communication with Tamsin Godfrey, HAC Project Manager, 11 March 2008.) This raised the issue of how 'digital' technologies are conceptualised by designer-makers. On the launch day, however, the scheme was well received by 18 attendees who appeared enthused and surprised by the range of equipment and opportunities on offer. Eight makers attended a collaborative work training session the following week.

In the event, 15 written proposals involving 17 individual makers, either on their own (nine proposals) or in collaboration (six proposals), were submitted by the deadline of 3rd April 2008. A selection panel met and it was agreed to take forward eight proposals involving 11 makers.

Despite encouragement of collaborative proposals, many applicants chose to put in an individual proposal and the majority of proposals were individual ones. The researcher felt this reflected the sole practice business model of these design and craft micro businesses.

Proposals covered a wide range of projects in scale and materials, from jewellery and small vessels to furniture and architectural features. The range of equipment that makers wished to utilise was also broad, from the plotter cutter to CNC routing, there were proposals that were applicable to every piece of equipment. Textiles and surface pattern featured prominently but so did ideas to do with image manipulation, manipulation of scale and using materials new to the maker. There were ideas that featured 2D pattern cutting for 3D objects, using digital data sources and the personalisation of goods, among others.

Appendix 1.5: Data Collection

Evidence for this research was collected by the researcher within four broad areas:

1. The participants' views on current practice (through interviews, presentations and website data).

2. The meanings of digital technologies for them (through questionnaire, interview, focus group and additional data collected at different stages of the project).

3. The practical and experiential aspects of using the technologies (through observations, field notes and photography).

4. The short term outcomes (objects created, attitudes changed, and their views of the impact of the experiment on their practice).

The following primary documents formed the basis of the textual data for analysis:

Eight interview transcripts with participating makers, conducted by the researcher, from May to July 2008 (one recorded interview with each individual that agreed to participate in the research) lasting 30-45 minutes. These interviews were carried out at Tremough or at the maker's studio, during the active phases of the project.

The transcript of a focus group discussion facilitated by the researcher with six participants. A focus group was conducted on 17th October 2008 as the project was reaching a final stage, during a day when makers were presenting their project outcomes.

Research field notes from observations, groups meetings and MiD progress meetings, informal discussions with makers and notes taken at exhibitions. There were a number of occasions during the project when the researcher was able to be present as objects were being manufactured, discussed or exhibited.

Memos and diagrams prepared during analysis.

Copies of project documents, such as exhibition, publicity and funding proposals.

Appendix 1.6: Interview Questions

Successful participants presented their finalised proposals on 25th April 2008. At this meeting the researcher gave a brief introduction to her research and participant consent forms were distributed. During the day each participant gave a ten minute account of their proposed project and this formed the first formal participant data. The researcher requested that she contact participants individually and make appointments to carry out a one-to-one interviews. Initial interviews were semi-structured and lasted for around 30-45 minutes.

A semi-structured interview template was developed. It followed advice to ask short, simple and open questions (Robson, 2002, Keats, 2000) and build rapport with interviewees. As interviews took place, certain questions emerged as more appropriate, Question 3 in particular was replaced in later interviews with the more direct 'Why is using digital technology attractive to you?'. The interview template included a more experimental section at the end titled: 'finally'. This was intended to stimulate possible discussion with the participants about their understanding of the value 'hand-made' or 'machine' made objects and the associations, for them, of the term 'crafted'.

Interview template: Introduction –Yourself

Can you tell me a bit about your own practice and background?

(further questions/discussion:

1.1: Where did you train?

1.2: Do you sell your work, and if so, where do you sell?

1.3: Roughly what proportion of your income is derived from making and selling?

1.4: How long have you been doing it for?

1.5: How do you describe yourself – Designer? Maker etc?

1.6: Do you have a studio?

1.7: What are your main materials and tools?

1.8: What do you think are the main problems in sustaining or growing your business?

2. M.i.D

Moving on to the Making It Digital project, tell me about your proposal?

(further questions/discussion:)

2.1: Have you applied on your own or in a group? Why was that?

2.2: What motivated you to apply?

2.3: What is your project about? Did you consider other proposals?

2.4: Did you consider other digital equipment? Which ones?

2.5: Have you used digital equipment like this before? Why did you choose this one?

2.6: Is it something you have been thinking about for a while, or did you develop it for Making it Digital?

2.7: Do you see any conflict between the use of digital technology and your craft/practice? For example, do you think people might view things made through digital means differently?

Help

3. Overall, can you tell me how you think this project might help you?

(further questions/discussion)

3.1: Are you doing it to develop new products or an existing range?

3.2 Is it an experiment?

3.3: Can you see yourself moving to more of this type of work?

3.4: What does Making it Digital offer that made it attractive?

3.5: What are you hoping to get out of it?

3.6: If you imagine for a moment it was wildly successful, what kinds of things would that mean?

Finally

4. Finally, have a look at this. It's a photograph of a wooden bowl made by David Pye. Pye was a craftsman and a teacher. In the 1950s he was a tutor at the Royal College of Art and from 1964 to 1974 he was Professor of Furniture. He made things using tools including a 'Fluting Engine' that he'd designed and constructed himself and that gave him the control over these very fine gradations of mark you can see, so he could gradually make the flutes get deeper.

4.1: Looking at this image do you think the fact that it was done, in part, by a guided system rather than completely free hand affects how you view it?

4.2: I suppose what I'm really thinking about is what does something being 'crafted' mean to you?

4.3: Is it something your customers ask about? What do you think they are looking for? That you made it? That it's a one-off? That the materials are local?

4.4: In your area, does it matter how much or whether something is 'hand-made?'

Appendix 1.7: Making It Digital: Focus Group Questions

A focus group activity plan was developed to promote interaction and group discussion (Wilkinson, 2004:178). A brief summary in included below.

Focus Group Interview Schedule, 17th October 2008

Facilitator: Isabelle Risner

Location: Digital Research Cluster interview room

Participants: 6 plus facilitator (3 female, 3 male), Time: 11 a.m. – to 11.45 am

Preamble:

tea, coffee, buns etc, 5 minutes.

Introduction to research and other participants

How information will be used.

Two sheets of paper in front of you. One has a red sticker, the other green . If you could just take 5 minutes to write down a couple of sentences or words in each box, or make a scribble or a sketch if you'd rather, of any good points on the green sheet and bad points on the red sheet.

Only put one idea in each box. Introduction to type of issues. Papers passed around. Top issues marked with stars.

XX can you tell us what's the issue that's got the most attention on the piece of paper in front of you.

Has anybody to anything to add?

Is this something you all think?

What was the problem with this?

Lets move on to a new issue. Next person round from XX what's the top issue on your paper? Is it very similar? Has someone got something different they would like to bring up?

15 mins discussion

Moving on to the green paper. Pass them to the right and put a star next to anything that you also think is important. So, if XX wouldn't mind starting what's the top positive issue on your paper?

15 mins discussion.

Ok, we've run out of time. I just wanted to say thank you again and conclusion.

Appendix 2: Practice-based enquiry: List of figures

Appendix 2.1: Description of the researcher's test process

The following notes describe a series stages, in one of a number of making processes and experiments, undertaken by the researcher as part of her practice-based research. A photograph, printed in The Guardian on Thursday 15th October 2009, was used as a reference image for a quick black marker pen sketch made by the researcher. The aim was to retain a sense of a quick hand drawn impression in a high contrast black and white image, still unmistakably of the House of Commons.

Figure 47: The black pen sketch of the House of Commons. I.Risner, 2010.

The sketch was used as the background image. The whole image including the sketchbook was scanned on a flatbed Epson scanner, including the spiral ring binding of the sketch book, emphasising its status as a sketch. It was scanned at a relatively high resolution - 600dpi. In this **transformation** the sketch has gone from a physical black pen line to a digital information file.

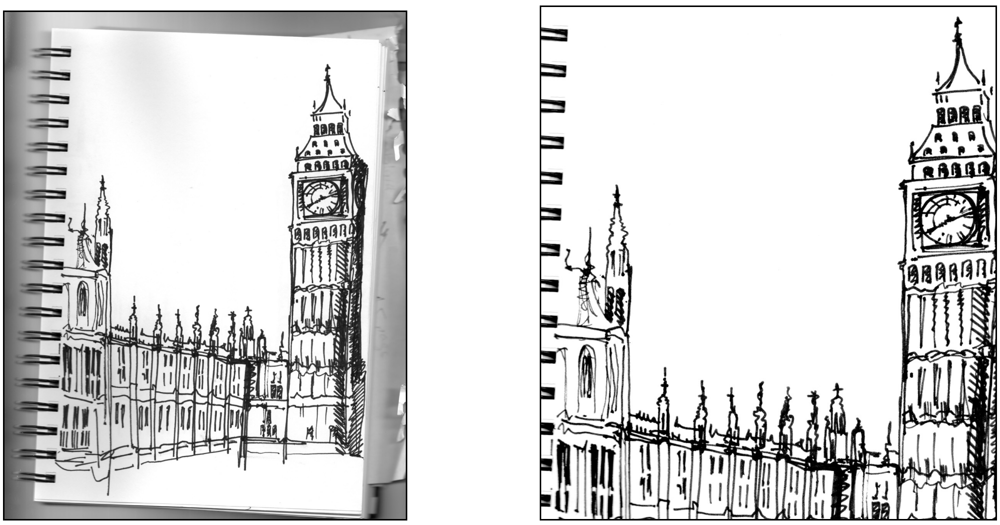


Figure 48: The scanned sketch and altered Photoshop file for engraving. I.Risner, 2010.

Adobe Photoshop was used to manipulate the file and create a Jpeg image to send to the laser engraver. Among the alterations made were cropping the image, applying a filter as well as altering the contrast levels. The new Jpeg file is the **second** transformation of the digital information file - a re-drawing of the available information in digital form.

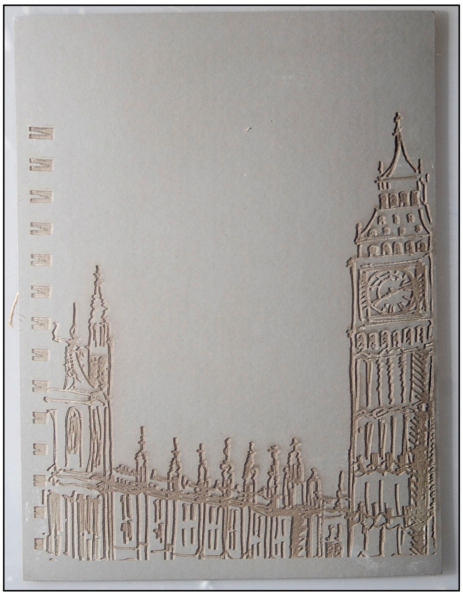


Figure 49: The engraved lino image. I.Risner, 2010.

Using the Trotec Speedy 500 laser engraver, a relief image was engraved into traditional hessian backed lino (See Health and Safety Notice , appendix 2.3). Alterations include re-sizing, positioning and choice of engraving settings.

Figure 50: The positive relief plaster, I.Risner, 2010.

By using the lino as a mould a flat plaster positive relief impression of the image is cast. A **fourth** transformation.

Figure 51: A selection of scanned newspaper cuttings and sections for engraving, I.Risner, 2010.

A second newspaper source, a story from the Daily Telegraph from Tuesday 13th October 2009, was selected and scanned. The image of the newspaper cutting was manipulated in Adobe Photoshop to alter the scale and contrast. A specific cutting selected and cropped and reversed, changing appearance and scale.

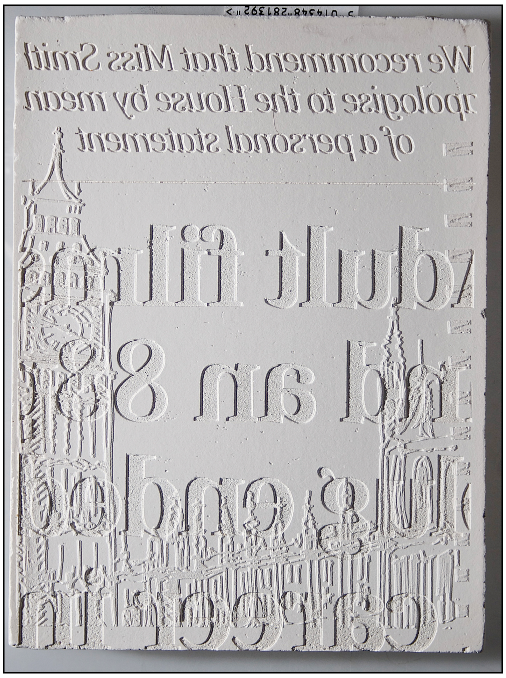


Figure 52: The re-engraved plaster block, I.Risner, 2010.

This second Jpeg was engraved into the original plaster block (See Health and Safety Notice, appendix 2.3), using the laser engraver to create a negative relief, over the top of the very low positive relief, combining sections of the two images, so that it appears to create an interference pattern, a secondary drawing effect - a **fifth** transformation of the line from the original sketch. The complex double pattern that can be seen in the photo, Figure 6.

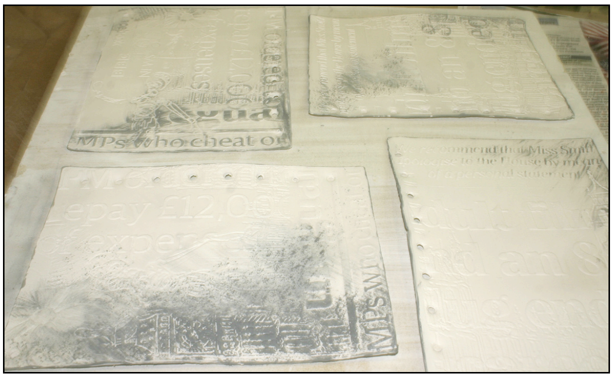


Figure 53: Unfired press moulded porcelain test pieces. I.Risner, 2010.

The plaster block was then used as a mould in conjunction with a large number of other previously engraved and cast plaster blocks, including images of flowers and figures that had been part of earlier tests. Thinly rolled porcelain clay was used to create a press moulded tile. Several plaster blocks were used to collage images together. The press moulded pieces were finished by using black stained slip to highlight sections and with other hand alterations, such as scratching the surface or piercing holes.

This meant that the final stage of the process, the creation of complex overlapping imagery and the physical alteration of the clay body, by hand, was an immersive individual process that engendered the feeling of creative 'flow' (Section 2.3.7). This **sixth** transformation into a new material resulted in a clay impression that combines positive and negative relief.

Figure 54:Fired porcelain tests, approx 13.3 cms x 17.7cms. I.Risner, 2010.

Figure 55: Fired porcelain tests with black stain, approx 13.3 cms x 17.7cms. I.Risner, 2010.

The pieces were high fired. Again, this is a physical transformation resulting in shrinkage and a state change in the clay, creating a translucent ceramic relief, the **seventh** transformation.

Appendix 2.2: Practice log numerical categorisation

The researcher used sketchbooks and a detailed written diary of progress (kept as a log within the Nvivo 8, software program) from 17th July to 6th November 2009, with the majority of the work carried out during September and October 2009. It covers all of the process and equipment tests the researcher carried out.

Issues noted in the researcher's log over the whole time period were subsequently re-read and categorised. The log has 36 entries, typically each around a page (400 words) long and consists of around 14,500 words. It is similar to a private diary; it was not kept every day, it very much follows the rhythm of making itself which tends to go forward unevenly and alongside other work. The analysis of this log resulted in categorisation of comments into six subject areas and 17 categories, as shown in the tables below. The researcher chose the categories by reading and re-reading the log and assigning quotes to themes and then building-up understanding by relating the concerns and opinions expressed to each other. Patterns of repeated concerns emerged fairly quickly. No comments are categorised twice. An attempt was made, where appropriate, to distinguish between issues that were related to digital processes and those related to traditional making processes.

Table of issues that emerged from analysis of personal practice work log:

Concern with:		**No. of log comments**	**Of which:**	
		Total	**Digital**	**Traditional**
General issues:	Costs of materials	5	1	4
	Access to equipment	5	4	1
	Lack of Time	3		
	Health and Safety issues	3	1	2
Noting and overcoming problems:				
	Set-backs/mistakes	13	3	10
	Technical problems	21	8	13
	Process descriptions	14	6	6
Comments regarding help asked for /given:		**33**	**12**	**21**
	Positive comments	29	9	19
	Negative comments	4	2	2

Concern with:		No. of log comments Total
Concerns regarding work outcomes:		
	Quality of outcomes	14
	Use of imagery	9
	Digital impact on work	7
Positive comments:		
	Satisfaction with outcome	14
	Steps forward	5
	Flow - immersion in process	3
Distractions:		
	Family/home	11
	Other work/events	3
	Total	**163**

This log is essentially a record of day to day problems, distractions and issues that are negotiated, often through getting advice and help, to arrive at an acceptable outcome. It covers both traditional hand making and digital making elements. Analysis of problems encountered, and the influence of digital technologies, is contained in the main thesis, Section 5.2.

Appendix 2.3: Trotec Engraver

The researcher used a Trotec Speedy 500 laser engraver to carry out the engraving processes within this practice-based enquiry. The Trotec Speedy 500 was available within the work shop of UCF, and at all times was used under the direction of trained technicians. The Trotec 500 is designed to engrave a wide variety of materials including acrylic, wood and paper.

Health and Safety Notice

The Trotec 500 Speedy laser engraver was used to engrave plywood and other materials for this practice-based research. During tests it was used to engrave other materials including dry plaster blocks and traditional hessian backed lino. These were engraved as part of tests to make ceramic press moulds. This was done within a limited practice experiment and under the direction and close supervision of trained technicians at all times.

Please note that Trotec has been consulted on the suitability of these materials for engraving and told us they are 'unsure' of the health and safety implications of engraving dry plaster or traditional lino. They emphasized the importance of operating the machinery with the correct air flow and extraction at all times.

The researcher therefore cannot endorse the use of these materials and emphasizes that there has been no health and safety testing undertaken as part of this research, the suitability and use of these or any other materials within laser engraving applications is not recommended by this research and would be undertaken entirely at practitioners own risk. The researcher would urge any other practitioner to consult with equipment suppliers and expert technicians and to use materials that are recommended, having regard to the operating manual and safety instructions.

The University College Falmouth COSHH assessment for casting plasters No.134295 was referred to and lists health risks, including inhalation of dust and fire risks, including toxic fumes produced when substance is involved in fire.

Appendix 2.4: Researcher's Mind Map

The analysis of practice also included the production of a mind map of the final process (shown below) dividing this process as a series of stages of making.

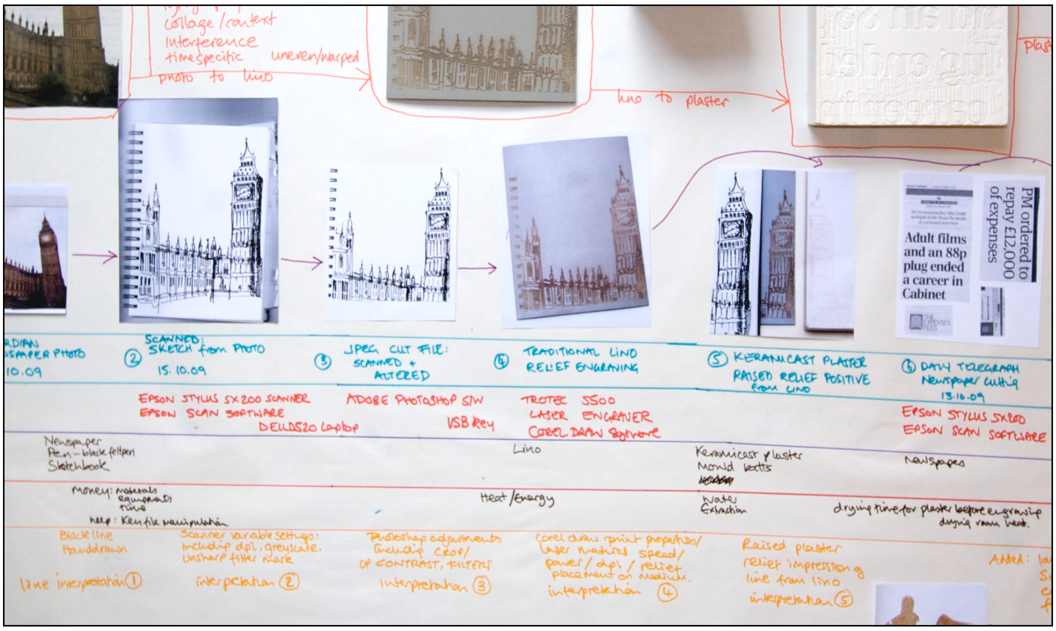


Figure 56: Visual mind map detailing transformations of data. Left-hand side shown. Approx.100cms x 80cms. IRisner, 2010.

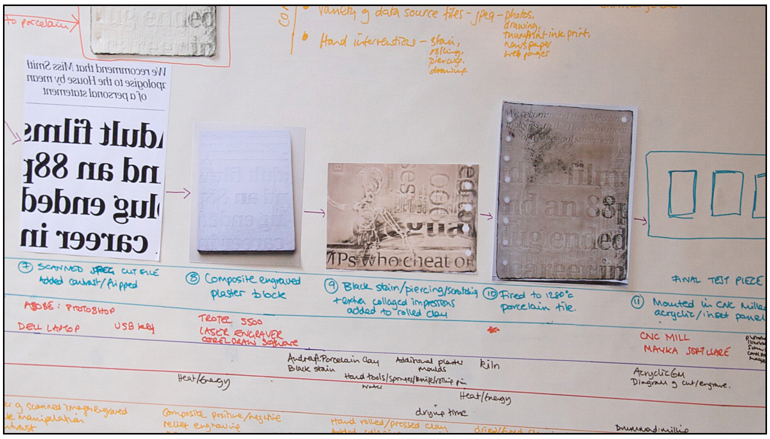


Figure 57: Visual mind map detailing transformations of data. Right-hand side shown. Approx.100cms x 80cms.IRisner, 2010.

This mind map sought to define each stage of making and interrogate its specific nature asking the question of whether the process resulted in 'crafted' pieces – work that meets the researcher's criteria for 'crafted' objects, and whether the opposition of crafted to machined is a meaningful distinction as shorthand for the skill value of the objects created.

Appendix 2.5: Email exchange with Dr. Naylor

Excerpts from email exchanges between the researcher and Dr. Larissa Naylor regarding map artwork development, March- April 2010.

09 April 2010 10:36

Hi Larissa,

I have attached a jpeg of an Adobe Illustrator map that I have created from your rock data and would like to use as the background image for my porcelain.
The division into ten panels is shown, the map would run behind as a background layer - the circles indicate where I am intending to overlay detail engraving - each one will be a different image perhaps a bit of text, a detail of some seaweed, a rock texture etc...

I have made the map by putting two of the Glamorgan jpegs together and tracing over with a graphic tablet

09 April 2010 10:47

Isabelle,

This is very exciting!
Are you around this morning? Perhaps best if we talk about it, as one of the lines you've kept is quite irrelevant - the brown one. The red line is important, and you could extend this line around to the right (I have the data for this) as it would make more sense in terms of framing your block movements as the red line is the edge of the 'higher' layer where the blocks originated from (western edge) and the extended red line I could give you 'catches them' in a 'boulder trap' hence the cluster of blocks on the right hand side.

You are right about North being inland.

09 April 2010 11:34

Isabelle,
You are right in terms of the colour coding of the blocks for each day. Blocks 5 and 9 need to be amended on your drawing though - as they both move from west to east between the start and end of the storm, so lines need to be drawn to connect these blocks. I hope this makes sense!?
#Larissa

12 April 2010 15:19

Isabelle,

Looks terrific, I like the shading as I think it helps differentiate the platform from the layer below.

It would perhaps get too messy to shade the area between the line running north - south (by 6, 9, etc, = boulder trap line) and the area to the east (with all the boulders in the trap), so I can understand why you want to leave that blank as per the rest of the space to the north of the intact platform. It would be more representative if it was shaded or perhaps the three areas were differentiated by height in the lino-cut? - i.e. 1) area to north with no boulders smoothest, lowest elevation. 2) Area which is shaded south of the jagged line is highest in elevation (i.e. the intact platform), 3) area between the boulder trap line and the platform is really uneven and no higher in elevation than the platform which is raised to the south and east of it. No idea if possible or artistically desirable but thought I'd throw this complexity into the mix!

Best, Larissa

Appendix 2.5.1

Execept from University of Exeter, School of Geography News, June 2010.

Dr Larissa Naylor, a coastal geomorphologist, is collaborating with Isabelle Risner, a PhD student at University College Falmouth. Isabelle is using some field data collected by Larissa as part of her RGS-EPSRC funded project: *Has rock coast vulnerability been underestimated?* These data are being used as the scientific input to Isabelle's research exploring the use of digital processes within designer-maker practice. Data collected (by Larissa) on the movement of boulders across a rocky shore platform is represented by a map that has then been overlaid with coastal related imagery. Isabelle's work considers the potential of collaborative engagement opened up by digital practices within craft. This work is being exhibited within ' Out of Hand' - an exhibition of work from students and alumni of University College Falmouth's courses in Textiles, 3D Design and Contemporary Crafts. This takes place at The Glove Factory in Appledore from 3-6th June 2010, as part of the 2010 Appledore Arts Festival called *Coastlines.* [http://www.appledorearts.org/index.htm]

Appendix 2.6: Map development, figs 15-18

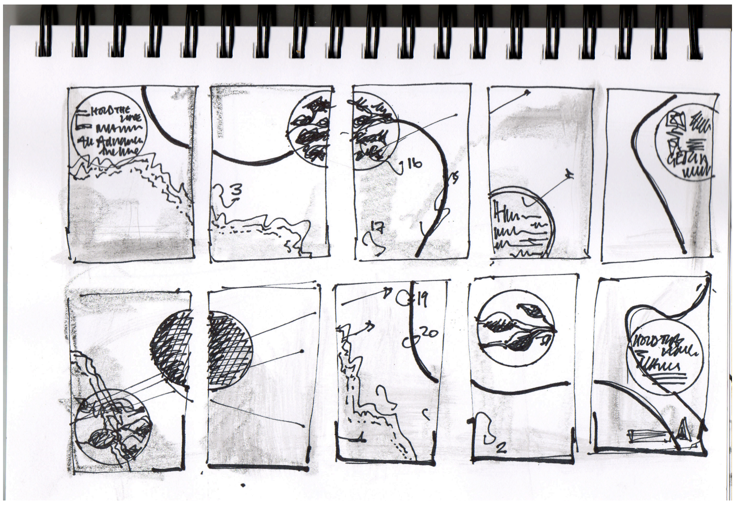


Figure 58: Sketchbook, first visual of layout of piece, April 2010, I.Risner.

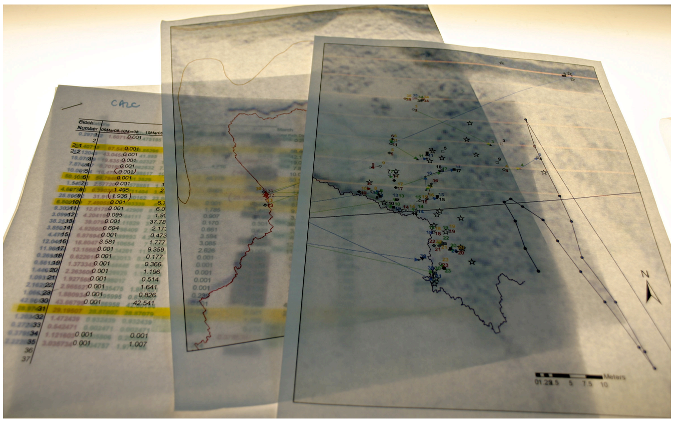


Figure 59: Example of data and maps used as source material. Photograph: I.Risner, 2010.

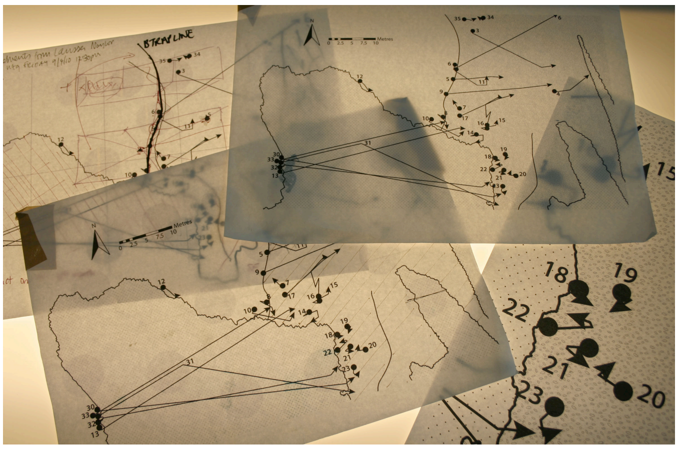


Figure 60: Map iterations. Photograph: I.Risner, 2010.

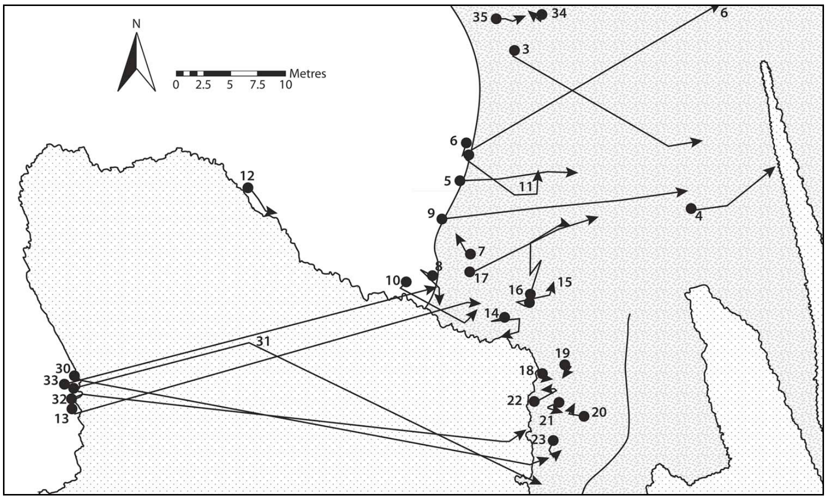


Figure 61: The final map artwork, April 2010. I.Risner, 2010

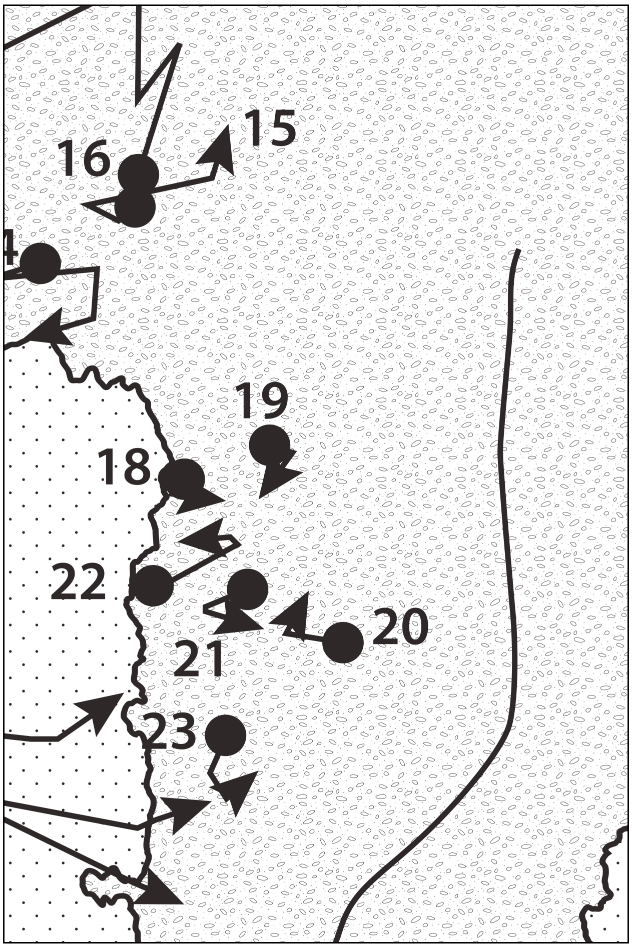


Figure 62: The Boulder Trap, digital artwork for Panel 9, 200mm x 300mm.I.Risner, 2010.

Figure 63: Detail of Panel 9, fired porcelain, ‘Moving Boulders’ May 2010. Photograph: I.Risner.

Figure 64: Work in progress, plaster mould, panels and artwork, April 2010.Photograph:I.Risner.

Appendix 2.7: Four contributed artwork images

Figure 65: Rock Erosion Memory, Mortar and Pestle photograph, Justin Marshall, 2010.

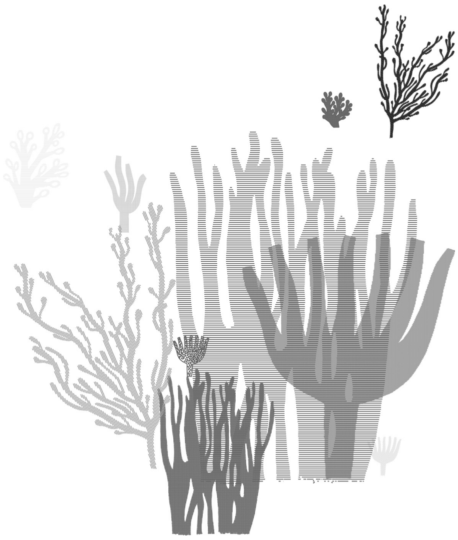


Figure 66: Digital Seaweed Drawing, Katie Bunnell and Jessie Higginson.

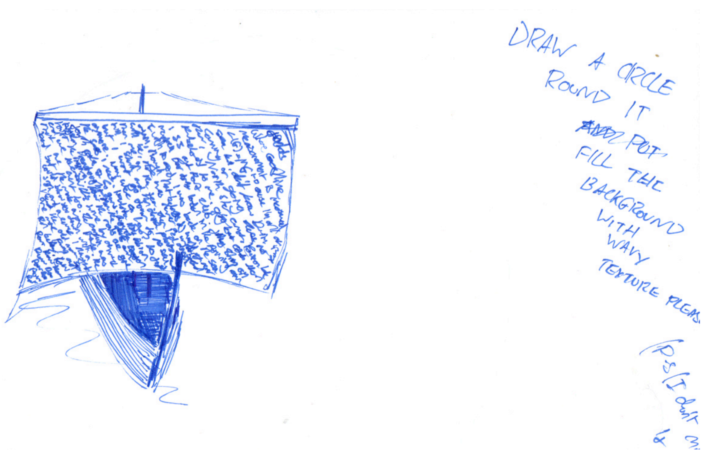


Figure 67: Coastline Measurement Sail boat, Conor McMahon, 2010.

Figure 68: Sea Kayak GPS journey from Meanporth to Durgan, March 2010, Ken McMahon.

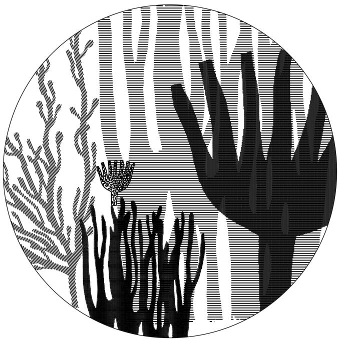


Figure 69: Final digital artwork for a number of circles.I.Risner,2010.

Figure 24: Artwork from Seaside drawing, Emile Cleverly, aged 6, 2010

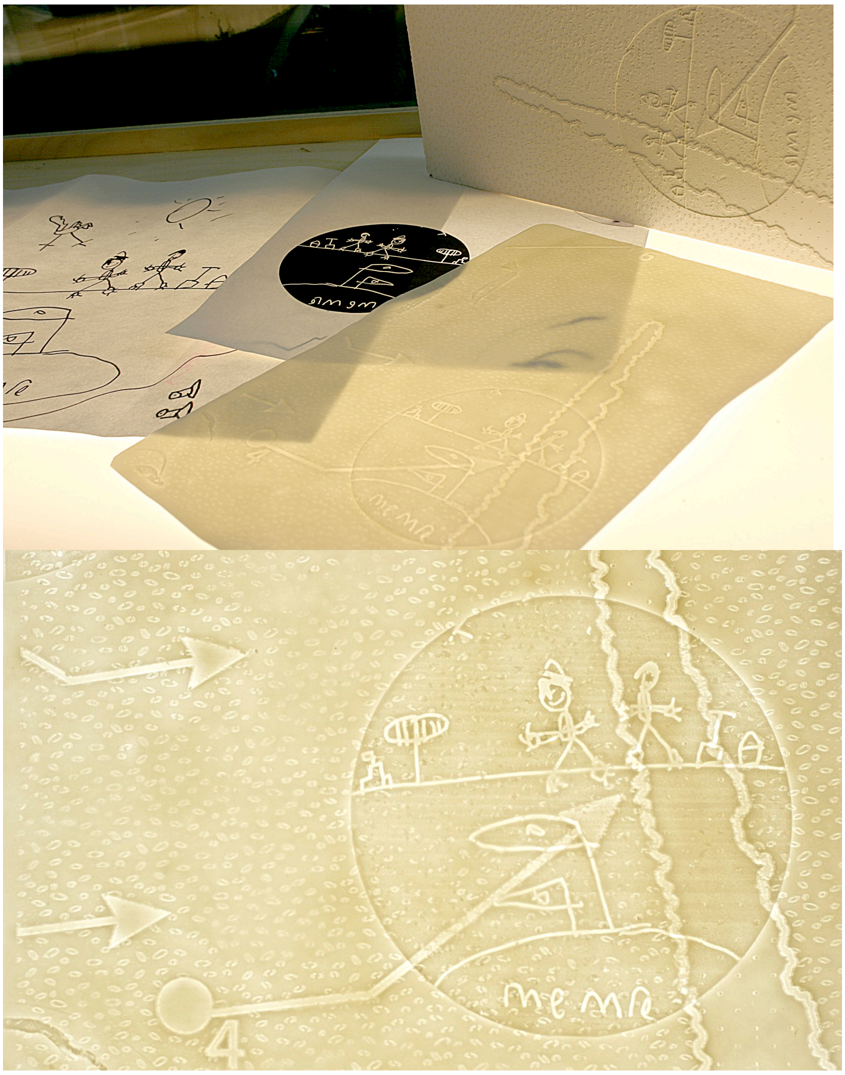


Figure 70: Seaside drawing, Emile Cleverly, aged 6, 2010. Artwork, with plaster and porcelain versions shown. Photograph:I.Risner.

Appendix 2.7.1 Description of technical process collaboration

In order to develop this collaborative piece, the researcher had to develop techniques though trial and error and repeated practice, to achieve clear tonal and relief profiles with good clarity and detail across a wide range of imagery. The researcher needed technical help from a Photoshop expert to set up a large template file with the appropriate circles in place, into which alternate images were imported in separate layers. Software expertise and tuition in manipulating images was also used. *Figure 24* shows a number of the circles. The images were balanced and composed across panels by the researcher moving them within a very large Adobe Illustrator file that was subsequently divided into ten individual engraving files. This proved to be a somewhat difficult technical challenge and the final preparation of the individual engraving files was done entirely by a digital expert with very considerable experience of this software. The successful completion of this project to a tight timescale was therefore dependent on access to technical software help.

Figure 19 shows a number of completed plaster blocks and work in progress. Variations in engraving times for different types of imagery mean that there was no standard time to process a single panel at the machine stage, the shortest taking only 15 minutes but the longest well over an hour per engraving process. As a number of separate stages (map engraving and circle imagery) and test processes were involved, many hours of machine time were used over the course of three to four weeks. Diary entries indicate a minimum of 22 hours of booked machine time between April 16th and May12th. The successful completion of this project was therefore dependent on access to machine time and technical help.

In order to manufacture an appropriate display, a bespoke light box was designed in conjunction with a staff member with considerable technical expertise. A 3D CAD design file was used to prepare and cut files on 3D router in wood and acrylic, which slotted together to make a wall-mounted casing. The materials, including two fluorescent light tubes and fittings, cost around £300 but the workmanship and design was freely available, as part of the overall exhibition design and manufacture of plinths. Again, this was technically outside the researcher’s capability. Whilst the issue of display is not purely a digital concern it was, in this case, related to the type of making process used because one of the benefits of digital technologies is the ability to relatively easily make multiple pieces. The availability of digital design and manufacturing facilities, in this case CADCAM software and a digital router, influenced the type of display possible and therefore the type of work possible. The building of a complex bespoke light box enabling the piece to be displayed at eye level and as a single installation was made practicable by the digital manufacturing facilities and technically skilled help available at UCF.

These three examples of substantial contributions of technical input to the work, software image manipulation, laser engraver supported access and building a light box display demonstrate the researcher’s dependence on skilled support. The researcher was fortunate to have free access to this kind of help by virtue of her studies, and believes that this support enabled a substantial extension to the practice work that it was possible for her to undertake in a short timeframe. It serves to demonstrate how the availability and use of digital facilities enlarges the sphere of activity around the maker, drawing in the digital tools themselves, the software and machinery but also all the attendant help, knowledge, skills and expertise that can make these resources work for the maker.

Appendix 2.8: *Moving Boulders* Artist Statement

Artists Statement

Glove Factory Exhibition, June 3rd – 6th, 2010. Appledore.

Isabelle Risner

UCF PhD Research Student

'Moving Boulders'

Strategies for managing change along coastlines, under pressure from coastal erosion and sea level rise are expressed in language with battle overtones: 'Hold the Line' or 'Advance the line' with hard defences to 'Managed Realignment' or 'No Active Intervention'[3]. This piece is concerned with these narratives of control and retreat played out against the backdrop of the sheer scale and dynamism of nature. Making use of data obtained through collaborative engagement with scientists studying movement of boulders on a rocky coast, the lines and arrows tell the story of the effects of storm on boulders in March 2008. The numbered boulders, some up to a tonne in weight and over a metre in length, were tracked as they moved across a Welsh shore platform over the course of a few days. Their surprisingly dynamic and mysterious wanderings are the background map and inspiration for this work. The movement is depicted in lines in the porcelain and these are overlaid with patterns representing other types of 'coastlines', other pressures and elements of coastal imagery and complexity. It is intended to express a sense of conflicting patterns and knock-on effects, when you move one piece others are out of alignment. We are left with an impression of how difficult it is to see more than a glimpse of order when new movement and new patterns are always emerging. A tension exists between each single panel and the overall pattern, representing the difficulty of making changes in the context of a wider situation.

Special thanks to Dr. Larissa Naylor, University of Exeter, Cornwall Campus, School of Geography.

Isabelle Risner

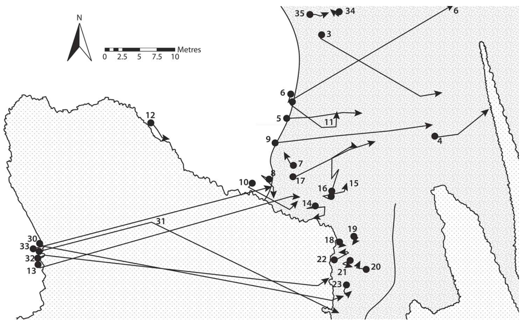
[3] Cornwall and Isles of Scilly Draft Shoreline Management Plan Review, www.ciscag.org. consultation open until 17 June 2010.

Appendix 2.9: Information Panel for MA Show, UCF, September 2010

The following information panel was prepared to accompany the exhibit at the UCF woodlane MA Design Show 7-11 September 2010.

‘Moving Boulders’

Isabelle Risner, *UCF PhD Research Student*



Strategies for managing change along coastlines, under pressure from coastal erosion and sea level rise are expressed in language with battle overtones : ‘Hold the Line’ or ‘Advance the line’ with hard defences to ‘Managed Realignment’ or ‘No Active Intervention’[4]. This piece is concerned with these narratives of control and retreat, and the conflicting pressures on coasts, played out against the backdrop of the sheer scale and dynamism of nature.

The background map has been developed for this piece in collaboration with Dr. Larissa Naylor, a coastal geomorphologist with the University of Exeter, Cornwall Campus, School of Geography.

This map is based on data collected as part of Dr. Naylor’s study tracking the movement of huge boulders (up to ¾ of a tonne in weight and 1.5 metres in length) as they became detached and transported by the elements across a rocky shore platform in Wales. The lines and arrows in the porcelain show the distance the boulders travelled, each one a numbered circle, during a storm event in March 2008. You can see from the scale in *Panel 2*, (top left) that they are surprisingly dynamic and mobile, the furthest moving over 40 metres in just a few days. *Panel 9*, (bottom row, right-hand side), shows the main part of the ‘boulder trap’, this has been shaded to indicate a lower area from which the boulders find it hard to escape. This photograph shows the type of coast Dr.Naylor’s study considers.

Super-imposed on the map are a number of other, more general, coast related images referencing everything from seaweed and seaside holidays to historical and policy associations. It is intended to express a sense of conflicting patterns and knock-on effects, different influences and worlds that need to be accommodated and reconciled. Each of the top five panels features a coast-related image contributed to the piece by invitation extended to a number of colleagues and family members. They are:

---

[4] Cornwall and Isles of Scilly Draft Shoreline Management Plan Review, www.ciscag.org, see detail contained in *Panel 8*, centre, bottom row.

Appendix 2.9: Practice-based enquiry: Information Panel

Panel 1: Sea Kayak GPS journey map from Meanporth to Durgan, March 2010, Ken McMahon. *Panel 2*: Digital Seaweed Drawing, Katie Bunnell and Jessie Higginson. *Panel 3*: Rock Erosion Memory, Mortar and Pestle photograph, Justin Marshall. *Panel 3-4*: Coastline Measurement Sail boat, Conor McMahon. *Panel 4-5*: Surf Photograph, Conor McMahon. *Panel 5*: Seaside Drawing, Emile Cleverly.

Photograph: J.Mendelssohn

The idea of collaborative engagement and collective authorship in ceramic craft practice, enabled by the transformation of a diverse range of imagery into standard digital formats and the use of digital production facilities, is the theme of Isabelle's PhD, which is titled: *The Integration of Digital Technologies in Designer-Maker Practice, a Study of Access, Attitudes and Implications.* Many thanks to all contributors and especially Andrew Harbert for the light box display. The research from Dr.Naylor benefited from funding from the Royal Geographical Society's Small Grants Scheme.

Appendix 2.10: Poster for Appledore Exhibition, June 2010

Figure 71: Appledore exhibition poster, UCF.

Figure 72: Exhibition at the Glove Factory, 3rd-6th June 2010. Photograph:I.Risner.

Figure 73: I.Risner: Moving Boulders installation, 2010. Wall mounted light box and fired porcelain panels. Approx.1500cms x 800cms. Photograph:I.Risner.

Appendix 3: Chapter 6: Professional Views

Appendix 3.1: How interviews were conducted

Chapter 6: Professional Views reports findings from interviews conducted among a small group of practitioners engaged with digital tools. Questions were deliberately aimed at exploring issues around impact on practice in three major areas:

1. Definitions of practice and changes in definitions.

2. Technical relationships and access to technology.

3. Challenges to authorship and probing for a sense of what ‘collective engagement’ means.

The questions used as a guide for each interview were as follows:

Email/Interview Questions:

1. One of the reasons I contacted you is because I believe you make extensive use of digital data and production techniques e.g CAD programs and laser cutters/engravers, CNC milling or routing and so on, in your current work – is that right?
2. **What role does digital technology play** in your work or what are the digital techniques you use most often?
3. **Where do you access production facilities?**
4. **What, if any are the problems** that occur to you about working in this way?
5. **What are the advantages** for you in working in this way?
6. **How has the use of digital technologies impacted** on the way you work?
7. **How do you see your use** of digital data or production facilities **changing** in the future?
8. **To what extent do you agree that working with digital technologies is a bit more of a ‘team effort’ than working in a traditional way?**
9. **Is there anything else** you would like to tell me about what you think about using digital data and production tools or facilities?

Thank you for your help.

Appendix 3.2: Interviews and interviewees

All the interviews were recorded and transcribed by the researcher, interviews were typically around 30 to 40 minutes long and between 2,500 and 4,000 words were transcribed from each interview, resulting in over 20,000 words of transcription material, in total. Transcriptions were compiled within the Nvivo 8 software. The researcher was concerned to make a relatively full transcription which was then analysed for key quotes and recurring concepts. The researcher followed an interview protocol, given to each participant, quotes used were sent to each participant for review and possible amendment, along with a consent form, which the interviewee was asked to sign and return, a process carried out in March 2012.

Appendix 3.2.1 Professional View Profiles

A brief description of each participant's practice is reproduced below. This is intended to give the reader a context for the type of work each participant undertakes.

Participant 10

Participant 10 runs a contemporary digital practice designing and making one-off sculptural pieces that are exhibited and sold internationally. The practice has also supplied designs for limited edition manufacture. Widely acclaimed work has been acquired for museum and private collections and the practice is represented by an international gallery. The work focuses on the employment of innovative materials and techniques, including 3D software and 3D print technologies, using historical and contemporary themes to instil narrative content.

Participant 11

Participant 11 is one half of a contemporary jewellery and metal work collaborative partnership, based in the SouthWest. Work focuses on figurative and sculptural pieces of all sizes that often incorporate SouthWest and coastal themes. The practice has been established for many years, the work has won numerous awards, forms part of a number of prestigious museum collections and is sold internationally.

Participant 12

Participant 12 runs a design and furniture making practice established since 2002, designing and making both one-off pieces and designs for manufacture. Objects explore themes within contemporary craftsmanship, integrating craft with 3D design software and digital manufacture techniques. Work has exhibited nationally and internationally, gaining widespread critical acclaim, and has been featured in numerous publications, the subject of awards and site-specific commissions.

Participant 13

Participant 13 runs a digital studio practice making one-off pieces for national and international exhibition, commission and sale in materials including glass, ceramic and mixed media. The work has won numerous awards and prizes, including the Jerwood Contemporary Makers and has been exhibited and collected widely, for example, work is held within the permanent collection of MOMA, New York.

Participant 14

Participant 14 is an artist and maker who works mainly within a collaborative digital research and academic setting. The work has developed over a number of years. It combines research and practice aimed at exploring the potential for experience and emotion to be enhanced and revealed through innovative applications of digital technology in the making of objects of beauty and significance to individuals. Work has been exhibited internationally, undertaken for public art commissions, for the NHS, art residencies and museum collections, or as part of published academic research.

Participant 16

Participant 16 graduated from the Contemporary Crafts BA (Hons.) degree course at UCF, First Class, within the last five years. They have gone on to set-up a contemporary practice that focuses on the design and manufacture of bespoke and custom made furniture and sculptural pieces, that combine craftsmanship and innovative digital techniques. The work has been well received and won a number of awards and prestigious commissions.

Appendix 4: Glossary of terms

A small number of key specialised terms used within this thesis are defined, for the purposes of this research, below.

CADCAM. Compuer Aided Design and Computer Aided Manufacture. Used to refer to the wide range of digital tools that assist in the digital design and manufacture of objects. Generally, 3D models of objects generated in CAD software are used to produce CNC code that drives CAM, numerically controlled manufacturing equipment.

CNC. Computer Numerically Controlled. A system which allows manufacturing production equipment to be controlled by computer. Many pieces of industrial equipment use this type of system, including milling machines and routers.

Co-design. Design practice that, for example, engages non-designers through consultation and communication strategies to enable collaborative solutions. Many variations of design practice are related to this concept. For more information and useful links see: http://www.designcouncil.org.uk/resources-and-events/Designers/Design-Glossary/Co-design/

Craft. The researcher identifies the process of 'craft' with the notion of 'intelligent making' developed by Cusworth and Press: '*a mix of formal knowledge, tacit knowledge, physical and mental skill, contextual awareness, innovation and personal creative autonomy. These are applied to practice that involves a skilful achievement of relevance in identifying an objectified focus for the craft process'* (Cusworth & Press, 1996:4). Further discussed in Section 2.2.

Design. Dictionary definitions of design may emphasise its planning aspect, for example: '*A plan or scheme conceived in the mind and intended for subsequent execution; the preliminary conception of an idea that is to be carried into effect by action; a project*' (OED, 2012). However, contemporary design practice encompasses a wide variety of approaches.

Dpi. Dots per inch. Standard format for the expression of print resolution.

Greyscale. Image made up of different shades of grey, usually 256.

Haptic. Haptics refers to the sense of touch and interaction with the external environment via touch. A haptic interface allows a user to interact with a computer by receiving tactile feedback.

Hardware. Expression used to describe physical equipment associated with the computer, such as any CAM equipment.

LOM. Laminated Object Manufacture. Process of cutting and layering sheets of paper to build objects.

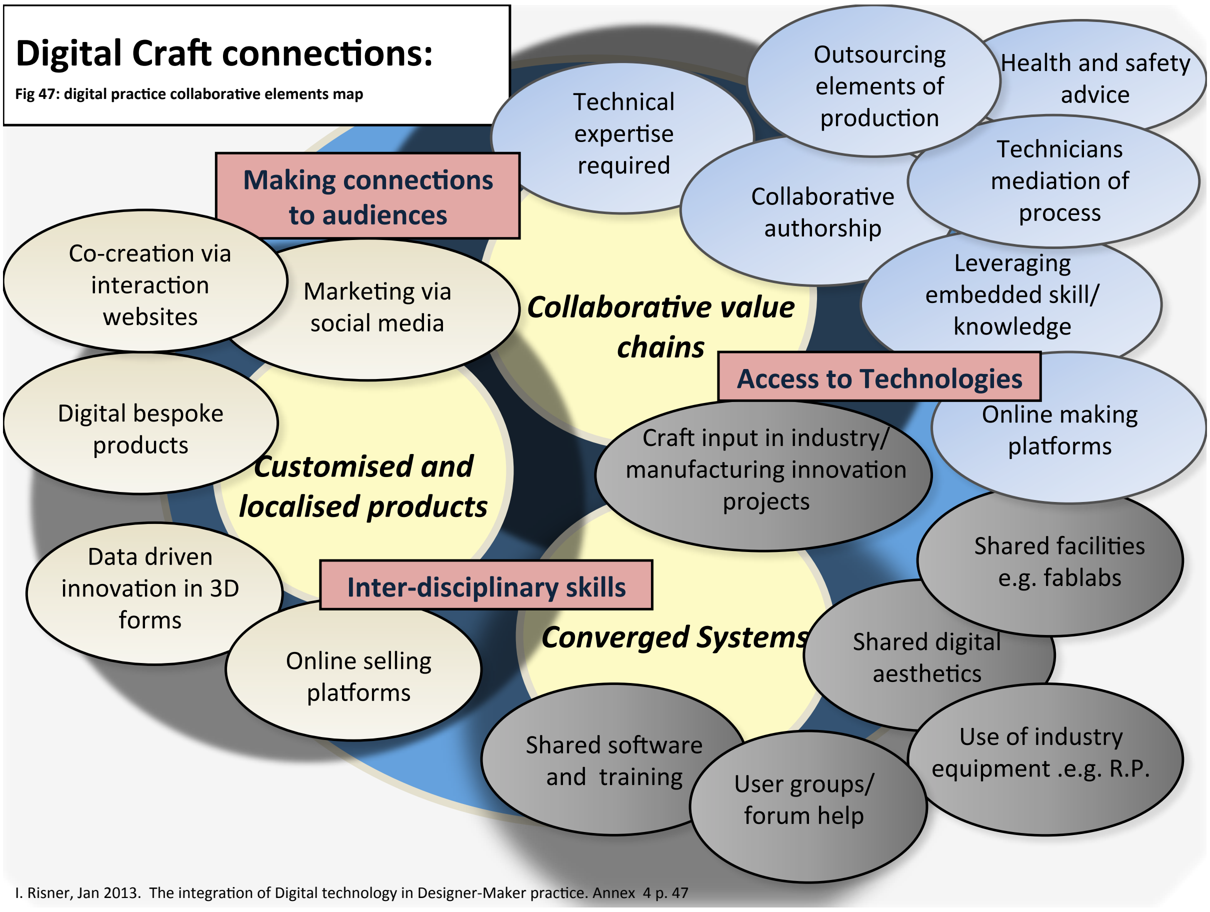
Press Moulding. Making work by pressing clay into a mould.

Rapid manufacture. Developed from rapid prototyping technologies, rapid manufacture refers to the ability to produce finished products in single or multiple numbers, from digital CAD designs which are output to rapid manufacturing systems, that build up 3D objects in layers in a variety of materials.

Rapid prototyping. A group of technologies which allows a CAD model to be manufactured in various materials by building up very thin layers. A variety of techniques include Fused Deposition Modeling (FDM), Selective Laser Sintering (SLS) and Stereolithography (SLA) among others, generally now termed 'Additive Manufacturing' for more information see, for example, the '*Additive Manufacturing Research Group*', Loughborough University (2012).

Slipcast. A process by which liquid clay is poured into a plaster mould. The plaster absorbs some of the moisture, leaving a hardened clay structure within the mould. The excess slip is poured away leaving a thin walled hollow form that can be removed from the mould.

Software. Expression used for computer programs used in the production of work. e.g. Photoshop, Illustrator, 3D Max, Rhino.


Digital Craft connections:
Fig 47: digital practice collaborative elements map
Technical expertise required
Outsourcing elements of production
Health and safety advice
Making connections to audiences
Collaborative authorship
Technicians mediation of process
Co-creation via interaction websites
Marketing via social media
Collaborative value chains
Leveraging embedded skill/ knowledge
Access to Technologies
Digital bespoke products
Craft input in industry/ manufacturing innovation projects
Online making platforms
Customised and localised products
Data driven innovation in 3D forms
Inter-disciplinary skills
Shared facilities e.g. fablabs
Converged Systems
Online selling platforms
Shared digital aesthetics
Shared software and training
Use of industry equipment .e.g. R.P.
User groups/ forum help
I. Risner, Jan 2013. The integration of Digital technology in Designer-Maker practice. Annex 4 p. 47