

# Interface

## Supporting notes



### A touring exhibition from the Devon Guild of Craftsmen

Interface is a collaborative exhibition developed by the Devon Guild of Craftsmen and Innovate Centre of Expertise for the Creative Industries, University of Plymouth.

This exhibition presents the work of fourteen leading makers and aims to question and discuss the use of digital technologies in craft and design.

The selected exhibitors show the route from conception to realisation by exposing the design and making process and the role of the computer based applications they use. Innovative and progressive work in furniture, wood, jewellery, metal and ceramics show how the computer/craft interface shapes, enhances or governs the work.

**Interface** – *a boundary across which two independent systems meet and act on or communicate with each other.*

Much of the 3D digital technology has been developed within the medical, engineering and architectural industries and it is only over the last 20 years that digital processes have become more accessible to art and design practitioners. Within art, craft and design it is still considered 'new' and only a relatively small, but growing, group of makers have tapped into the possibilities.

This exhibition brings together some of those leading makers. It covers a wide sphere of making, from one-offs and small batch production, to one exhibitor who maintains a stock of 4000 computer files for 100 'off the shelf' products, each using different digital technologies.

Processes such as Rapid Prototyping (RP), Laser Cutting and Computer Numeric Controlled Milling (CNC) are complex processes and terms. The later part of these notes has a glossary of terms and short descriptions of processes.

A common question asked in the crafts world about new technologies is *'Might we lose touch with craft and craft processes because of new technology?'* The question is worth asking because these developments are already creating change.

For some years the ceramic tableware industry has been using Computer Aided Design and Computer Aided Manufacture (CAD/CAM). The technology became efficient and sophisticated enough to circumvent the skilful but laborious process of modelling, by hand, the plaster 'blocks', traditionally the first step in the process of a new ceramic design. With CAD/CAM, a three-dimensional model can be drawn on the computer and rotated and viewed from any angle. Add to this the ability, once the design is finalised, to produce the actual 3D model used to make the moulds and

calculate shrinkage, and you have a fast, accurate, modelling process which is light on labour.<sup>1</sup>

An individual maker may not subscribe to the 'quicker is cheaper therefore better' philosophy of some mass producers but, for individual makers, an awareness of the technology and its possibilities must be important. Justin Marshall, ceramicist, is interested in two areas where digital technology may prove to be invaluable to individual makers. The first is potential ways for independent makers to collaborate with industry and the second is how digital technology could further economic sustainability for independent makers.

Therefore a better question is '*How do we adapt to the introduction of new technologies?*'

Nothing gets 'un-invented' unless it's useless or superseded by something better. Once the technology arrives, then it's up to designers and users to find creative ways of using it.

No-one who has grown up with the internet would wish to abandon it. We might lament the decline in letter writing because of the rise in e-mail but it will make no difference. It's even possible that handwriting and calligraphy may have a surge in popularity as a response to the uniformity of phone and computer text.

So do we regard 3D computer technology as a tool or, as Justin Marshall suggests, do we look for the possibilities in the technology and reach for the previously unachievable?

An inclusive definition of a tool is:

*A moving entity whose use is initiated and actively guided by a human being, for whom it acts as an extension, toward a specific purpose.*<sup>2</sup>

Tavs Jørgensen, ceramicist, makes the comment that creating through a CAD program offers huge possibilities but it is essentially a static and calculating exercise far removed from the physical and intuitive relationship with the form the traditional craft maker experiences.<sup>3</sup>

David Goodwin's jewellery is designed and modelled on a rapid prototyping machine and then cast in precious metals. These pieces could not be made without RP and their creator is sure that 'modelling something in a 3D environment, your hand on the mouse, is actually in itself a craft.'<sup>4</sup>

It's clear that the technological possibilities are very wide and future trends are limitless. A new world has opened up and it's up to us how we use it. After all, no-one would look back at the introduction of photography and make the claim that it killed off painting.

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<sup>1</sup> CAD/CAM and the British ceramics tableware industry, Neal French, The Culture of Craft (ed. Peter Dormer)

<sup>2</sup> Abstracting Craft. The Practiced Digital Hand. Malcolm McCullough

<sup>3</sup> autonomic project 2005

<sup>4</sup> David Goodwin, Crafts, May 2005

Makers are often wedded to traditional processes, materials and making techniques and, unless exposed to developments in technology, often a part of formal education can get 'left behind'. Much of the new technology is fairly difficult to use and requires time and motivation to become familiar with – a much easier task for someone who is already computer literate.

CAD and CAM lend themselves to some disciplines better than others. Textiles can make use of all sorts of applications, digital fabric printers using Photoshop which then prints directly onto fabric, CNC (computer numerically controlled) knitting machines and embroidery machines are now commonplace.

Jewellery is also suited, partly because of scale, so desktop CNC milling machines and laser cutting may be used in production. Ceramics is more likely to use indirect applications of CAD, making mould components or cutting extrusion plates for example.

At the very least, digital technology can speed up, or eradicate altogether, some laborious repetitive tasks. To foresee all the potential applications and possibilities is impossible as the technology is continuously evolving.

This exhibition may not answer all the questions that we might want to ask but it shows how these exhibitors are using new technology to make, sometimes in tandem with more traditional craft practice, wonderful work.

Ultimately, the pieces, whichever processes are used to make them, will speak for themselves.

## Technical terms

The following is a list of digital processes and terms used by the makers in the exhibition, for development and/or design, and referred to in the text panels and catalogue. The names of exhibitors who have used these different processes are written after the explanations in italics)

**Computer Aided Design (CAD):** is the use of a wide range of computer-based tools that assist engineers, architects and other design professionals in their design activities. In this exhibition, *CADCAM is used by all the exhibitors.*

**Computer Aided Manufacture (CAM):** is the use of a wide range of computer-based tools that assist in the manufacture of product components. 3D models of components generated in CAD software are used to generate CNC code to drive numerical controlled machine tools.

**Computer Numerically Controlled (CNC):** refers specifically to a computer "controller" that reads G-code (programming language) instructions and drives the machine tool.

Computer Numeric Control / Rapid Prototyping: CNC (computer numeric control) / Rapid Prototyping (RP) are a range of technologies that cut or build physical objects direct from computer (CAD) files. CNC/RP has been developed in an industry context and over the past few years its use by artists has increased. There are two basic groups each with a range of processes:

1. **BUILDING (Rapid Prototyping)**, which builds three-dimensional objects in a range of materials using a system that converts computer-generated designs into a series of very fine layers or slices.

All RP allows you to create almost any 3-D shape you can imagine. If you can design it in a CAD program, you can probably create it. There is the need for structural integrity during the building process so, in some cases, you need to add internal bracing to a design so that it does not collapse during the printing or curing phases.

**Fused Deposition Modelling (FDM)**: like most other RP processes (such as 3D Printing and stereolithography) FDM works on an "additive" principle by laying down material in layers. A plastic filament or metal wire is unwound from a coil and supplies material to an extrusion nozzle which can turn on and off the flow. The nozzle is heated to melt the material and can be moved in both horizontal and vertical directions by a numerically controlled mechanism, directly controlled by a Computer Aided Design software package. The model is built up from layers as the plastic hardens immediately after extrusion from the nozzle.

*Brian Adams, Gilbert Riedelbauch*

2. **CUTTING AND MILLING**, which cuts or shapes existing materials, such as timber, plastic or metal. Cutting is generally applied to materials in sheet form while milling generally involves shaping an object on a lathe.

*Gordon Burnett (milling), Olivier Geoffroy (CNC cut), David Goodwin, Justin Marshall, Drummond Masterton*

**Stereolithography (SLA)**: This technology uses a UV laser to cure a liquid epoxy resin. The laser describes a shape for layers approx 0.1mm thick and these layers build to form an object as a build table drops within a tank. The resulting model / object is semi-transparent and generally has an off-white or yellow colour to which different finishes can be applied.

Resulting pieces are lightweight with the strength of polystyrene plastic. You can mount it, drill it, etc., so you can try it out in actual use. For example, a chair manufacturer could produce different arm rest shapes using stereolithography and try them out on actual chairs to see how they feel.

*Ann Marie Shillito, Kenji Toki*

**Selective Laser Sintering (SLS)**: This process is similar to SLA except that a powder is sintered (fused) by a laser. The powder is spread on a build table within a heated chamber and the laser provides the additional heat to sinter the shape it describes for each layer of the object. The powder comes in a variety of forms, such as polystyrene, nylon and glass-filled nylon so a variety of colours and finishes can be attained.

*Justin Marshall*

**Direct Metal Laser Sintering (DMLS)**: A fine layer of metallic powder is spread over a plate and is sintered by a laser beam which describes the data from a CAD file. Like other build technologies the object is constructed as consecutive fine layers or slices are built up while the object moves down the build chamber.

**Thermojet Modelling (Wax)**: This process builds a model / object from wax much like an ink-jet printer prints coloured ink but using heated wax droplets. The resulting objects can be fragile but are useful for investment casting, particularly suited for

jewellery. It can also be a quick method of producing prototypes for design development and is easily carved by hand. The colour and the consistency of the wax give the objects an appearance that may not be suitable for finished objects.

## Other Techniques

**Casting / Moulding:** In some instances the basic RP object serves as the artwork but in many cases the object acts as a prototype for casting or moulding. Because of cost and the limited size of build chambers artists have generally been concerned with producing relatively small objects. However, large objects can be produced by using adhesive to connect smaller parts or through welding cast parts together. Parts can be nested in the build chamber so as to save on cost.

### Some secondary techniques for RP include:

**Cast Metals:** Investment Casting using a RP object to create a mould to cast aluminium, stainless steel, etc. Cast metals can also be CNC machined.

*Drummond Masterton, Simon Maidment*

**Injection Moulding:** Generally a thermoplastic polymer is injected into metal mould, which can be opened to remove the object.

*Drummond Masterton*

**Vacuum Casting:** Uses polyurethane resins to produce low cost models.

*Gordon Burnett, David Goodwin, Morgen Hall*

**Cutting and Milling:** CNC cutting and milling has been in use for a longer period than RP and is relatively common in manufacturing. There are a range of applications for cutting, bending, hole-punching, milling, engraving, etc. and a number of different technologies, which are driven by CAD data, are used. The advantages of CNC are its accuracy and speed.

**Routing:** This technique can be used to cut a range of materials such as wood and aluminium, plastic and Styrofoam. The spindle on the machine follows a path described by a computer file and this allows for a high degree of accuracy and is particularly useful for the mass production of identical shapes. It is possible to build layered objects through stacking sections or profiles, although there is usually a limit to the thickness of material that can be cut. Internal corners are a problem as the diameter of the spindle means they will have a radius. CNC routing is widely used by industry and particularly wood workshops and sign writers, who often use it to cut plastic lettering.

*UntoThisLast*

**Laser:** This technique uses a laser to burn or melt a path described by computer files and is mostly used to cut metal, including stainless steel. There is a higher degree of accuracy and speed than other cutting methods. The depth of cut can also be controlled with the laser so that forms can be made through the removal of material. The edge finish along the cut is better with a laser than with other techniques.

*Simon Maidment, Janet Stoyel*

**Waterjet:** This technique uses a high-pressure waterjet forced through a narrow opening to cut a range of soft materials such as paper, carpet, cloths or foam. When an abrasive is added to the water (abrasivejet) then harder materials such as aluminium, stone or glass can be cut. There is a limit to the thickness of material and a finer cut than routing is possible.

**Wire:** This technique is generally used to cut soft materials such as foam and there are basically two methods: one where a horizontal wire moves through a block of foam and describes a shape by moving up and down the vertical axis and another where a vertical wire describes a shape in a manner similar to a waterjet. The vertical system allows for thinner sheets to be cut.

**Fabrication:** The accuracy of CNC cutting means that elements can fit together easily for the fabrication of artworks. Apart from cutting, CNC technology can be used for milling, drilling, tapping, bending, welding, grinding, etc and many industrial items are fabricated or assembled from components at the end of a CNC process. Although cutting processes typically work with sheet materials it is possible to use CNC machining centres to “carve” blocks of material such as stone or metal. It is also possible to build objects from layered sections of sheet material or to construct an armature for cladding.

Above information sourced from:

SCAN, [www.scansite.org](http://www.scansite.org) SCAN consists of a network of 12 organisations in the UK. SCAN is committed to identifying new models of production and distribution of artworks and other cultural products), Wikipedia and [www.howstuffworks.com](http://www.howstuffworks.com)

## Haptic Technology

**Haptic** - The word "haptic" means "of or relating to or proceeding from the sense of touch" (<http://www.dict.org>) and comes from a Greek term meaning 'able to lay hold of'.

**Haptics** is the study of human touch and interaction with the external environment via touch and encompasses any operation where a human or animal feels the environment with the body or its extremities.

A haptic interface is a device which allows a user to interact with a computer by receiving tactile feed back. This feedback is achieved by applying a degree of opposing force to the user along the x, y, and z axes. These devices can be used by people with disabilities or people who learn best through tactile or kinesthetic experiences. The use of haptic devices that once were cost prohibitive but now are incorporated into mainstream devices such as the iFeel Mouse and the iFeel Mouseman, promote inclusion and acceptance of "adaptive" technology into the "daily computer experience" of people with and without disabilities.

3-dimensional haptic devices can be used for applications such as surgical simulations and remote operation of robotics in hazardous environments.

2-dimensional haptic devices can be used to aid computer users who are blind or visually disabled; or who are tactile/kinesthetic learners, by providing a slight resistance at the edges of windows and buttons so that the user can "feel" the Graphical User Interface (GUI). This technology can also provide resistance to

textures in computer images which enables computer users to "feel" pictures such as maps and drawings.

*Anne-Marie Shillito and Kenji Toki both refer to haptic technology in their artist statements.*

Information sourced from: Adaptive Technology Resource Centre, University of Toronto and Interactive Systems Research Group (ISRG)

## **Machines**

**Ceramic Digital Printer:** This piece of equipment produces ceramic transfers up to A3 in size. Designs can either be developed digitally using Photoshop, Illustrator or Corel draw, or copied directly from an existing image.

This process goes some of the way to replace the process of silk screen printing traditionally used for producing ceramic transfers. It is really useful for prototyping a range of ceramic designs and an economically viable alternative for producing one off and short runs of ceramic patterns.

*Justin Marshall*

**Plotter Cutter:** This enables cutting, plotting or scoring of designs on to thin sheet material, such as paper and sticky backed vinyl. Developed for the sign writing industry this technology can quickly and accurately cut text or images from graphics files produced in programs such as Adobe Illustrator or Corel Draw.

The Roland Camm1 is a roll feed machine and can cut material up to 600mm wide and many metres in length.

*Morgen Hall, Tavs Jorgensen*

**Laser Cutter:** The laser cutter enables cutting or engraving of 2D sheet material from CAD data. A wide range of materials can be cut to a variety of depths, depending on the material's qualities including, paper, fabric, card, thin plywood and acrylic sheet. The most commonly used file formats: Adobe Illustrator and Corel draw.

This is a relatively simple piece of equipment to use and facilitates quick and accurate production of highly complex 2D design work.

**3/4/5 Axis Milling Machine:** This large scale industrial milling machine is capable of machining three dimensional forms and surfaces. Using the 4th and 5th axis attachments it is capable of producing highly complex shapes with multiple undercuts and internal surfaces. It can machine sheets, blocks and bars of most materials including hardened steels to produce highly accurate models with quality surface finishes. The machine also incorporates a touch probe that allows 3D data to be gathered from an existing object, enabling reverse engineering.

*Richard Hooper*

**Z Corp 3D Printer:** This rapid prototyping technology produces complex 3D objects from 3D CAD data. It uses either a plaster or a starch based powder which is spread evenly across the bed of the machine in thin layers, areas of this are then hardened by a solution deposited by inkjet heads. This process is repeated to produce a three dimensional object through the continuous build up of two dimensional layers, enabling the production of complex 3D forms with internal and external structures.

*Brian Adams, Drummond Masterton*

Information sourced from [www.autonomic.org.uk](http://www.autonomic.org.uk)

## **Useful websites**

Wikipedia

[www.scansite.org](http://www.scansite.org)

[www.autonomic.org.uk](http://www.autonomic.org.uk)

[www.howstuffworks.com](http://www.howstuffworks.com)

[www.innovatecentre.org.uk](http://www.innovatecentre.org.uk)

[www.challengingcraft.org.uk](http://www.challengingcraft.org.uk)

[www.autonomic.co.uk](http://www.autonomic.co.uk)

[www.fluidforms.at](http://www.fluidforms.at)

[www.pixelraiders.org](http://www.pixelraiders.org)

## **Contributing artist's websites**

[www.simonmaidment.com](http://www.simonmaidment.com)

[www.clothclinic.com](http://www.clothclinic.com)

[www.oktavius.co.uk](http://www.oktavius.co.uk)

[www.brianadamsceramics.co.uk](http://www.brianadamsceramics.co.uk)

[www.kenjitoki.com](http://www.kenjitoki.com)

[www.davidgoodwin.com](http://www.davidgoodwin.com)

[www.morgenhell.com](http://www.morgenhell.com)

[www.justinmarshall.co.uk](http://www.justinmarshall.co.uk)

[www.craftaustralia.com](http://www.craftaustralia.com)

[www.eca.ac.uk/tactius](http://www.eca.ac.uk/tactius)

[www.untothislast.co.uk](http://www.untothislast.co.uk)

## **Further Reading**

The Culture of Craft. Peter Dormer

Abstracting Craft, The Practiced Digital Hand. Malcolm McCullough

P. de Burlet

Education Officer

The Devon Guild of Craftsmen

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