

The Language of Process:

How new materials and technologies are changing product design

EXHIBITION CATALOGUE

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It was a conversation with MMU Special Collections curator Stephanie Boydell that was the beginning of this exhibition. She asked why I hadn't brought any of my production design students to the collections recently? I knew it was a great collection, and other 3-Dimensional Design staff used it extensively. However, for me the collection felt mainly historic, or too focussed on craft made pieces. It didn't really cover the area of design that I was most interested in engaging my students with, namely contemporary material and process led product design.

To my surprise, Steph asked me what contemporary production design pieces would I like to see in the collection? I don't know if she realised what she'd started, but I've been running student study trips to the Milan design fair for the past 10 years. I knew exactly the pieces that had been an inspiration to me and my students… and I had a list!

As a result, we set about putting together a new collection. We wanted it to include products that pushed the boundaries in their use of the latest digital technologies, and objects that reinvented the way we processed materials to develop new structural and constructional properties. We wanted to highlight designs that used sophisticated computer aided design programmes in the development of new forms never before possible. We wanted pieces that combined new technologies and traditional materials, pushing the relationship between craft making and production manufacture. In a world where we are beginning to question the ethics and ecological impact of consumerism and consumption, we also wanted to showcase projects that looked at the whole of the design and manufacture supply chain, to challenge our established models and put forward proposals of how we might produce more responsibly within a global manufacturing economy.

The result is "The Language of Process", an exhibition of work that illustrate these new ideas and approaches, and point to some of the potential futures for product design and manufacture. Some pieces might appear quite traditional, almost hand crafted, whilst others appear alien, questioning established ideas about beauty and function. However, they illustrate just some of the range of creative responses designers are taking to the opportunities brought by new materials and processes. The work might surprise, delight or even offend, but they challenge our preconceptions of what is possible, and the future of product design.

Thanks

I would like to thank all the designers who have contributed pieces to this exhibition, and express my gratitude for their generosity. It was at times a logistical "challenge" as we negotiated purchases and loans from designers across Europe, and as such I'd like to especially thank MMU Special Collections curator Stephanie Boydell, for all her support in keeping me focussed on the task, and sorting out the many varied complications we encountered along the way. It was also Stephanie's ability to secure generous support from across the university which has enabled us to acquire many of the pieces on display for our permanent collections.

I'd like to thank the Crafts Council for the loan of Geoffrey Mann's "Shine" candelabra, and I'd especially like to thank designers Michael Eden and Daniel O'Riordan, for lending us pieces from their personal collections. A special mention has to go to Kram & Weisshaar, who not only printed the beautiful scale models of the full family of their "Breeding Tables" project, but also manufactured the magnificent light box for us to display them in, all at their own expense.

I'd like to thank Louise Clennell for her help in editing this catalogue, for unscrambling some of my more convoluted sentences. Thanks to Jo Phillips for his graphic work on not only the catalogue, but for all the promotional material for the exhibition, and a final mention to all the staff in MMU Special Collections for their help in setting up the exhibition.

Thank you to Tricia, Graham, Adan and Billy, the technical staff in Manchester School of Art CAD/CAM and wood workshops, who helped with the construction of last minute plinths, and the laser cutting of text panels. And I'd also like to thank my design students, Gianluca Mingolla and Joshua Dodds, who cut short their summer holidays to help manufacture and construct both Ben Wilson's "Chairfix", and the "Download: Box-O-Rama" side table from Droog.

and finally...

For anyone who wishes to study these pieces in more detail, and get a hands-on experience of interacting with them, most are now part of our fully accessible MMU Special Collections. This unique collection tells the long and fascinating story of objects through history, and I feel privileged that the pieces I've purchased will play a part in continuing this story, and become the teaching aids to inspire future generations of design students.

David Grimshaw
Programme Leader for MA/Msc Product Design at the Manchester School of Art, Manchester Metropolitan University.



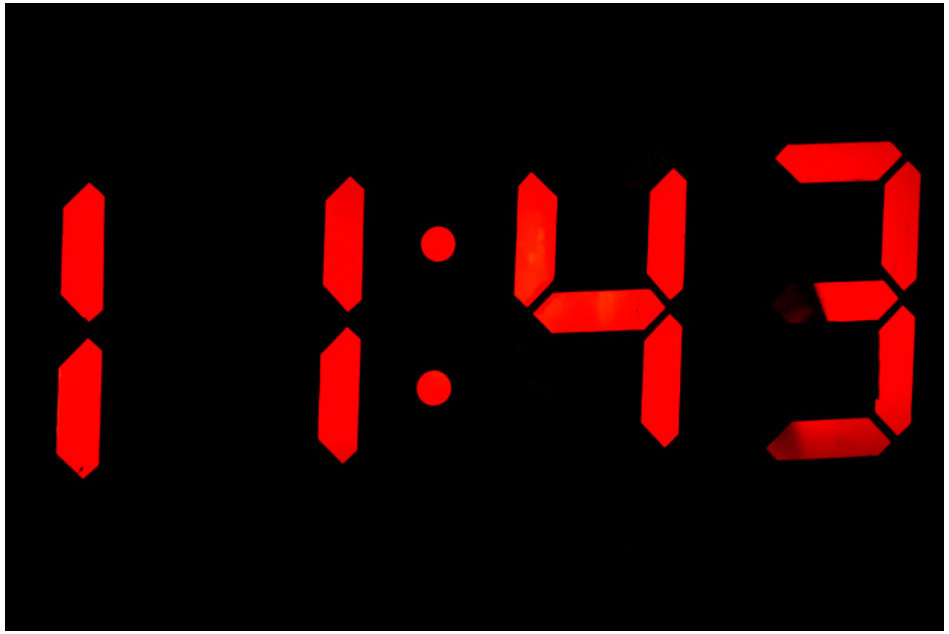
Femur Stool
Assa Ashuach
2013
polyamide

Assa Ashuach believes that complex technology can help to simplify design. In his work, he tries to reduce a design to its simplest form using sophisticated computer software and the latest 3D printing techniques.

The *Femur Stool* is Ashuach's latest design and echoes the shape of a femur or thigh bone. The designer generates an initial 3D stool form then each stool is customised to support the weight of the person who has purchased it. A computer algorithm calculates the volume of material needed to support the given weight, in this case a person weighing up to 120 kilogrammes (18 stones and 12 pounds), and removes any mass that is not contributing to the strength. The form of the stool will change depending on the weight of the person, so a stool for a lighter or heavier person will look different to this one. The finished design is then 3D printed using laser sintering. Ashuach's work highlights a potential shift in the role of designers, who are increasingly surrendering control of aesthetics to the computer programme, with software used to control the final look of a product.

Assa Ashuach is an Israeli born product and furniture designer. He studied industrial design at the Betzalel Academy of Art and Design in Jerusalem and came to London to complete an MA in Design Products at the Royal College of Art in 2003. His studio is based in London and he teaches on the MA Furniture and Product Design at The Sir John Cass Faculty of Art, Architecture and Design in central London.

Photography: Visuals and product design by Assa Ashuach Studio



Analog Digital clock
Maarten Baas, www.maartenbaas.com
2009
iPhone app

Dutch designer Maarten Baas' often-rebellious attitude has seen him challenge the conventions of function and taste with his subversive approach to product and furniture design.

Available to download for just 69 pence, Baas' *Analog Digital* clock appears, at first, to be a simple LED clock. However, closer inspection reveals a shadowy figure visible behind the LED numbers. When the numbers on the display change, it becomes apparent that this is not a small, LED clock but is, in fact, a large pane of glass. The 'clock' was created during a 12-hour performance piece, filmed in a single take. A performer stood behind the glass, painting on and wiping off the changing numbers every minute. Ironically, the creation of *Analog Digital* is only possible due to the ability of digital cameras to record a single, 12-hour long sequence. The 'clock' invites the viewer to consider the human toil that would be necessary to replicate the automated functions of our digital world.

Dutch designer Maarten Baas was born 1978 and graduated from Design Academy Eindhoven in 2002. Initially famous for his iconic "Smoke" series of charred classic furniture, his work appears in many international design and museum collections. He founded Studio Baas with Bas den Herder in 2005. His unique, handmade work has now developed towards a larger scale of production, enabling Baas to undertake projects for hotels, restaurants, galleries, museums and private commissioners across the world.

Image: © Maarten Baas, www.maartenbaas.com



Garland
Tord Boontje
2002
laser-cut, etched metal

As Professor and current Head of Design Products at the Royal College of Art, Tord Boontje is a major influence on the development of design and education in the UK. In his own practice, he has worked for many major manufacturers, and brings this expertise and experience to his role as a design educator.

Garland was developed with Habitat, and utilises the same photo-etching process that manufactures computer components. This high-precision process enables an extremely delicate floral design to be etched from a sheet of metal, with a level of detail that would be impossible to achieve by hand. The resultant fine metal filigree is so malleable that it allows the user to shape "Garland" around a light bulb to not only shade the light source, but also cast beautiful shadows across the room. The use of photo-etching has resulted in a lighting product that is cheap to manufacture, store and deliver as a flat sheet, but has a sophistication and interaction that allows each delicate lattice of flowers to become individual and unique.

Tord Boontje was born in the Netherlands in 1968. He graduated from Design Eindhoven Academy in 1991, and the Royal College of Art in 1994. Early projects involved creating low-cost or free products such as *Transglass* (1997), but it was *Garland* that established his studio's reputation, and its philosophy that modernism does not have to mean minimalism. Boontje has worked with diverse international clients including Alexander McQueen, Swarovski, Moroso and Perrier-Jouet, and his work is represented in museum collections including the V&A and the Design Museum in London, and the Museum of Modern Art in New York. Since 2012, his studio, workshop and retail outlet have all been based on one premises in Shoreditch in East London.

Image: © Studio Tord Boontje



Fresh Fat Bowl
Tom Dixon
2004
PETG Co-polyester

Tom Dixon is one of the UK's most successful designers and is often described as a maverick. He has greatly influenced design in the UK and has an innovative approach to materials, production methods and distribution that has even included giving his work away as a means of making it more accessible.

The *Fresh Fat* bowl is part of the *Fresh Fat* collection, a range of pieces made from clear plastic that challenge the notion of plastic as a low value, throwaway material. Plastic beads are heated in a machine to an even temperature and extruded through a nozzle by hand. The machine operator weaves the melted plastic onto a concave mould and the temperature of the plastic allows it to stick to the previous layer. The process is simple, fast and precise, relying on the steady hand of the machine operator to control the weave of the linking structure. The finished bowl combines the clarity of glass with the durability of plastic. Dixon has applied an inventive production method to a low cost material to create a beautiful centrepiece that belies its modest origins.

Tom Dixon was born in Tunisia and came to live in London when he was four years old. He dropped out of art school in 1980, following a motorbike accident, and taught himself to weld whilst trying to repair his motorbike. This subsequently led to the creation of welded furniture including the *S Chair* in 1988, which has been in production by Cappellini since 1992. He was Head of Design at Habitat for ten years from 1998, and Creative Director of Artek from 2004-09. He has worked as a designer for Cappellini, Driade, Moroso, Swarovski, and fashion designers Jean Paul Gaultier, Ralph Lauren, and Vivienne Westwood. He established his own company in 2002 to design and manufacture furniture and lighting that is sold in more than 60 countries around the world.

Image: © Tom Dixon



Design for Download
EventArchitectuur for Droog
2011
birch plywood

For the past two decades, Droog have been one of the worlds' most influential design collectives. 'Droog' translates into English as 'dry', as in dry wit, and their work is characterised by a subtle sense of humour that enables them to connect to their users.

In *Design for Download* Droog sought to question standard production methods and take the democratization of design one step further by enabling anyone with an internet connection to select and configure one of their designs. The schematic diagram for the design could then be downloaded and the customer could choose to either construct it or take it to a local fabricator to be made up. This localised production not only reduced the costs and environmental impact of transportation, but also pointed to a future where global companies could support sustainable, small-scale manufacturing and contribute to, rather than compete against, local economies.

Droog was established in Amsterdam in 1993 by product designer Gijs Bakker and design historian Renny Ramakers. It continues to pioneer new directions for design, working collaboratively with designers and other partners on a range of products, spaces, events and communication tools.
Design for Download is a project initiated by Droog and was made possible by AgentschapNL.

Image: © Droog



Wedgwoodn't Garniture
Michael Eden
2012
polyamide and copper-plating

After working for 20 years as a studio potter, Michael Eden undertook a postgraduate research degree at the Royal College of Art. He wanted to explore how digital design and manufacturing could be combined with the traditional craft skills he already possessed. In doing so, Eden radically altered the nature of his work, creating a playful and sophisticated hybrid of heritage and modernity.

Eden's *Wedgwoodn't* tureens reinterpret classic pieces by Josiah Wedgwood. They are designed using computer software and their surfaces are perforated with small holes reminiscent of the internal structure of a bone, a reference to the original Wedgwood's bone china body. The tureens are printed using a 3D printer and are copper-plated, adding texture and materiality to the sometimes-characterless surface of a 3D printed object. Eden brings a rich knowledge of ceramics to his pieces, placing his new work within the established traditions of ceramic-making, and bringing a material sensitivity to the 3D printing process that is informed by his own history as a craftsman.

Michael Eden was born in Blackburn. For twenty years, he and his wife ran a ceramics business in Cumbria producing functional, domestic, slip-decorated earthenware. From 2006-8 he undertook an MPhil research project in the Ceramics and Glass department at the Royal College of Art, London. Here, he experimented with methods of 3D printing using digital data to create ceramic objects with the same properties as conventional ceramics, including his first *Wedgwoodn't* tureen. This award-winning piece garnered critical acclaim and led to subsequent research, commissions and collaborations at a national and international level. Eden is based in Cumbria and, as well as producing his commissioned work, he is also a Digital Research Fellow within Manchester School of Art at Manchester Metropolitan University.

Image: © Michael Eden
Photograph courtesy of Adrian Sassoon



Earthbowl – Manchester Region
Fluid Forms
2008
laminated walnut and maple

Fluid Forms are part of a growing number of companies that are using online interfaces to enable customers to design their own unique products. By digitally interacting with CAD models, or by inputting data, customers can create individual, customised designs.

To create a*n Earthbowl,* the customer must first input a postcode or location such as a park, mountain or lake into the Fluid Forms website. The customer can zoom in and out of the map until s/he is happy with the placement of the map in relation to the shape of the bowl. Using data from Googlemaps the topology of the landscape is sent to a CNC router that cuts a unique bowl from a solid block of laminated walnut and maple plywood. The automated processes developed by Fluid Forms require no technical knowledge on the part of the customer and hint at a future where creating personalised products is as easy as clicking a mouse.

Fluid Forms was co-founded by Hannes Walter and Stephen Williams in 2005 at the Science Park in Graz, Austria. They launched their first design-your-own prototype vase at the end of 2005 and continue to explore innovative ways of using creative coding and digital production methods.

Image: © Fluid Forms
Photography by Günther Kubizer



Streets Clock - Manchester City Centre
Fluid Forms and John Briscella
2008
acrylic

Fluid Forms are part of a growing number of companies that are using online interfaces to enable customers to design their own unique products. By digitally interacting with CAD models, or by inputting data, customers can create individual, customised designs.

To create a *Streets Clock* the customer must first input a postcode into the Fluid Forms website. A street map relating to the area around the postcode appears on the screen and is superimposed with an image of the clock face. The customer can zoom in and out of the street map until they are happy with the placement of the map in relation to the clock face. The data is sent to a laser cutter which cuts out the clock face from a sheet of acrylic or wood. The automated processes developed by Fluid Forms require no technical knowledge on the part of the customer and hint at a future where creating personalised products is as easy as clicking a mouse.

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Image: © Fluid Forms
Photography by Alexander Karelly, Lupispuma



Blow Away Vase
Front
2009
porcelain, hand painted in-glaze

Swedish design group Front create surprising and delightful objects that play with preconceived notions of materials and objects.

Their *Blow Away Vase* is created by digitising a traditional Royal Blue Delft vase. Computer software is used to distort and stretch the vase's form, mimicking the effect of a mighty gust of wind. The CAD generated form is passed on to the artisans at Royal Delft who use their skills in slip-cast moulding to create a vase which exactly matches the new, distorted form. The illustrations are applied to the vase by hand making each piece unique. Front have taken a familiar ceramic object, understood to be hard, brittle and static, and created the illusion that it is soft, malleable and dynamic. Their design questions our understanding of the permanence and immutability of materials and objects, and like a magician, it leaves us feeling delighted, puzzled and bewitched.

Front are a Stockholm-based design collective formed in 2003 by Sofia Lagerkvist, Charlotte von der Lancken, Anna Lindgren and Katja Savstrom (who left the collective in 2010). They are all involved in each aspect of a design from initial idea to final product. Their objects often communicate a story about the design process, the material an object is made from, or about conventions within the design field.

Image: © FRONT
Photography by Adrian Hunter, Manchester Metropolitan University



Sketch Furniture
Front
2006

For this project, Front asked whether it is possible to produce an object by drawing directly into space and then capturing these movements in a material object. They made it possible by developing a technique combining motion capture and rapid prototyping.

Motion capture is a process for recording the movement of objects or people. In the film industry, it is often used by animators to track the movement of actors and the resulting information is used to create realistic, digital characters in 2D or 3D. Front recognised that motion capture could be used to track a finger as it sketched out the form of a piece of furniture in the air. With nothing to guide them but their spatial awareness, the designers drew in space. The line generated by these movements was transformed into a CAD model. The model was printed using a laser sinterer - a high power laser that fuses small particles of plastic together to create a three dimensional form. The resultant pieces may not be considered to be beautiful, but they have a fluidity that echoes the free movement of the original sketch. The process of making them demonstrates the ability of digital technology to create objects from data that only exists as fleeting, transient movements in space.

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Image: © FRONT



Bloom.MGX table lamp
Patrick Jouin for MGX
2010
polyamide

Patrick Jouin is a prolific designer whose projects span product and furniture design, interiors and architecture. His work often pushes the boundaries of technology to create new forms that exploit the development of new materials and methods of production.

The *Bloom.MGX* table lamp features multiple, interlocking components but is 3D printed as a single piece, complete with fully functioning hinges that transform the shade from a bud to a flower. By taking advantage of this technology, Jouin has created a complex piece that requires no assembly or gluing. The lamp is inspired by the way a flower opens, transforming from a bud to blossom. Pressing down on the central ring of the shade causes the 'petals' to part and reveal the light. This single action allows the user to control the form and brightness of the lamp, revealing an object that is technically complex, yet at the same time elegant and poetic.

Patrick Jouin was born in France and graduated from ENSCI-Les Ateliers in Paris in 1992. He worked as a designer for Philippe Starck before establishing his own agency in Paris in 1998. In 1999, he met the French chef Alain Ducasse and they have collaborated on the design of several restaurants including the Plaza Athénée and 58 Tour Eiffel (Paris) and the Mix (Las Vegas). In 2007, he designed the bicycle attachment points and terminals for the free bicycle rental service that operates in Paris. His furniture is produced by Cassina, Alessi, Kartell, and Ligne Roset.

Image: Agence Patrick Jouin iD - Bloom - MGX - crédit Thomas Duval



Breeding Tables
KRAM/WEISSHAAR
2003 – ongoing
Tables – steel and glass; models - polystyrene

German-Swedish design team Reed Kram and Clemens Weisshaar have waved goodbye to traditional concepts of design and manufacture. Instead, they have applied new ways of thinking about design and production to take advantage of developments in production technologies. The result is a hybrid of computer technology, industrial manufacturing and hand finishing.

When Kram/Weisshaar designed *Breeding Tables*, the end product was not a single table but an indefinite number of tables, each one unique. The designers use a computer to carry out algorithmic modelling sequences. This creates an infinite number of table shapes based on a set criterion of height, structure and stability. The computer then creates a three-dimensional model of a table shape and tests the viability of that shape. If it is deemed suitable for production then the pattern for each leg is sent to a CNC router to be cut from sheet steel. The bend and joint information is engraved onto each table leg and the cut, flat leg is moved to a bending machine. A fabricator follows the instructions on the table leg, turning each bend in the leg the specified number of degrees. Once all of the table legs are bent to shape, they are welded together, powder- coated and attached to the tabletop by skilled technicians. This complex process results in a 'family' of individual tables that are all related. The process combines design and chance, with every design generated and controlled by the power of the computer programme.

Reed Kram and Clemens Weisshaar founded KRAM/WEISSHAAR in Munich and Stockholm in 2002. Kram holds a BSc from Duke University in North Carolina, and a Masters from the Massachusetts Institute of Technology, School of Architecture and Planning. Weisshaar completed an apprenticeship as a metalworker before going on to study product design at Central Saint Martin's College of Art and Design and the Royal College of Art in London. Weisshaar lives in Munich and Kram lives in Stockholm.

On loan from KRAM/WEISSHAAR Image: © KRAM/WEISSHAAR



Plytube Stool
Seongyong Lee
2010
plywood tubes

Seongyong Lee is interested in re-thinking traditional materials and making processes. He believes that making should be responsible as well as creative, designing pieces that are economic in their use of materials and at the same time elegant.

The traditional method of making hollow, wooden tubes is wasteful. Lee sought to address this problem by applying the principal of cardboard tube construction to plywood. He created *Plytube* from thin layers of wood veneer made into a tube in a similar way to a cardboard tube. The result is exceptionally light, robust tubes that can be manufactured to different diameters and wall thicknesses, and in a variety of wood veneers. The *Plytube Stool* perfectly demonstrates these qualities. It has a minimal frame constructed from plywood tubes, it is extremely strong, and yet weighs just 820 grammes. The stool hints at the potential uses for this innovative production technique, and offers the promise of exciting possibilities yet to come.

Seongyong Lee is a Korean designer. He studied at Seoul National University and completed an MA in Design Products at the Royal College of Art in London in 2010. His *Plytube* series was acquired for the permanent collection at the Design Museum in London.

Image: © Seongyong Lee



Shine candelabra
Geoffrey Mann
2010
bronze, silver plate

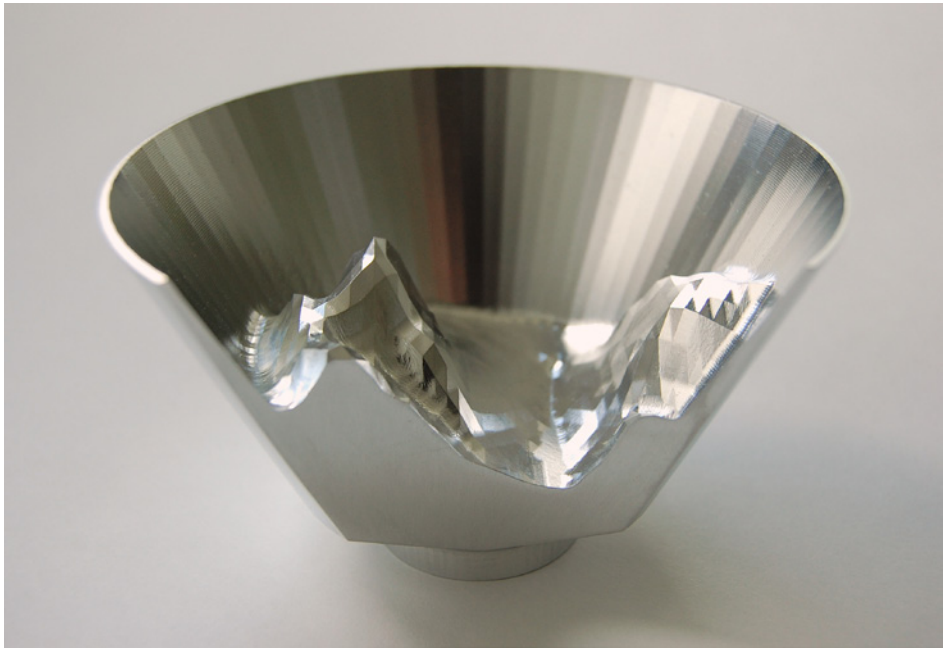
Supported using public funding by
ARTS COUNCIL ENGLAND

Geoffrey Mann's practice explores the existing boundaries between art, craft and design. He has created physical representations of a moth's flight around a light source (*Attracted to Light*, 2005), and recreated the effect of a ripple of air across the surface of a liquid in the form of a bone china teacup (*Blown*, 2009).

To create *Shine*, Mann scanned a Victorian candlestick with a planar 3D scanner. When scanning a polished metallic object, the laser beam of the scanner is unable to distinguish between the surface of the object and its reflection, resulting in a model full of visual interference. To an engineer, the result is a failure, but to a designer it presents an opportunity. The surprising outcome of the scanning process has created a new form, embellished with unpredictable spikes. The CAD model was 3D printed then cast in bronze and silver-plated. Mann's piece has successfully explored the potential for digital technology to create unexpected new forms when pushed to its limits, and has transformed the ordinary into the extraordinary.

Geoffrey Mann studied 3D Design at Grays School of Art, Aberdeen, and ceramics and glass at the Royal College of Art, London. He lives and works in Edinburgh where he established his studio practice, Studio*Mrmann.

On loan from the Crafts Council.
Image: © Geoffrey Mann Photography by Nick Moss



Etive
Drummond Masterton
2012
aluminium

Drummond Masterton is part of a group of academic researchers who are investigating digital manufacturing and challenging traditional boundaries between craft makers and industrial production.

Etive is a small cup containing a miniature recreation of the landscape of Glen Etive within its walls. The topography of the landscape was translated into a 3D wire frame mesh using computer software. The co-ordinates of the mesh were programmed into a multi-axis CNC milling machine which cut out the shape of the cup from a solid block of aluminium. The cup is cut away at one side revealing the interior in all its fine detail, but at the same time rendering its function as a cup obsolete. As a result, *Etive* is a conundrum. It has the aesthetic of a highly toleranced engineering component combined with the decorative beauty of carved ivory. It is a non-functional cup shaped by digital technology for intimate and personal contemplation.

Drummond Masterton trained as a 3D designer at Grays School of Art, Aberdeen and at postgraduate level at the Royal College of Art. He is currently the Course Leader for Sustainable Product Design at Falmouth University.

Image: © Drummond Masterton



My New Flame
Moritz Waldemeyer for Ingo Maurer
2012
LED candle

Ingo Maurer is one of the worlds' most influential lighting designers and manufacturers. Whilst his company strives to develop work that embraces new technologies, Maurer never relies on innovation alone to justify the work, always endeavouring to produce designs that possess a poetic beauty.

My New Flame is a digital candle developed with fellow German lighting design Moritz Waldemeyer. It celebrates both the beauty of the candle and the beauty of electronics. The circuit board becomes the decoration of the candle body as well as controlling the flickering 'flame' of the LED. With its warm glow and dancing movement, the 'flame' is astonishingly realistic. In the hands of a less adept or sensitive designers, a battery-powered candle might become a novelty item. However, they succeed in turning this idea into a sophisticated recreation of a candle flame, at once captivating and fascinating the viewer.

Ingo Maurer was born in Germany in 1932. He emigrated to the USA in 1960 where he worked as a freelance designer in New York and San Francisco. He returned to Germany in 1963 and founded DESIGN M studio three years later. Since then he has produced over 150 different lights and lighting systems for international venues, public buildings and private commissions.

Moritz Waldemeyer was born in Germany in 1974. He has developed lighting for clients including Swarovski, Ron Arad and Zaha Hadid. In addition to production design and bespoke installation work, his highly creative approach has also seen him design light-studded costumes for the likes of U2, Rihanna, and the London Olympic Ceremony.

Image: © Ingo Maurer GmBH
Photography by Tom Vack, Munich



Traditionally Worn Vessels
Gareth Neal
2009
oak

Gareth Neal works at the intersection of craft, design and technology. His work is grounded in the history of objects and making, and he creates contemporary interpretations of traditional forms by exploring new making techniques.

Neal's *Traditionally Worn Vessels* reinterpret the vessel form using a CNC router. The router cuts into the wood at varying depths and the curved shape of the vessel appears within the solid block of the wood. The deep cutting leaves thin, brittle slices that are easily damaged but this is not considered a problem. As the vessel begins to chip, it develops an individual character that is unique to each piece. By combining the inventive use of machine making with a deep understanding of material qualities, Neal brings individuality and unpredictability to his work. He successfully demonstrates that machine making does not have to result in monotony and uniformity.

Gareth Neal established his design practice in 1999 and is currently located in East London. His studio works on a range of projects from individual pieces and bespoke commissions for private clients and collectors to production pieces for industry. Neal is a researcher and lecturer at the University of Brighton.

Image: © Gareth Neal



Ripple Tank Table
Daniel O'Riordan
2010
oak, glass

Daniel O'Riordan's technically complex furniture and lighting designs strive to capture fleeting moments in nature and render them permanent and eternal.

For the *Ripple Tank Table* O'Riordan used specialist software to simulate the effect of raindrops hitting water. The software created a 3D wire frame mesh and the co-ordinates of the mesh were programmed into to a CNC router. The router followed the path of the co-ordinates and shaped the outline of the raindrops onto the solid surface of the oak. The process of cutting takes up to 64 hours as the router head sweeps countless times across the timber. The oak was polished by hand and attached to panes of glass to give the effect of floating in the air. The resultant surface has an illusion of liquidity that is at once seductive and astonishing. This translation of liquid to solid is only made possible by the power of sophisticated CAD software and the skill of the designer in using the software to achieve the desired effect.

Daniel O'Riordan trained in Bath and has worked as a ceramic artist, interior designer and lecturer. His interests lie in taking a 'craft' approach to the use of technology and rapid prototyping. He is currently a lecturer at Nottingham Trent University where he specialises in the development of 3D digital modelling simulation and production techniques.

On loan from Daniel O'Riordan
Image: © Daniel O'Riordan



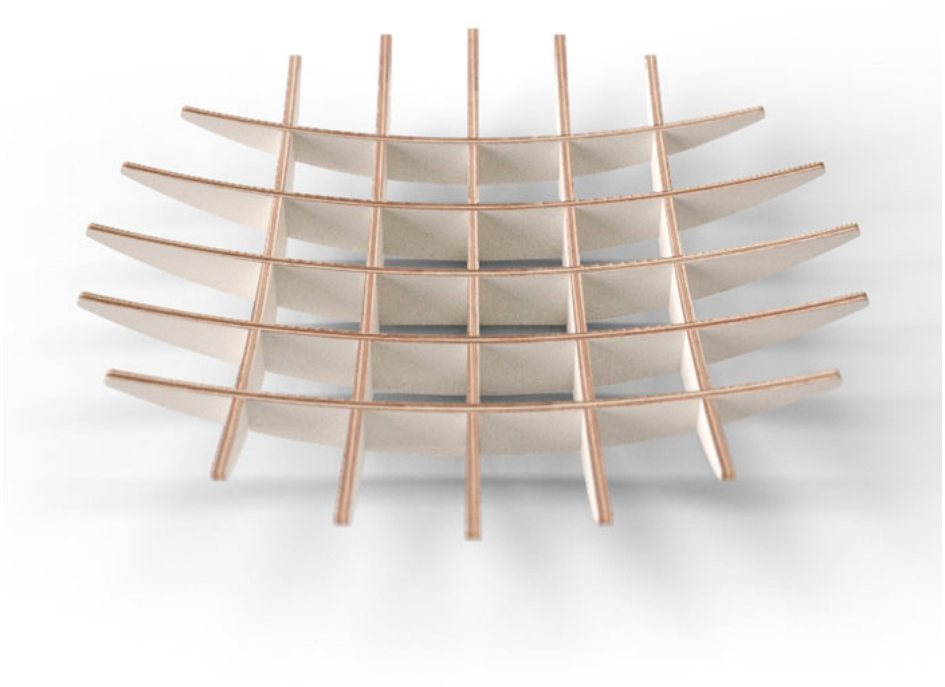
Kitset - Floral Lampshade
David Trubridge
2006
bamboo ply

Inspired by the natural habitat of New Zealand where he lives and works, David Trubridge seeks to translate the beauty that surrounds him into furniture and products for the home.

The *Floral* lampshade takes a simple leaf shape as its starting point. CAD tools are used to map the shape over a sphere to create an elegant structure. A CNC router cuts out each leaf individually ensuring they fit together perfectly to create the delicate sphere. The design is not only beautiful, it also aligns with Trubridge's ecological ambitions. The leaves are made from sustainable bamboo ply and the CNC manufacturing process produces little waste. The lampshade packs into a small box that is easy, and light, to transport. By considering all of these factors, Trubridge has created a digitally designed and manufactured product that is produced responsibly and sustainably.

David Trubridge graduated from Newcastle University in 1972 with a degree in Naval Architecture. After sailing around the world for five years, he settled in New Zealand in 1985 and began making furniture influenced by his travels. In 2001, his work was spotted at the Milan Furniture Fair, kick-starting his career as an international designer and manufacturer. In 2011, he opened a showroom, workshop and design studio in Hawkes Bay where he now employs twenty staff.

Image: © David Trubridge Design



Fruitbowl
Unto This Last
2008
birch-ply composite

Unto This Last are a small design and manufacturing company based in London. They describe themselves as 'micro-manufacturers' and all their products are designed and made in their workshop using a digital router. They describe their purpose as being "*to offer the convenience of the local craftsman's workshop at mass-production prices*".

The *Fruitbowl* illustrates how a flexible digital manufacturing process can become a successful business model. It is made from a birch-ply composite, which Unto This Last use to make all of their products to simplify the supply chain and keep lead times short. Computer software also helps to reduce material waste, by optimising the use of each sheet of plywood. Customers can order from 100 product lines, which translates into 2000 individual products when taking into account the varying sizes and finishes available, including bespoke colour finishes. Unto This Last carry no stock in their shop, removing the need for warehouse storage, and each element of the business has been carefully considered and simplified to keep the costs of materials, premises and transportation as low as possible. By doing so, Unto This Last can offer well designed products at a competitive price. The ingenuity and creativity of the designers has resulted in an innovative and highly efficient business model that they hope to recreate in other locations.

Unto This Last are named after an essay on economy written by the Victorian art critic, social thinker and philanthropist John Ruskin, and first published in the Cornhill Magazine in 1860. Following Ruskin's line of thinking, they advocate for a return to local workshops where products are made by skilled craftspeople. Unto This Last were founded by Olivier Geoffrey who believes that utilizing the latest technology will help to achieve the vision of craftspeople working within the local community. They are currently based in Brick Lane in East London.

Image: © Unto This Last



Nurbs Coffee Table
Unto This Last
2008
birch-ply composite

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Image: © Unto This Last



Endless Flow dining chair
Dirk Vander Kooij
2010
recycled plastic

Dirk Vander Kooij's *Endless Flow* furniture range has pushed the boundaries of 3D printing and created a completely new scale of production.

Frustrated by the limitations of existing 3D printing, which could not produce large-scale pieces such as furniture, Vander Kooij began to experiment. He took a robot arm, previously used in industrial manufacturing, and connected it to a hopper containing melted plastic recycled from old fridges. Vander Kooij programmed the arm to create a chair by extruding the soft plastic through its tip in lines, like toothpaste squeezed from a tube. The plastic was laid down layer upon layer, slowly building up into solid walls, until a piece of furniture emerged. By thinking creatively about the 3D printing process Vander Kooij has taken it from a small-scale, slow and expensive process, into something bigger, faster and cheaper. The resultant designs have a bold character in their clearly visible, layered construction, and the theatrical spectacle of their making turns manufacture into performance.

Dirk Vander Kooij graduated from the Design Academy in Eindhoven in 2010. Following his graduation, he exhibited at the Salone de Mobile in Milan where his work immediately drew media attention. He returned a year later, having refined his technique, and he now employs four members of staff at his workshop.

Image: © Dirk Vander Kooij



Airborne Snotty Vase – Pollinosis
Marcel Wanders Studio
2001
polyamide

Marcel Wanders is one of the world's most acclaimed international designers. He has applied his highly individual design approach to the creation of products for clients as diverse as Alessi, Capellini and Marks & Spencer, as well as numerous designs for his own company Moooi.

The *Airborne Snotty Vase* series was one of Wanders' more technically challenging projects. At first glance, the vase appears to be a highly considered and crafted form, reminiscent of the vases used for Japanese floral arrangements (Ikebana). However, its origins are far less spiritual. Using a high-speed, microscopic digital scanner, Wanders captured a sneeze as it propelled a spray of mucus through the air. A single piece of snot was captured digitally, then enlarged and hollowed out using computer software, before being 3D printed. This exquisite and intriguing vase pushes the limits of what is technically possible, finding creative inspiration in the act of a sneeze, and beauty in the form of snot.

Marcel Wanders is a Dutch designer of products and interiors. He graduated from the School of the Arts, Arnhem, in 1988 and opened his own studio in Amsterdam seven years later. Wanders first came to prominence for his *Knotted Chair,* which was produced by the Dutch design brand Droog in 1996 and was subsequently purchased by the Museum of Modern Art in New York and the V and A in London. In 2001, he co-founded the design label Moooi, of which he is the Art Director.

Image: ©Marcel Wanders Studio
Photography by Maarten van Houten



Chairfix
Ben Wilson
2003

Limited edition shown here:
***Alphabeta* graphics by**
Village Green, 2012, printed MDF

Ben Wilson's work is as diverse as it is inventive. He collaborates with other designers, artists and technologists to push the boundaries of manufacturing processes in innovative and playful ways that reflect his engaging, personal approach to design.

Chairfix is Wilson's witty take on the Airfix models he made as a child. Using a CNC router, the components for a chair are cut into a flat sheet of plywood or MDF. The sheet resembles plastic model-making components waiting to be assembled, and once purchased, the components are pressed out and assembled into a chair. This simple production method keeps delivery costs low and enables sheets to be pre-printed or painted with individual designs before cutting. By creating customised, or limited edition pieces, Wilson can add value and individuality to a batch-produced object without affecting the manufacturing process.

Ben Wilson studied 3D Design at Manchester School of Art and graduated from the Royal College of Art in 2001 with a Masters degree in Design Products. His design studio is based in East London and he currently teaches at the Royal College of Art's School of Design.

Image: © Ben Wilson

Glossary of Terms

Algorithm – a computer programme that follows a set of step-by-step instructions to either calculate or generate an optimal conclusion to a given function

CAD – Computer Aided Design

CAM – Computer Aided Manufacture

CNC – Computer Numerically Controlled

CNC/Digital Router – A computer controlled router that can cut out simple 2D shapes like a jigsaw, or can be used to create 3D forms by milling

Data – digital information used in computer programmes

Highly toleranced – a component that is very accurately manufactured e.g. a component for a jet engine

Laser – a very thin beam of focussed, single frequency light

Laser cutter – a machine that uses a high-powered beam of laser light to cut materials such as plastic, wood and metal

Laser Sintering – a process using high power lasers to melt together small particles of plastic or metal to create a 3D forms

LED – Light Emitting Diode, an electrical semi-conductor that uses electroluminescence to emit photons like a miniature light bulb

Milling – the process of cutting the top surface of a material with a vertical rotary cutter. This can be used to make the surface flat or, by moving the cutting head up and down across the surface of the material, it can be used to make 3D forms

Motion capture – a system using multiple video cameras to track the location and movement of an object or point in space

Nurbs – non-uniform rational b-splines used in computer modelling programmes for generating and controlling the curves and surfaces of a computer model

Photo-etching – a negative image is projected, using ultra-violet (UV) light, onto the surface of a metal sheet coated with a photo-sensitive polymer. The UV light hardens the coating in the areas where the image is projected, and the remaining polymer is washed off. Acid is used to burn (etch) away all the areas not coated with polymer, leaving just the projected image

Powder coating – a surface treatment for metal using powdered, coloured paint which is applied to the surface using an electric charge and baked to create a tough skin

Router – a woodworking machine with a vertical rotating cutter (like a drill). It can be moved from side-to-side and up and down, and can be controlled by hand or by a computer.

3D Printing – an additive method of manufacturing that makes 3D forms by building up shapes using multiple, microscopic layers or slices of plastic or metal.

3D Scanner (laser/digital) – a laser beam is projected onto an object and the time it takes for the reflected beam to return to the sensor enables the computer to calculate its distance from the scanner. This information is used to create a 3D map of the surface of the object.

3D wire mesh – a contour map generated by a computer programme to describe the surface of a 3D form

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