Future Factories

DESIGN WORK BY LIONEL THEODORE DEAN

PAUL ATKINSON

www.futurefactories.com

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Future Factories

Envisage a future where you could visit a dedicated 'Future Factories' website, which could be accessed in a gallery, a department store or directly from your own home or mobile phone. This website would display a range of products, and you could choose any one of them. Once you made a selection, you would be presented with an animation, which would show that particular product in a constant state of metamorphosis, as it appears to grow, change and mutate on the screen. At any given moment you could pause the animation and view a three-dimensional computer model of the product, rotating it to see it from any angle. The animation would continue, and any number of 'snapshots' of the product at various stages of its growth could be taken, and if required, printed onto paper for closer examination. Each one of these 'snapshots' would be a unique form – never to be repeated. If you then decided to purchase one of the designs, you could order it directly from the website, and the product you had selected would be manufactured automatically, exactly as you had seen it on screen, and delivered directly to you. An original. A one-off. A work of art?

This is the 'Future Factories' concept. A system where the exact form of the product you purchase is not decided by the designer, but randomly generated by a computer, and chosen by you, the consumer.

'Future Factories' began life in the Design Department of the School of Design Technology at the University of Huddersfield. Research monies were used to fund the post of a 'Designer-in-Residence', whom, it was intended, would carry out their work alongside design students from the BA/BSc (Hons) Product Design and BA (Hons) Transport Design courses. In this way, the department aimed to introduce practice-based research to the delivery of three-dimensional design courses as well as demonstrate to students the pace, rigour and structured approach to project work of a professional designer.

Applicants were invited to propose a project on which they would work during the residency. The successful applicant, Lionel Theodore Dean, presented an embryonic idea for the exploration of the possibilities of using a relatively new technique called 'Rapid Prototyping' for the final production of finished artefacts. The project was fresh, exciting and potentially stimulating for students to see unfolding, and Lionel's approach to design was particularly suited to the School as it combined theory and practice in a balanced way. This exhibition explains the radical shift in the methodology, development and production methods that emerge from this unique approach to design, and displays the distinctive products that result from its application.

Individualised production

Mass production is a relatively recent concept. Prior to the introduction of the factory system, the individual skills of craftsmen would be reflected in the end results of their labour. Each product made would be more or less faithful to the original 'specification', yet would inevitably contain an element of variance. Many craft processes are a balance between demands made of the process and the control of it. Hand-blown glass is a good example of this. A craftsperson's inaccuracy, rather than resulting in scrap, might produce an interesting deviation on a theme. The design formula itself might be organic, evolving over time. This lack of consistency, far from being seen as a negative by the consumer is often valued. In contrast, mass production depends on uniformity and repeatability. Mass production has made desirable objects affordable. It has allowed levels of design development and the use of sophisticated processes not possible at lower volumes. There is however a perception that something has been lost. The omnipresence of mass-merchandise fosters within us a desire for something personal and unique, something we can imbue with a soul or character of its own. 'Future Factories' considers the automated production of one-off pieces from organic, ever changing designs, which promotes the notion of the unique and fosters the processes of personalisation. Individualised production already exists in a process known as 'Mass Customisation'. This can be defined as a process that affordably allows mass-market goods and services to be made specific, in order to meet an individual customer's requirements. The term 'Mass Customisation' was coined by Stan Davies in his book 'Future Perfect' (Davies 1987). The term is deliberately paradoxical. There are many different models for mass customisation suiting different products and market sectors. They are all however, consumer driven, and the key to mass customisation remains modularisation and reconfiguration. This may be through a combination of options, where the consumer selects from an extensive but finite range of colours and finishes. Alternatively, consumers may provide data on personal preferences or accurate measurements of body parts to enable the production of 'tailor made' products. Consequently, examples of mass customised products range from genuine medical 'needs' such as perfectly fitting hearing aids (Fu 2002) to desired product differentiation in a kitchen stove or better-fitting bespoke jeans (Marsh 1997). In contrast to mass customisation, the 'Future Factories' model derives no input from the consumer. Where mass customisation consists of consumer selection and specification, 'Future Factories' allows the consumer only to select the moment at which the process of form generation is arrested. Each artefact produced is therefore a one-off realisation of the designer's formula, as interpreted by computer software.

Archetypal form

Steel supplants glass

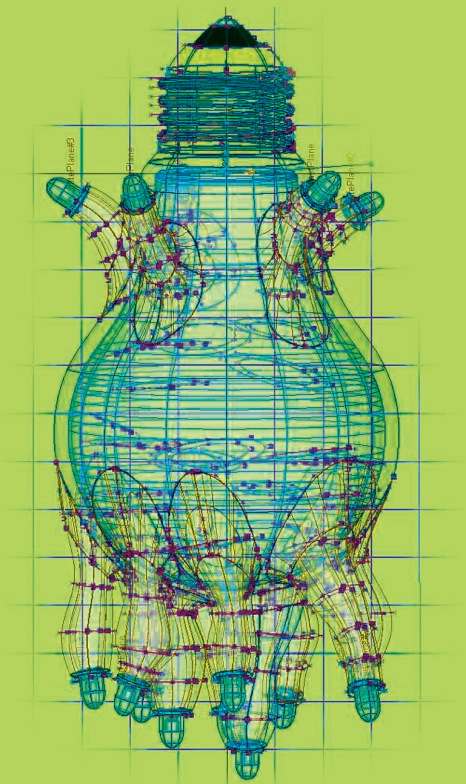
Nodules appear

Protrusions swell

Tentacles taper

Peppered light

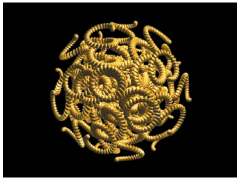
Lampadina Mutanta

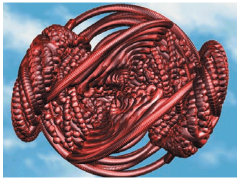


Computer generation of random form

The generation of random forms by computer is not in itself an original concept. It has long been appreciated that computers have the ability to add a random element to any mathematical function. As computers have increased in power and speed, the capacity to randomly generate complex three-dimensional forms can be seen as a logical development. Perhaps some of the best-known computer generated forms are those resulting from the collaboration between the artist William Latham and the mathematician and computer graphics expert Stephen Todd. Latham had developed his own hand-drawn system for generating abstract forms called 'form synth'. In this system, geometric forms could be combined, undergo a series of pre-determined deformations and then be joined with other forms to 'marry' and create 'offspring'. The offspring consisted of complex forms bearing characteristics of both 'parent' forms. In the late 1980s Todd used the extensive resources of IBM's UK Scientific Centre at Winchester to develop this method and combine it with elements of Richard Dawkins' 'Biomorph' system (Dawkins 1993) that demonstrated the power of natural selection. The outcome of this work was a powerful piece of software called 'Mutator'. The end results from this software were staggering. The system has developed a great deal since, most notably in its widely disseminated form as the 'organic art' software package from Computer Artworks; yet its potential has not been fully realised. Hopefully the 'Future Factories' concept will explore a small part of this potential.

ORGANIC 3D FORMS CREATED BY PAUL ATKINSON USING THE **'ORGANIC ART'** SOFTWARE PACKAGE. REPRODUCED WITH PERMISSION OF WILLIAM LATHAM





The driving force behind 'Mutator' was the creation of art. As the authors stated, 'some artists feel that it provides a genuinely new way of working, and it has certainly led to the creation of forms that would not have been created by other methods' (Todd & Latham 1992: 105). Although the resulting 'sculptures' were only ever intended to be seen as 2D representations of complex 3D models presented as art in a gallery context, the principle behind it can just as easily be used to create variations on 'usable' forms to produce designs for 'anything from buildings to shampoo bottles' (Computer Artworks 2003).

Vegetal root

Extension

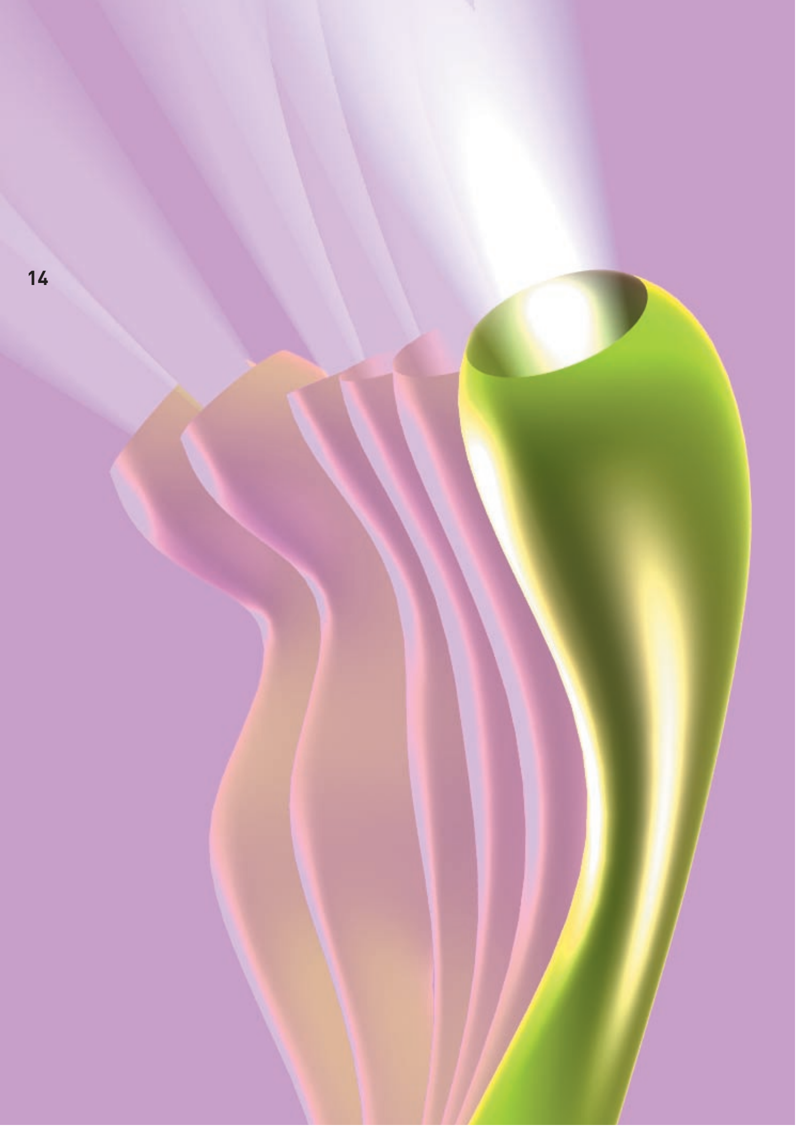
Distension

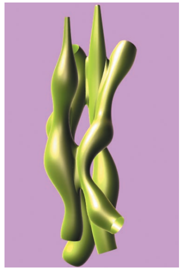
Plasticity

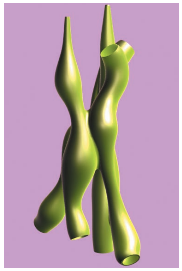
Attenuation

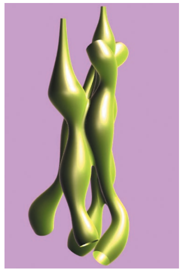
Pulsing glow

Tuber









Design formulas

Computer generated art has little in the way of physical constraints. The adaptation of these forms into functional products though, requires far more control. Advances in CAD have brought a shift to parametric solutions as a way of defining computer models. In parametric design, relationships between the different features of a model, instead of the features themselves, are specified. Using parametric design, computer models can be quickly manipulated and alternate solutions considered simply by changing the variables, or the parameters that define the product.

'Future Factories' designs are defined by parametric models. In these, ranges are set for certain parameters to which random values are assigned by the computer. These limits are imposed in order to maintain functionality and constrain the form. This leaves an organic model free to mutate within a series of interrelated parameter envelopes. Each design is defined by a production formula, which can yield an infinite range of equally valid outcomes. We are able to categorise objects in nature by the recognition of common patterns and proportional relationships in spite of significant variance. 'Future Factories' aims to achieve this same balance between order and chaos, between manufactured uniformity and individual sensibilities. It is a system for the automated production of one-off outcomes that are distinctly individual yet of a recognisable design.

Two fundamental approaches to the concept of variance are used in the 'Future Factories' model; manipulation of the core 3d form and the application to the core form of a variable feature. For example, the footprint of the 'Let's Twist Again!' candlestick is fixed, the legs being evenly spaced, for stability. The tops of the legs are also constrained but not fully. Each top remains in the same radial plane as a foot, again for stability. The height of each leg may vary between limits, and a relationship is applied to ensure an even spread of heights between the legs. The only constraints on the form of the legs are the amount of interference needed to make a joint, and that the legs spiral in the same sense and in a smooth curve.

In 'Lampadina Mutanta', Light Emitting Diodes (LEDs) are mounted in the ends of 'tentacles'. The end of each 'tentacle' is constrained to accept an LED and the directions in which they point are restricted to certain angles from the vertical (to avoid glare). Three distinct characters of 'tentacle' have been designed; 'Drops' which form like stalactites and taper as they 'grow' downwards as if under gravity; 'Tentacles' which are able to resist gravity and can curl and coil; and 'Risers', which form like stalagmites and curl under gravity as they lean out from the bulb body. These three types appear in varying proportion and random positions over the bulb form.

Drifting hydra

Suspended

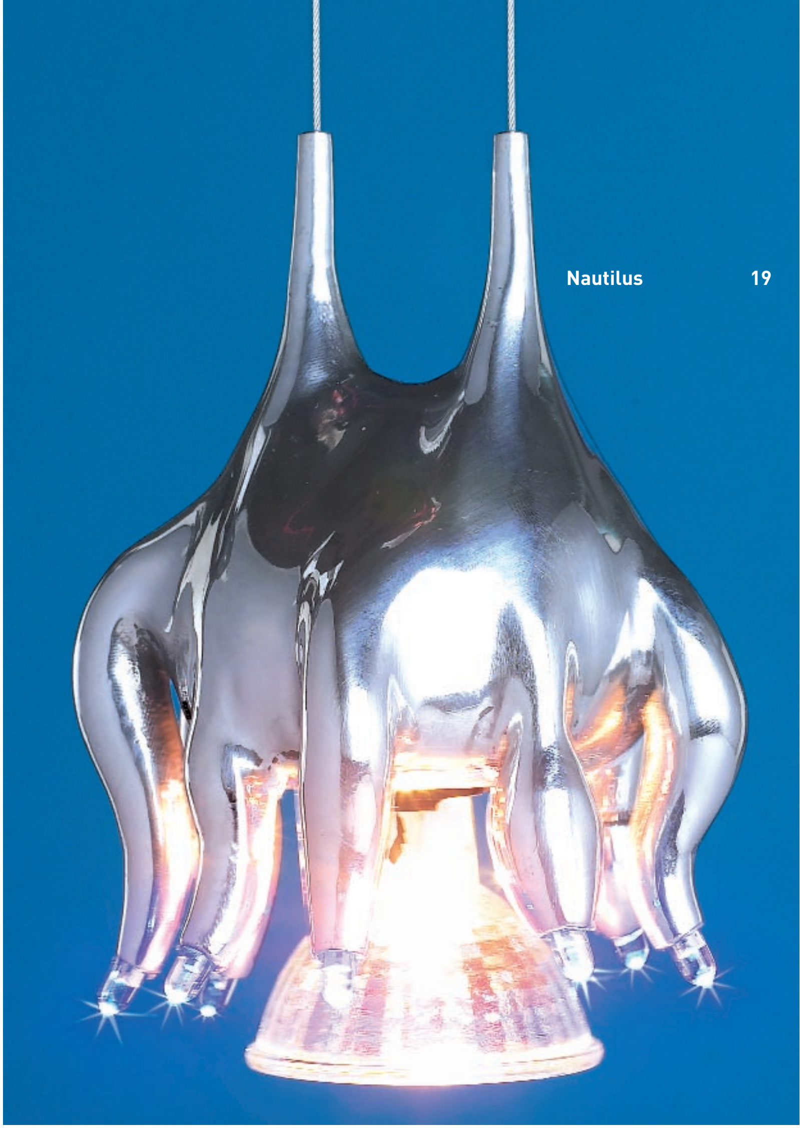
Searching

Medusa sways

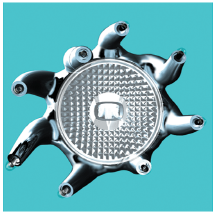
Veiled radiance

Floodlit depths

Nautilus



Nautilus

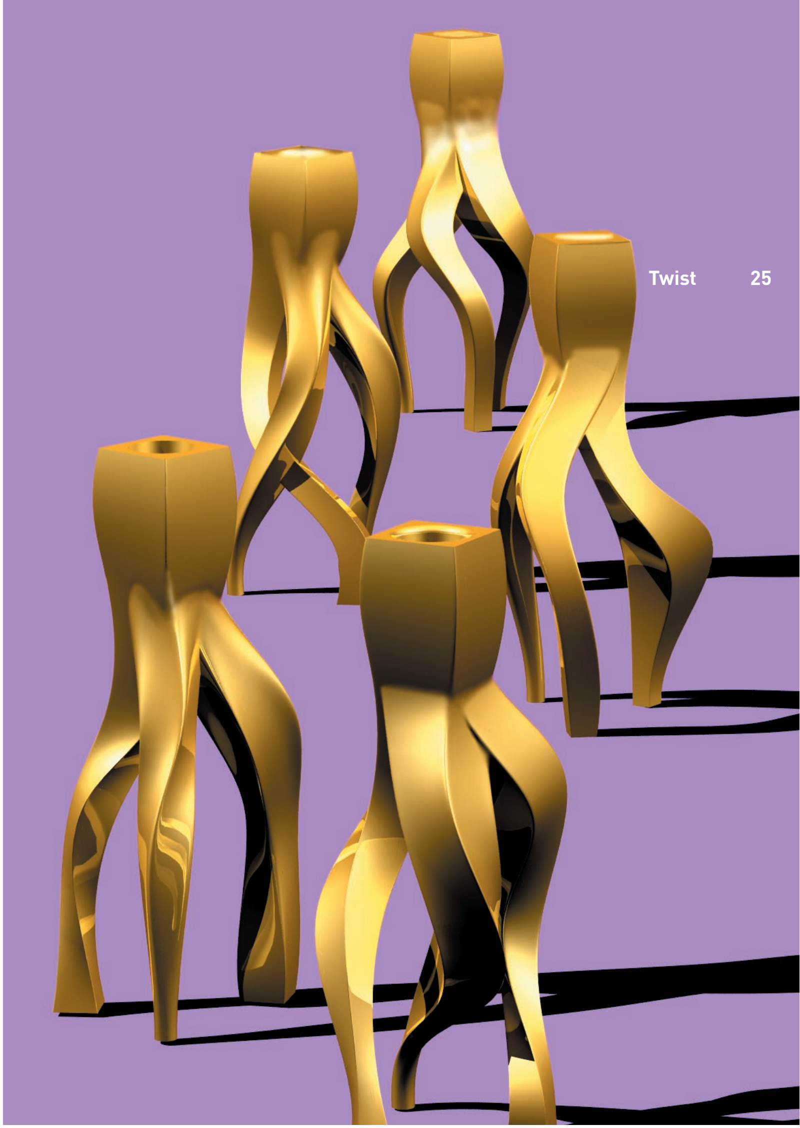


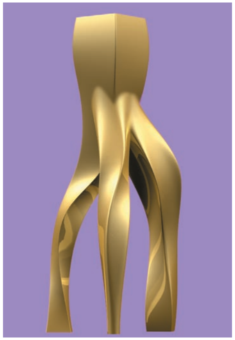
Direct digital manufacture

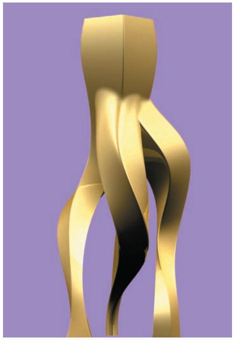
The 'Future Factories' project employs state of the art technology to design and manufacture products. As described, forms for these products are created using the latest solid modelling CAD software. Algorithms (mathematical rules) are applied to various parts of the form to allow them to change within a specified range of movements (this is referred to as the parameter envelope). Each design will contain a number of elements, each having their own algorithm. The rate of change of each element is also randomly selected by the computer, which ensures that the mutation of the design is different every time the animation program is run, and that the products created using the system are completely unique. The animation, when stopped, generates a special computer file of the model, which is then sent to a rapid prototyping machine for manufacture.

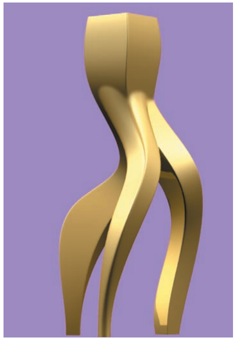
Rapid prototyping is a method of production originally developed to reduce the development times for complicated engineering components. A component is designed using CAD software, and the resulting solid model is used to directly generate a plastic version of the component, which would be almost impossible to produce in any other way without going to the expense of special tooling. A computer is used to 'slice' the solid model into layers 0.1 of a millimetre thick. In one version of the technology, a laser is then fired into a tank of special resin, where it cures a layer of the model from a liquid state into solid material. The position of the tank is then altered by 0.1mm, and the process repeated. In this way, a three-dimensional solid resin model is created from the computer file. This approach is called 'layer additive' manufacturing. Newer versions of this technology use all sorts of materials, including powdered plastics and sintered metals, with which solid objects can be 'printed' one layer at a time. The technique is almost identical to that in a standard inkjet printer, and as in reprographics, model files can be emailed to an agency for production or made on the desktop. Through direct digital manufacture, a revolution is underway in 3D Product Design that is likely to be as radical as that already seen in Graphic Design.

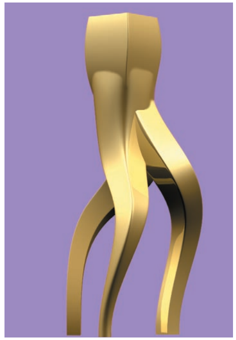
Rapid Prototyping as a process has only ever been considered for the production of trial components (although as with the computer generation of random form, there are a number of artists and sculptors using the technology to produce art). 'Future Factories', however, proposes to use this technology for the production of finished functional objects, and in doing so, highlights the creative potential inherent in direct digital manufacture.











Implications

'Future Factories' represents a convergence of art and science; of the aesthetic and the technological. This integration of the perception of beauty; the computer generation of form; and neutral industrial production is more intricate than it might at first appear. Adopting such a paradigm raises complex issues for design. If consumers make an aesthetic judgment on a form, which has been generated by software, then who has 'designed' it? Is programming the computer a major contribution or not? The future role of designers and where they fit into the design process will need to be examined.

'Future Factories' acts to blur distinctions between craft and design. If the focus of 'craft' is taken to be the conception of form leading to one-off production; and 'design' is taken to be concerned with the conception of form leading to a specification for large-scale manufacture, then the distinction between a craftsperson and a designer is clear. Yet 'Future Factories' allows the selection of a form generated by software for immediate one-off machine production. Although such a system can make an infinite variety of related forms, it could, if required, reproduce any number of exactly the same form. 'Future Factories', then, would seem to fit both the definition of craft, in that it allows one-off variations in form; of design, in allowing repetitive production of the same form; or neither as the form is not generated nor conceived by the person who selects it, or by the designer who specified the design's parameters. In this context, the definitions of 'craft' and 'design' as discrete processes become hopelessly blurred, intertwined, inextricable, and as a result, meaningless.

Every aspect of the design education curriculum may be affected. CAD might be concerned less with design for mass production and more concerned with direct digital manufacture. The teaching of materials and processes premised on mass-production may have to consider support for such digital technologies. Possibly, even the visualisation skills taught will be affected if, as is entirely plausible, the final production techniques employed influence the conception of forms early in the design process. To what extent are current designers' forms for products influenced by the ease of manufacture in injection moulding? And how many student projects are based on the concept of mass production for a certain age, gender or lifestyle? There may need to be a move from the 'accepted wisdom' of market research and more consideration of the needs of the individual – the celebration of diversity over convergence. There would at least be a requirement to learn more about 'people' and less about 'markets' – more about the subjective choices people make about objects and the emotional relationships they enjoy with them. In short, less materials technology, more material culture.

Coiled limbs

Entwined

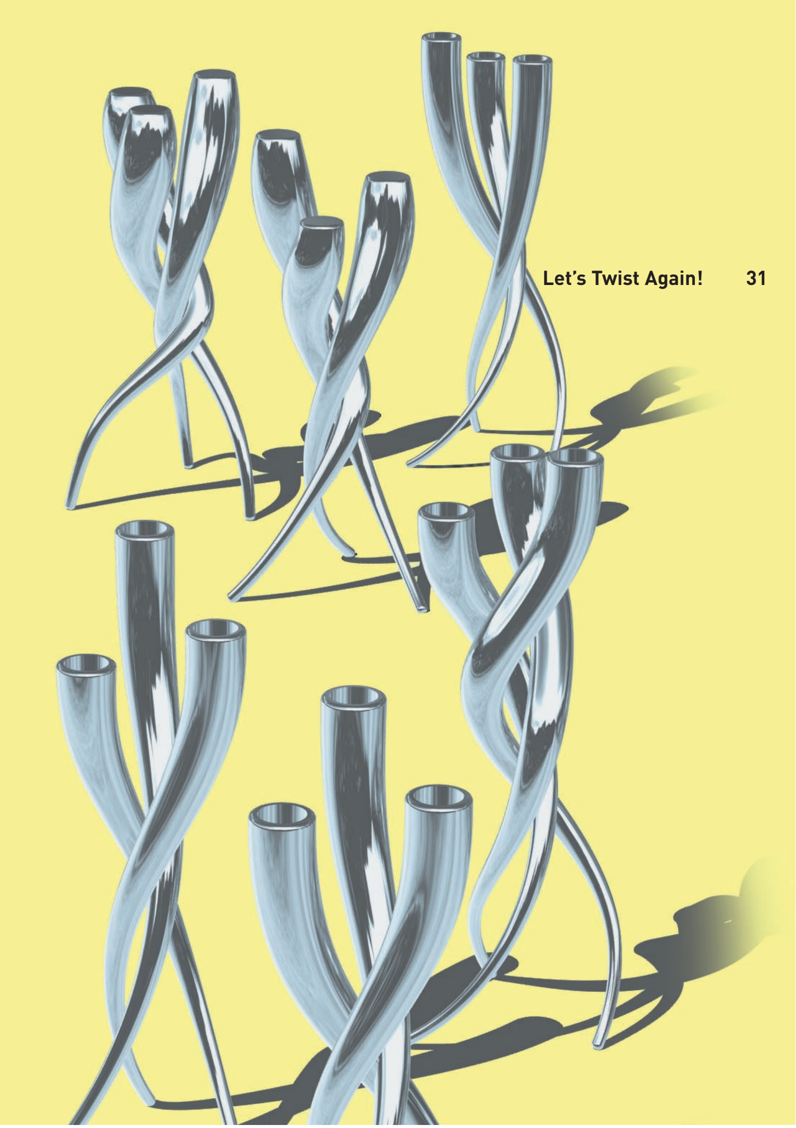
Rising

Falling

Spiral jive

Elegance dancing

Let's twist again!



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Conclusions

The 'Future Factories' project demonstrates that the use of computer-generated organic forms to produce viable artefacts for one-off production is a realistic proposition. Obviously, 'Future Factories' is not a suitable model for the production of complex technological objects (at least not yet). But the thinking behind it, and the manufacturing system proposed by it fit comfortably with today's drive for individuality.

The implications of the wide scale adoption of such techniques by industry are potentially serious, and moves to protect the process via patents have been made. The system has the potential to change the perception of design by consumers and manufacturers, and to influence considerably the education and training of designers. Despite the philosophical questions the process raises about the terms 'design' and 'designer', and the scope for confusion as to whether the end results are 'art', 'craft', or 'computer generated', there are a number of pragmatic considerations. There is potential for the process to impact on manufacturing and retail industries. 'Future Factories' allows for the economic large-scale production of artefacts while providing important reductions in wastage from over-production of unwanted items. At the same time the system promotes additive over reductive manufacturing processes, cutting down on the production of waste material. As such, it points the way to a more sustainable model of a consumer society than the one we take for granted today.

Paul Atkinson

University of Huddersfield October 2003

Further Reading

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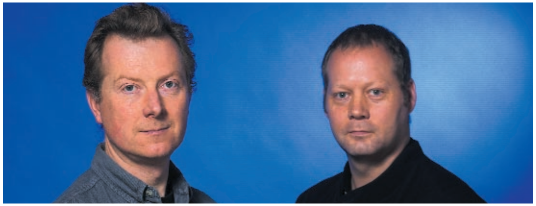
Biography notes



Lionel Theodore Dean

Lionel is a graduate engineer and has a Master's Degree from the Royal College of Art. He worked as an automotive designer for Pininfarina in Italy, before starting a design consultancy in 1990. Initially his work focused on automotive design with international clients, but over the years he has diversified into interior products. Whilst intended for volume production, Lionel's products seek to explore the boundaries between art and design. Lionel's work has received many accolades and international design awards, and several of his designs are in commercial production.

Paul Atkinson

Paul Atkinson is the Research Leader for the School of Design Technology at the University of Huddersfield. A practicing industrial designer, educator and design historian, he has spoken at conferences around the world and published a number of articles on design, design pedagogy and the history of design.

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