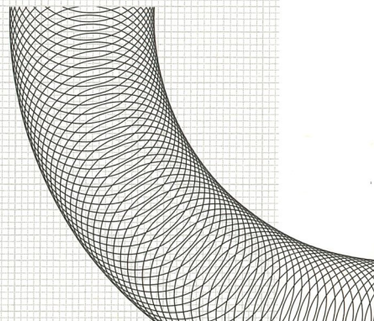
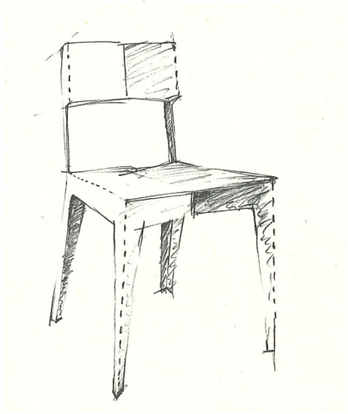
THE SLOW PROTOTYPE

Words: Brian Parkes

Aesop's famous fable of the tortoise and the hare takes on ever more resonance in our accelerating age. While speed has given us many advantages there is still much to be said for slow and steady in any race. Like most things, the design process has sped up exponentially. Since the 1960s computers have aided product designers to realise more and more complex forms and interrelations with ever-increasing efficiency. The screen and the keyboard have become indispensable tools for most designers in the twenty-first century, and the use of these tools now dominates design education in the industrialised world.





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Adam Goodrum, *Stitch* sketch, 1995, pencil on paper. Photo: Adam Goodrum

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Adam Goodrum, *Stitch* prototype, 1995, plywood, piano hinges. Photo: Adam Goodrum

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Adam Goodrum, Aluminium *Stitch*, 1995, aluminium. Photo: Adam Goodrum

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Adam Goodrum, *X-Ray chairs*, 1996, acrylic. Photo: Paul Pavlou

Arguably the most critical step in the product design process – particularly for any product that involves human interaction – is the realisation of the object in three dimensions at actual scale. For any designed object that is going to be handled, used or sat on, the full-size prototype allows the necessary testing to ensure suitability to purpose and enables the resolution of formal and aesthetic details. The production of the prototype can also very often assist in determining the ultimate manufacturing process.

Since the late 1980s, rapid prototyping technologies have provided alternatives to the traditional methods of working directly – or through skilled artisans – with clay, plaster, timber or other raw materials. Today, rapid prototyping takes many forms and involves a variety of different technologies.

'Rapid prototyping' refers simply to the automated process of transforming a virtual model (produced with computer-aided design [CAD] software) into an accurate physical object – a three-dimensional version of sending a document to print. The prototype is built up in cross-sections, layer by layer, using liquid, powder or sheet material. Almost any shape can be created. The machines used for this vary significantly in scale and output material, and there are now even 'office' or 'desktop' versions (usually referred to as 3-D printers) that can be purchased for as little as $15,000 to $20,000. Generally speaking, the larger the prototype, the more expensive the technology required to produce it. So, for example, it is currently not feasible to produce full-scale rapid prototypes for furniture.

It should be noted that Australian designers have developed a significant international reputation for producing highly resolved, functional prototypes. This perceived strength – along with the quality of many of the prototyped products – has influenced an encouraging growth in the number of Australian designers now having products manufactured by European, Asian and North American companies. Part of the reason for this strength is the continued emphasis within several Australian design schools – such as the Industrial Design program at the University of Technology, Sydney, or the Furniture program at the Canberra School of Art – on exploring materials and processes in the workshop environment. A lot of designers here have the ability to actually make the products themselves, while others, particularly those in Sydney and Melbourne, are very well served by access to small and medium-sized factories with skilled workers who specialise in particular materials or processes.

In recent years here in Australia we have seen a plethora of highly finished – though not always highly resolved – prototypes produced to supply various design competitions. There is a danger in the haste to meet the demands and timelines of these competitions, in focusing on styling rather than testing a particular idea.

Adam Goodrum, *Stitch*, 2004, aluminium. Photo: Blue Murder Studios

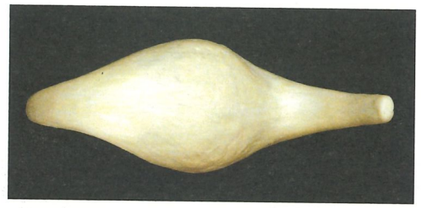
Sydney-based designer, Adam Goodrum, is the most recent Australian to have work manufactured by the venerable Italian furniture manufacturer Cappellini. His *Stitch Chair* was launched at the Milan International Furniture Fair in April this year, and the story of its development is a salient example of just how un-rapid the process of prototyping can be. Goodrum began working on the first prototype in 1994, and went on to make 15 actual-size prototypes and more than 20 smaller-scale models, refining various elements of the design at every step.

The earliest versions were made from plywood with attached piano hinges. Although they lacked the fluid movement of the final chair, they illustrated that the innovative central axis fold was possible and allowed Goodrum to accurately finetune the ergonomics with relatively minimal expense. These early prototypes also revealed a breakthrough for him in the design process. As the hinged join opened and closed it became a pinch-trap, forcing him to consider incorporating the hinge into the plane of the folding material itself. Subsequent versions were made in Alucobond (an architectural product with thin aluminium sheet sandwiching a flexible core), acrylic (with a silicone-strip hinge) and aluminium, which was to become the ultimate material.

In order to produce the aluminium versions, Goodrum approached a metal engineering company in Bankstown to get the components cut out of 4mm aluminium sheet with a computer-controlled water-jet cutter. It had taken more than a year, but he finally had a working prototype that was resolved enough to investigate production. However, after weeks of driving around Sydney's industrial zones and meeting with the owners of many factories, Goodrum became frustrated at the lack of capacity to make the integrated hinge in Australia and was forced to shelve the project for almost a decade.

In 2004 he revisited the *Stitch Chair* prototype for his portfolio presentation in the Bombay Sapphire Design Discovery Award,[1] redefining the chair by making a ten-colour version and refining minor details. The striking colour combination and some quality photography resulted in widespread exposure for the chair through the print media and exhibitions, and Goodrum once again began to consider opportunities for commercial production, this time in Europe. When he first showed the prototype to Giulio Cappellini in 2006, Cappellini was genuinely surprised at how resolved and well made it was and remarked that a young designer would not have got so far on his own in Italy.

Following much negotiation, Cappellini produced two further prototypes – largely to explore what efficiencies could be achieved in the tooling required for production and to add protective polycarbonate stoppers to the feet of the chair. Twenty pre-production units were produced for the Furniture Fair and were given a thorough road testing by thousands of visitors. The *Stitch Chair* was widely praised and will be distributed internationally later this year.



Stefan Lie, *Genie Tea Pot* handmade clay model (top view) used by Walden Design to generate the virtual 3D computer model. Photo: Stefan Lie

Stefan Lie, *Genie Tea Pot* handmade clay model (side view) used by Walden Design to generate the virtual 3D computer model. Photo: Stefan Lie

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Stefan Lie, *Genie Tea Pot*, computer-generated render in white. Image: Walden Design Pty Ltd

Stefan Lie, *Genie Tea Pot*, rapid prototyped parts (final). Photo: Stefan Lie

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Stefan Lie, *Genie Tea Pot* rapid prototyped parts as they came out of the rapid prototyping machine. Photo: Stefan Lie

Even with the use of rapid prototyping technology the entire prototyping process can still be a relatively slow affair. Another Sydney designer, Stefan Lie, produced his first version of the *Genie Tea Pot* in 2005 using fused deposition modelling, a three-dimensional printing process (the teapot was also produced as an entry in the Bombay Sapphire Design Discovery Award). He initially made four actual-size models from modelling clay to resolve the fluid form. The final version was then copied by a 3-D computer modelling expert to create a virtual model. The virtual model provided an opportunity to refine certain design details such as the lid shape and the wall thickness. Because of the scale limitations with the 3-D printing process, the prototype had to be produced in two halves and glued together. The model was then sanded and sprayed to look as though it was made from ceramic. By this stage the prototype had cost more than $2,500 and had taken many weeks of time-consuming work.

As with Goodrum's chair, the *Genie Tea Pot* prototype photographed well, was widely published and could be shown to prospective manufacturers. In early 2007 the team at Workshopped in Sydney agreed to facilitate the manufacturing, and the final product should be available in Australia toward the end of this year. Interestingly, Lie used the rapid prototyping technology to create an oversized original for making moulds that allowed for the shrinkage of clay in the drying and firing process. Actual-size ceramic prototypes have since been produced, and are currently being refined to ensure the spout pours evenly without dripping.

A growing number of artists and designers are utilising rapid prototyping technology to create one-off and limited-run pieces. Here, the prototype is becoming the finished product itself, ironically echoing the artisanal history that the technology has to some extent replaced. A great example of this can be found locally in the work of Gilbert Riedelbauch, who teaches in the Computer Art Studio at the Canberra School of Art. Riedelbauch's recent work, *Pod lamp 2 red*, is a functional reading light that suggests an organic string of pods housing 30 low-energy LED lights.[2] The major formal elements have been produced from ABS plastic in a rapid prototyping machine. During the virtual modelling of the components, the specific requirements for housing the electronics and assembling these components needed to be taken into account. Through this process, the produced parts are instantly ready for assembly. No tooling is required, there is almost zero waste material and the ABS plastic can be recycled. The final production stage is indeed rapid, but the initial modelling is the outcome of the craftsman's meticulous labour.

Rapid prototyping has undoubtedly brought a great deal of speed and efficiency into the design industry but it should still be understood as a fast tool in a slow process. However, as the technology becomes more and more accessible, it does open the door to the possibility of the digital distribution of actual things: a near and very real future where we will be able to download and 'print' a new watchband or coffee cup with the same ease that a song can currently be purchased on iTunes.

www.cappellini.it
www.stefan-lie.com
www.workshopped.com.au
www.craftact.org.au

Stefan Lie, *Genie Tea Pot* finished prototype (back right view). Photo: Stefan Lie

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***Brian Parkes** is Associate Director and Senior Curator at Object: Australian Centre for Craft and Design, Sydney. Since January 2008 he has also been an Adjunct Curator for the Museum of Arts and Design, New York.*

NOTES

1. This annual exhibition has been presented by Object Gallery since 2006. This year's *Bombay Sapphire Design Discovery Award Exhibition* will open at Object Gallery, Sydney, on 6 September and run until 2 November 2008.
2. Gilbert Riedelbauch's exhibition *Highlights*, featuring a series of works produced through rapid prototype technology, will be shown at Craft ACT in Canberra from 6 February to 14 March 2009.