



Feature ● From idea to object

Igor © Designed and modelled by Cedric Seaut

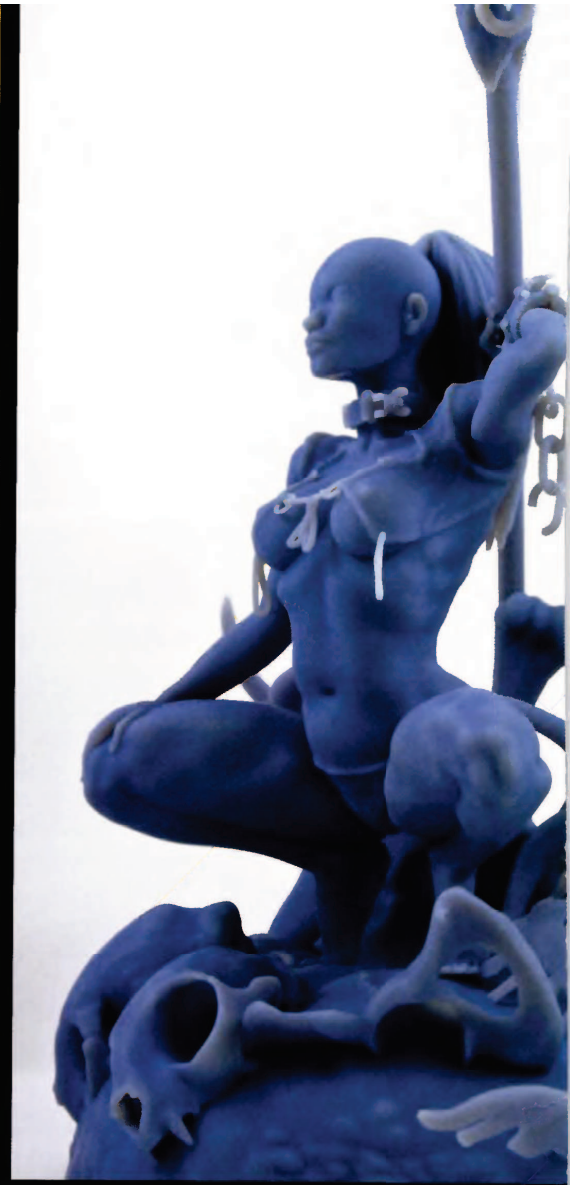


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The Call © Designed and modelled by Cedric Seaut

46 ● 3DArtist



Custaway © Designed and modelled by Pascal Blanche



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FROM IDEA TO OBJECT

3D printing truly is the stuff of science fiction. But the idea that you could design a physical object on your computer – a vinyl figure, a bracelet, a sculpture – and then print it out as easily as you print off a map or a letter is not that far away from being possible. In fact, it actually is possible, and the only reason every home doesn't have one is that 3D printers are still incredibly expensive. But using them is coming down in price, and a flurry of companies have sprung up to capitalise on this. Quite simply, you send them your design, and then they send you back your model.

And for digital artists, this is good news indeed. Andrew Hickinbottom (<http://andyh.cgsociety.org/gallery>) has been collecting vinyl toys for years: "I have always admired the artistry and craftsmanship of them, and have been interested in how they were produced. 3D prototyping/printing seems to be getting more and more common, and I kept seeing some great examples out there, so I figured I should get one of my characters done."

But of course, art isn't the only reason to get excited about 3D printing. It has tremendous potential for inventors who can whip up their own prototypes or doctors who can speedily produce parts to help them practise operations. "We started with designers, scale modellers, architects, 3D artists, gamers," explains Clément Moreau, CEO of 3D printing firm Sculpteo (www.sculpteo.com), "but now we are receiving demands from a growing variety of businesses: we have more and more demands from communication and advertisement companies, industrial companies, sport clubs" and much more.

It's the range of materials and therefore objects that can be printed that is driving the explosion in 3D printing. Peter Weijmarshausen of Shapeways (www.shapeways.com) says that "almost anything is possible when 3D printing. People are using Shapeways to print custom parts for their hobby (remote-controlled cars/planes, model trains, puzzles, miniatures and so on), jewellery, home décor, design and mathematical art objects, and gadgets." He continues, "Hobby items are the most popular, closely followed by bespoke jewellery" and says that Shapeways has even printed the parts to a fully-working helicopter. Sculpteo has similarly "seen a growing demand for really customised items (like figures). We also have a lot of professionals or hobbyists doing prototypes or series of their new (or tailor-made) devices," reveals Moreau.

Otherwise known as rapid prototyping, 3D printing is increasingly becoming an affordable option. And – as Poz Watson finds out – as the technology has improved, so too has its possibilities for the digital artist



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Printing out Trixie

Her eyelashes and hair were originally single-sided polygons, so Andrew increased their thickness before submitting the design

Creator **Andrew Hickinbottom** explains the changes he made before printing



Trixie was wearing hoop earrings in the original design, which Andrew judged to be too small and removed. Once he saw the print quality, it was a decision he regretted

Andrew embossed the dark parts of Trixie's eyes so that they could be seen clearly, and made sure the topology was made up of quads

Andrew also decided that Trixie's devil tail would be too easy to snap off, so he removed it altogether

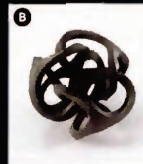
This 6.7-inch figure would have been taller, but Andrew decided Trixie's legs and ankles were too thin for a full-bodied figure, so he created a base to balance the figure



“Our processes are able to create any object based on the 3D file,” continues Moreau. “The object can have a mechanical working movement, you can enclose objects inside one another, and build a lot of things that are not possible to build by any other techniques.” Moreau co-founded Sculpteo in 2009 because he realised that not only was 3D printing capable of creating real, functional objects, but also “people have a real interest in customising their own environment, and 3D printing is a very efficient technology to create unique pieces that really fit with your needs.”

But how does 3D printing actually work? Well, there are essentially three different ways to create solids. Firstly, you can cut a shape out of a mass of a certain material. Secondly, you can pour a liquid version of a material into a mould and then let it set. And thirdly, you can add a material bit by bit until you have the shape you desire. This third technique was largely ignored until the invention of 3D printing, which creates an object millimetre layer by millimetre layer, so that any shape can be built. There are various 3D printing techniques – including selective laser sintering and fused deposition modelling – and there is even an open source project, called RepRap, under way that would build a 3D printer that would be able to create all the parts needed to make up a 3D printer! If RepRap is successful, then the technology would be available for all. Then, home users would be able to whip up photo-decorated mugs as simply as they now print a photo, or create a part for a child's toy when it goes missing or breaks. But, in the meantime, there's no need to think about the ins and outs of the technology, as it's the affordability and accessibility of the web-based companies that are getting people excited.

Akin Bilgic (www.cggallery.com) first came across 3D printing at SIGGRAPH in 2008. He explains: “Offload Studios, a 3D printing company from Vancouver, had a few of the prints they



A Sculpteo creates a model football out of sandstone using the Z Corp ZPrinter 650

B This design by Rothsheba was created out of Shapeways' Grey Robust material

C High-gloss white glass is one of the most recent materials Shapeways has added to its list



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PREPPING TO PRINT

- Make sure you know what files your chosen company will accept. You should be able to export this straight out of your 3D software, but if not then use a conversion program like AccuTrans 3D
- Design all-round views of your object - not just the front and back
- Think carefully about thickness. Different companies will have different standards, but 0.2mm is probably the smallest detail guaranteed to be visible. Also, don't join big bits with thinner elements, because your model will probably snap!
- Consider a range of materials. Again different companies offer different substances and finishes, so do your homework before you order
- Make sure your model is watertight, with no holes, breaks in polygons or uncapped ends. All the obvious geometry mistakes must be fixed
- Don't use single-sided polygons; everything has to have a thickness
- A closed shape will be treated as a solid object, which is expensive. To save money, you could make a hole in the bottom of the model and then give the objects an interior thickness
- Most 3D printing sites give you a preview of your model, so check it carefully before you approve it!

“Our processes are able to create any object based on the 3D file”

had done on display with Pixologic, the makers of ZBrush. Up until that point I had seen 3D printing was an emerging technology that might prove useful in the distant future, but this was the first time I had ever seen it done so well that I felt it was a viable solution for the average 3D artist to take advantage of.” Bilgic kept in touch with Offload Studios (www.offloadstudios.com) and eventually they decided to go ahead with some collaborative work.

“The process was incredibly easy,” says Bilgic, “since Offload took care of most of the grunt work for me. I just handed them my source files and they did the rest. This was before ZBrush had the 3D Print Exporter plug-in that could have made the process a little easier for the studio, and allowed me to help out more in the process of creating the prints. The team also helped me with a few of the parts that weren't the easiest for them to print, like thin ropes and shoelaces, which I manually thickened up a bit.”

If you've got work you'd like to be able to hold in your hand, then start browsing the internet for sites that suit your pocket and needs. At Sculpteo, Moreau explains that “price depends on the volume of the piece you would like to get printed, as well as on the material you would like to use. The typical orders we receive go from £15-150.” He adds that they currently offer “a discount of 5% for five samples of the same figures, and up to 20% for more than 50 samples.”

Shapeways does not do bulk discounts, but Weijmarshausen explains that its “pricing is currently based upon the actual amount of material used in the product and the material chosen. This price is not based on the volume of the bounding box it is

printed in, but is determined on the volume of the finished product. Each 3D printing material is priced according to cubic centimetres. For example, White Strong & Flexible is \$1.50 (plus \$1.50 set-up costs per model), Grey Robust is \$2.50, Stainless Steel is \$10, and so on.”

Hickinbottom chose Shapeways when he wanted to print his Trixie model. He says: “Obviously, the bigger you print it, the more it will cost, and if you make it hollow, it works out much cheaper. There are many different types of plastics (and even metal and glass) that you can choose for printing, but I settled on the company's most popular - White Strong & Flexible material - due to its strength and finish. Printing my Trixie figure (plain white/unpainted) at 6.7 inches high, cost just over £200 including postage from the Netherlands.” And small is generally the way orders go, with Moreau noting that at Sculpteo the range they print between is 5mm to 30cm.

● Akin Bilgic's *The Sky Fishermen* model demonstrates the incredible amount of detail that is available to those looking to 3D print their work





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“It’s been amazing to see how fast the industry has grown. From what I understand, the newest printers print the material in such thin layers that they aren’t even visible to the naked eye”

As well as improvements in the hardware side of things, of course 3D software is getting in on the act, and the most recent version of ZBrush is particularly attuned to the needs of the 3D printer. Some of the most useful new features in ZBrush 4 are the new Clip brushes and the ShadowBox. Paul Gaboury from Pixologic (www.pixologic.com), says that the latter gives “the artist a new tool to draw out geometry by masking on three planes. This tool has given ZBrush users new ways to create complex geometry in minutes.” There’s also the Decimation Master, which will allow “any ZBrush user to take an extremely high-million polygon model down to just a few thousand polygons without losing any detail. This new amazing plug-in allowed the rapid prototyping companies to just be an artist again and not have to worry about the polygon count their sculpt could not exceed in order to be printed out.” Of course, even with this sort of software assistance, taking your design into the real world inevitably means that – if you have fudged anything – it’s immediately going to be shown up. Fortunately, Hickinbottom was “over the moon” when he saw his model: “It was so great seeing a virtual model made real for the first time – great definition, weight and quality. The surface was a bit rough, and you can see some stepping where the layers were sintered, but that was to be expected. There are many tutorials on the site explaining what to do if you want to take it a step further and smooth it down or paint it. I followed the painting tips on the company’s website, and it came out brilliantly when given a lick of paint.” And quality is getting better and better. Bilgic adds, “It’s been amazing to see how fast the industry has grown. From what I understand, the newest printers print the material in such thin layers that they aren’t even visible to the naked eye any more – and things like feathers and hair are a real possibility now.”

And as anything becomes (more) possible, 3D printing becomes a real option for genuine creativity. Jewellery is one of the most popular areas, as are vinyl toys and even furniture. And in the world of sculpture, it’s allowing avant-garde artists to push the boundaries in terms of the materials used, with Dutch designers Studio Wieke Somers (www.wiekisomers.com) actually using human ashes to create its 3D-printed sculptures.

Back in the world of plastic, Bilgic continues, “Lines and shapes I’d sculpted in the virtual world can all of a sudden be physically touched and felt. It’s a very rewarding experience.” And your options are growing all the time, with Moreau noting, “Real metal (even gold or silver) 3D printing is already popping up, and should be democratised in the next few years.” But to be satisfied with what you create, you have to work within the limits that do still exist. They differ from company to company, but Moreau says, “Of

course we have to respect some constraints for the finished part, like minimum wall thickness (down to 1mm in white plastic) to ensure some solidity. Anyway, our website software is able to tell the customer if the 3D file is correct (ie defines a physical part), fix it if it does not, and check if the object will be strong enough.” When it comes to submitting your model, Moreau’s advice is simple: “Think object! You are going to design something that you want to hold in your hand.”

“It’s a huge market waiting to be tapped into,” says Bilgic. “I’ve been looking into starting my own toy line, or selling limited-edition 3D prints of my work as art pieces. It’s really up to the artist to find new uses for this amazing tech.” Hickinbottom too is interested in producing his models on a larger scale, and has been “looking into manufacturing companies like Ownage and Atomic Monkey. They cast in plastic, with really smooth, detailed results. They can also paint figures to specifications and mass-produce them – even creating packaging. I’m still looking at quotes, but it’s definitely something I’d love to do. It’s a big investment, but even if it doesn’t pay off financially, it would be so satisfying to see these Trixie figures on people’s desks!”

And you don’t have to go to the extreme of creating your own line of products in the traditional way. Shapeways has a community site that allows visitors to order their own copies of your designs. Weijmarhausen says, “We see new ideas and designs every day. For instance, when Apple’s iPad came out on a Friday, we saw iPad covers in our Shapeways shops for sale as early as the following Monday.”

Ultimately, 3D printing is still in its infancy. Bilgic predicts that “considering all the possibilities it can be used for – from art to manufacturing – it’s clear that the future is bright for the 3D printing industry, and perhaps even brighter for the 3D artists behind the printers.”



3 Moving parts are possible these days as shown by this Sculpteo robot.

4 3D printing requires a number of different stages; this is how white plastic models can be created with the EOS Formiga P100 at Sculpteo.

5 Shapeways now offers a service where children’s drawings can be printed onto models.

6 This napkin ring is part of the Shapeways creator range, which enables users to customise designs on the site.

7 Pctunia, by Dolf Veenvliet, was one of the first models made at Shapeways.



THE EVOLUTION OF 3D PRINTING

■ **1977** – Patent is granted to Wyn Kelly Swainson. The first incarnation of 3D printing saw a laser shone through liquid monomer to solidify it

■ **1984** – The birth of a more practical technique – called stereolithography – saw Charles Hull set up 3D Systems

■ **1993** – MIT patented another technique, based on inkjet technology

■ **2004** – Adrian Bowyer started what would become the open source RepRap project – basically a system in which a 3D printer could create the parts to make another 3D printer

■ **2005** – The first high-definition colour 3D printer (the Spectrum Z510) was launched by Z Corp

■ **2006** – Ceramic was added to the list of possible materials, as a technique to combine powdered clay and binders was invented

■ **2008** – The first version of RepRap, which could manufacture 50 per cent of its own parts, was brought out. The second version is still in development



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MAKING ANIMATION EASIER



An academic perspective

Eileen Reynolds, an assistant professor at the School of Art, Design and Media at Nanyang Technological University (www.adm.ntu.edu.sg), is experimenting with 3D printing as a way to create models to use in her stop-motion animation work. She explains: "Normally, at our school, the 3D printer is used for our product design area. They do rapid prototyping. Since there has been more interest in stop-motion animation, there is also more interest in short cuts when it comes to sculpting or animating various sequences."

Reynolds is currently in the planning stages of a project entitled Big Bio, which she describes as being "an experimental film using clay, pixilation and sand animation based on some of the popular Frankensteinian themes of 'creation and creator' and 'defying the laws of nature', where we see scenes of morphing from organic into synthetic." Her subject matter suits her intended methodology, and she enjoys mixing techniques because she "believes in the tactility of the image." Her work is exposing 3D printing to her students, which "allows them to expand their ideas and it seems to make them more courageous about mixing various animation methods together. Depending on what they need to animate, it helps them to know there are alternative ways of creating something."

