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the shape of things to come

digital production takes off

the shape of things to come

Using digital production, designers are creating brave new objects that could never have been conceived or executed by any other method

By Kenneth Hayes

The recent arrival on the market of furniture, light fixtures and accessories made entirely by rapid prototyping techniques is something of an event in the history of contemporary design. Of course, designing and manufacturing with the aid of computers isn't new, but digital design is quickly creating a brave new world of hyper-organic shapes. Rapid prototyping technologies enable the translation of digital models directly into three-dimensional objects, expanding the potential to generate complex forms. Expensive prototypes or tools are not needed to produce these objects. This breakthrough isn't merely technical or formal. The real significance of these items is that they could not have been conceived or executed by any other method.

The mind-bendingly curved lampshades by Belgium-based Materialise completely defy the limits of moulding. Many of the nested vases and seamless fixtures presented in In Dust We Trust, an exhibition

Patrick Jouin's Solid S1 stool (shown in close-up at left) is produced by stereolithography, in which layer upon layer of a photosensitive polymer is solidified using laser.

PHOTO BY THOMAS DUVAL

curated by Italian rapid prototyping lab OneOff at Milan's Salone del Mobile last year, can't be reproduced either by casting or by carving. And the elements of French designer Patrick Jouin's Solid chairs interlock in a way that even the most skilled human hand can't manage.

Ron Arad, who first worked with Materialise in 2000, has declared the technology to be an entirely new method of making things – with rapid prototyping, one can now "grow" forms. Patrick Jouin is no less enthusiastic. He describes the limitless possibilities as paving the way for a new era in industrial aesthetics, advancing a general tendency toward immediate materialization, in which design and production merge. That brings to mind the old sci-fi fantasy that one day we might simply push a button in our homes and the objects of our desire will instantaneously materialize before us. Indeed, Arad claims that there will come a time when a plumber will download parts rather than buy them at a hardware store.

Those scenarios are yet to come, but the results right now are startling and slightly eerie. Jouin's Solid C2 chair may be one of the largest works realized by these means, yet it evokes nothing more substantial than interlocking blades of grass. Its quality of being more like an object in the mind than a thing in the world is shared by many of these new products. They approach the strange state of being purely mental emanations. Disembodied, literally untouched by human hands in their making, they are like phantasms materialized out of some ether or ectoplasm. Looking at them in a photograph, it's sometimes difficult to know if they're two- or three-dimensional. This new generation of objects make convincing candidates for the post-modern idea of the simulacrum, the hypothetical copy without an original. While these objects are entirely reproducible, they are in no sense prototypes for some other mode or method of production. Simply by being no more than what they are, they are bringing the era of the prototype to an end.

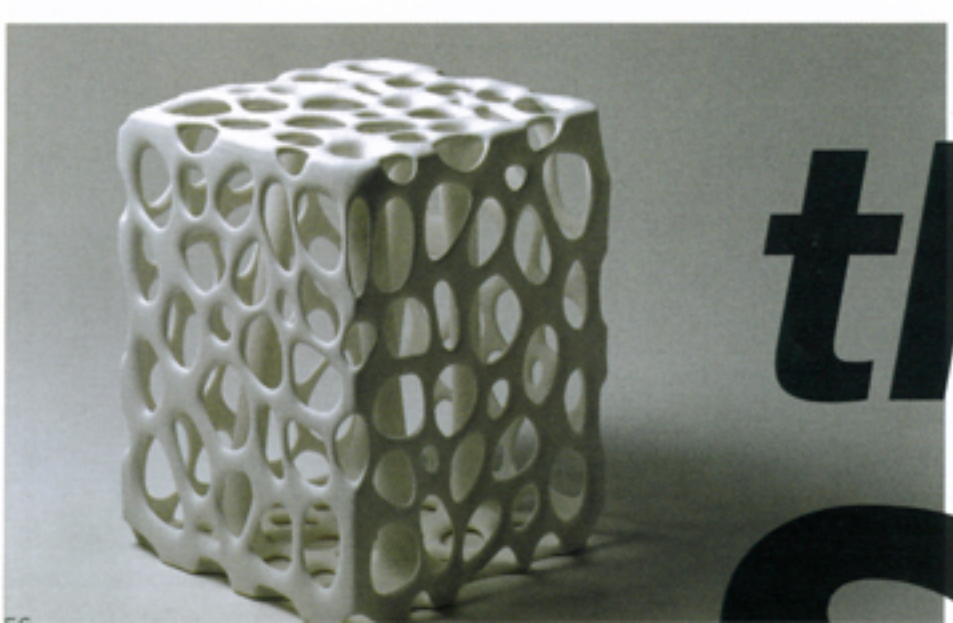
In the age of mechanical reproduction, patterns, models, jigs, and moulds retained the aura of a prior age, one in which objects were scarce, jealously guarded, and carefully preserved. These prototypes were made like sculpture, by means removed in principle as far as possible from those used in mass production. They were invested with authority not only because they governed the form of subsequent production, but also because they imbued the copies made from them with a residue of the very humanist values that industry was rapidly dismantling. Prototypes guided mass production with the phantom hand of an original maker. Digital fabrication makes a definitive break with this tradition. It eradicates all intermediaries, and with them the last remnant of the guilds that once protected the skills and prerogatives of craft workers.

Digital design is primarily driven by the difficulty that complex or double-curved surfaces traditionally present to all modelling, parametric control and accurate reproduction. The digital procedure is essentially that of infinitesimal calculus. Irregular, three-dimensional bodies are reduced to a series of extremely thin two-dimensional slices in order to make them calculable. The number of slices determines how closely curves can be approximated. A relatively small number produces a raster effect (similar to a blurred two-dimensional image); an infinite number of slices – a purely theoretical limit – would produce true complex curves. Guillaume Delvigne used this conspicuous gradation to produce a witty technological *trompe-l'oeil* in one of his projects exhibited in In Dust We Trust. He designed a set of three curved lampshades from a single computer model rendered in 72, 144 and 300 dpi resolutions. These grades refer to the resolution of the digital rendering, not that of the production. Each lamp actually takes the same time to fabricate, despite its apparent degree of digital texture.

The general method of digital design explains its affinity with complex curves, but not the historical accident by which the entire range of digital fabrication came to be known as rapid prototyping. Some 30 years ago, fabrication of models from digital data began to move from the shipbuilding and military and civil aviation industries through university research units into professional design practice. But these systems were so costly and their operation required such expertise in programming that they could be used only by advanced engineering offices, some very large architectural firms and designers working in the automotive industry. Early machines were restricted to making prototypes of forms that were

Jouin's Solid C2 chair (above) evokes interlocking blades of grass.

The S1 stool (below), also by Jouin, is made of a resin polymer.



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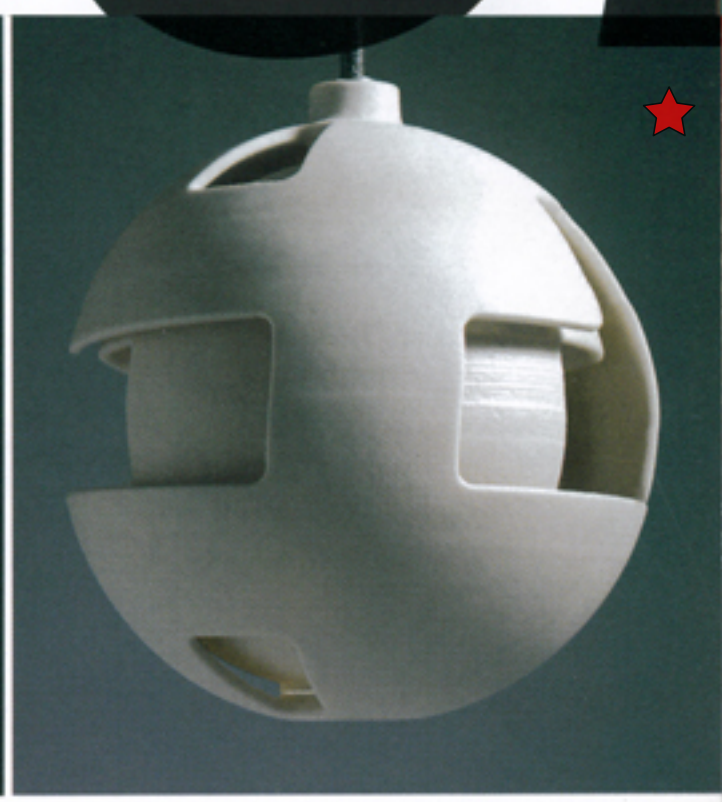
extremely difficult or even impossible to model by conventional means. The term rapid prototyping reveals more about the impression these techniques made on early users than it does about the production process itself.

Fabrication from digital models by subtractive techniques – cutting, turning, grinding or milling – has been around since the '70s, when computer numerical controlled (CNC) multi-axis milling was used to carve replacement parts for the restoration of Antoni Gaudí's famous Sagrada Familia cathedral in Barcelona. CNC tools, from laser cutters to band saws, have already penetrated many workplaces and changed how things are made, although often without any corresponding change in form.

Digital additive fabrication, on the other hand, is a bigger challenge, both technically and conceptually. It makes three-dimensional objects by stacking and laminating many individual layers, which can be done in a variety of ways. Patrick Jouin used stereolithography to create his Solid collection. The procedure (which was created in 1986 and entered the commercial market two years later) uses a computer-guided laser beam to solidify thin layers of a photosensitive liquid polymer. As each scanned layer is solidified, it is lowered into the polymer bath so that a second layer can be traced across the surface. This action is repeated until the final product is achieved. Afterward, the object can be finished by



Guillaume Delvigne's 72dpi_144dpi_300dpi lamps (above left) are representations of a single item in different resolutions.

The Stratum lamp shade (above right), by Tomas Ortiz Ferrer and María Elena Martínez Fayo, is a sphere within a sphere.

PHOTOS BY IL VIO GALLO

sandblasting or painting. Other systems use lasers to sinter (coalesce powder to solid through heat) successive layers of metal or ceramic powders. While these powders are more durable than the liquid resins, laser sintering tends to cost more and is not suitable for large pieces. In a technique called 3-D printing or plotting, a liquid binding agent is sprayed onto a layer of powder. The powder sticks wherever the binder is sprayed. Today, almost any powdery material can be used. For a sustainable approach, objects can even be made with cornstarch. Medical researchers have even used rapid prototyping to build up layers of cultured cells to make replacement tissue for burn victims, "print" plastic bone grafts and create custom-fitted prosthetics.

Tremendous advances in computers have placed us at the verge of the general dissemination of these techniques. Instruction in rapid prototyping is standard in design and architecture schools, and digitally fabricated buildings and objects have caught the imagination of designers and the public alike. Now that this technology has arrived at the point of producing consumer objects, perhaps the question is, why was it not adopted sooner?

The simple reason is that rapid is a relative term. Despite all technical advances, it takes almost 40 hours to produce a single copy of some of the items designed for the In Dust We Trust show. Even the

Designed by Arik Levy, the organic shape of Black Honey.mgx (below) was manufactured by Materialise.

The nylon Cocoon.mgx lamp shade (bottom), designed by Assa Ashuach, was produced in one piece by Materialise.

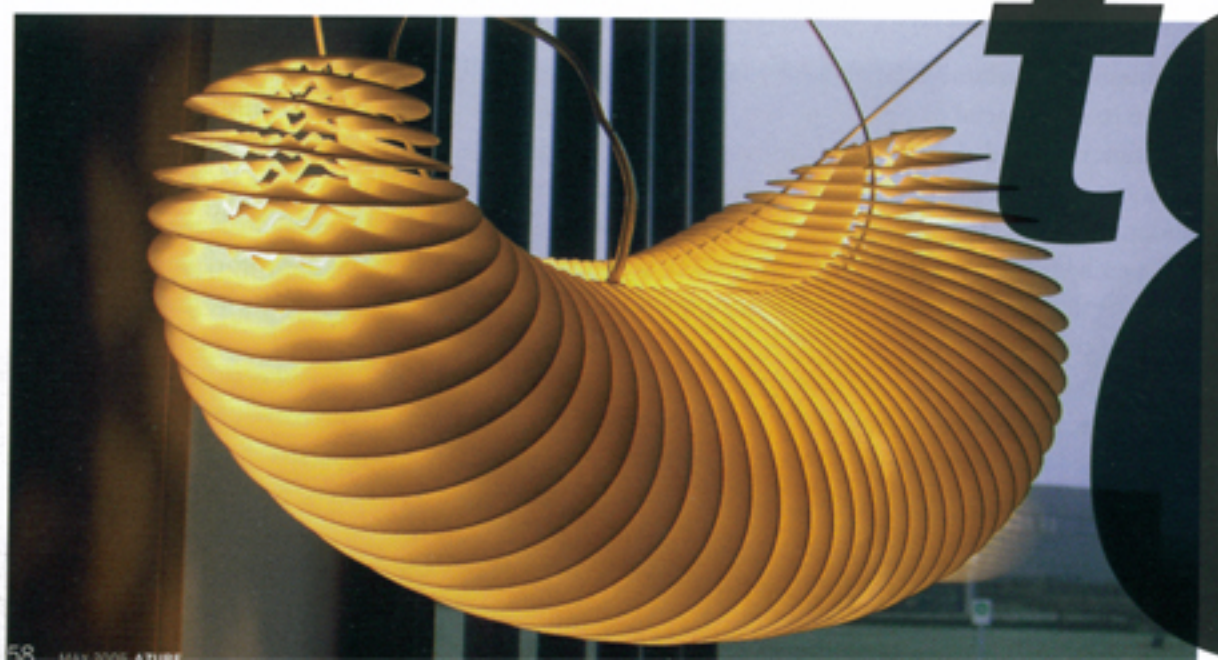
smallest items in the collection take no less than seven hours to fabricate. This technique is obviously not about to replace such standard industrial methods as injection moulding, which can make plastic chairs in mere tenths of a second. What is fast in making a prototype is unimaginably slow as production.

For now, manufacturing time will restrict digital additive fabrication to the making of patterns for unique components to be cast, in which case it readily competes with the cost of a skilled die-maker or machinist. Many of the items now for sale are likely subsidized in one way or another: they may have been developed and promoted as part of university research and design instruction, or they may be the experimental spin-off of a prototyping practice that has more substantial industrial applications. In Dust We Trust was essentially a workshop aimed to give designers and students access to future technology. (Model Ideas, another OneOff show about rapid prototyping, was exhibited in Milan in April). Materialise produces goods using the over-capacity of a medical prototyping company. For the time being, these objects are sold at a premium as novelties, but eventually they will lead the market to make this method more competitive.

Other reasons for this delayed reception are more esoteric, but no less real. Assimilating this production method requires that we abandon some deeply cherished ideas about things, not least of which is the modernist notion of truth to materials and techniques. If, for example, subtractive fabrication is a development of carving and additive fabrication a development of moulding, then rapid prototyping as a whole points to the general convergence of these historically distinct techniques. Increasingly, it does not matter if a shape is made by one means or another. Digital production not only eliminates all manual skill; it also denies all previous procedural and material specificities.

At its most radical, digital additive fabrication has far-reaching consequences for the status of the designer. While industrial mass production concentrated control of design in the hands of a few, digital additive fabrication means mass customization could extend the role of designer to many. The ultimate importance may be that it promotes the amateurization of design. Already designers need only gain access to the system for the duration of a single job, which eliminates all the constraints and safeguards placed on production by the cost of tooling. More consequentially, the method does not require its user to cultivate a feeling for form through long devotion to a particular and specific technique. Quite the opposite – the immediacy of results promotes a radical de-skilling. Perhaps this is consistent with our impatient times, but it could also exacerbate the feeling that things have grown trivial.

Ron Arad's sci-fi scenario may be well on its way to realization. The results, however, may not be the ones desired, as the work of German artist Karin Sanders suggests. Her art practice consists of bringing both three-dimensional digital scanning and digital additive fabrication into gallery spaces. She invites viewers to be modelled in miniature and placed on display. These works, which Sanders pointedly calls self-portraits, embody the technology's total logic, making it universally accessible and ultimately responsive to individual desires. In just a few hours, people with no experience whatsoever in sculpture can make painstakingly accurate representations of themselves. But in this brave new world, it has become strangely difficult to say that people made them.



PHOTOS COURTESY MATERIALISE