Rapid Manufacturing (edit for Innovation magazine)

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[Please note. This text is based upon the GH article in the MADE/RCA Rapid Manufacturing booklet. In order to make it work as a stand-alone, I have added some background on rapid manufacturing and the genesis of RM. Then in order to achieve the reduced word count, I have removed the discussion on biomimetics.]

Design unconstrained

Before machines, making things — hairpin or temple — was a struggle: man versus material and process. Men and women toiled with blades, cudgels, spikes, fingers and thumbs to tame brutish and reluctant materials into useful shapes and structures. We developed and repeated the designs that worked best and could be accurately and efficiently made. Initially we chipped or carved away at stone or wood; later we could form a mouldable material like clay or molten metal, or twist, knot or weave stalks and leaves or fibres like flax and wool. Much later, with printing, we could transfer liquid pigment onto cloth or paper, to make marks. This was the basic vocabulary of manufacture, from the first ever tools dating from 2.5 million years ago, through the dawn of the Machine Age circa 1760 right up until a few years ago. Carving begat machining, forming led eventually to injection moulding, and printing gave us the basis for micro-circuitry, but to this day we mostly make things in these same basic ways.

Teach them what they can't do

Struggle is still a good word to describe the relationship between design intent and manufacture. Every combination of material and process has its own strict design rules: in plastic moulding, terms like *undercut, draft angle, split line, sink mark, wall thickness* and *line of draw* reverberate through the design offices of industry and the sore heads of newly qualified product designers, who must learn not so much what you *can* do, as what you *can't*. It's tough, and just as the forces of environment and competition shape the products of nature – trees, tigers, viruses – so the constraints of material and manufacture encourage economy and elegance in human designs. In a 1972 interview,

when asked if constraints were good for design, the celebrated designer Charles Eames replied: “Design depends largely on constraints”. So struggle is good, then – it makes for healthy and handsome products.
Thousands of years of human experience demonstrate that making things is difficult. And in the modern age, because manufacturing needs tooling, it’s also expensive and inflexible. These appear to be universal truths.

A new kind of manufacturing

But even universal truths are vulnerable to scientific and technological challenge. Thus rapid manufacturing (RM) has arrived with the message that no, making things can be easy, inexpensive and eerily free of the kinds of constraints we’ve got used to. RM is the logical extension of rapid prototyping (RP), a collection of processes that build parts particle at a time, grain by grain, rather than by carving or forming in the old ways. RP dates only from 1986 but it has developed quickly and, though it was intended originally for prototyping, it is now being applied to the manufacture of parts for end-use by consumers — so RP becomes RM.
Rapid manufacturing requires no tooling, so there’s no long wait while tools are carefully machine and adjusted, and huge cheques are written for their purchase. Far from it, with RM you approve the final prototype on Wednesday and start production on Thursday. And consumers can influence the product they’ve ordered if we let them, only the data need be changed, so mass customisation — a dream for decades — becomes real at last.

The death of constraints?

With RM we enter a future of production without tooling, of mass-customisation and shapes and structures we simply couldn’t have made the old ways. This extreme design freedom is wonderful in theory but in practice somewhat problematic. Dr Richard Hague, head of the Rapid Manufacturing Research Group at Loughborough University told me: “We gave up trying to write design rules for RM. The truth is, you can make just about whatever you want”. Rules and constraints are pretty synonymous, so what happens to Charles Eames’s assertion about design *depending* upon constraints?

For designers and for humanity at large, this is virgin territory. For two and a half million years design and manufacture have been constrained by the physical limitations of manufacturing processes. RM removes these constraints in a clean break with all of history.

Opportunity and caution

RM represents a daunting challenge for product design, which will need rethinking if future designers are to function successfully in such an unconstrained creative environment. Perhaps these designers will be working – one could better say collaborating – with automated design tools that mimic Nature's process of evolution, generating new ideas and refining them to economic perfection. Design education must be at the forefront, anticipating and driving change as we adapt to an RM world.

It is very possible that the arrival of RM creates the hinge point for a second industrial revolution. If all the age-old principles of manufacture are superseded by a completely new paradigm, surely this must be so. RM is disruptive; it changes everything. Its unfolding influences on global economic and social patterns are hard to anticipate, but they will be profound.

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