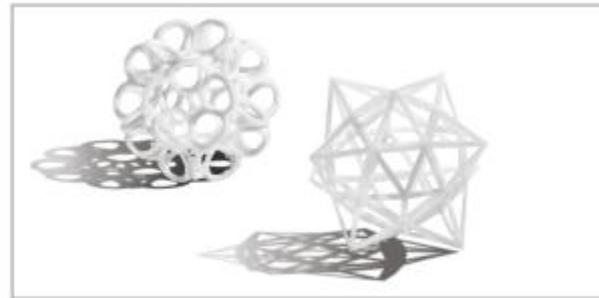


8 Reasons Why Product Development Will Never Be the Same Again

- And 5 Ways 3D Printing is Responding



Based on a presentation by Dr. Phil Reeves from Econolyst, at the
Objet Press Event, EuroMold 2011

March 2012, Objet Ltd.

Changes Influencing the Use of 3D Printing

There are a number of important changes taking place today that, when considered cumulatively, are effecting and will increasingly effect how we design and develop products.

This white paper aims to categorize the different global trends that are channeling our economies and societies towards the mainstream use of 3D printing and then to show how 3D printing is responding in turn to those changes.

Despite its multiple aliases, the technique variously known as 3D printing, rapid prototyping and additive manufacturing is not a particularly new one. The process of creating a solid object by laying down successive layers of material has been in use for twenty years. In that time it has remained largely immune to mainstream media forces, heard of by just a handful and only properly understood by a tiny fraction; those involved directly with product design on an industrial scale.

However, in the last two to three years the industry has begun to gain widespread exposure at a dizzying pace. Below we've identified 8 trends that are now causing the mainstreaming of 3D printing, rapid prototyping and additive manufacturing technologies. These trends can be grouped under the broad headings of; societal, environmental, economic and technological changes.

Societal Changes

The first of these, societal changes, are having a profound impact on the nature of production and the supply of goods around the world.

1. Mass Customization to Mass Personalization

With the prolonged exposure to easily available mass-produced goods available since the 1950's, a certain 'desensitization' of the senses has begun to set in among consumers over the last decade.

Consumers are not always satisfied with an off-the-shelf product. They also increasingly want to be involved in the design and development process in order to get an end product that more closely fulfills all aspects of their demands. The reaction is not just mass produced goods, but also mass customized goods.

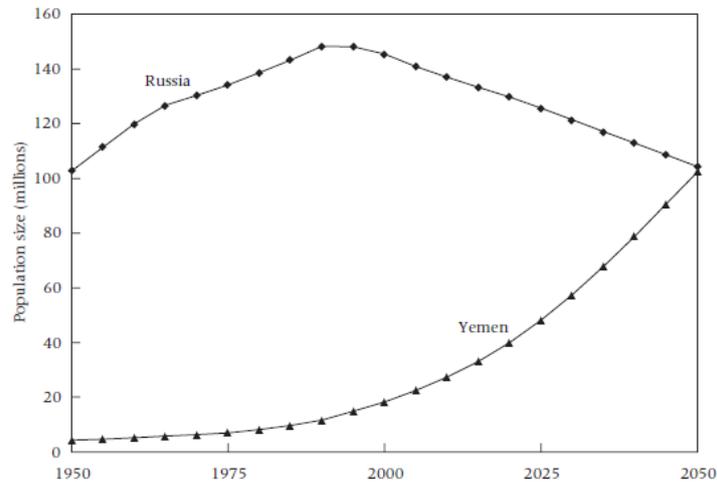
A single automobile model, for instance, is today typically produced in millions of different customizable versions. But mass customization has already been around for quite some time now.

Newer still is the phenomena known as 'mass personalization', which takes customization to the next level by enabling individual products to conform to the exacting requirements of individual consumers.



2. Demographics in Flux

The other big societal change is demographics. Firstly the sheer number of people on the planet is now over 7 billion – representing in itself a huge consumer group. But more significant perhaps is where the growth is taking place – outside of Europe and North



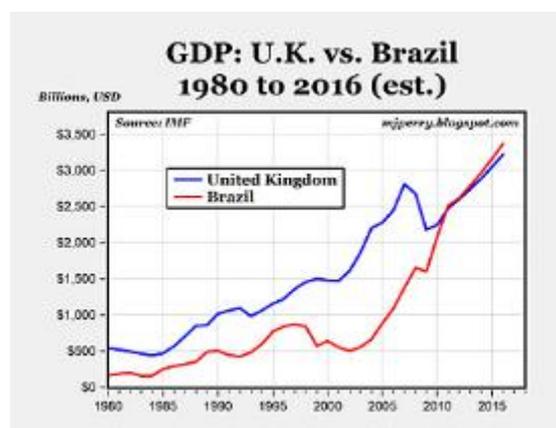
SOURCE: United Nations 2001.

America. Consider what it means for product demand and supply, for example, when a country such as Yemen has the same population as Russia, as it is on line to do by the year 2050.

3. Shifting Centers of Wealth

New centers of wealth are springing up in different parts of the world. Countries outside of Europe and North America such as China and India now have identifiable strata of wealth which manufacturing companies are targeting.

Countries that we never considered as 'consumers' ten years ago are very much so today, enabled by the changing fortunes of wealth. Brazil, for example, is now a wealthier country (in absolute terms) than the UK – the first time ever that a Western European nation has been overtaken by a South American one. As in the case of shifting demographics, this influences how we develop new products and the speed at which we develop them.



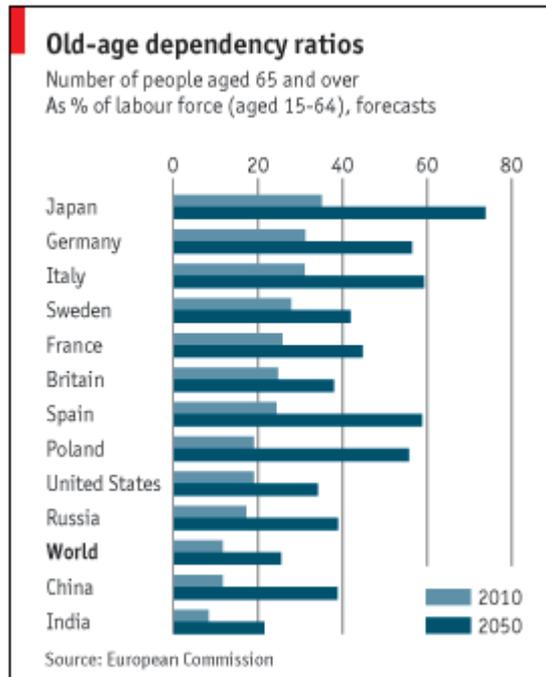
4. Ageing Western Populations

As parts of Europe face very high dependency ratios over the coming years we have to consider how this affects what and how we produce.



The so-called 'dependency' demographic resulting from an ageing Western population has very specific needs in terms of healthcare, mobility, independence and recreation. And they are all consumers – in fact, one of the richest segments in society.

Industry needs to respond to these opportunities and also take them into account when considering the manpower cost of producing future goods.



Environmental Pressures

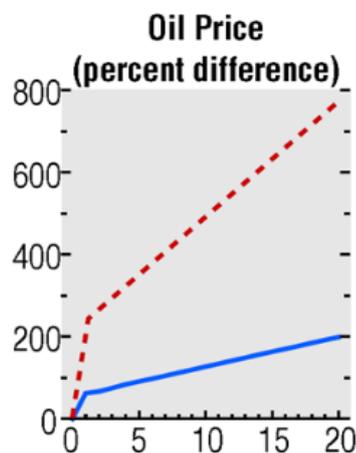
Various environmental pressures are changing how we design and build products. Industries are being pressured by legislation, taxation and government to change the way they work and the way they design and build goods. It is now mandatory in many industries to know (and to reduce) the 'carbon footprint' of the products being made. We need to determine if a product can be recycled, re-used and its end-of-life. All of this affects how we make the product in the first place.

5. Scarcity of Resources

We all take for granted that certain products will always be here. But not all materials will be here forever. And that changes how we think about building and designing products.

For example, IMF economists give serious consideration to a scenario where oil production declines at 3.8% annually.

The most alarming aspect of this scenario is that supply reductions of just 3.8% would lead to an oil price spike of 200% immediately and 800% over 20 years, seriously affecting much of the plastics materials that go into our consumer goods and packaging.



In the graph, blue line is optimistic scenario, red line, peak oil scenario. Source: <http://www.imf.org/external/pubs/ft/weo/2011/01/pdf/c3.pdf>



6. Ethical Consumerism

Consumers are also changing the way they buy products, opting for methods that are less exploitative of scarce resources, fragile ecosystems and cheap labor pools. Product development strategies must increasingly respond to these considerations and adapt.

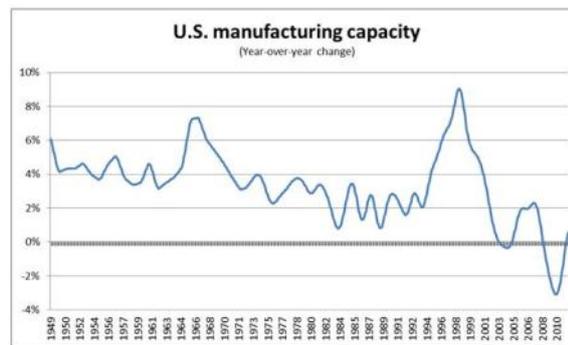
Economic Travails

7. The Economic Slowdown

With the symptoms surfacing in 2008, the economic slowdown across Europe and the US means that today, there is significantly less capital investment available in the market.

Less capital investment translates into less money available for equipment investment and maintenance, which in the US alone, has led to a massive slump in overall productive capacity.

As a result, companies need to mitigate risks in product development; increase certainty that the product is valuable and that people will buy it; and ensure a fast return on investment for those products chosen for market.



Source: <http://money.msn.com/ways-to-invest/5-companies-growing-the-economy-mirhaydari.aspx>

Technology Changes: 'The Internet Age'

At the other end of the equation are the consumers pulling on the manufacturers with more and more expectations. What's driving this? Increased global connectivity and in particular computers in the home which create the ability to engage directly with manufacturers. We also now have a fairly developed culture of online trading where consumers feel at home engaging in the supply chain in order to get what they want.

8. Social Media & Social Networking

The advance of social media and social networking is also having a growing effect on how we make and buy products. It is now common practice to 'crowd surf' to check if a product will be liked before we head into full production.



Once the products are on the shelves, a company can no longer rely on slick marketing alone to maintain sales. If a product doesn't work or perform as it should, the social network will let the world know about it – with potentially fatal consequences for any company or brand that refuses to take sufficient heed of the crowd.

5 Ways 3D Printing is Responding to Global Change

There are 2 general ways in which 3D printing is responding to the forces outlined above. First we see 3D printing enabling consumers to re-position themselves right at the heart of manufacturing. Second, we see more and more companies engaging across the supply chain.

1. Demand for Online Content is Accelerating

As a response to the growing societal demand to be involved in the development process and a growing demand for personalized production, today we find a plethora of very low cost 3D printing machines for the home and for the educational & maker community.

This trend is spurring increasing demand for online 'iStore' repositories and libraries where home makers can download and then 3D print an ever increasing array of products. We will also find in the coming years an increasing number of web shops and online web portals where consumers can become co-creators by engaging directly with their own product designs.

The development of home based 3D printing and online data allows consumers to become in effect, mini-factories, thus compressing the supply chain from the CAD terminal straight to the consumer.

2. Manufacturing is Shifting Back to the Consumer

Until quite late into the industrial revolution people still learned a trade and made products with their own hands. The process was slow, inefficient and relatively unaffordable for the vast majority of people. The industrial revolution brought factories and mass production machines into play to standardize goods and ensure a cheap supply of products to meet the burgeoning demand of European citizens.

Today, now that mass produced goods are largely attainable, we see a rebounding trend back to more individually-designed goods. This trend is a

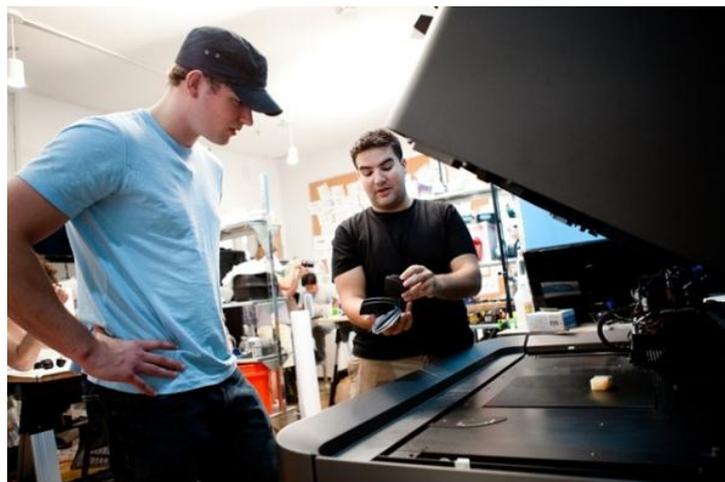


result of the ‘squeeze’ from both the societal move to mass customization and personalization on the one side; and the economic times we now find ourselves in, where the high capital investment required for mass production is prohibitively expensive for many entrepreneurs to set up on their own.

One positive response being enabled by 3D printing is the ‘Quirky’ business model – named for the New York-based firm founded by entrepreneur Ben Kaufman. Quirky’s business model is based on the principle that traditional manufacturing is becoming increasingly above and beyond the reach of everyday designers and entrepreneurs.

In traditional manufacturing plants it can take anywhere between 18 to 24 months of planning and capital investment before a new product actually rolls off the production lines and into shops. This process effectively raises the barrier to entry for people who may have a new innovative idea and who want to turn these ideas into a commercial product within a reasonable time to market.

With an in-house 3D printer, Quirky is able to shorten and simplify the product development process and enable people with good product ideas to be able to rapidly and efficiently create working prototypes that can be held and tested, thus



Product ideator Tim Hayes with Ben Kaufman, Founder and CEO of Quirky in the Sundance Channel original series "Quirky".
Photo Credit: Christian Clothier

eliminating a major stumbling block in the way of bringing their product to market. Today Quirky designs and develops a number of new consumer products from scratch every single week.

The Quirky model is a natural response to the economic pressures of today’s downturn, the demographic changes that represent new opportunities in both home and foreign markets, and societal changes that are pressuring the way we consume resources.

The implications of the Quirky model for Western national economies may also be significant in the years ahead. If the deepening of the recession continues to hit manufacturing capacity, 3D printing may be able to offset



some of the loss by bypassing the traditional capital-intensive process, enabling the speedy development of a wide range of innovative products.

The value & differentiation here in both the 'iStore' trend and the Quirky trend is in the content and the development of user communities of designers and innovators who are now able to produce for themselves. In both cases, 3D printing represents the hardware enabler – the consumer value is in the fast and relatively easy realization of a new idea into a working prototype and even real product.

3. More Companies are Engaging Across the Supply Chain

We will increasingly see 3D printing as an enabler for companies to engage across the supply chain. 3D printing will increasingly be used as a distribution solution where parts are made to order, without the need to hold stock near to the consumer.

This is having a profound impact already in the small number of application areas using 3D printing on a daily basis such as lamp shades and iPhone covers. With the rise of 3D printing service bureaus, and now even Cloud-based 3D printing services, making parts on-demand and nearer to the consumer will continue to make supply chains increasingly lean and efficient in the coming years.

The potential benefits of this tool-less and inventory-free supply chain include lower material consumption, less waste, lower carbon footprint, reduced capital investment, mitigated risk, and the ability to easily differentiate your product from the rest.

4. Desktop 3D Printers are Proliferating in Office Environments

We can expect an expanding penetration of desktop 3D printers into more offices and smaller offices thanks to the rapidly increasing capabilities of the models available today. While the larger, more complex 3D printers will continue to be a natural part of a centralized



The Objet30 Professional Desktop 3D Printer in the Small Office Environment



prototyping lab in virtually every large manufacturing company, the rise of the desktop 3D printer – imbued with increasingly similar levels of accuracy and producing comparable 3D models to the industrial size machines, will become more and more defused through the many smaller firms and boutique design houses.

Desktop 3D printers are becoming ever-more affordable and advanced in their accuracy & resolution quality and in their ability to suitably simulate the fit and form of parts and products envisioned by designers and engineers. They also offer today a greater range and versatility of materials than ever before.

The *Objet30* desktop 3D printer for example offers a range of 5 different 3D printing materials, including different opaque shades and a polypropylene-like material for prototyping snap-fit parts.



The Objet30 Professional Desktop 3D Printer with a Range of 5 Printing Materials

The plethora of professional-level desktop 3D printers available for under \$50,000 is rapidly expanding, placing fast and professional rapid prototyping capabilities at the service of virtually any design house or small engineering firm.



Architectural 3D Model Printed on an Objet 3D Printer. Courtesy of Rietveld Architects.

The resulting rise of the professional desktop machine is a game changer for smaller firms – providing better risk mitigation in an era of scarcer investment capital, faster innovation cycles, better communication within the supply chain and overall lead-time compression. This will enable companies on one side of the world to respond agilely to the plethora of new demographic and

consumer group opportunities on other sides of the world – for example, in the newly emerging markets of Asia and South America.

Those companies with their own 3D printing capabilities will be able to develop an edge – enabling them to compete with much large multi-nationals when it comes to rapidly transforming ideas into working products.



5. High-End 3D Printing Capabilities Will Continue to Exponentially Improve



Objet260 Connex Multi-Material 3D Printer

Today's high end 3D printers have improved exponentially over the last decade. For an example, Objet's original *Quadra Tempo* released in 2000 delivered 20 micron print layers (a game changer in its day), featured 1536 jet nozzles in 4 print heads, based in a single block and the machine printed one material, known in its time as M510.

Compare this to the latest *Objet260 Connex* delivering double the print quality from just half the number of print nozzles, at a significantly higher run speed – and in a machine with half the footprint.

In place of just one material, today's machine features a choice of 68

different materials with ranging properties from opaque to transparent, rigid to flexible, and standard to engineering plastics. It can also combine up to 14 different material properties and color shades within a single model prototype.

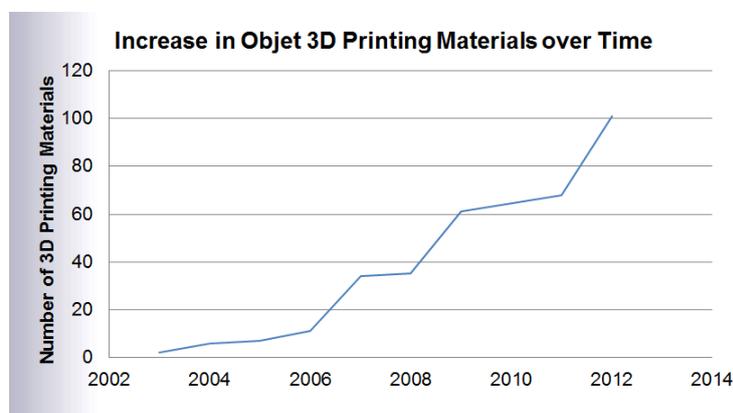
So not only are 3D printers becoming more capable, but the range and mechanical properties of 3D printing materials, especially for inkjet based technology, is expanding exponentially.



Lamp Prototype Created on the Objet Connex Multi-Material 3D Printer. Courtesy of Patrick Gunther.

These developments are working to constantly reduce the price of 3D printed components, compress lead times and expand the range and

functionalities of 3D printed parts. The result of all this is that advanced 3D printers are becoming a must-have fixture within every large product development company from the automotive sector to electronic goods and



household appliances. Manufacturers will be able in future to cut out much of their secondary tooling processes such as injection molding, resin tooling and soft tooling. And all of this will go into helping them compress their time to market, reduce their costs and also reduce the burden they place on the environment.

Conclusion

When faced with the rapid pace of change in the years ahead, 3D printing represents a potent device, one that could mitigate many of the structural challenges of our economies and societies, allowing more businesses to compete and take advantage of developing opportunities around the world.

The growth of personal manufacturing and online content in itself has the potential to re-invent whole economies. Bolstered by the emergence of the 'Quirky' model, 3D printing may bring a level of self-sufficiency back in the face of scarcer resources, greater ethical consumerism, more demand for personalization, shifting demographics and new centers of wealth.

3D printing has the potential to help offset the decline in Western manufacturing, replacing the top heavy 'too big to fail' model with a lighter, more agile and more evenly spread production base providing higher added value.

Such a model puts innovation back into the hands of more citizenry – and could spur a new round of global and technological innovations leading to a new, grassroots prosperity. While perhaps still a shadowy vision, the vision is being rapidly animated by the increasing capabilities of 3D printing itself - lower prices, more advanced prototyping capabilities, smaller machines and a greater range of 3D printing materials than ever before.



Dragon Prototype - 3D Printed in Objet Clear Transparent Material

With all of the trends taken together, it's a safe bet to assume that the future of product design and development will look very different a decade hence. But rather than frighten, this knowledge should help to invigorate entrepreneurs and businesses into renewed action. 3D printing will help by becoming an essential component in leveling the product development playing field - enabling every company to leverage the most from the opportunities that are coming to the fore even now, as we speak.



About Objet

[Objet Ltd.](#), is a leading provider of high quality, cost effective inkjet-based 3D printing systems and materials. A global company, Objet has offices in North America, Europe, Japan, China, Hong Kong, and India.

Objet's 3D printing systems and 3D printing materials are ideal for any company involved in the manufacture or design of physical products using 3D software or other 3D content. Companies using Objet's solutions can be typically found in [sectors](#) such as consumer goods & electronics, aerospace & defense, automotive, education, dental, medical and medical devices, architecture, industrial machinery, footwear, sporting goods, toys and service bureaus.

Founded in 1998, the company has thousands of [customers](#) worldwide including a substantial share of the relevant Fortune 100 and Fortune 500. Its award-winning technology (12 awards in 5 years) is based upon over 110 patents and patent pending inventions.

Objet's advanced 3D printing systems and range of over 65 [materials](#) enable professionals to build prototypes that accurately simulate the true look, feel and function of an end-product, even complex, assembled goods. The [Objet Connex™](#) line of multi-material 3D printers features the world's only technology to simultaneously jet 2 materials. With this, users can print many different materials into a single part and print various mixed parts on the same build tray. Users can also create advanced composite materials, or [Digital Materials™](#) featuring unique mechanical and thermal properties. Objet's range of over 60 [3D printing materials](#) simulate properties ranging from [rigid](#) to [rubber-like](#), [transparent](#) to opaque and standard to [ABS-grade engineering plastics](#), with a large number of in-between shore grades and shades.

[Objet's 3D printers](#) are available in a range of form-factors, from cost-effective desktop 3D printers ideal for entry-level professionals all the way to industrial-scale multi-material machines for front-line designers and top manufacturers. Objet's 3D printers feature the industry's highest-resolution 3D printing quality, based on 16-micron (0.0006 in.) super-thin layering, wide material versatility, office friendliness and ease of operation.

For more information, visit us at www.objet.com, and for more about 3D printing industry-related news, business issues and trends, read the [Objet blog](#).

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Objet Ltd.
Headquarters

T: +972-8-931-4314
F: +972-8-931-4315

Objet Inc.
North America

T: +1-877-489-9449
F: +1-866-676-1533

Objet GmbH
Europe

T: +49-7229-7772-0
F: +49-7229-7772-990

Objet AP
Asia Pacific

T: +852-3944-8888
F: +852-217-40555

Objet Shanghai Ltd.
China

T: +86-21-51750566
F: +86-21-58362468

Objet AP
Japan

T: +81-3-5389-5290

Objet AP
India

T: +91-124-4696939
F: +91-124-4696970

info@objet.com www.objet.com



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