

# 3D PRINTING AND CO-CREATION OF VALUE

Lillian Clark

*Portsmouth Business School  
University of Portsmouth, UK*

Levent Çallı

*Faculty of Computer and Information Sciences  
Sakarya University, Turkey*

Fatih Çallı

*Faculty of Computer and Information Sciences  
Sakarya University, Turkey*

## ABSTRACT

A digital manufacturing method currently receiving much attention in both academic and popular press is additive manufacturing, more popularly known as 3D printing. Many firms are already utilising 3D printing technology as a flexible, low cost and efficient tool for prototyping. However, 3D printing has implications outside of manufacturing, as this technology has the capability to enable both retailers and consumers to design and produce new products, selecting materials in accordance with their expectations and demands. In addition, as 3D technology improves, consumers will be able to produce their own products from their homes, realising a democratisation of design and production – the so-called “Third Industrial Revolution”. Adapting to these new technologies and the resultant changes in consumer behaviour will in turn require new perspectives and practices in marketing. This paper examines the current state of the 3D printer industry and speculates on the impact this technology will have on co-creation of value within marketing strategies.

## KEYWORDS

3D Printing, Additive Manufacturing, Co-creation

## 1. INTRODUCTION

If we consider that the First industrial Revolution was underpinned by steam power, and the Second Industrial Revolution was underpinned by the use of production lines to facilitate mass production, then we are now witnessing a Third Industrial Revolution, underpinned by the emergence of digital production methods. In this revolution, products will be designed using digital platforms and then produced anywhere in the world via additive manufacturing, more commonly known as 3D printing (The Economist, 2012).

For retailers, the ability to quickly produce a model of a product at a reseller’s premises or consumer’s home will have tremendous impact on production and inventory management systems. For manufacturers, mass production platforms, which historically rely on the economies of scale inherent in producing high volumes to reduce unit costs, will lose their importance as key manufacturing costs will primarily comprise two expenditures: the 3D printer itself and the production material (Stefano, 2012). Manufacturers will begin to focus less on the logistics, inventory management and supply chain activities inherent in mass production, and instead focus more on digital product design, 3D research and development, 3D marketing activities and the staff/expertise needed to fulfil these functions (ibid). 3D printing technology is also transforming national R&D strategies, most notably in South Africa where 3D printers are seen as being a key component in bringing SME’s into the country’s innovation network (Campbell et al, 2011). 3D printing technology is being increasingly used in education. In 2012, 3D printer company Stratasys reported that 40% of their sales came from educational institutions (Kharif 2012) and the UK Department for Education has announced a programme to use 3D printers to boost the teaching of STEM and design subjects (Gov.uk, 2013).

But perhaps the biggest impact of this Third Industrial Revolution will be on the consumer, as this technology will allow production of simple, every-day products from home. For example, instead of ordering replacement parts for a kitchen appliance from a factory and enduring the long wait times for processing and shipping, consumers will be able to quickly “print” the replacement parts themselves. Or, instead of buying a popular cartoon character figure from a toy shop, children will be able to download 3D models of the character from the internet, make whatever modifications they want, and then produce their own toys from home. In effect, the Third Industrial Revolution will enable the consumer to act as producer as well as customer.

Overall, 3D printing could have a profound impact on economy, industry structure, market dynamics and consumer behaviour. To specifically understand the impact of 3D printing on marketing, this paper will start with a brief explanation of the current state of 3D printer technology, and then discuss how this technology will affect current marketing practices, in particular the concept of co-creation of value.

## **2. THE 3D PRINTER INDUSTRY**

Subtractive manufacturing identifies a product as something that is created by cutting, drilling or sanding raw materials into the desired shape. Additive manufacturing, on the other hand, identifies a product as a set of layers which are then built in stages to create the final product. Using the principles of Additive manufacturing, 3D printers convert digital models of a product to a three-dimensional object by laying down these layers using appropriate materials – the so-called “printing” process. For example, a freely-moving ball-bearing can be manufactured on a 3D printer as a single component, complete with individual balls (Berman, 2012). As a result, many manufacturers are already using 3D printing for prototype production in order to realise the flexibility, cost and time saving advantages inherent in this technology.

Until recently 3D printers for home use were prohibitively expensive, costing upwards of USD8,000. In 2012, the first 3D printer designed and priced for home use became available (McKendrick, 2012). This 3D printer, priced at USD499, uses plastic as the raw printing material and can create an object up to 15cm in size. While the supplies used by the printer are relatively affordable (the plastic powder used in the layering process retails for approximately USD44 per kilo), slow processing times and complex software modelling packages have inhibited adoption of the home 3D printer (Additive3D, 2012). However, some retailers are recognising the potential appeal of this technology to consumers and are offering 3D printing services to their customers, where consumers can create “mini-me” models of themselves and their family (Asda, 2013).

As of the end of 2012 there were nearly 20 different 3D printer production companies worldwide. Growth rates for the 3D printer industry are projected to be 300% over the next 7 years, with a potential market of USD5.7 billion by 2017 (Gartner, 2013). There are however several other factors, aside from hardware costs and software complexity, that may inhibit consumer 3D printer adoption:

- The limited capacity to support production of multi-material objects. While objects can be produced from a number of single materials such as bronze alloy, plastic, or liquid polymer, production of objects using more than one material has proven difficult, and there currently isn’t even an agreed standard format for 3D printers that incorporates more than one material which also limits the capability to produce electronic components (Nusca, 2012).
- The growing recognition that 3D printers can potentially create ethical dilemmas by enabling consumers to produce objects that are illegal or harmful. For example, an engineer and amateur gun expert produced a .22 calibre gun using a 3D printer that could pass through a metal detector and was capable of firing 200 shots with no corrosion or abrasion (Beckhusen, 2012).

Applying Diffusion of Innovations theory (Rogers, 2003) to 3D printers, it is clear that this technology is still at the so-called Innovators stage, and it is not yet clear whether this technology will make the successful transition to the visionary Early Adopters, let alone the more pragmatic Early Majority cohort. One factor that will affect home 3D printer adoption will be the marketing strategies used to promote this technology and its related services.

### **3. 3D PRINTING, CO-PRODUCTION AND MARKETING STRATEGY**

Firat & Venkatesh (1995), in their description of the postmodern consumer, argue that the distinction between consumer and producers has become increasingly blurred and consumers are demanding a greater role in production. Prahalad & Ramaswamy (2004) recognised that consumers could no longer be viewed as “outside the firm” (p.6) and describe the concept of co-creation, where the consumer and the company work together to create a service and/or experience. This co-creation of value has had a profound change on marketing activities, for example in the way social media is used for collaborative consumption and service design (Batista and Ng, 2012; Zeleny, 2012), and the importance in marketing strategies of integrating customer involvement in new product development (Svendesen, Haugland, Gronhaug, 2011). However, the concept of co-creation of value has been problematic when the discussion turns to co-creation of the product itself, and Prahalad & Ramaswamy (2004) are at great pains to exclude the concept of product customisation in co-creation of value: “Note what co-creation is not. It is neither the transfer or outsourcing of activities to customers nor a customization of products and services.” (p. 10). Other researchers, in exploring the concept of the consumer-as-producer (the so-called “prosumer”), argue that the prosumer is only of economic significance if “exchange value” for companies is generated (Humphreys & Grayson, 2008). Some industries such as the music industry, recognise the inevitable rise of the prosumer and the potential marketing opportunities for this segment, but are concerned at the potential IP issues inherent in this type of product co-creation (Gamble & Gilmore, 2013). Jimenez et al (2013) propose a taxonomy of co-production, in which they distinguish between customer-company interactions during any stage of production (Co-production), tactile consumer input (Co-manufacturing), mental consumer input (Co-idealation/Co-design), and modification of an existing product (Mass customisation).

But it can be argued that 3D printing is all about product co-creation, and can involve any or all parts of Jimenez et al’s taxonomy. In theory, the consumer should (software and hardware limitations notwithstanding) be in a position to create objects as they see fit, either based on an existing product design or from development of a completely new design, with or without specialist assistance. Zeleny (2012) sees self-customisation (p. 452) as inevitable, and 3D printing the platform for this activity. Bastista & Ng (2012) argue that for the fashion industry, 3D printing will be the key to the future of that industry, and suggest that in the future clothing retailers will offer 3D printing services to consumers who do not have home printers.

A key problem then arises as the consumer may lack the knowledge or training to successfully design a product. A consumer may wish to create a shoe or a chair using 3D printing, but will lack the knowledge to know what materials are required to build a stable piece of footwear or furniture. One possible response to this dilemma is to offer collaborative design services, whereby a suitable professional works with the consumer to design the object and materials specification, which the consumer can then fabricate themselves (Hermans, 2013). An example of this type of collaborative service is Shapeways, which also provides design tutorials, modelling services and actual production of the object (Steen, Englis and Meyer, 2013).

Co-production of products can also affect the consumer’s attitudes towards an organisation, which can have implications for marketing strategies. For example, studies show that in a co-production scenario, a consumer will take more credit if the product exceeds expectations but also more blame if the product falls short of expectations, suggesting that co-production may have a significant role in marketing strategies of those products where customer expectations are uncertain (Neeli and Leone, 2003).

### **4. CONCLUSION**

While 3D printer technology is still in early stages as far as the consumer market is concerned, it is feasible that in 15-20 years consumers will be producing basic products using this technology on an on-going basis, either via 3D printer services or from home. In this context, the consumer will become both the producer and the consumer – the democratisation of design and production.

For marketers, the 3D printer is a technological innovation that presents both opportunities and challenges. For example, the toy industry has on one hand an excellent opportunity to create a range of bespoke toys for consumers, including dolls or figures based on popular films that also resemble the child (or adult), especially if support on designing and producing the doll is provided such that the consumer does not need to actually own a home 3D printer. On the other hand, 3D printing also enables the consumer to produce

their own doll, with no input from the toy company whatsoever. In this case, the marketing challenge would be to provide an engaging consumer experience that would encourage use of their 3D services – in effect, extending co-creation of value to incorporate both the experience and the product. This extended co-creation of value will have a marked impact on business strategies, introducing new intermediaries to support consumers, reducing the power of suppliers if not replacing them altogether, and requiring a redefinition of the product design to product delivery value chain.

## REFERENCES

- additive3d, 2012. Which is the best 3D printer? Accessed 28/10/13 at [http://www.additive3d.com/3dpr\\_cht.htm](http://www.additive3d.com/3dpr_cht.htm)
- Asda, 2013. Create amazing 'mini me' versions of your and your family at Asda! Accessed 14/10/2013 at <http://tinyurl.com/khs8hz8>
- Batista, L. and Ng, I., 2012. The emergence of relationship-based retailing – a perspective from the fashion sector, *New Technologies, Business Models and Customer Experience*, 10-11 December 2012, Oxford UK.
- Beckhusen, R., 2012. Gun Lobby Loves 3D-Printed Weapons. Accessed 28/10/13 at <http://www.wired.com/dangerroom/2012/08/3d-weapons/>
- Berman, B., 2012. 3-D Printing: The New Industrial Revolution. *Business Horizons*, Vol. 55, No. 2, pp 155-162.
- Campbell, R.I. et al, 2011. Additive manufacturing in South Africa: building on the foundations. *Rapid Prototyping Journal*, Vol. 17. No. 2. pp 156-162.
- Firat, F. and Venkatesh, A., 1995. Liberatory Postmodernism and the Reenchantment of Consumption. *Journal of Consumer Research*, Vol. 22, No.3 pp. 239-267.
- Gartner, 2013. Forecast: 3D Printers, Worldwide, 2013. Accessed 28/10/13 at <http://www.gartner.com/DisplayDocument?id=2598122>
- Gov.Uk, 2013. New 3D printers to boost STEM and design teaching. Accessed 28/10/13 at <https://www.gov.uk/government/news/new-3d-printers-to-boost-stem-and-design-teaching>.
- Hermans, G., 2013. Wordpress of Objects: Addressing Layman Participation in a Post-Industrial Society. UbiComp'13 Adjunct, September 8-12, 2013, Zurich.
- Humphreys, A., Grayson, K., 2008. The intersecting roles of consumer and producer: a critical perspective on co-production, co-creation and presumption. *Sociology Compass*, Vol. 3, No. 3, pp. 963-980.
- Jiménez, Fernando R. et al, 2013. A classification schema of co-production of goods: an open-systems perspective. *European Journal of Marketing*, Vol. 47, No. 11/12, pp.1841 – 1858.
- Kharif, O., 2012. 3D Printer Makers Aim at Home Market. Accessed 28/10/13 at <http://www.businessweek.com/technology/3d-printer-makers-aim-at-home-market-01092012.html>
- McKendrick, J., 2012. At last: a 3D printer for the home, priced at \$500. Accessed 28/10/13 at: <http://www.smartplanet.com/blog/business-brains/at-last-a-3d-printer-for-the-home-priced-at-500/23769>
- Neeli, B., Leone, R.P., 2003. Psychological Implications of Customer Participation in Co-Production. *Journal of Marketing*, Vol. 67., No. 1, pp 14-28.
- Nusca, A., 2012. 3D printing: The hype, the hopes, the hurdles. Accessed 28/10/13 at: <http://news.cnet.com/8301-11386-3-57549959-76/3d-printing-the-hype-the-hopes-the-hurdles/>
- Osak, M., 2012. New technology could reduce dependence on economies-of-scale model. Accessed 28/10/13 at: <http://business.financialpost.com/2012/11/28/new-technology-could-reduce-dependence-on-economies-of-scale-model/>
- Prahalad, C.K. and Ramaswamy, V., 2004. Co-Creation Experiences: The Next Practice in Value Creation. *Journal of Interactive Marketing*. Vol. 18. No.3. pp. 5-14.
- Rogers, E. M., 2003. *Diffusion of Innovations (Fifth Edition)*. Free Press.
- Steen, M., et al, 2013. *The impact of knowledge capabilities on corporate venturing*. International Journal of Entrepreneurship and Small Business, Vol. 18. No. 3. pp. 282-297.
- Stefano, T. F. (2012, 7 20). *3D Printing: A New Dimension for Manufacturing*. 1 21, 2013 tarihinde [www.ecommercetimes.com](http://www.ecommercetimes.com): <http://www.ecommercetimes.com/story/75695.html>
- Svendsen, M.F. et al, 2011. Marketing strategy and customer involvement in product development. *European Journal of Marketing*, Vol. 45. No. 4. pp 513-530.
- The Economist, 2012. The third industrial revolution. Accessed 28/10/13 at <http://www.economist.com/node/21553017>
- Zeleny, M., 2012. High Technology and Barriers to Innovations: From Globalization to Relocalization, *International Journal of Information Technology & Decision Making*, Vol. 11 No. 2 pp. 441-456.