THE IMPACT OF 3D PRINTING ON
THE WORLD OF PRODUCT DESIGN IN
THE NEAR FUTURE

by Richard Wenborn
Contents

1.0 The capabilities and limitations of 3D printing ................................................................. 2,3,4,5
   1.1 What is 3D printing? ...........................................................................................................2,3
   1.2 Capabilities. Does it serve a customer need? What are its benefits? Are there other non-directly related or companion products or services worth considering? .................................................................3,4
   1.3 Limitations. What limitations does the technology have? Is it possible to overcome these limitations? .......... 4
   1.4 Does it have the ability to affect existing competitors already on the market? Which companies are most at risk and what possible strategies may they adopt to manage this? .................................................................5

2.0 Possible marketing strategies for 3D printing ......................................................................5,6,7
   2.1 Segmentation, the target market, positioning and the message .............................................5,6
   2.2 The 4 P’s .................................................................................................................................7

3.0 Evaluation of the possible impact of 3D technology on the world of product design ..........8,9

4.0 Conclusion ................................................................................................................................10

5.0 References................................................................................................................................11,12
THE IMPACT OF 3D PRINTING ON THE WORLD OF PRODUCT DESIGN IN THE NEAR FUTURE

Preface

3D printing is right at the peak of inflated expectations of the 2012 Gartner Hype Cycle report. The Economist magazine and the BBC news have equated it with a third industrial revolution. This report will look at whether this technology is overhyped with unrealistic expectations or whether it really does have the ability to change both the way we design products and the products themselves. In order to assess its potential to be commercially successful in the near future this report will look at the capabilities and limitations of 3D printing and at possible marketing strategies. It will then use this information to help evaluate its impact on the world of product design and assess whether this technology will really be advantageous to future product designers.

1.0 The capabilities and limitations of 3D printing

1.1 What is 3D printing?

Gartner Hype Cycle is an analytical tool developed by IT research firm, Gartner Incorporated. This methodology gives technology buyers the ability to decide when it is the best time to adopt a new technology. The Hype cycle has five phases known as: technology trigger, peak of inflated expectations, trough of disillusionment, slope of enlightenment and plateau of productivity. A technology has to go through these stages before it reaches the plateau of productivity. 3D printing is right at the peak of inflated expectations and has been predicted to take 5 to 10 years before it should reach this plateau where the technology will be broadly accepted and applicable.

Richard Wenborn 10214705
3D printing is an additive technology, a printing process that uses layers to create three-dimensional objects. It transfers a computer aided design (CAD) program of an object to a printer that digitally slices the design into very thin cross sections called layers. The 3D printer then prints successive layers of liquid, powder, or sheet material, each corresponding to the layers of a virtual cross section of the CAD model. The first commercial 3D printer was a stereolithographic printer invented by Charles Hull in 1984. There are now a number of technologies that are capable of doing 3D printing. The main difference being in how the layers are built up to create the objects. Some new technologies are able to use multiple materials such as Polyjet Matrix, developed by a company called Objet, where two liquid photocurable polymers are jetted from a 96 nozzle print head and are cured by a UV light immediately after printing. A key advantage of this process is its ability to simultaneously print parts with different mechanical properties.

1.2 Capabilities. Does it serve a customer need? What are its benefits? Are there other non-directly related or companion products or services worth considering?

Anthony Ulwick who invented the outcome-driven innovation process states that ‘customers buy products and services to get jobs done’ and that an opportunity for growth is an outcome that is underserved, that is it has not yet been satisfied by existing products and services. Listed in the bullet points below are the unsatisfied jobs that this technology is able to get done that traditional manufacturing technologies were either unable to do or achieve to the same standard.

- 3D printing can be used for making prototypes as well as for making the final product. 3D printers were originally used in engineering and design firms to produce and refine prototypes, hence the name ‘rapid prototyping’ and have enhanced the design process. The table below will look at what these benefits are and at how they have made the job of the job of designing a product easier right from ideation to marketing.

<table>
<thead>
<tr>
<th>Improved communication</th>
<th>Better quality of final product</th>
<th>Greater Speed</th>
<th>Reduced Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prototyping can now be done on site thereby improving communication between different groups such as R&amp;D, internal/external customers, engineering, marketing, sales and management</td>
<td>1. 3D printing permits companies to detect unforeseen design, fit and function flaws very early in the 3D printing design process thereby ensuring better product quality. Also allows for rapid design changes</td>
<td>Decreasing the development time of the design, minimize costly mistakes and increase the effective communication of the newly designed product.</td>
<td>Sales are closed much earlier. Time is expensive with innovation.</td>
</tr>
<tr>
<td>2. 3D printing processes do not require tooling, which allows for more freedom when creating new designs. This gives the engineers and designers the opportunity to rethink the way they design new products.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Benefits of 3D Printing to the Design Process
• 3D printing is increasingly being used to make final products as well. Included among the items currently being made are toys, jewelry, sculpture, replacement parts and even medical items such as hearing aids. Phil Reeves an expert on the 3D printing industry claims that 3D printing now dominates the market for In-The-Ear hearing aids, as 3D printing is able to customize the outer shell of the hearing aid making them more comfortable. [I. Materialise, 2011]. The ability of 3D printing’s to create bespoke, customized products is an advantageous capability of this technology.

• 3D printing has the ability to achieve shapes that are unachievable by traditional manufacturing methods. This will allow designers to release products that were originally unachievable with today’s technology.

• 3D printing can allow companies to produce some of their products in one manufacturing method rather than a combination of methods such as in traditional methods.

• This technology is able to produce products in one assembly rather than multiple assemblies. This could mean less split lines, thereby improving the overall aesthetics of the products.

1.3 Limitations. What limitations does the technology have? Is it possible to overcome these limitations?

Even though 3D printing has progressed in the past ten years there are still limitations with the technology at the present time. The bullet points below list the obstacles that are still in the path of its progress.

• Cost – cost of the printer and materials used. Although the prices of printers have reduced, good quality printers that use multiple materials and produce durable products are still expensive. The cost of most materials for additive systems is expensive, and although there is a large range of materials available for use, many of these materials remain substandard for manufacturing applications and therefore for some products. Many materials are provided in powdered form and the process of making them into powder may affect their long-term properties. More advancement is needed for plastics and conductive metals to be processed using the same machine.

• Speed of manufacture- most 3D printing involves small projects. Additive processes are many times slower than most conventional manufacturing processes. It therefore may not be suitable for large sized applications.

• Quality assurance and the management of regulations. Issues can arise with quality assurance if manufacturing is taken out of a carefully controlled environment. If something goes wrong with the printed product, it would not be clear who was at fault; that is, whether it was the designer, the person making the product or the materials used. Good manufacturers in industry go through quality control in order to pass quality assurance standards. For example, a CE marking on a product declares that the product conforms to the essential requirements of EU. Issues could also arise over the production of illegal objects such as guns. Who would regulate their licensing and what they are made of.

• Intellectual property (IP)- A 3D printer must have CAD file in order to produce an object. This can be obtained in three ways. The user can design it on computer using CAD software, the files can be downloaded from open-source archives or a CAD file can be produced with a scanner that is able to take three-dimensional measurements from various angles. If a user downloads from a website they must have permission and this could come with a charge making it too expensive for some products. Also the copying of popular merchandise could infringe copyright law.

• Although this process can create intricately designed objects, current 3D printing materials for investment casting are inclined to occasionally yield rough surfaces.

• Support material is needed for the process. This material could have health issues for users (the dust) and environmental problems with the elimination of waste.
1.4 Does it have the ability to affect existing competitors already on the market? Which companies are most at risk and what possible strategies may they adopt to manage this?

Thus type of technology is an additive method of manufacture therefore its competitors must be subtractive manufactures i.e. those that use traditional method of cutting, reforming, molding, casting and stamping products.

For its competitors to have an effective strategy they would need to highlight the limitations of 3D printing.

Below is listing some of the limitations that they could highlight on:

- Mass production - competitors could work on and advertise their ability to manufacture large quantities of products at a cheaper price.
- Quality Assurance – they could push for more regulations for quality assurance, such as all products must have CE marking on a product declared.
- News laws for patenting and copyright – this would prevent 3D printers from getting hold of designs without charge thereby increasing the cost of their manufacture.

2.0 Possible marketing strategies for 3D printing

In order for the marketing of 3D printing to be successful the marketers will need to target and focus on a segment of the market where they think that the outcome will be most favorable. They will then need to position 3D printing within this target market correctly so that its users can differentiate it from other technologies. Once both the target market and the positioning are established the marketers can concentrate on the 4 Ps, that is, product, place, price and promotion.

2.1 Segmentation, the target market, positioning and the message

In order to establish a target market, this report will use the theory of ‘the diffusion of innovations’ as an analytical tool for segmenting the market. Researchers, such as Everett Rogers, used this theory to explain how a population takes up innovations. They believe that a population can be divided up into five segments. These are the innovators, the early adopters, the early majority, the late majority and the laggards. Lee Robinson says that it is ‘best to think of each segment as static’ and that ‘innovations spread when they evolve to meet the needs of the successive segments’ [Enabling Change, 2009, Les Robinson]. 3D printing has already been used by large companies for prototyping and in some niche markets and university departments, so it must have already met the needs of the innovators and early adopters. This report will therefore concentrate its marketing strategy on the early majority, as the technology seems to be just at the beginning of this segment. This segment of the population is cost sensitive, risk averse and value good industrial standards. The target market could be expanded to include small businesses and other government institutions such as schools and hospitals. The price of 3D printing has decreased over time and some printers are now available at £1000. This reduction in price should make it more affordable for these institutions and businesses. Domestic users are important, but as with 2D printing, in the beginning it was the firms and schools that had the printers first, the movement of printers into homes occurred because these users saw the benefits and wanted to have their own.
Positioning is the perception that customers have of a product. It is how they think about a product and how they compare it to its competitors. The messaging strategy for 3D printing should therefore inform the potential users of its positioning within the market by highlighting the special advantages of a 3D printer.

Ulwick says that companies must decide whether their messaging strategy has functional or emotional characteristics and has created a functional-emotional matrix to help make this decision.

3D Printing fits into the fourth quadrant of this matrix. The marketing strategy should therefore be based mainly on its functional characteristics.

### Emotion vs. Function

<table>
<thead>
<tr>
<th>Quadrant 1</th>
<th>Quadrant 2</th>
<th>Quadrant 3</th>
<th>Quadrant 4</th>
</tr>
</thead>
</table>
| Emotional Complexity | Jewelry  
Cosmetics  
Food and beverages  
Packaged goods | Emotional Complexity | Automobiles  
Apparel |
| Function          | Chemicals  
Raw materials | Function          | Electronics  
Appliances  
Software  
Services  
Medical devices  
3D printing |

**Ulwick, Anthony W., 2005**  
*Figure 6.1 Ulwick pg 111*
2.2 The 4 P’s

The 4’s are the four major marketing decisions that need to be made before launching a product. These decisions, product, place, price and promotion need to be combined in the best possible way so that they satisfy the customers of the target market.

<table>
<thead>
<tr>
<th>Product (Based on its functionality and related benefits)</th>
<th>Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>• product customization- 3D printing gives the user the ability to alter the digital design and to achieve the exact product requirements that have been set.</td>
<td>• Specialized shops- online and in the market place</td>
</tr>
<tr>
<td>• Prototyping -Faster and cheaper prototyping</td>
<td>• Trade shows</td>
</tr>
<tr>
<td>• Visual presentations- the ability of 3D printing to provide visual representations for displays such as in museums</td>
<td>• Educational Conferences</td>
</tr>
<tr>
<td>• Spare parts and small batch manufacturing – companies can make their own spare parts and only manufacture when needed- therefore less stock issues</td>
<td></td>
</tr>
<tr>
<td>• 3D crafts- the ability of 3D printing to allow you to design and manufacture your own designs- a benefit to schools and craft manufacturers.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Price</th>
<th>Promotion</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Financing</td>
<td>• Trade fairs</td>
</tr>
<tr>
<td>• Leasing Options</td>
<td>• Reports and adverts in Industrial Magazines</td>
</tr>
<tr>
<td>• Wide price range according to functionality of printer</td>
<td>• Media- documentary’s and news broadcasts</td>
</tr>
<tr>
<td>• Low price range for craft users, higher prices for users requiring more functions</td>
<td>• Stands at Educational conferences and adverts in educational magazines Hospital catalogues</td>
</tr>
</tbody>
</table>
3.0 Evaluation of the possible impact of 3D technology on the world of product design

This report will use two tools in order to assess the possible impact of 3D technology. Firstly, it will use the Futures Wheel to help identify the future consequences of change. Jerome Glenn created the Futures Wheel in 1972. This wheel helps the user brainstorm both direct and indirect consequences of an event or in this situation a new technology. A change is identified and then the consequences of the change, and these are identified as first, second and third-order consequences. The final visual map will display the implications of the technology so that the impact can be analyzed more clearly. Secondly, this report will use this information to help create a SWOT analyses.
## SWOT ANALYSIS: 3D Printing

### Strengths
- Faster, and cheaper prototypes of better quality
- The ability to customize products
- One stage process— that is no need for tools and labour
- 3D printing has the ability to achieve shapes that are unachievable by traditional manufacturing methods
- This technology is able to produce products in one assembly rather than multiple assemblies. This could mean less split lines, thereby improving the overall aesthetics of the products

### Weaknesses
- Size limit—cannot print anything that is bigger than the printer,
- Materials—although the technology is advancing to enable more base materials and also to enable multi-material printing it still limited
- Speed of processing— not suitable for mass production
- Cost—materials are expensive and larger printers with increased functionality are expensive

### Opportunities
- 3D printing could allow companies to increase the diversity of their products—that is, well known brand manufacturers, such as those of mobile phones, could have the electronics manufactured in the normal way but have the casing personalized. This would give the customer the opportunity to have their own input into the design. Therefore, all products even those that are mass produced will become customizable.
- 3D printing could allow the printing of replacements for broken parts. It could be possible to source a part by using either a picture or code and then printing it.
- 3D printing could encourage the setting up of more service 3D printing companies similar to ‘Sculpteo’ and ‘Shapeway’s who will do the printing for you and let you add a ‘personal touch’ to products.
- This technology could offer an opportunity for companies to specialize in making materials for 3D printers.
- It could also provide an opportunity for lawyers in the services industry to set up practices that specialize in patents and copyright for 3D printing.
- Another opportunity could arise for appliance companies to offer to fix a broken appliance on site by being able to print out the broken part form a 3D printer situated on site.

### Potential Threats
- Could enable the unauthorized reproduction of work usually protected by protected by a variety of rights— such as copyright, patents, designs, and trademarks
- Customers could object to the cost of licensing when printing designs making too expensive for most users
4.0 Conclusion

In order to measure the impact of 3D printing on the world of product design this report will need to look at both its present consequences and those of the future. 3D printing has already had a large impact on prototyping as it has made the process more cooperative, more efficient and faster. This has not only benefited companies because it is less costly but also because, for companies to be successful, they now need to innovate quicker. Another major impact that the technology has is its ability to customize products, which has made it especially successful in some parts of the medical industry such as hearing aids.

There are some limitations to the technology at the moment such as the variety and quality of materials and the speed and size of object that can be produced. This should be overcome by development in the technology in the next 5 to 10 years.

A future consequence of 3D printing could be a change in laws around patenting, copyright and safety. 3D printing could also lead to the rise of illegal products such as guns and to a black market for some everyday products.
5.0 References

Books


Websites


