

The Effects of 3D Printing on the Manufacturing Industry

Additive manufacturing has been around since the 1980s. Up until now, 3D printing has extensively been used by hobbyists, product designers and for research purposes. Its applicability to the manufacturing industry has been limited mostly because of the current slow speed of 3D printers when compared to industrial machinery. But because 3D printing has demonstrated a rapid rate of change in terms of price and performance, and has showed potential for having a significant economic impact, this technology has been identified as one of the technologies with the greatest potential of disrupting a whole industry – the manufacturing industry. Therefore, this study investigated and evaluated how the landscape of the manufacturing industry will change due to the rise of 3D printing.

To evaluate the potential impacts of 3D printing, the current state of the traditional manufacturing sector was examined. From this analysis, the major advantages and disadvantages of traditional manufacturing were identified:

- **Advantages:** traditional manufacturing methods produce a large quantity of one standard product at a fast rate and relatively low cost. There are reduced labour costs because this process has become highly automated;
- **Disadvantages:** traditional manufacturing is capital intensive, energy intensive, and inflexible. This process lacks in flexibility because the same plant can typically only produce a single product. Furthermore, it is very costly and time-consuming to make changes to a manufacturing process after the assembly line has been installed.

This project also investigated the current use of 3D printing in two of the most innovative industries: auto manufacturing and aviation. It was found that the use of 3D printing for rapid prototyping is now common practice, especially in the automotive industry. This is mainly due to the fact that 3D printing is a highly flexible method. 3D printing enables the creation of complex shapes or objects within hours and at a low cost. Nevertheless, the use of 3D printing to mass produce automobile or aircraft components is still very limited, mainly because traditional manufacturing remains the most cost effective method to produce a large quantity of one standard product. Within 5-10 years from now, we expect that 3D printing will play an important role in enabling manufacturers to improve their process efficiency, speed up product delivery time, and expand their portfolio of products and services. This can be accomplished by using 3D printing in conjunction with the following recent trends of the manufacturing industry:

- **Kaizen, six-sigma and Lean:** Unlike subtractive manufacturing methods, 3D printing does not generate any waste because it creates products layer by layer. Furthermore, 3D printing can improve process efficiency by reducing wait times for the production of custom or specialized components, and by reducing shipping times and costs by printing items locally.
- **Service provision:** Integrated product-service offerings are becoming increasingly popular in the manufacturing industry where there are many competitors offering similar products. Existing manufacturers can use 3D printing as a tool for service provision. For example, 3D printing today can produce highly customized products, tailored to the customer's specific needs, and it can make it easier for manufacturers to maintain warranty programs by printing discontinued parts.
- **Mass customization:** Mass customization is the ability to create customized goods and services for a relatively large market with a production efficiency that is comparable to mass production.

We do not expect 3D printing to be able to replace existing mass customization processes within the next 5 years; however this could be a reality in the more distant future (i.e. 5+ years from now), with the anticipated advances in 3D printing technology. 3D offers the advantages of faster production times and reduced wait times for receiving products.

This review and analysis showed that 3D printing is a technology that is still at the development stage. It is unrealistic to think that 3D printing will immediately revolutionize the manufacturing industry. To play a more important role, the performance of 3D printers (e.g. speed and quality) will first need to improve. We recommend that large manufacturers should invest more money towards researching 3D printing technologies and its applications. Research will potentially speed up the development of new additive manufacturing techniques that use metal instead of plastics, increase the quality of the products printed (pieces that are lighter and stronger), and manufacture items at a faster rate. Manufacturers should also start thinking about new business models that would enable them to take advantage of the benefits of 3-D printing, and plan for the future accordingly. We anticipate that as soon as the technology allows 3D printing to compete with traditional manufacturing in terms of cost, quality, and efficiency, the landscape of the manufacturing industry will be significantly impacted. 3D printing might transition from a “complementary” technology to a disruptive, replacement technology. These major changes are not expected to occur in the short term, but we believe that a disruptive transformation could occur within the next 10 years.