Primer on 3D Printing (Additive Manufacturing)

Mehmet Ilhan Bayoglu

Many of us have already heard about 3D printing. Turning something that you only have a virtual design for into something solid in real life! I'm sure most have wondered about it: Can it really do all people say it can do? What can be done with it? What *can't* be done with it? As someone who works with 3D printing daily, I can confirm that it is just as impressive as you might think it is, and more.

3D printing, formally titled "additive manufacturing" allows one to create an item without specialized tools or molds. All we need is a suitable 3D printer and spools of material. It can enable many innovative ideas into solid forms in almost all industries, like aviation and locomotive transport, agriculture, healthcare, and more (Shahrubudin et al., 2019). Its flexibility can allow 1) manufacturers to serve multiple markets at the same time, 2) one company to be able to customize its products from customer to customer without additional costs, 3) customers to find the products they need for cheaper and more easily (Weller, Kleer & Piller, 2015). It is even recently possible to do sophisticated and durable 3D concrete printing using waste materials as part of the raw material which can change the building and construction industry (Tu et al., 2023).

As a senior high school student who is looking forward to pursuing mechanical engineering in university and who has been dabbling in 3D printing ventures for the last two years, I am eager to share what I have learned so far with my peers. It would be my pleasure to make more people aware of this innovative field and maybe even try it out for themselves in the future. I am sure that once people get into it, they will see it for the limitless endeavor it is.

It can answer economic scarcity. Since the 3D printing process doesn't require extra necessities like different molds for each product, tools other than the printer itself, or assembly work to complete, it opens many possibilities for manufacturing by reducing production costs (Weller, Kleer & Piller, 2015).

I also can't skip mentioning the RepRap Project founded by Dr. Adrian Bowyer. The point of this initiative was to make a "self-replicating" low-cost 3D printer (*RepRap - RepRap*, n.d.). This project gives people who have a computer the ability to build their own 3D printer with the necessary materials and open-source (meaning, everyone has access to it and the right to build with it) knowledge. This way, every owner of a RepRap 3D printer can print new ones as much as they want as long as they have the raw plastic materials. This is an example of how 3D printing can be a social endeavor, not just a business one or a hobby. People all over the world can and do come together offline or online to teach each other new techniques, try new printers and materials and test the limits of the technology. Projects like RepRap that encourage people to come together and share resources is how 3D printing can succeed in not just being an innovation, but an *inclusive* innovation with the chance to help marginalized communities empower themselves (Woodson et al., 2019).

Personally, the more I learned about and practiced 3D printing, the more I fell in love with the troubleshooting and social aspects of it rather than the products I created at the end of the process. Trying to figure out what went right or wrong in my designs was a fun mental exercise that led me to talk to many people all around the world whenever I got stuck. Also, I even made some money myself by helping people who needed special plastic parts for their projects or just people looking for cool decorations. Even in my small example, you can see hints of economic opportunity, market potential, endless possibilities, and how social a business and hobby 3D printing can be.

Of course, like all technologies, 3D printing has drawbacks too. To conclude, I want to share with you a table of the many advantages and disadvantages of this technology (Appendix). I hope all of this information can give you a good idea of the world of 3D printing and inspire you to try it out yourself if you find the means.

References

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Appendix

3D Printing Advantages and Disadvantages Comparison Table

Advantages of 3D Printing	Disadvantages of 3D Printing
Flexible Design: Allows more complex designs.	**Limited Materials:** Selection of plastics and metals is not exhaustive.
Rapid Prototyping: Parts can be manufactured within hours.	**Restricted Build Size:** Print chambers have small sizes, larger parts need to be joined after printing.
Print on Demand: Saves space and costs as no need for large stock inventories.	**Post Processing:** Most parts require cleaning up and other post processing methods.
Strong and Lightweight Parts: Important for industries like automotive and aerospace.	**Large Volumes:** Cost per unit does not reduce significantly when scaled up for mass production.
Fast Design and Production: Objects can be printed quickly depending on complexity.	**Part Structure:** Layers can delaminate under stress due to the layer-by-layer production process.
Minimising Waste: Only the material needed for the part is used, reducing wastage.	**Reduction in Manufacturing Jobs:** Automation could lead to job losses in manufacturing sectors.
Cost Effective: Saves time and costs by using a single step manufacturing process.	**Design Inaccuracies:** Some printers have lower tolerances, requiring post processing to meet design specifications.
Ease of Access: More accessible with local service providers offering outsourcing services.	**Copyright Issues:** Increased risk of fake and counterfeit products due to accessibility of the technology.
Environmentally Friendly: Reduces material wastage and can improve fuel efficiency with lightweight parts.	
Advanced Healthcare: Capable of printing organs and advancing medical technologies.	

Note. Sourced from TWI Global's website (TWI Global, n.d.)