

IMPACT OF 3D PRINTING ON LOGISTICS

Adam Wieczorek

University of Warmia and Mazury in Olsztyn, Oczapowskiego 4, 10-719 Olsztyn, Poland,
E-mail: adam.wieczorek@uwm.edu.pl

Abstract. 3D printing technology is becoming more and more commonly used production method. This method of production is perceived as a trend that can have a significant impact on logistic service in the future. The article presents a description of the technology, along with its capabilities and restrictions. An important point is the impact of 3D technology on the functioning of the supply chains. The advantages gained by using 3D printing technology have also been demonstrated. The article sets the target for future opportunities for logistical support through the use of 3D printing technology. There are also presented individual theories among entrepreneurs about the current changes taking place using 3D printing. This article is based on the literature of periodicals and specialist articles.

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1. INTRODUCTION

Printing 3D, also known as additive manufacturing, has been known for several years now, but it is becoming increasingly popular nowadays. Initially used to make prototypes for the space and automotive industry, it is currently used in almost every field. Many companies are eager to invest in 3D printing technology, believing that this will lead to an increase in the company's economic performance. 3D printing offers many benefits such as: reducing production waste, high quality with lower weight, customization, impacting on air pollution or adjusting to individual orders. It also has limitations such as the long production time of large quantities of products, which is why it is completely unprofitable to mass production. 3D printing, however, is not only a new form of producing goods, but also significant change to the handling of production processes. Logistics goals can be defined as fulfilling 5R rule, delivering the right material at the right place, at the right time, at the right quantity and at the right amount. In this sense, 3D printing can have a big impact on logistical and supply chain operations, since it limits the resources required only to the printer, the raw material to, and the digital product. Complete customization of current 3D printing programs can undermine global supply chains and decentralize them. Despite the many changes that it can bring, it is also an opportunity for faster order fulfillment to the customer, at lower costs, achieving the same or better quality, which can ultimately lead to improved customer service.

2. PRINTING 3D IN LOGISTICS

2.1. Outline of 3D printing technology

3D print is also determined as an additive manufacturing, and is becoming more and more popular trend in the world. Due to the promotion within the media it is getting a revolutionary possibility for both: entrepreneurs and individual consumers. The vision of 3D printing by companies shows that it has almost no limitation as to what can be printed, by using only one 3D printer. Nowadays more and more companies presents the possibility of using 3D printing (3DP), such as usage in aviation, healthcare and even in food industry. One of the major examples could be Mercedes-Benz Trucks enterprise, which in 2016 announced the fact of using spare parts within their vehicles printed by 3D technology (Daimler media, 2016). But it is not only one, invested in 3DP start-ups, as there are many more such as: GE, BMW or Nikon (Vanian, 2016).

As to technological aspects of 3DP, it is a process which in quite simple way can be described, as the functions of 3D printer are similar to the regular printers.

Both of the devices are getting information from digital files, but the 3D printer make the layers which in final effect will become the solid, full-scale product. When it is needed to produce something by 3D printer, the following processes must be done. Firstly, the digital design of the product must be made in a special software. Secondly, the right material must be provided for the printer. As for now the most popular materials, used by 3D printers are: polymer, metal, ceramics wherein the demand for metal printed goods is getting bigger (Müller & Karevska, 2016, p. 13). Thirdly, we need to use proper 3D printer as for the size of our final product. Of course there are few methods of printing used accordingly to the needs of final products (3Dprinting.com). Various technologies determine various costs and time needed for the printing, which are crucial factors for the consumers, and affects significantly the level of logistics service.

2.2. Current use of 3D printing

Presently, enterprises are more and more eager to try and use 3DP in a way of supplying their customers. 3D printing has broad application, from individual customers up to global usage of manufacturing industry. In an example of individual users, 3D printing was mainly used to produce small things and gadgets. In technological development, 3D printers influenced the widespread of “do it on your own” culture, as a way of promoting the presumption. Such evolution affected positively on customization of production to the individual needs of customers. Therefore 3DP represented an opportunity for the enterprises which wanted to adapt the production to the needs of their customers. The high spectre of customization may be one of the major factors of gaining the competitive advantage on the market. The concept of customization is also connected with the level of supplies held in warehouses by enterprises. One of the most advanced markets in usage of 3DP is prosthetics and healthcare market (Economist, 2016). Application of this technology allows the competitive prices with the faster process of adjustment and production. Another interesting fact is about Adidas and Nike company, which provide the special tools on their websites providing the client to design shoes which will be one of a kind, or adjusted strictly to the medical recommendations (Vincent, 2017; Millsaps, 2016). Implication of technology in presented examples allowed to: reduction of time by production, diminution of supply levels, better customization and improvement in logistics service level.

Another kind of example applies to complex products. 3D printer allow to print every three-dimension object, therefore make easier to produce difficult goods or items, with only one machine using. Such opportunity has been seen by automotive and processing industries. Present predictions state that by 2019 about 10% of producers will be using 3D printers in their production processes (Basiliere, 2015). As an example of automotive production the BMW showcase is important. As for now they have used almost one hundred thousand parts printed by 3D printers, and they

have come up with conclusions that production was shorter, and allowed them to get more profits (BMWgroup.com, 2016).

Another fact is decentralization of production sites and manufacturing the goods only for exact needs. General Electric, after opening their modern factory used 3D printers to print some of their products. Thanks to that some of their goods became 25% lighter and more durable. Another interesting fact is that before 3DP they gained supplies for many suppliers, and after implementing 3D printers they simplified it (Kellner, 2015). 3D printers have some advantages when used in a places which are hard to get such as oil rigs. Implementation of 3D printers in such places allowed the workers to produce the tools they needed, when they needed them (Shell.com). Also the society in evolving regions needs some kind of special resources, but the access to them is also difficult. In example of Nepal, actions were taken to create there special laboratories of 3DP, where people would print needed goods for human aid agencies. Predicted cost reduction of logistics services can be up to 50% (theguardian.com).

Such modern technology contribute to the development of new form of enterprises and business. New places are being created which are allowing the access to 3D printers, when everyone can use finished design or use own and print the goods at the spot, without waiting as it would be made by ordinary methods of production. There are also some services where we can search for designs and after download them and print, which allow us to shorten the time needed for getting the goods we need. In many of such projects there is a problem of intellectual property and the rights for some of the models or designs. Some of them are free to download, but others are protected by special software. New systems of protection and access for them are developing, allowing the transfer of design directly to the point of print which does not have to be located within the enterprise – customer (3dtrust.de). Such solutions allow to use 3DP without having the resource such as printer. So it is a special way of evolved outsourcing, which diminish the costs of production, lead – time and customization for the client. Due to the fact that 3DP is still developing, so in future we can see wider usage in common. Such technology may influence the logistics service and supply chains as well.

2.3. 3D printing in logistics

One of the most important factor when it comes to the 3DP and logistics is the possibility of disruption of functioning of global supply chains. This technology broadly used undermines the sense of long-road transportation, and centralized production sites. At the beginning it is important to state, that with current technology 3DP is not suitable for use in mass production sites of equal goods. Putting aside this downside, 3DP is still significant force of potential development in a way of getting competitive advantage and better logistics service. Implementation 3DP in business has a chance to improve the functionality of supply chains and opera-

tions to the new level of effectiveness (Müller & Karevska, 2016, p. 34). 3D printing can also develop the operations of product planning, even before start of the production. Prototypes printed by 3D printers, can show faults which can be corrected, what would improve effectiveness in a way of costs (Müller & Karevska, 2016, p. 34). Such benefits can raise the level of quality of customer service. Another fact is about self-sufficiency of production. In enterprises which have many machines and devices, every accident generate massive costs and increase time of production and process of transportation the goods to the client. 3D printers can be used also as a source of spare parts to the machines and other devices. Processes connected with service of machine park are really important element of logistics services (Müller & Karevska, 2016, p. 34). By using of 3DP it is possible to supply production sites with the right resources “on the spot”, with the reduction of the delivery costs without elongation of lead time. Next aspect is connected with direct production of components or end products. 3DP is changing not only the main operations but also the logistics ones. Modern technologies and new form of production may improve the additional value not only for the client but also for the enterprise. Value chains consisting the 3DP gives many opportunities for entrepreneurs about the forms of production, range of products and where to produce, in a way to maximize benefits both for enterprise and customers (Müller & Karevska, 2016, p. 34). In a cases like that the logistics service of main processes functions differently, because of restriction of 5R rule to providing right resource for the printer and people needed for operating it. This is the opportunity of improving the lead time of product, and time of transport of it, which finally is cheaper, and delivered in a shorter amount of time.

Right now the most common way of using 3DP by enterprises is connected with spare parts market. There are many warehouses in which spare parts are stored. Some of these products is in constant rotation, but many of them arrear and are not needed. Such situation leads to overflow of warehouses and increase of cost of goods maintenance, which results in poor effectiveness of supply chains. One of the solutions was proposed by Kazzata. Instead of warehousing of the parts, the digital files are stored within the servers and computers (Kazzata.com). When there is need for part, enterprise may print the digital design or send it to the nearest place with 3D printer. Such activity could also be provided by logistics operators. Such actions influence the cost of goods maintenance, lead time and reduction of logistics and main processes costs. Another really important fact is about limitless customization possibilities for customers. Healthcare is using more and more 3DP to create prosthetics for disabled patients. It is really important for such people as almost every product is individual. Logistics operators who have access 3D printers could provide the right materials for the printers and customize the product for the individual need of customers. Additionally they may be responsible for fast and safe delivery of the product in right place on right time. It need to be stated as well that such places are planned to be developed from stationary place to special trucks which are moving around the city or even the country so the access would be a lot

easier for the client (Molitch-Hou, 2015). Further ideas of customization is connected with internet shopping, as one of the most popular way of buying products. Many of enterprises are allowing people to use special software on their websites to customize their own product. Nowadays about 10% of people are using such possibility, but one of the third is interested in such system (Spaulding & Perry, 2013, p. 1). Production enterprises may cooperate in such case with logistics operators who provide the postponing services by usage of 3D printers. Local distribution centres may have almost finished goods at warehouses, but because of such cooperation, customers may choose the final looks and application of the product, right before the delivery. Customers would get in that way added value without longer lead time and differences in price. One of the aims of logistics according to the 5R rule is to provide right resource in right time. It is very important fact for entrepreneurs and customers. Reverse logistics and service of guaranty actions may use 3DP for immediate repairs, or producing the needed goods. Such actions reduce time of realization and improve satisfaction of client with logistics service. As an example it can be stated the fact of cooperation between UPS and Fast Radius. Fast Radius implemented 3D printers in strategic point near the global aviation centre of UPS. In such places good are printed up to 1 am at night, and delivered to destination even at the same day (Berman, 2016).

Right now it is only possible to speculate and foresee what effects of 3DP to the logistics services and supply chains functionality will have. It is considered to be dangerous to transport enterprises which may feel less need for their services. Both, transport and logistics service enterprises are aware of chances of the of 3D printing. There is however opportunity for logistics operators, as they can provide transport services and 3D printing as well at the same time. Such services are interested in, therefore are providing a chance for every competitive logistics operator. Universal implementation of 3DP may totally change the global supply chains and influence the needs of last-mile transport, changing the requirements placed on logistics service in future.

3. CONCLUSION

3D printing is undoubtedly becoming increasingly popular and more commonly used. For entrepreneurs, benefits such as improved individualization, reduced production waste, or matching production sites to demand, state a good chance for growth and competitive advantage over others. Depending on the industry, 3D printing technology may be a substitute for the current technology or complementary to them, at least in the current development. The biggest challenge now for 3D printing is the time and speed of printing large amounts of goods, so implementing it for mass production is unprofitable right now. 3D printing affects not only the functioning of the main processes, but also on how they are handled by logistic proc-

esses. Matching the product to the tastes of the customer in the final stages of product finalization guarantees a better level of service at the same time of waiting for the order. 3D printing also reduces the need for storage space, smaller quantities of raw materials for production, and their unification, or reduced demand for long-distance transport. This form of production undoubtedly has the potential to transform global supply chains into local by decentralizing production sites. It is also a chance to create a new type of business, and modern companies that function as logistic integrators – 4PL. As a result, the customer would receive a high quality product in less time, in the exact place he chooses, with the competitive or for some lower priced goods. Going further into the future, 3D printing can undoubtedly become the benchmark for many changes to both the finished product, the core process, and logistic processes.

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BIOGRAPHICAL NOTES

Adam Wieczorek is an assistant, graduate of Economics of transport specialty and logistics of the UG Faculty of Economics in Gdańsk. He has been an employee of the Department since October 2014. In 2015, he began his PhD studies at the University of Gdańsk in Economics. Research interests focus on the issues of transport management and transport rolling stock and logistics, and in particular the definition of logistics factors shaping the competitive advantage of companies. He conducts classes in logistics, logistics in the company and operational management.