An Analysis of the Trends and Countermeasures of 3D Printing Industry Logistics Development in China

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Keywords: The logistics of 3D printing industry, Current situation and trend, Countermeasure analysis.

Abstract. With the rise of personalization and the breakthrough of printing technology, 3D printing industry is rising, which has been used generally in multiple areas and industries day by day. For the manufacturing, as well as for the logistics industry, the 3D printing is a subversive technology that can make heavily impact to the traditional production and transportation. From the perspectives of the 3D industry, this paper analyses the present situation and trend of 3D industry’s logistics and supply chain and its problems during the development. Then we have some countermeasures and suggestions about the logistic support of the development of 3D printing industry.

The 3D printing technology represents a new trend in the development of manufacturing industry, so it is predicted to promote the realization of the third industrial revolution with other digital production model. And this mode of production will certainly have a huge impact on today’s business model and production model. To catch trend of 3D printing, which is well-developed recently, logistics enterprises should keep pace with the times and adjust themselves to the 3D printing industry. This paper analyzes the 3D printing industry and the development of logistics and supply chain. Then, on the basis of it, we put forward some suggestions to develop the logistics and supply chain of 3D printing industry (§4.1-4.3). From the perspective of logistics and supply chain of 3D printing industry, we can get the reason of the rapid development of 3D printing industry, as well as the status and future development trend of logistics industry. In addition, the research on the current situation of industrial logistics with good prospects for development will help to sort out the situation and problems, put forward suggestions and countermeasures, which will have an important guiding role for the future development of the logistics industry of 3D printing industry.

The Overview of 3D Printing Industry in China

3D printing is a kind of technology based on the digital model file, using metal powder or plastic and other materials that can be bonded, to make the object by printing layer by layer. 3D printing is a kind of new printing technology, the three-dimensional printing mode to subvert the people of the past thinking, to create objects in the stacking way. As long as the raw materials, design documents and equipment, people can print out their products anywhere. It can say that 3D printing is like a bridge of the virtual world and the real world. So after designing the virtual digital network data, there can be a large number of virtual data printed into real objects by 3D printing, which can refresh human being’s view of the world.

3D printing originated in the United States. Generally, people always be curious about some new things and make some attempts. However, after 20 years’ development of 3D printing in the United States, people’s novelty may have been depleted, while the early demand has become full. Therefore, developing future demand and improving an industry cannot simply rely on people’s attempt, but become an indispensable part of people’s daily life. Only in this way, an industry can have a long-term development. This is also true for the 3D printing industry. After the popularity of 3D printers in the future and there may be one in each house, the 3D printing market will focus on the research of high-performance printing equipment and the expansion of printing supplies. Moreover there may be higher level industry chain and supply chain of 3D printing industry to provide professional services.
3D printing industry kept increasing from 1993 to 2012.

Currently, in the 3D printing industry market, the leading enterprises are basically from Europe and America. 2012, 3DSystems and Stratasys accounted for 25% of global 3D printing industry revenue. However, the Asia Pacific region is also closing step by step and its market size is in a constant expanding period, which growth rate is expected to remain above 60% in the future.
3D printing industry logistics means that the logistics supply chain to improve the service of 3D printing industry, divided into raw material logistics, parts and whole machine logistics, finished goods logistics and reverse logistics. Nowadays, with the rapid and unpredictable development, human productivity has been greatly liberated since the industrial revolution and 3D printing technology came into being in the consumer demand. In the future production and life, there may be no fixed commodity production process and consumers may be no longer required to adapt it but design the product in person. So, customers can freely print out their own design with the printer and printing materials. The old large-scale production and intensive labor and social production mode may face a huge impact which means that many enterprises will collapse and people no longer need the assembly line work.

**Features of 3D Printing Industry Logistics**

(1) The logistics development of 3D printing industry now is at the initial stage, while the scale is small, the system is not planned, and the logistics activities are scattered. With the rapid development of 3D printing industry market, the development prospect is good. Along with the development of 3D printing industry, its logistics must catch up. However, the logistics and supply chain of the 3D printing industry is not complete, mainly dependent on the original social production logistics supply chain system, not the unique supply chain system of 3D printing industry itself. On the other hand, from a macroscopic perspective, 3D printing industry logistics will become more and more professional and there will be a 3D printing industry logistics and supply chain system that adapted to the development of 3D printing industry. In this system, the separation of the supply chain will produce specialization, more specialized suppliers, and the printing enterprises will be more focused. In addition, Product design service business will become an independent special service and home printing devices will transfer to the downstream consumers.

(2) 3D printing industry keeps enriching its materials and expands the application field gradually, meanwhile, the logistics of raw materials and finished goods has begun to take shape. One of the key to the development of 3D printing industry is the research and breakthrough of raw materials, while more types of printing materials are the foundation of 3D printing. In recent years, the research on the raw materials of 3D printing has made many breakthroughs. At present, there are more than 100 kinds of materials can be used in 3D printing, including: thermoplastic, wax, paper, rubber, metal, nylon, gypsum, alloy, ceramics, edible materials, etc.. For a variety of materials procurement, transportation, processing and distribution, the 3D printing industry logistics services have begun to take shape. With the continuous enrichment of raw materials, 3D printing can be applied in more fields. So far, 3D printing has been applied in many fields, such as manufacturing, service, education, scientific research and so on. After connecting with the logistics, 3D printers are used in more industries and its products are also distributed to the application of various fields. As 3D printing industry contacting with diverse areas, its logistics links need to be improved and
changed in order to adapt to the characteristics of different fields, to provide the most suitable services in various fields.

(3) 3D printing produces in MTO mode so that the inventory management is more simplified. To be more specific, the difference of the cost of manufacturing diversity and complex products by 3D printing is small, only the consumption of different materials. Manufacturing 3D printing only consumes printing materials, which determines 3D printing will not produce excess material waste, both the production of simple single product and production of complex and diversified products. For 3D printing, no matter how complex or simple, there are only the questions about the making time and different types of raw materials, which will not increase the additional cost. Therefore, the 3D printing industry can control the material consumption and inventory management more accurately and its storage and distribution of its raw materials are also more planned and purposeful.

(4) The design space of 3D printing product is infinite, which can meet the demand of individuation, and its logistics links provide favorable support for the individual and the present manufacture. To begin with, the basic processes of 3D printing are file designing and print production. Only taking the customer demand as the premise and designing what customer truly want, the printing product can produce the proper value. For example, designers can design and modify the products according to the customer's ideas until the customer is satisfied, then print it out. In addition, designers can also innovate the products that can stimulate consumer desire and guide the consumer. A free and creative design of the product can not only make the design of the 3D printing unlimited, but also meet the needs of individual consumers.

Under the background of personalized demand, it needs a more personalized logistics supply chain as a solid backing. Among the personalized production, in addition to providing different raw materials, processing and distributing different products, these logistics links are to be able to print the product that can meet the customers satisfaction in the designing and producing process, even beyond it.

The Different between 3D Printing Industry Logistics and Traditional Logistics

Compared with traditional logistics, 3D printing industry logistics has its unique characteristics.

(1) 3D printing logistics will weaken the upstream supply chain of traditional logistics. When technology has made a breakthrough, printing time would be reduced and the 3D printing may have quantitative production in the future. But printing and manufacturing links will be more in the hands of consumers, which means that the supply chain of supply, production, transportation, warehousing and distribution will become a whole part. The logistics link between the logistics and the consumer terminal will become an important logistics service project.

(2) The transportation and storage of 3D printing materials will become the mainstream business of 3D printing logistics. When the 3D printing technology matures, 3D printing will spread to each home, manufacturing sectors will shift to the consumer side. So 3D printing materials will become the largest part of consumption and storage and transportation of this part of the project has become the mainstream of logistics service.

(3) The fourth party logistics services are going to become the darling of the 3D printing industry, and it can bring greater profit margins. When the logistics service of the supply chain is sharply reduced, the logistics industry should reform the service type and develop new service items. At the same time, the design services, distribution planning services, as well as technical support that provided by the fourth party logistics to 3D printing will have a good prospect.

Development Trend and Existing Problems of 3D Printing Logistics

The Transportation and Storage of Printing Materials will be the Most Important Part of Logistics

The transportation and warehousing of 3D printing materials in the future will become the most important part of the logistics business, for the following reasons:
(1) While the costs of 3D printing increased, consumer demand increased. In the future, costs of purchasing and installing the 3D printer will gradually decline. As it will be gradually accepted by the majority of consumers, it will promote consumers to use 3D printing. When each family has a 3D printer, consumption of machine and spare parts will become stable, and it just consume the print material. Therefore, the consumption of 3D printing materials will also become the most important part of logistics and warehousing.

(2) With the breakthrough of print materials research, more materials can be used for 3D printing. On the other hand, because of the breakthrough in the use of technology, 3D printing applications in various fields have been used in large-scale and 3D printing material consumption demand will increase significantly. From the field of material itself, with the continuing popularity of 3D printing technology, the upstream raw material production enterprises, which produce bulk commodities such as steel, chemical fiber, ceramics, gypsum, cement and stone, will be the supplier of 3D printing material. Thus, an important new logistics business areas will emerge as the times require in the future, that is, 3D printing material storage and distribution. IDTechEx, which is a well-known research company, pointed out in its "3D Printing Materials 2014-2025: Situations, Opportunities and Forecasts", the output value of the 3D printing materials like plastic and metal would reach $244 million before 2015, and 3D printing materials market will have more than $615 million output value, which obviously further confirms the potential of the logistics industry to develop 3D raw materials related businesses.

(3) The evolution of the 3D printing business model makes the manufacturing and printing links transfer to the downstream consumer side and omit the middle link. With increasingly mature development of the Internet of things and cloud manufacturing, distributed manufacturing mode of 3D printing will come true. As a matter of fact, people can manage 3D printing, finance and trade through the Internet and electronic equipment, and even mobile device. On the other hand, manufacturing and printing links will be gradually transferred to the industrialized enterprises and the consumers who manufacture daily consumables. Logistics can also send the printing material to the user. The further innovation of 3D printing business model will make 3D printing logistics change the previous business service model and focus more on the semi-manufactures distribution.

Logistics of 3D Printing Finished Goods Distribution will Gradually Reduce

Now as more and more small 3D home printer to enter the market, as well as the development of the Internet and the Internet of things, remote off-site operation will become more and more popular. In the future, many design documents of consumer staples can be downloaded from the Internet and then handed over to the 3D printer to print. So these products no longer need logistics. Meanwhile, the enterprise just need to place 3D printers and materials in the production workshop, then they can print parts and assemble automatically. This model will obviously bring huge time and economic benefits for the manufacturing enterprises, but also dislodge the necessity of the global parts warehouse. Parts logistics business will also be significantly reduced. Therefore, with the installation and popularization of 3D printers, while manufacturing end and consumer end will overlap, its terminal distribution will become redundant, which can only be eliminated in the progress of the times.

Reverse Logistics for 3D Printing Materials and Finished Goods will be More Perfect

3D Printing is Based on Customer Demand for Order Manufacturing. Which let 3D printing reduce a certain enterprise inventory. In many of the traditional production process, we manufacture products through cutting, carving, grinding and other methods, which will make the material in the production gradually reduced, then cut and shape finally, known as the reduction of material manufacturing. But 3D printing belongs to additive manufacturing, in the production process it only needs to add materials, use printing material accurately, and produce quantity. Different from the traditional "reducing material manufacturing" that produce a large amount of material, 3D printing can reduce material waste and majority of the material that need to be recycled by reverse logistics. For example, in the process of jade manufacturing, from the molding to the sculpturing and burnishing, they are in the process of reducing the jade material. Although the recovery rates of
different types of raw materials are not the same and the reuse rate is not high, 3D printing can end the waste of materials at the process of manufacturing and simplify the link of material recovery. In addition, majority of 3D printing materials can basically be fully recovered and re-use. So, the waste of 3D printing products is almost zero. This environmentally friendly processing methods are quietly changing the traditional manufacturing process.

**The Business Model of 3D Printing Industry Logistics Tends to be Simple**

Providing a wide range of services for enterprises to obtain benefits, the traditional logistics is a multi-channel profit industry. Traditional professional logistics provide the basic transportation, warehousing, packaging, distribution and other services to reduce business costs and improve customer satisfaction, as a role that optimizes the supply chain. Logistics has become the third source of profit for enterprises to create potential value. However, in the era of 3D printing, it does not need the complex JIT distribution, also does not need complex management of material or product category, while the global logistics scheduling is decreasing gradually. Therefore, many traditional logistics business have been weakened, while the rest main business may be only simple warehousing and distribution services. At the same time, due to the reduction of value-added services, the competition between the logistics enterprises will deteriorate, and the logistics industry will further reduce the profit margins.

**Weaker Storage Function, and Higher Efficiency in Loading and Unloading Transportation, and Other Links**

When the 3D printers popularize to the production enterprises in the future, products are produced by 3D printing according to orders. Producing products in strict accordance with the demand will reduce the printing materials and goods inventory level greatly, but also make all kinds of supply chain and logistics enterprises to reduce dependence on inventory. It weakens the functions of logistics and warehousing in the 3D printing industry. At the same time, the relatively complex logistics business such as loading and unloading, packaging and handling links will be simplified and have a significant improvement of efficiency.

**The Fourth Party Logistics Develops Rapidly and Supporting Services Improve Gradually**

Affected by the development of 3D printing industry, its logistics and supply chain will also continue to reform, so the original logistics services have been unable to adapt. Thus, 3D printing supply chain will breed new service projects similar to the fourth party logistics company. The fourth party logistics business will no longer be simple and mechanical transport, distribution, processing and circulation, but the organic integration of software development, model design, transportation services, partner relationship management, contract management and brainpower. These new logistics companies will provide customers with demand planning, manufacturing, transportation, market monitoring, parts management, recycling, reverse logistics services and other new business. In essence, they are different from the traditional third party logistics enterprises that provide professional service, and the fourth party logistics will become a "one-stop" service provider of product’s lifecycle management.

**Problems in the Development of 3D Printing Logistics**

(1) Lacking of macro co-ordination and planning. At present, China's 3D printing industry is still in the early stages, as the tracing phenomenon is very obvious and its own industrial base is weak. So, compared with the developed European and American enterprises, China's 3D printing industry is still lag and many resources are completely dependent on importing. What’s more, the lack of 3D printing talent and technology is more serious. Although some enterprises only have brief period of enthusiasm, and go with the trend, many other companies gradually began to engage in 3D printing and the relative 3D printing industry business. In the 3D printing quietly rising stage, there are not enough professional suppliers and service providers in the supply chain system. Not only that, the 3D printing market platform includes third party testing support, financial support, e-commerce,
intellectual property protection and other support is relatively scarce. At present, 3D printing enterprises in China are still at the primary stage of development that develop on their own, while the industry integration is low and there aren’t major breakthroughs in technology research and development. So the popularization and application are unable to start. And the situation of industry sustainable development is worrying. If the development of an industry does not have macro co-ordination and planning, it just as general sanders and there is no cohesion. Therefore, it is very difficult to break the siege on its own.

(2) The convergence of industrial chain and supply chain is not harmonious. In recent years, China’s 3D printing industry chain has been basically formed, but the development of each aspects is not balanced. For example, printing equipment, laser scanner, 3D print data acquisition has developed rapidly, but 3D printing materials and printing software development will be a drag, which is now the short board of the hold industry development. Due to the 3D printing industry is still in the early stages of development, the main tasks are installing infrastructure. And early people’s curiosity and reaching of 3D printing let the time of people use the machine grow slowly. So now the logistics is mainly aimed at delivery assembly of 3D printing equipment and purchasing of raw materials. At present, Chinese 3D printing enterprise scale is small, and the technical aspects of research and development and the promotion of demand has not been a major breakthrough, the international competitiveness of the industry is small. Finally, the 3D printing industry market size is small, the slow growth of its demand is still unable to stimulate the development of the industry, not to mention its development of the logistics industry.

Logistics Development Countermeasures of 3D Printing Industry

Building Intelligent Logistics Compatible with 3D Printing by Mining the Potential of Big Data

3D printing industry logistics more emphasis on information and intelligent construction. In the era of data explosion, it is an important direction of information technology and intelligent building. Big data, also known as the huge amount of data, refers to the huge amount of involved data that cannot be extracted and sorted out the effective and critical information within a reasonable time through the current tools or means. The process of 3D printing products generally includes four parts: order acquisition, 3D file design, 3D printing production and logistics distribution. In this process, the logistics enterprise is a bridge among designers, consumers and manufacturers. It can collect a lot of data and information on the 3D printing market demand and consumer preferences. If the logistics enterprises can carry out the full analysis and management of massive data and mine the potential information in the big data, they can keep pace with the times to build itself into intelligent logistics enterprises. So that it can seize more market opportunities, optimize of logistics services and continue to create value.

Expanding the Type of Business and the Developing the Fourth Party Logistics

In the context of the fierce development of the 3D printing industry, its logistics model will be greatly simplified and the type of service dramatically reduced. So it is necessary to develop some new logistics services in order to adapt to the development of 3D printing. To avoid weakening the function of logistics enterprise, we need to realize the difference operation and be different from the traditional logistics. The 3D printing logistics industry need the early development of 3D printing design and software services, the medium development of materials purchasing and transportation warehousing services and later processing service. For example, in the 3D printer update period, the assessment service of the 3D printer was came up. The tester designed the model or download it from the Internet, then printed it out through the 3D printer and record some parameters in the process of printing. After printing, the tester should measure the printing accuracy, printing time and the effect of printing. Finally, analyzing the data of all kinds of records and writes the evaluation report of the test and evaluate the performance of a 3D printer. This new type of service quietly popular in the printer vendors. In the early development of the 3D printing industry, there are many
unclear systems and regulations so it needs to constantly develop systems and standards. The 3D printer evaluation services make a variety of businesses that produce machines become more standardized, and the 3D printer performance and products can also have a standard measure. Therefore, the innovation of logistics services continue to emerge under the influence of the development of 3D printing industry. Only continuous innovation can adapt to the development of 3D printing industry, in order to increase the core competitiveness of the logistics service enterprise and it will not be eliminated by the times.

Establish a System of 3D Printing Industry Logistics Supply Chain Network to Achieve the Overall Planning

The development of an industry needs systematic planning and support. If allowed to its natural development, the outcome may not be the best. If a new industry can develop in a planned way in its early stage of development, we can make the development path of it more disciplinary, also make the development of enterprises to adapt to the development of industry and era, more critical is that the facilities and services of the whole industry can be synchronized with the development of the industry itself. The supply chain plan of 3D printing industry needs to be planned orderly in the development of 3D printing industry. Only establishing systematic 3D printing supply chain and new logistics mode can complement each other and jointly promote the 3D printing. The establishment of a new supply chain and logistics service system to adapt to the development of 3D printing is not only for the development of logistics, but also to do a strong backing for the overall development of 3D printing industry. With a system of supply chain and logistics system, the development of 3D printing is equivalent to grow wings. From the service of spare parts procurement and transportation, the 3D printer assembly, model design; to the printing materials storage and transportation, printing products processing and circulation; even the reverse logistics of printing products, can circulate smoothly between suppliers, manufacturers and consumers. Not only that, the system of 3D printing logistics and supply chain system can eliminate the consumer's psychological resistance to new things and promote their consumer demand. Whether the machine, parts and printing materials logistics or reverse logistics of products, integrated logistics system makes the 3D printing industry products circulate faster among suppliers, manufacturers, logistics providers and consumers, more system and reduce the error on the way, so as to promote the development of 3D printing industry.

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