

Association crafter approach with technology: Customized product design with 3d printer

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Abstract

Before the industrial revolution, production had been taking place on the basis of craft, products had been designing and producing specifically to people. In time, diversifying and expanding consumer needs had led to the evolution of mechanical production to the production of hand. The mass production associated with the industrial revolution had made it possible to produce many of the same products and cheaply. Initially, this new mode of production made easier to be able to access the objects but eventually human beings covered with surrounding objects had led to emergence concept of "man-made world" and began to look for new ways to get rid of the uniformity of mass production. This quest had emerged the concept of "mass customization". Companies wishing to increase user satisfaction began to offer personalized services and products to users. However, this can be done within certain boundaries in the traditional manufacturing approach. Today, 3D printer, which is a revolution in the production technology, a new way to produce Customizing products. It becomes possible to produce custom designed products just a craftsman with sensitivity quickly. This study aims to investigate the relationship between 3d printer with customization and detection future application areas.

Keywords: Product design, 3d printer, Mass production, Customization

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1. Introduction

According to Cox (2015) , “Craft is usually taken to mean an object which has a high degree of hand made input, but which is not necessarily made or designed using traditional materials.” input, but which is not necessarily made or designed using traditional materials.” the desires and expectations of customers with hand workmanship. The construct of a product in craft production was shaped according to the materials, hand workmanship and skillfulness of craftsmen. This situation was realized on one person for the design and process of making products and was concluded with leaving the effects on a product of personal knowledge and experience. In time, the consumption needs increased in variety and the number of products that would be produced started to increase. The new consumption needs that continuously broadened and became varied paved the way for production to evolve from hand workmanship to mechanical production (Ekmekçioğlu, 2012, quoted from Heskett, 1987). The perception of craftsman production remained insufficient on the subject of meeting these new and increasing needs and as a result of this, the concept of “mass production” emerged.

Mass production that had the attribute of a revolution in the automobile industry and that was put into practice completely by Henry Ford in 1913 provided important advantages in a short period of time (Çetin, 2006). This system that was based on the perception of the standardization of products and production processes, while it decreased the periods of assembly and costs, it increased the production capacity and became the dominant production system by spreading rapidly throughout the world. The principle of standardization has also been used extensively in the fast food sales enterprises, such as McDonald’s, and in the banking and financial sectors (Akgeyik, 1998). Even if this form of production, which has continued its reign throughout the years, made it easier to attain objects, it reached its final limits in time. Consumers who wanted to be rescued from the sameness of mass production, entered into a search for different products and services that met their personal expectations. To manufacture products that meet personal expectations could be possible with individualized mass production. However, individualized mass production can be made in definite limits within the perception of mass production. The perception of “individualized mass production” arose in the form of a low level of individualization and products with standard sub-parts and processes that would lower the costs.

The development of the perception of individualized mass production felt a need to be fed from the scientific developments and the new technologies. The essence of technology is based on the struggle of humans with nature. The effort of humans to exist in nature has required striving to attain a method for life throughout their existence. Harmony with nature and the formation of a manner of resisting nature expresses a contradiction. The overcoming of this contradiction makes the aim of existence definite. Whereas, this aim, with the life principles obtained, in other words, it is shaped with methods. The use of the opportunities of knowledge defines the formation of the concretizing of technology by reducing it to a practical life level. In other words, science, which is an abstract concept, attains a concrete identity with technology. Even more science produces even more technology. It can be stated that a prolific loop is constituted between technology and science (Göker, 1995). This loop and change created a new world that included technologies giving 3-dimensional physical outputs. Today, 3D printers have entered into our lives with the development of computer-aided production technologies. 3D printers, without the need for any model, have been transformed into a 3-dimensional physical products by performing an electronic detail with different techniques that is prepared in a computer environment. This technology that is superior to the traditional production methods from many aspects, has an important potential from the aspect of individualized production. The developments in this direction have opened and are opening the way to changes in many traditional processes and work definitions. Finally, it is possible to mention a new production process. It has become possible to produce in a rapid manner the individualized design products with a new perception of production.

With this study, the transformation of the production systems and relationship between individualization and inclusion within the production systems of the 3D printer technologies has been

examined and evaluations related to the process on companies that make individualized product design and production with 3D printing have been realized.

2. The Process of Transformation in the Production Systems

Production is a human activity that emerged as the result of human needs not being met completely by nature. Even if production is defined by economists in the form of creating a benefit, according to engineers, it is the process of making an added value change on a physical thing or of transforming a raw material or semi-finished goods into a useable condition. Whereas, this production system can be defined as a system that with a transformation unit of raw materials and/or semi-finished goods brings them to the condition of a product (Karaca, 1996). The production systems have also encountered change with the requirements of the time and developments in technology.

2.1. The Handicraft Style Production System

The handicraft style is known to be the oldest of the production systems. Craftsmanship that is the same age as the first stone implements of human beings, is related to the making of objects that provided for being able to maintain life easier. This production type of humans was included within the culture that started to produce in response to nature and at the same time, has also continued to be a lifestyle of those who are engaged with this work up until the present-day (Doğan, 2012). In the craft type production, products are designed in the direction of the desires and expectations of customers and are produced with hand workmanship. When mentioning crafts, besides their being hand labor, it is also possible to mention a learning process. Furthermore, it is based on measurements made on the necessity of a learning process of approximately ten thousand hours' experience for attaining mastery (Sennett, 2009). This production system, although it is a superior production system from the aspect of sensitivity to customer desires, suitability to customer in design, flexibility and product choices, the production capacity and speed is very low and the cost is high. Consequently, the craftsmanship type production remained insufficient on the subject of meeting the increasing and varied consumption needs with the developing technology in time, the multiplication of the number of products that needed to be designed together with the acceleration of production and consumption. The mass production concept emerged along with standardization and within the thought of management rationality that acquired importance around the beginning of the twentieth century as a solution to the high cost, not being able to produce standard products and limited capacity problems brought by the handicraft production style (Agrawal and Hurriyet, 2004).

2.2. The Mass Production System

The mass production concept emerged with its becoming necessary to make new ideas and methods due to the fact of the low capacity and of the products being very expensive in the handicraft production style. The proposals related to "division of labor and specialization" by Adam Smith and the proposals related to standardization in production and useable parts in place of each other by Eli Whitney, the foundations of mass production were constituted (Çetin, 2006). Along with capitalism and mechanization, industry based on maximization of profits took the place of the craftsmanship type production form and the process of the mass production of goods started (Bıçakçı, 2008). Henry Ford put mass production completely into practice. In Henry Ford's activities that started in 1913, he had two basic aims: to increase production capacity and at the same time, to reduce costs. He developed new and effective methods, such as part design in a manner that would provide for the ease of manufacture, standardization of jobs and moving bands (assembly lines) for reaching these aims (Akgeyik, 1998). Henry Ford, who opened a trend in the world of production as an innovator of the mass production method by discovering the assembly line, expressed in a concise manner the basic principle on which mass production was based with the slogan, "You can have any color as long

as it's black" (Bardakçı, 2004). Although the production speed and capacity are high in mass production, sensitivity, suitability and flexibility to customer desires are low. Finally, in the present-day world of objects, it is insufficient to produce high quality and inexpensive products that are only the needs of the users. Users who want to be rescued from the sameness of mass production, expect more than sufficient functions, high quality and low costs. Mass production not answering the conditions of a changing market caused new production perceptions to arise that could answer needs.

2.3. The Individualized Production System

The concept of the individualized production was first defined by Davis (1989) as to produce products and/or services that are suitable to the individualized desires of every individual and that would meet the individual needs (Silveira et al., 2001). Individualization approaches individuals in the form of the customer is not like any other customer, every customer has different expectations, different tastes and needs (Çetin, 2006). Individualized mass production is a production structure that can make production with high productivity and high speed, such as in the mass production of individualized products in the form of small consignments and with the aid of advanced manufacturing technologies and modern information technologies. Thanks to this structure, while it benefits from the speed and cost advantages of mass production, thanks to the personal products, it can create customer satisfaction. The best example of individualized mass production is the Dell Computers Company. When a consumer wants to purchase a Dell brand computer, he/she enters the Internet and can designate the features of the computer he/she wants to purchase. The computer having the features designated by the Dell customer is delivered within 5 days. This feature has been very effective in an increase in the competitive strength of Dell. Pine (1993) defends that the individualized products are more effective compared to standard products in providing customer satisfaction. According to Pine, customers do not want product choices, they want products that meet their needs completely. Within the framework of these developments, in the present-day, the interests of enterprises for individualized mass production have increased rapidly with the objective of increasing customer satisfaction (Soyuer, 2005). However, this system can make products that have standard sub-parts and processes in a manner that lowers cost and with a low level of individualization with the traditional production methods. It could be possible with developments in the production technologies to be able to raise the level of individualization.

2.4. The Computer-aided Production System

Computer-aided production is a form of production that has emerged with the developments in production systems and technologies. In parallel with the developments in computer technologies, the computer production processes have been included in time. All of the design-production activities are carried out by computers. Products with a high level of quality can be produced with this production system. Furthermore, the period of products waiting at the enterprise have been reduced to a minimum level. This system requires the use together of systems, such as computer-aided design, computer-aided production and computer-aided engineering. Carrying out of all of these activities through computers in a manner connected to each other provides for the realization of these activities in a short period of time (Gersil, 2007).

3. The 3D Printing Technology and the Production of Individualized Products

The 3D data of any electronic detail designed with the assistance of computer-aided design (CAD) programs without feeling the need for templates, models and other tools and materials and by using a 3D printer, is sent to the machine and the 3-dimensional physical part manufacturing is made (Yılmaz et al., 2013). On the other hand, in the existing production methods, it is mainly subtractive production or intensifies as machining. Materials are removed from the main mass for constituting the object with these methods and the raw material takes its form with the milling, lathing, cutting and other methods. However, objects are constituted with fewer losses with 3D printing, moreover, in general, only the required material is used for constituting the object (Prince, 2014). Terry Wohlers, the chief advisor and chairman of the Wohlers Company, which is a 3-dimensional production company, stated, "If you are making milling manufacture, it is not unusual to discard as scrap-remnants 80-90% of the materials you used" and concretized the comparison (Yılmaz et al., 2013)

The 3D printing technology has passed through a 3-stage evolvement. In the first stage, architects, artists and product designers used 3D printers for making prototypes and mock-ups of the new products. The second stage is the use of the 3D printers for the final product manufacturing. This stage is also called "direct digital manufacturing" or "rapid manufacturing" (Berman, 2012). This stage is the period we are passing through at present. In many places in the world, the 3D printing is not only for the prototype, it has also started to be made for the final product manufacturing. It is projected that this will increase in the upcoming years. Whereas, in the third stage, the final users will have and use 3D printers, just like laser printers (Berman, 2012). Today a large number of reviewers are of the opinion that a small number of persons will have a 3D printer and that the demand for 3D printers will be limited (Barnatt, 2013). According to Barnatt (2013), in a period of perhaps 20 or even less than 10 years, a majority of persons in the developed countries will use 3D printers regularly to manufacture their digital designs or will purchase the products or spare parts manufactured for them by others

A reduction in the prices of 3D printers and the services becoming more reachable has produced many new areas of use. Individualization for the masses is in the lead of these (Acher et al., 2014). Users with a 3D printer can contribute to the design process of products and thanks to this, products can be manufactured that are suitable for external appearance, individuality and tastes of the users. The perception of standardization that came together with the perception of mass production created objects designed and manufactured for standard persons.

However, every person has different physical structures and tastes. Following the Industrial Revolution, a majority of the time craftsmanship was perceived as a production type belonging to the past within the changing perception of production. Whereas, the reason lying behind this perception is the dominance in the markets of the single type of products emerging from a factory production system. No matter how much the products in the showcase are conspicuous for their broad spectrum, it is known and accepted that a great majority of these products manufactured in factories are not single and unique. In other words, the fact that the attributes are not single and unique and that usually, the price of the product is low, is excused with its being economical (Doğan, 2012). Craftsmanship could be observed as a former lifestyle, such as a production type dethroned with the Industrial Revolution or produced by the materialistic culture belonging to the past. No matter how much the machinery production that took its place provided for the products for which a need was felt more rapidly and manufactured inexpensively, the interest and need for craftsmanship could not be abolished completely. The perception of approach in the form of individuals for which every customer has different expectations, tastes and needs in the craftsman production type, by uniting with the 3D printing technology, has once again found a place in our lives.

4. Examples of Companies Engaged in Manufacturing Individualized Products with 3D Printing

The individualized final production with 3D printing is a production method that has started to be implemented by different companies in many places in the world today. In this study, examples of companies engaged in the design and manufacture of individualized products with the 3D printing technology have been examined and it has been disclosed how and at what level the companies have realized individualization.

Protos Eyewear: Protos Eyewear is an eyeglass company originating in California (Fig. 1). The company acts with the perception of designing and manufacturing the most suitable eyeglasses to the face measurements and shapes of persons. John Mauriello, the founder of Protos, emphasizes, “The fact that the features of persons are very different makes even a change of only 1 millimeter important.” First of all, the user sends photographs of the front and side appearances of his/her face to the company and a selection of frame is made on the interpretations and style proposals coming from the company. Subsequently, eyeglasses are manufactured with 3D printing with the algorithm used and by designing eyeglasses suitable to the facial measurements of the person.

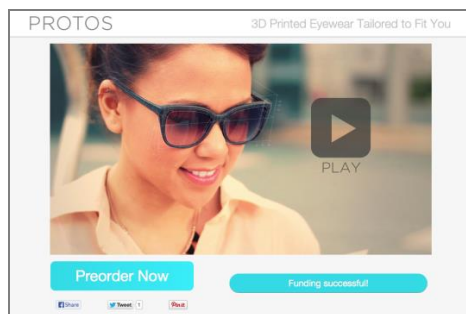


Fig. 1 . Protos Eyewear web page (www.protoseyewear.com)

Spexy Me: Spexy me is a company manufacturing eyeglasses with individualized 3D printing (Fig. 2). First of all in the process, the customer sends to the company a photograph of the front appearance of his/her face and the frame, lens and color selections are made. The face of the user is scanned with a 3-dimensional scanner and individualized eyeglasses are designed that are suitable to the measurements of the person. Subsequently, the user eyeglasses are tested virtually and are manufactured with 3D printing. The delivery period is 2 weeks.



Fig. 2 . Spexy me web page (www.spexyme.com)

Sneaking Duck: Sneaking Duck is an eyeglass company. It presents the opportunity of individualized eyeglasses with 3D printing, even if limited (Fig. 3). The user selects one of the 4 kinds of eyeglasses and color manufactured with a definite 3D printing. Subsequently, the length of the eyeglass frame temples or arms is determined. Furthermore, the company also has the possibility of writing the requested writing on the frame temples or arms.

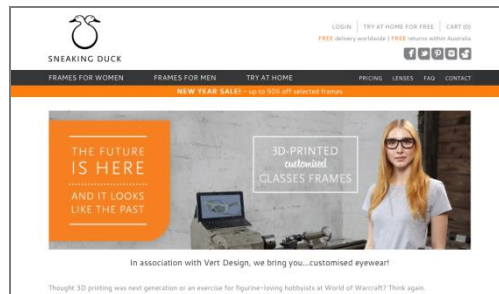


Fig. 3 . Sneaking Duck web page (www.sneakingduck.com)

Eyewear Kit: Strategically, the company aims to reach more persons. The brand is manufactured with eyeglasses for prescription eyeglasses, sunglasses or indoor eyeglasses with more economical solutions. Furthermore, the 3D printing technology is used for every part of the eyeglasses, the lenses, frames and individualization. The company also presents the opportunity of individualizing a person’s own eyeglasses with an application given the name of “eyewear design kit” (Fig. 4).

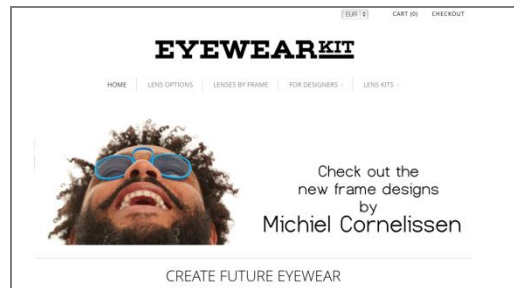


Fig. 4 . Eyewear kit web page (www.eyewearkit.com)

Own Phones: Own phones is a company that makes wireless earphones with 3D printing suitable to the ear structures and individualities of the users {Fig. 5 (a)}. Their aims are to design and manufacture earphones that will not come out from the user’s ear no matter what the activity. First of all, for this, the user takes a video of his/her ear by using the Own application. Subsequently, this video is transformed into 3-dimensional data and earphones suitable to the ears are designed. In this process, the design and color preference can also be made {Fig. 5 (b)}.



Fig. 5. (a) Own Phones web page ; (b) Own Phones individualized wireless headphones (www.ownphones.com)

Normal Earphone: Normal Earphone is a company that makes individualized cable earphones with 3D printing suitable to the ear structures of the users {Fig. 6 (b)}. First, the user sends the photograph

of his/her ear via the Nrml application. Preferences are answered for the design variables on the application. The individualized earphones {Fig. 6 (b)} are delivered within 48 hours.

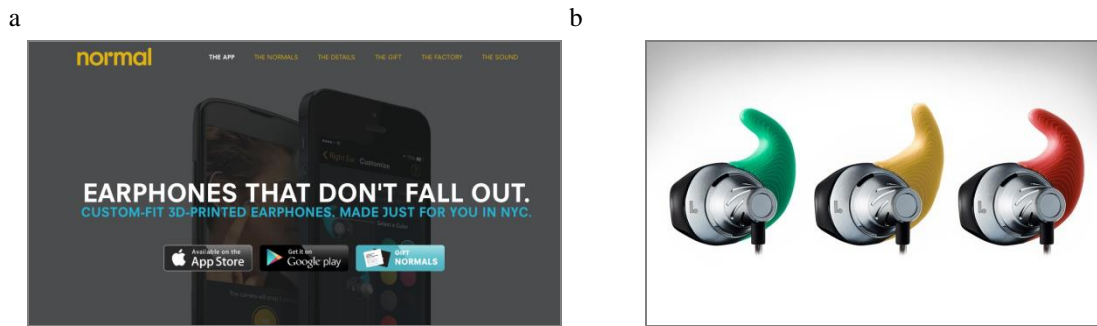


Fig. 6. (a) Normal Earphones web page ; (b) Normal individualized wireless headphones (www.nrml.com)

Feetz: Feetz is a company engaged in the design and manufacture of individualized shoes with 3D printing {Fig. 7 (a)}. The Feetz customers scan their feet with an application called “feetz up” and with a digital code they developed and gave the name of “Size me” provides the maximum suitability to the feet measurements and shape. Information is also obtained for the daily activities and lifestyle of the user. Subsequently, the color, shape and material selections are made {Fig. 7 (b)}. The shoes that are manufactured with the 3D printing technology can be delivered within 7 days.



Fig. 7. (a) Feetz shoes web page ; (b) Feetz individualized beach shoes (www.feetz.co)

Sols: Sols is a company that manufactures soles for shoes with 3D printing that are most efficaciously suitable to the feet of the user {Fig. 8 (a)}. The company works with the perception that even if the lengths of feet are the same, the feet structures are different. First of all, the user takes the video of his/her feet by using the Sols application. Subsequently, the models of the feet are constituted and then soles {Fig. 8 (b)} are manufactured with a 3D printer from antibacterial and light plastic that are suitable to the feet.

a b

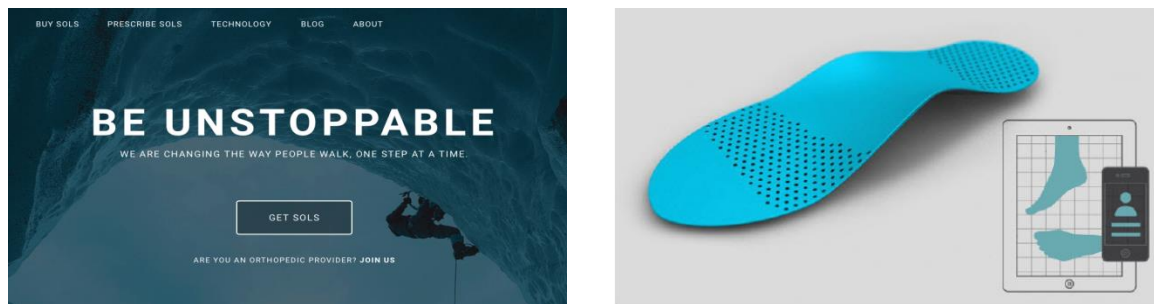


Fig. 8. (a) Sols shoes web page ; (b) Individualized sole example (www.sols.com)

Suuz Jewellery: Suuz is a company that manufactures individualized jewelry with 3D printing {Fig. 9. (a)}. The perception of the company is expressed with the sentence, “Personal is better.” First of all, the user selects one of the pieces of jewelry that can be individualized. Subsequently, by individualizing online the features, such as color, material, the writing to be written on it and shape, it can be seen immediately in 3-dimensions and an order can be placed {Fig. 9 (b)}.

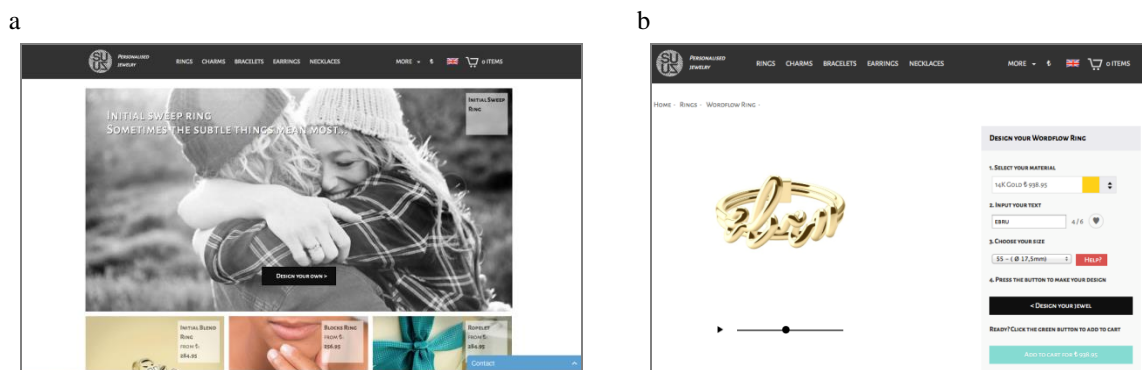


Fig. 9. (a) Suuz Jewellery web page ; (b) Suuz Jewellery individualized example (www.suuz.com)

5. Evaluation and Discussion

The most important difficulty encountered in design is the need to benefit from existing knowledge for estimating the future and to reach a successful result to the degree of accuracy of the estimates. Estimating the future, creating the design product and results are continuously in the state of formation within each other. It is rather difficult for the designer to be able to conform and to be able to change his/her ideas and thoughts quickly to continuously changing aims. The success of design products are also made more difficult to this degree. The limitations in the craft production, the becoming worthless in spite of abundance in mass production, the use of mass production capabilities in manufacturing, and the rapid and individualized solutions make them worthy of discussion.

The technologies used for mass production were the cause of great changes for the world of products and this technological development as a very strong factor reached a strength that crushed the craft production. Craft products were constrained, both in finding their value and in providing sufficient gains for the producers. Whereas, mass production stands face to face with the results of not being able to apprehend the opportunities presented by craft products. The experiences encountered in both directions include advantages and disadvantages for both production processes. The new world, besides having the technological infrastructure and opportunities, has production systems that could aspire to unite the strong aspects of both sides with the communications network

it presents. The individualization opportunity presented by craft production can be carried to the technological processes.

The place of the 3D technologies, which are also the subject of the study, is important within the changing production systems. The individualized final product manufacturing with 3D printing is a production method that has started to be implemented at many places in the world today. The research studies made within the scope of the study give an idea about with what sort of development this production has occupied a place. Personal tastes, such as in the application areas of fashion, jewelry and accessories of the individualized product manufacture with 3D printers are important sectors and sectors where both tastes and physical measurements are important, such as eyeglasses, earphones and shoes, have come into the forefront and it is observed that there has been an increase in this direction, especially in the eyeglass companies.

A great majority of the companies examined present the opportunity of individualization with interactive applications. This opportunity has the attribute of the integration to the technological process of the user interaction having the chance to be able to establish a direct communication with the producer in the craft production. The web-based interaction process is in the forefront in the examples examined. On the other hand, the applications realized through direct meeting with the customers of the companies having these technologies have become concentrated. Here, the detailed needs of the production needs are the determinant. This situation can be interpreted in the direction that the web-based development could be easier and more rapid from the aspect of the taste-focused sectors.

While the individualization level of some companies is high, some companies present the opportunity of individualization as styling on the basis of measurements on standard models. In case there are series products of the brand, it can also be thought that there could be a major factor in the marketing of small differences that would provide for individualized products with 3D printing. When it is evaluated on the marketing strength and price effect of a special expression processed on shirts or on the frame temples or arms of eyeglasses, then it can be asserted that this technology will have a significant strength. Furthermore, it is observed that the delivery periods of the individualized products have been shortened to some extent and do not create an important weakness.

In conclusion, when it is evaluated within the scope of the new technologies and the communications network, the inputs that would be provided by the individualized products are still at the beginning level. However, it sets forth the assertion of an expanding system for the near future with an increase in the examples and enrichment of the contents. It is not easy to estimate under which headings and at what level the development will be, but it appears to be important to follow the developing technologies and to continuously research the opportunities that could be provided for the sectors. This development is a candidate for becoming new openings from the aspect of many companies and sectors and for the basic components of holding a strong place in the market.

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