



ROLE OF DIGITAL PRODUCTION TECHNIQUES IN FURNITURE MANUFACTURING

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Abstract

Furniture emerged with the most primitive form of life, and it maintained its importance as a significant part of everyday life according to people's needs. In particular, there were developments in production techniques when societies became sedentary. As a result, furniture production and its use became widespread. Later on, in terms of quality more complicated and more developed furniture were produced than before thanks to the opportunities provided by the developments in production techniques. As to in our day, the widespread use of computer aided design and digital production concept has a serious effect on furniture production. Today these technological innovations enable furniture manufactured with quite different methods from half a century ago as can be manufactured more in quantity, more quickly and almost without any error probability. Digital production techniques, which provide this opportunity and still develop, enable more complicated designs to be manufactured by taking into consideration the requirements of the indoors. In this context, it is thought that computer aided design and digital manufacturing systems will develop and provide innovative opportunities in the future.

Keywords: Furniture, Computer, Digital Production Techniques

MOBİLYA ÜRETİMİNDE DİJİTAL ÜRETİM TEKNİKLERİNİN ROLÜ

Özet

Mobilya, yaşamın başlangıcı ile beraber en ilkel haliyle ortaya çıkmış, insanların ihtiyaçlarına uygun olarak sürekli geliştirdikleri gündelik yaşantının önemli bir parçası olarak her zaman önemini korumuştur. Özellikle toplumların yerleşik hayata geçmesiyle birlikte üretim tekniklerinde gelişme sağlanmış, bunun neticesinde mobilya üretimi ve kullanımı yaygınlaşmıştır. İlerleyen dönemlerde de üretim tekniklerindeki gelişmelerin sağladığı imkanlar ile bir önceki dönemlere göre daha komplike, nitelik olarak daha gelişmiş mobilyalar elde edilmiştir.

Günümüzde ise yaygın olarak kullanılmaya başlanan bilgisayar destekli tasarım ve dijital üretim kavramları mobilya üretimini ciddi şekilde etkilemiştir. Bu teknolojik yenilikler, yarım asır önce çok farklı yöntemlerle üretilen mobilyaların günümüzde çok daha fazla sayıda, daha hızlı şekilde ve neredeyse hata olasılığı olmadan üretilebilmesine imkan vermişlerdir. Bu imkanı sunan ve halen gelişmekte olan dijital üretim teknikleri mobilya üretiminde daha karmaşık yapıdaki tasarımların iç mekanın ihtiyaç duyduğu gereksinimleri karşılayacak şekilde elde edilebilmesini sağlamaktadır.

Bu çalışmada, mobilya üretiminde özellikle çıkarma, ekleme ve biçimlendirmeye dayalı dijital üretim sistemlerinin kullanımının geçmişe kıyasla sağladığı değişimin ve avantajların ortaya konulması amaçlanmaktadır.

Anahtar Kelimeler: Mobilya, Bilgisayar, Dijital Üretim Teknikleri

1 Introduction

As global consumption concept evolved, manufacturing a large number of products with high quality has become commercial target of furniture manufacturers. In this context, system and software platforms used in digital manufacturing techniques have been developed every other day and new opportunities been created.

As a result of this, a large number of furniture with sensitive sizes and complex structures can be manufactured. Digital manufacturing techniques have an important role today for the images on designers' minds to be transformed into design, to be applied accordingly and for the furniture to be obtained.

In this context, especially removing and adding processes are mostly used in terms of digital manufacturing techniques in furniture manufacturing.

2 Manufacturing Systems Based On Removal Process

Working principle of manufacturing based on removal process of digital manufacturing techniques is removing materials from the main material. Different methods are used in removal technique. These are electronic, chemical and mechanical cutting methods [1].

In this point it should be stated that especially mechanical cutting is used in furniture manufacturing.

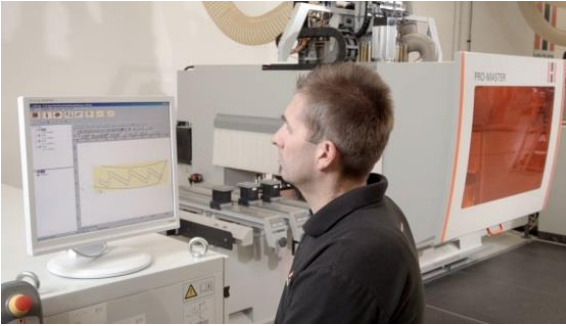


Figure 1. The process of drawing the furniture component that will be manufactured on the computer [5]

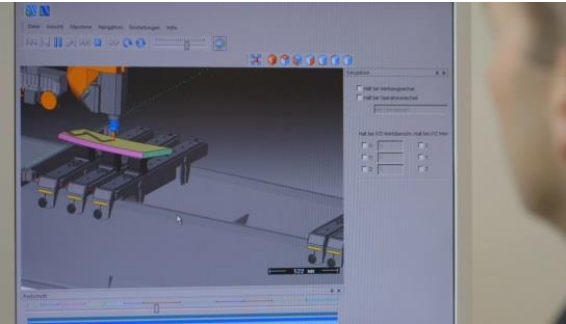


Figure 2. The simulation created by CNC machine before the production [5]

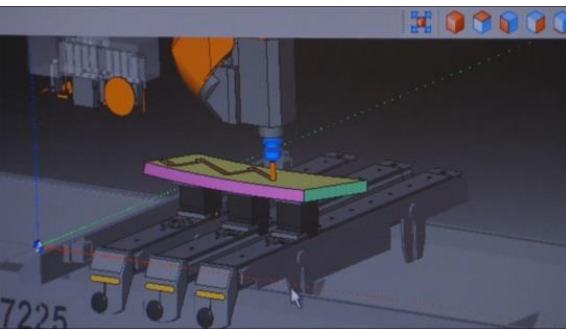


Figure 3. The simulation created by CNC machine before the production [5]

Digital manufacturing based on removal process is not different from two-dimensional cutting. Machines used for two-dimensional cutting have two axes. Cutting edge moves throughout x and y coordinations in a specific distance. Z coordination is added for removal process so that three-dimensional cut can be carried out by moving through three dimensions. But CNCs with three axes cannot create all forms. In this stage CNCs with for four, five and six axes used in machine and aircraft industry have been developed. The features of cutters which have many axes are indeed the same as the ones with three axes [2], [4].

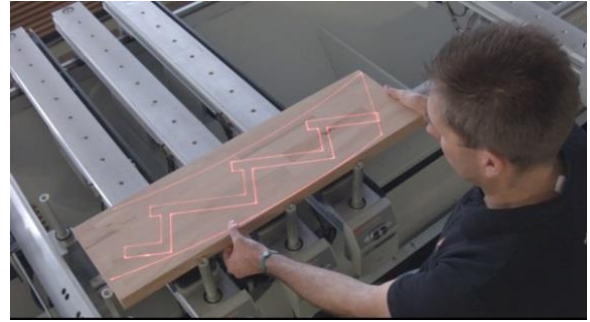


Figure 4. Placing and fixing parts into CNC machine for the production [5]



Figure 5. The furniture part manufactured [5]



Figure 6. The examination of the furniture that will be manufactured with CNC before the production [5]

But the axes can rotate in these systems. Cutters with six axes are the most developed devices in this system. Most of the organic-formed designs can be manufactured in one time [2], [4].

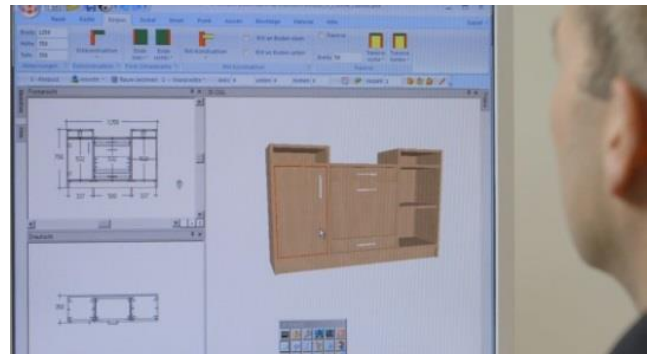


Figure 7. The process of drawing the furniture component that will be manufactured on the computer [5]

2.1 CNC Types

CNC machines used in wood structure manufacturing can be classified according to the processing head. There are types of these machines whose platforms can work in vertical axis besides working in horizontal axis. It should be classified according to axis number depending on the head movement direction. Versatile movement of the platforms allow machine to process faster [3].



Figure 8. Manufacturing on CNC with the end of saw [5]

2.1.1 CNC Machines with three axes

Machines with three axes work in X, Y, Z coordinations depending on coordinate plane. Movement is only throughout these axes. This machine is capable of doing many standard processes [3].

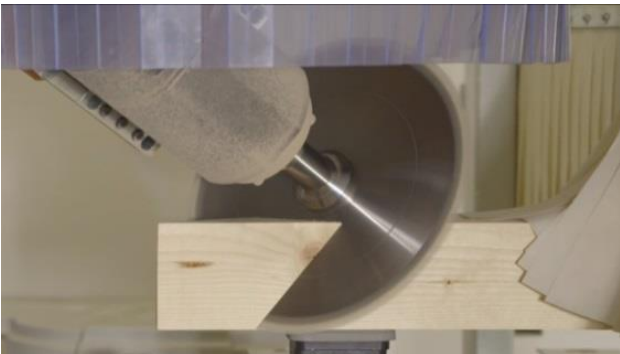


Figure 9. Manufacturing on CNC with the end of saw [5]

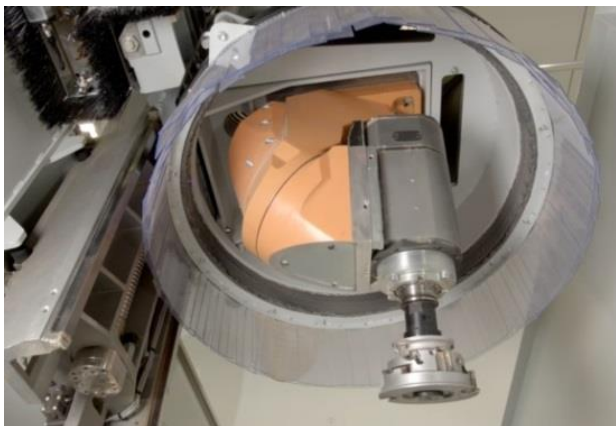


Figure 10. 5-axis CNC head [5]

2.1.2 CNC Machines with five axes

Movement capability of these machines is very developed. As well as X, Y, Z axes, they can work vertically to the work surface or in a required angle [3].



Figure 11. 5-axis CNC head [5]



Figure 12. The furniture part manufactured [5]

2.1.3 7 axle Robots

7 axle robots enabling much bigger size and more sensitivity than CNC systems which provide a working area of 400 centimeters are used in furniture production. 7 axle robots preferred for complicated circular shapes and far more details are also preferred in automobile and space industry [6].



Figure 13. Manufacturing furniture through 7-axis robot [6]



Figure 14. Manufacturing furniture through 7-axis robot [6]



Figure 15. Manufacturing furniture through 7-axis robot [6]

Thanks to the systems based on removal process, manufacturing process of furniture has been shortened and the opportunity of use of indoor elements manufactured has increased. The use of systems providing mass production allows manufacturing a large number of products with the same quality.

3 Manufacturing Systems Based On Adding Process

Manufacturing based on adding process is different from digital manufacturing based on cutting and removal processes. Adding process has three different types. First one is layer adding method which creates the object by adding layers with a specific thickness. Second is contour processing method called stereolithographic. Third is casting method which melts the material and freezes it in a mold [2]. At this point, layered manufacturing comes to the fore in manufacturing furniture.



Figure 16. Pieces of furniture manufactured with 3D printer [7]

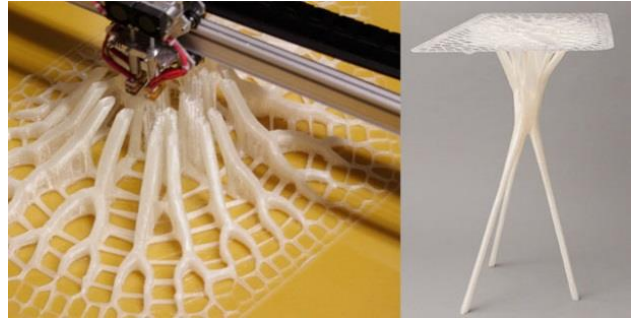


Figure 17. Pieces of furniture manufactured with 3D printer [8]



Figure 18. Manufacturing furniture with 3D printer [8]

Layered manufacturing is an expensive and limited method used mostly in prototyping systems. In this system, three dimensional printers are used. These printers create the three dimensional model formed at digital environment physically by adding dusts with 0.1 mm sensitivity on ,top the other [2], [10].

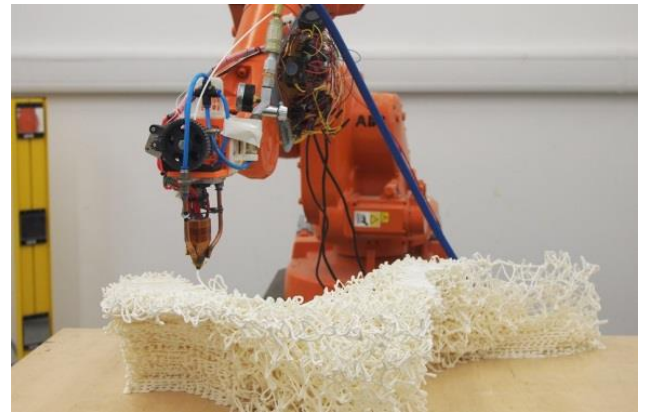


Figure 19. Pieces of furniture manufactured with 3D printer [9]



Figure 20. Manufacturing furniture with 3D printer [9]

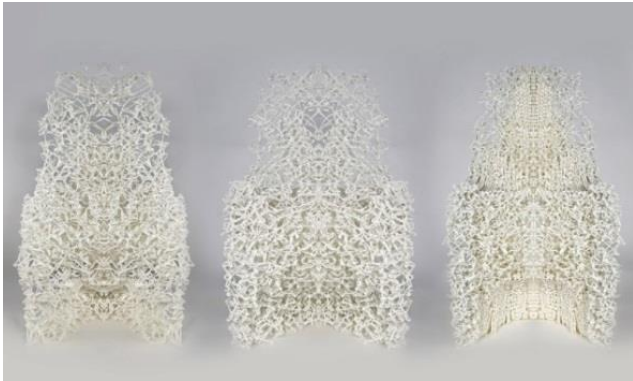


Figure 21. Manufacturing furniture with 3D printer [9]

With layered manufacturing method, a dimensional object can be copied and if it has any mechanical function, the newly created object can also carry out these functions.

4 Conclusion

Nowadays, developments related to the process of design and production of furniture, which is an inseparable part of interior space, attract attention. Furniture, which was hard to produce with production techniques that were complicated, required craftsmanship and belonged to earlier periods are now easily produced thanks to systems depending on removing and adding. Thus, designers substantially gain freedom and can put the designs in their minds into practice. In this context, when the change in today's production methods compared to those in the past is noted, it can be said that computer technologies and digital production techniques which are developing and offering vast opportunities will continue to create new possibilities in the field of furniture production in the future, as well.

5 Acknowledge

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6 References

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