

PRIMJENA NOVIH TEHNOLOGIJA U PROCESU PROIZVODNJE NAMJEŠTAJA NA PUTU KA INDUSTRIJI 4.0

THE APPLICATION OF NEW TECHNOLOGIES IN THE FURNITURE MANUFACTURING PROCESS ON THE WAY TO 4.0 INDUSTRE

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REZIME

Posljednjih godina proces proizvodnje namještaja se značajno unapređuje primjenom novih inovativnih tehnologija u procesu proizvodnje, digitalizacijom i automatizacijom procesa. Unapređenja se vrše u svim fazama procesa proizvodnje namještaja, od dizajniranja i projektiranja namještaja, preko proizvodnje do prodaje proizvoda.

U radu će se predstaviti nove tehnologije koje utječu na unapređenje kompletnog procesa proizvodnje namještaja kako bi i proizvodnja namještaja dobila karakteristike industrije 4.0.

Ključne riječi: proizvodnja namještaja, tehnologija, industrija 4.0

ABSTRACT

The process of furniture manufacturing has significantly improved in recent years through the application of new innovative technologies in the production process primarily through digitalization and automaation.Improvements have been made in each stage of the furniture manufacturing process, from designing and planning through production to sales. This scientific work is going to introduce new technologies that enable improvement of entire manufacturing process so that the process itself could develop characteristics of industry 4.0.

Keywords: Furniture manufacturing,technology,industry 4.0

1. INTRODUCTION

Working methods and conditions in the developed countries are changing considerably, in such a way that the most difficult and dangerous jobs are done by robots and specialized machines. This method comes as a result of opening new automated and digitalized factories. Mass production is slowly replaced with the desire to satisfy the needs of each individual customer. This is, in fact, the essence of the fourth industrial revolution known as Industry 0.4. This trend of innovation is slowly expanding to other countries as well. Digitalization is considered as a priority for success and survival in the global market, which is the reason why this revolution is making its way into the wood industry.

2. INDUSTRY 4.0

Industry 4.0 represents a new approach based on linking of systems through the integrated (internet) technologies. The goal is to link different manufacturing segments, especially communication between machines, workforce, different products as well as the entire business systems. 5 basic phases of Industry 4.0 are as follows:

1. Digital component
2. Smart machines
3. Vertical integration
4. Horizontal integration
5. Smart barcode

The digital component can easily be differentiated based on color shape, dimensions and stages of production. 'Smart machines' have the option of self-control, supervising and optimization. They are simultaneously communicating with a production control system as well as a barcode. Vertical integration begins in the sales department where the customer creates their order. Data with automatic instructions on the production process is then added to the order which is then forwarded to the production control system. Manufacturing done this way almost completely eliminates possible errors. [5]

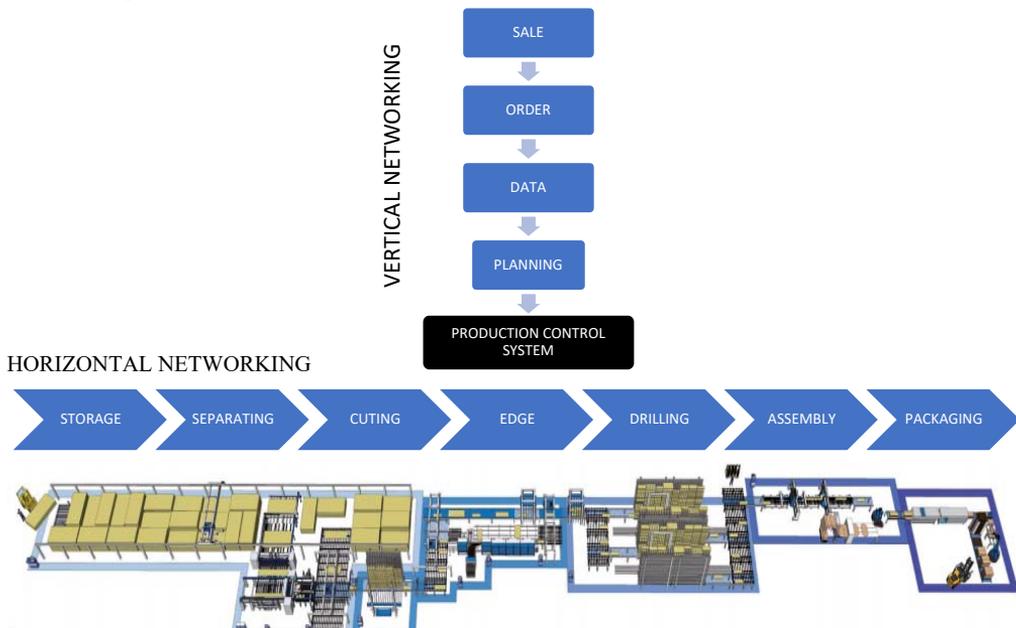


Figure 1. Vertical and horizontal integration in Industry 4.0 (Furniture manufacturing process)

Horizontal integration represents manufacturing process, that is transparent towards each supplier from material to tool suppliers. Smart barcode follows the entire process without errors, independently from other components. Applying integrated 'smart' production furniture industry is directly headed towards Industry 4.0. There are 9 technical facilitators that characterize this industry (figure 2). They are mutually integrated in a unique chain forming in such way furniture manufacturing system. Machines that lead this manufacturing process are 'smart machines', therefore, they control the process. Resources are used efficiently and according to the needs of the costumes. For this process to function without any hindrance, all components should be integrated. Information flow is well organized and supervised through the control system.

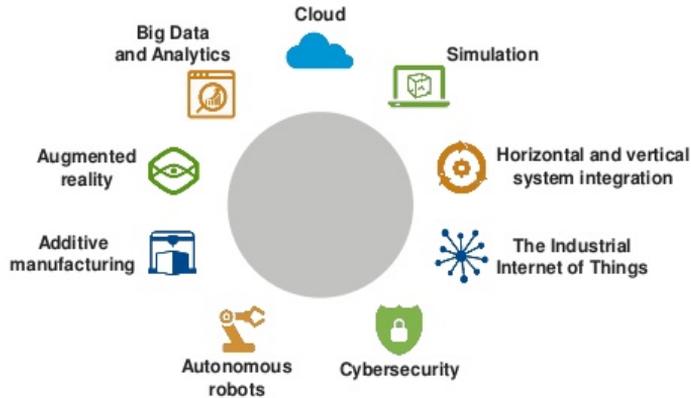


Figure 2. The technical enablers of Industry 4.0

Key component of this kind of production is the barcode as it contains instructions that the machines should follow. Every barcode is unique. It is generated through virtual technology with parameters required for the machine. As it is generated the barcode is assigned a code so that it could be tracked in the manufacturing process. At the beginning of the process, 'smart storage' recognizes material needs so that the manufacturing process can go on without a hitch.

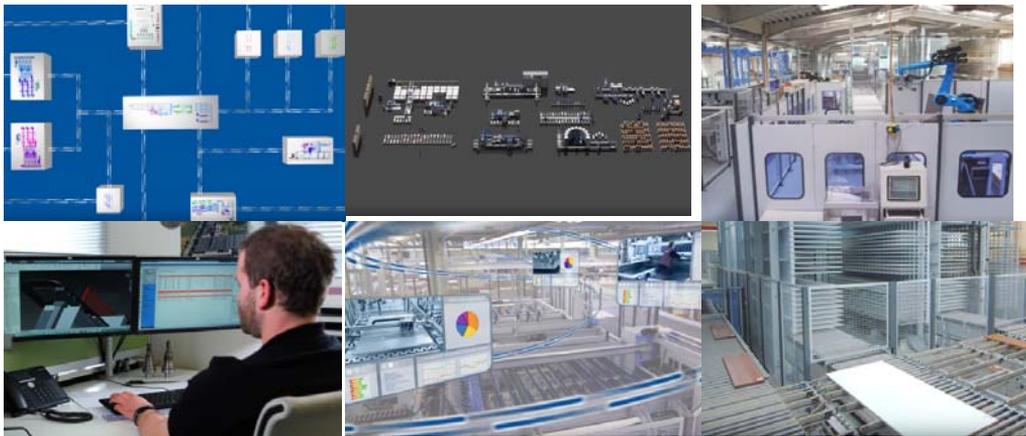


Figure 3. Example of integrated „smart“ furniture manufacturing (HOMAG)

Advantages of this kind of manufacturing are viewed in automatic sorting of plates that enables optimization of the process. All the data collected during the manufacturing process is stored in one place. That way analysis and optimization of the manufacturing process is possible. Data sorting plays a key role in integrated manufacturing, where the data is processed and forwarded to final production stage. [5]

3. MODERN TECHNOLOGIES IN FURNITURE INDUSTRY

One of the fundamental features of modern technology is the possibility to programme machines. Programming or reprogramming is defined as the possibility of intervention on a robot or a machine without an actual physical human. In order for a robot or a machine to perform a certain task, programming should be done in advance. Movement and the entire required operations are defined this way. There are two basic programming types for modern robots and machines guided programming and textual programming. [2]

When discussing modern furniture manufacturing, 3D modeling and visualization should not be avoided. Modeling is especially useful in furniture manufacturing. It is practically impossible to imagine furniture manufacturing without some 3D tools. Besides modeling tools, there are additional tools that help create a realistic representation of a 3D model, the so called 'Rendering tools'.



Figure 4. SketchUp, 3D modeling programme

There are many modeling programmes. Some of them don't require any fee. The best known are SketchUp, PRO100, KitchenDraw, Astra, Furniturer, Bazalna, bCAD, K3, SolidWorks, Sculpturis, Maya, etc. Virtual glasses are used for visualization. Their usage makes it easier to work with the necessary information in different locations in the manufacturing process.



Figure 5. Visualization through „smart“ glasses

Industry 4.0 requirements are introducing specific improvements into the furniture manufacturing process. Products offer is flexible and it doesn't depend on the series size. Furniture factory is able to respond quickly to customer's demands.

After a customer makes their order it is time to define necessary materials, equipment, and tools, etc. Thanks to the advantages gained through the application of the new innovative information technologies such as the Internet of Things, Big Data, Cloud it is possible to prepare all the necessary logistic support in an optimal time for manufacturing process of each individual product or series. For example, when buying material of certain specifications it is possible to find a supplier anywhere in the world, who will in a given time and for the best price on the market deliver such material. Transport of said material is tracked in real time. In case of any changes, such as delivery time, change of costumer's request, etc these new innovative information technologies allow for quick reaction and ensure that there are no hold ups in delivery and that that or other material of requested specifications, from the same or different supplier is delivered timely.

Modern technology with a high level of automation, such as numerically controlled machines, modern processing centers, flexible manufacturing systems make way for a new approach to wood processing and furniture manufacturing technology. Industrial robots are widely used in the wood industry, primarily in the linear furniture manufacturing process, especially in an assembly line, varnishing, gluing, grinding, production control as well as mechanical wood

processing, storing and even primary wood processing. Speaking in general, there is no part of manufacturing without a robotic help, as we can see in a given pictures below. [2]

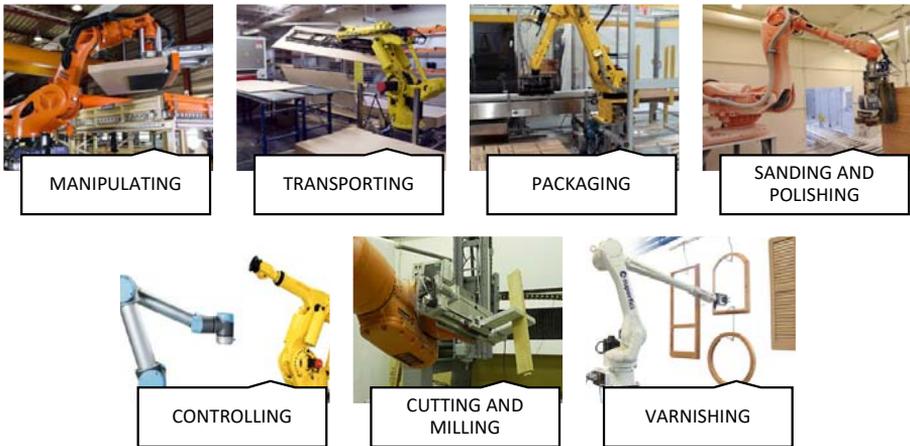


Figure 6. Examples of robots in the wood industry

The fundamental segment of modern manufacturing in the wood industry is CNC processing systems. Compared to classic processing systems, these are much more efficient due to its flexibility and processing accuracy. Advantage of these kinds of machines is the possibility of completing different operations in sequence without having to reset the workpiece. This flexibility is increased through automatic tool switching, minimal backlash, usage of many axes during the processing and many other possibilities. These centers are sometimes equipped with programmes that can control speed and amount of scrapings (in case of wood processing), a lifetime of tools, calibration, and other manufacturing updates. An example of CNC machine in use in furniture manufacturing.



Figure 7. CNC machine (Biesse Rover A 12/15)

In order for the manufacturing process in CNC processing system to function properly, there are a few basic conditions that should be met such as design, CAD, CAM, control, and processing procedure. A special advantage of these systems is the possibility of connecting with

other similar machines (robotic arms) into a flexible processing unit. These systems can manufacture hundreds of different parts at the same time with very little human help. This exactly represents an introduction to Industry 4.0, where these systems are integrated into one complex unit where the entire process can be controlled. [2]

For robots and numerically controlled machines to be able to perform complex operations some degree of artificial intelligence is required. That means they are able to interpret information about the position of working object and tool. All the information in the machine not entered by a human being are collected through sensors. Successful robotic work requires complex information such as position, size, orientation, temperature, color, force, etc. These types of information are collected by sensors.

By using the mentioned sensor all parameters of the manufacturing process are controlled as well as specifications of each individual furniture element and speed and flow of processing and furniture manufacturing. Application of these technologies in furniture manufacturing ensures increased productivity with shorter setting time, reduced number of mistakes and machine deadlocks while the quality is increased. The sensor ensures a decrease in the waste amount due to the monitoring of the process in real time. Product competitiveness is increased due to broadened functionality provided by the Internet of Things.

The fundamental component of industry 4.0 is connecting using networking and Internet. Regarding to the fact that high criteria has been made, even the world biggest software companies are issuing to come up with an answer to this challenge. This is exactly how the networks are made that allow networking of a billion machines around the world. [3]

5. CONCLUSION

Information technologies are the fundamental and the most modern tool in development of industry, no matter the sector. Transition to Industry 4.0 demand fulfillment of certain element crucial for this type of manufacturing. Among these is new social infrastructure, especially education and training, application of new systems as well as meeting the technical conditions (computer web, broadband networks, analytical systems, cybernetic security, secured terminals, etc). Besides integration of manufacturing systems, there should exist connection in global chain to ensure global cooperation.

Such processes are efficient and characterized by high quality and processing and manufacturing precision. Human interventions are reduced and manufacturing processes are flexible. Manufacturing is approached systematically and monitoring is made easier. Of course, there are some disadvantages to this approach such as complex and expensive technical demands, the security of data protection and external factors.

Knowledge should help model these processes so that data safety is increased, development cycles analyzed justifying its investments. Work should be done on detection of trends by new business models. Technology of furniture manufacturing should rely on modern manufacturing processes while using special machines that will enable transfer to Industry 4.0, that is, integration of these systems into a closed circle. Such approach will bring wanted efficiency and competitiveness on the market.

6. REFERENCE

- [1] Perić E.: Indusrija 4.0, Hrvatska gospodarska komora, Zagreb, 2017
- [2] Z. Karadolamović, Savremeni proizvodni procesi u drvnoj industriji, Beograd 2013.
- [3] <https://www.dw.com/hr/%C5%A1to-industrija-40-zna%C4%8Di-za-moju-malu-tvornicu/a-19218317>
- [4] <https://culmena.hr/hr/industrija-4-0/>
- [5] <https://www.homag.com/en/your-solution/networked-production-industry-40/>