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CONCURRENT FURNITURE ENGINEERING

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Abstract

The basic aspects of concurrent engineering and its major place in furniture engineering process our days are presented. The benefits and the main differences between this engineering and the traditional engineering are discussed. 3D modeling is the key feature of concurrent engineering furniture design. Two different examples are used to illustrate the idea of concurrent engineering of furniture. They are presented by 2D and 3D CAD based models. 3D models, CAD systems and CNC programs have significant role in this innovative process and optimization. The conception of concurent engineering has icrease application in furniture engineering process in Bulgaria even though in not full extent.

Key words: *concurrent engineering, furniture design, 3D modeling, CAD*

INTRODUCTION

Concurrent engineering is known as a method of designing and developing products, in which the different stages run simultaneously, rather than consecutively (Loch, C. and C. Terwiesch, 1998; Bartoline, G. and E. Wiebe, 2005). It revolves around creating new products as quickly and efficiently as possible. While concurrent engineering is somewhat of a new production business strategy, it offers four main advantages that other, more traditional systems do not (Fig.1).

Maximizes Quality - The quality of the product is optimized because this strategy relies upon extensive product testing and utilizes known data. It also limits the amount of defective products.

Faster Development - Products can be designed, developed and created in a short time and can reach the market as quickly as possible.

Reduced Costs – Optimizing the process leads to reduction in development and manufacturing costs.

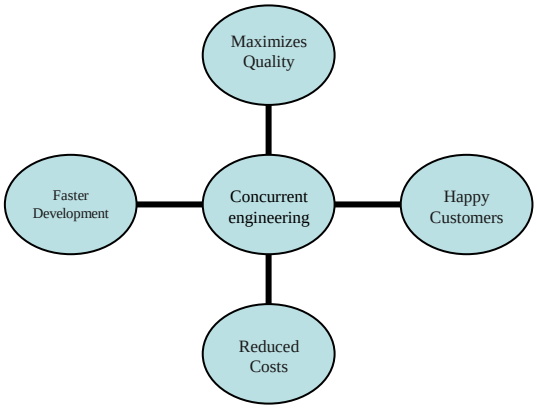

Figure 1. Advantages of concurrent engineering

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Happy Customers - Thanks to the effective product development and creation strategy, customers receive top of the line products.

Concurrent engineering design

The concurrent approach to engineering design, based on 3D modeling is represented on Fig.2. **3D modeling** is the key feature of concurrent engineering design of products, including furniture. The concurrent nature of this design is based on three key activities which are connected - Ideation, Refinement and Implementation (Bartoline and Wiebe, 2005). These three activities are further divided into smaller segments such as: problem identification, preliminary ideas, preliminary design, modeling, design analysis, design visualization, servicing, financing, marketing, producing, planning and documenting. In the ideation phase design engineers interact with service technicians to ensure that the product will be easily serviceable by the consumer or technician. This type of interaction results in a better product for the consumer. 3D modeling and graphics knowledge have great importance in engineering design and production (Станева, Н., И. Авале, 2008; Станева, Н., 2008). With the use of a modeling approach everyone involved in the work can have access to the current design through a computer database. This data sharing is critically important to the success of the design process. Also this database helps to improve the financial aspect of the production process along with planning, managing and marketing phases. For achieving these optimization processes concurent engineering uses two main databases - CAD and CNC programing.

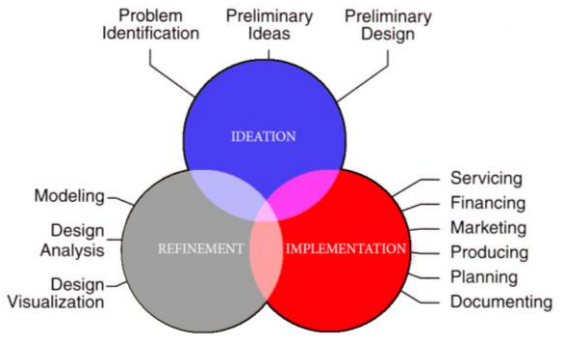

Figure 2. Concurent engineering design

Concurrent - Traditional furniture engineering.

In concurrent furniture engineering, the engineering process is paralleled with the mock-up process which saves a lot of time – Fig.3 (Wang C., 2011). This is possible because engineering could response to any error caused by a design flaw based on daily production feedbacks. In this case by the end of engineering process, the mass production engineering documents are ready by using the same amount of time while in sequential furniture engineering, only preproduction documents are completed.

Things are different in the traditional furniture engineering process. The preproduction engineering happens first then the documents will distribute to production to trigger the mock-up process. Production associates will provide feedbacks in the process of making mock-ups. Engineers cannot start the compilation of mass production documents until all the feedbacks are collected from production. Obviously, the traditional engineering takes a

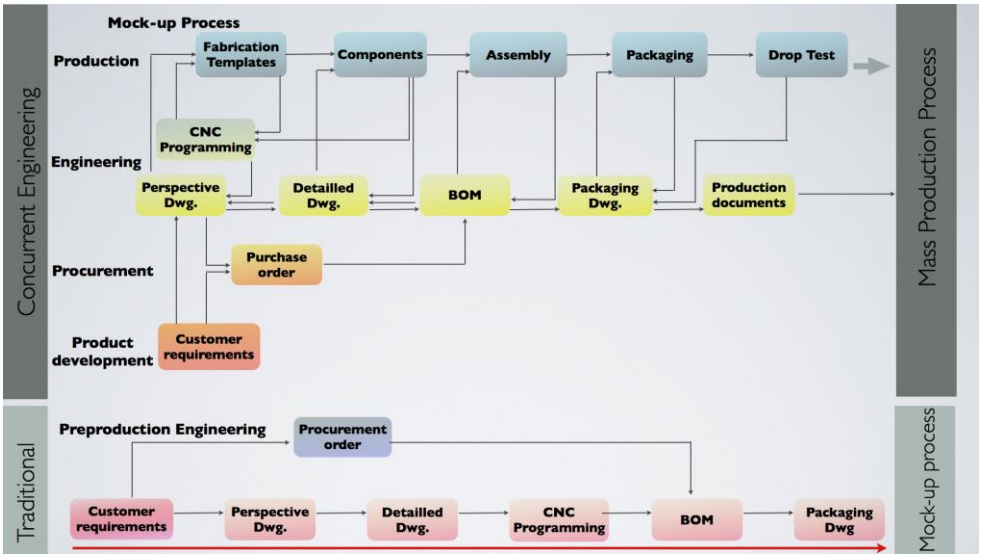

Figure 3. Concurent-traditional furniture engineering

lot of engineering iterations, while the concurrent engineering requires less engineering design cycles.

EXAMPLES OF USING OF CONCURRENT FURNITURE ENGINEERING

Concurrent engineering makes designing of funiture easy. Using CAD systems, helps engineers to creat and construct complex shapes and details of the furnitures. The next examples will reveal the proces and the benefits of using CAD based systems.

Figure 4 represents 2D model of chess table constructed from three octagonal parts which are made from MDF (Medium Density Fiberboard). Using Auto CAD 2014 makes creating this 2D model precise, easy and time saving. 3D model of the chess table is also created with AutoCAD. Created 3D model which helps to get realistic view of how will the finished chess table look like is shown also on Figure 4.

After the exact 2D model of the furniture and the realistic 3D visuals are created the production process can be started. Using CNC based machines makes this process cost efficient, time saving and precise. The basic ideas of the combining of the two systems can be explained like this. The scheme (Figure 5) for cutting different 2D elements of the table is made by using Auto CAD 2014. This scheme ilustrates how elements for producing four chess tables are placed on one MDF plate with dimenssions of 2800x2070 mm. After this scheme is created in Auto CAD it is converted in .DXF file so the CNC machine can read the needed information from the new file format. Importing DXF file into the control can be made by using the supplied USB port, the Floppy Disk or the Ethernet LAN connection. When the file is imported to select the desired parts from the CAD file to be produced from the machine mouse and keyboard are used. The mouse and the keyboard are also used to

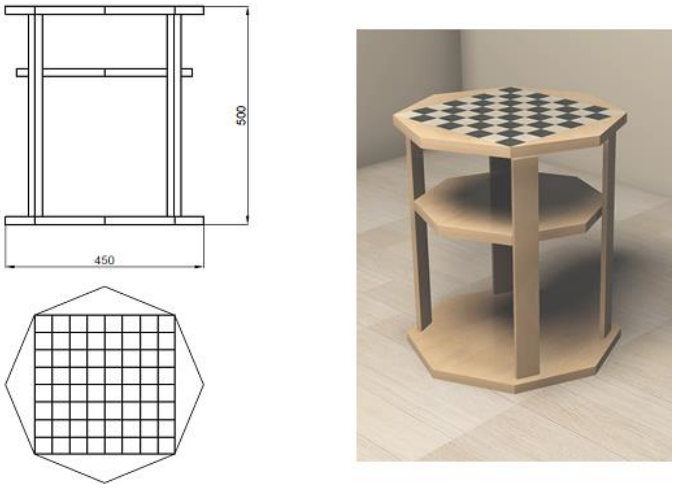

Figure 4. 2D and 3D models of chess table

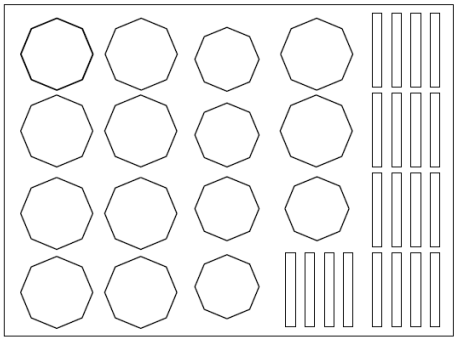

Figure 5. Scheme for cutting

select the type of the machine, change the part zero point, add in cutter comp and the tool path is created automatically. There is ability to see the graphic of the work which makes changes to any part of it easy and simple. Graphics show both programmed path and the cutter compensated path. With the CNC control the job can be stopped at any point for any reason and resumed right where it was left off. The control automatically keeps track of where it was machining when stopped and will start right back up at the beginning of that line or arc or where ever it was programmed.

The possibility of achieving exact radiuses in designing furniture details using again CAD based systems and 2D and 3D models is illustrated with the next two figures.

Model who represents the exact form and radiuses is made with a CNC machine. This model is used in 3D vacuum pressing machine so the cork can be shaped to the exact shape. This process contains the next steps:

- Creating 2D model of the desired shape using Auto CAD;
- Importing the 2D model file .DXF format into the CNC machine;
- CNC creats the matrix which will be used in the 3D vacuum pressing machine;
- The cork is impregnated so it becomes more plastic and easy to shape;

- Finally using the matrix and the impregnated cork material with the help of the 3D vacuum pressing machine the shapes are created and they are ready to be assembled.

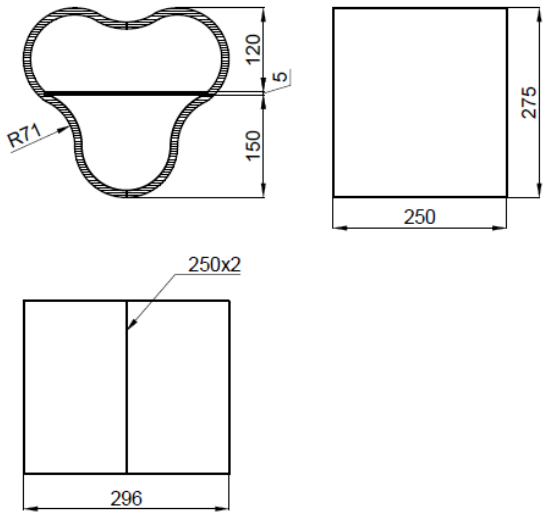

Figure 6. 2D model of the shape

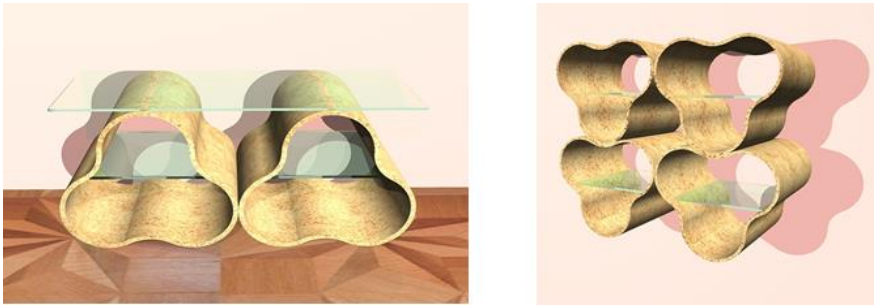

Figure 7. 3D models and arrangment of the cork shapes

Basic reasons for companies to implement concurent furniture engineering.

- The quality of drawings is ensured because the feedbacks from the mock-up process are kept up to date. This helps engineers to find the design problems in the begining.
- Engineers can work on changes immediately because they do not have to compile mass production documents based on the mock-up feedbacks as in the traditional engineering.
- Supervisors do not have to check the whole production documents from beginning to the end.
- A lot of engineering lead time is saved by synchronizing the preproduction process and engineering process.
- Concurrent engineering can eliminate multiple design revisions, prototypes, and re-engineering efforts and create an environment for designing right the first time.

- Companies that use concurrent engineering are able to transfer technology to their markets and customers more effectively, rapidly and predictably.

CONCLUSION

The conception of concurent engineering has application in furniture engineering process in Bulgaria even though in not full extent. More and more Bulgarian companies recognize that concurrent furniture engineering is a key factor in improving the quality, development cycle, production cost, and delivery time of their products.

The reasons that companies choose to use concurrent engineering is for the clear cut benefits and competitive advantage that concurrent engineering can give them.

Acknowledgments

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