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APPLICATION OF MODERN TECHNOLOGY FOR INCREASING EXPERTISE OF EMPLOYEES IN MECHANICAL INDUSTRY

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Abstract: Production system is often used as synonymous with manufacturing system and assembly system. Other notions used to describe different types and sizes of production systems are line, factory, plant and workshop. In hierarchy perspective production system is part of manufacturing system and parts production and assembly systems are part of production system. Basic elements in production systems are humans, machines and equipment. Software and procedures might be added to the list. In this paper it is shown the possibility of CAD/CAM application in order to educate employees in area of machining and design of mechanical parts. Practical example is done in order to show the way of usage and path for further development.
Keywords: CAD/CAM tools, education, machining, design

INTRODUCTION

The process of creating goods and/or services through a combination of material, work, and capital is called production.[1] Production system is often used as synonymous with manufacturing system and assembly system. Other notions used to describe different types and sizes of production systems are line, factory, plant and workshop.[1]

In hierarchy perspective production system is part of manufacturing system and parts production and assembly systems are part of production system. Basic elements in production systems are humans, machines and equipment. Software and procedures might be added to the list. [2,3]

Today, computers are integral component of almost every system. Modern production can`t function without them. The vast types of software are being used to make production better, cheaper, simpler and more effective in every aspect – from organization to technical aspects of making parts and assemblies.

In order to be competitive on market, besides improving technology, we need to improve knowledge of employees.

CAD/CAM TECHNOLOGIES AND APPLICATION

Computer-aided design (CAD) and Computer-aided manufacturing (CAM) are two disciplines, of many, that are used by engineers and designers in wide variety of applications. CAD activities are a part of integrated management of development activities in the product lifecycle, and as such it is used with other parts, such as CAM, that can be as integrated modules or stand-alone products.[4]

In production, CAD software's are used to model parts, to make technical documentation and to make assembly of parts for better understanding of machine design. CAM software's are used for connecting design and production of workpiece. That is one of the application. They can also be used to assist in all operations of manufacturing plant (management, transportation, etc.). [5]

Today, successful companies are using integrated CAD/CAM systems to quickly place the product in market and reduce costs. The interest of this paper are CAM software's for manufacturing workpiece, from CAD 3D model using CNC machines and that interest will be explain in further text.

Nevertheless, CAD design must be mentioned here in order to complete the process. It is not possible to use CAM software without created 3D model of part. The software used here is Inventor and Inventor CAM. Autodesk Inventor and Inventor CAM represent CAD/CAM software tools used in:

— parametric modeling, animation assemblies created from individual parts, creating technical documentation (Inventor). Parametric modeling helps designers to present their idea as a 3D model. The model is created based on the geometrical design features that can change at any time for necessary corrections in the design process.

— implementation of 3D models into production (software prepares 3D models for physical processing, generating G code used for programming CNC machines) (Inventor CAM). Inventor CAM is a certified integrated CAM engine for Inventor that has full connectivity with the model in Inventor. Inventor CAM is used in the mechanical manufacturing, electronic, medical and consumer products, machine design, automotive and aerospace industries, as well as workshops for the manufacture of molds, tools and rapid prototyping.

APPLICATON OF CAD/CAM TECHNOLOGIES IN EDUCATION OF ENGINEERS

Today there are numerous methods for learning how to work in CAD/CAM software's. One of the example are functions embedded in Autodesk Inventor (Figure 1):

—— Online Support – represents online material in order to learn how to use Autodesk Inventor. Some of online material can be downloaded for offline usage.

—— Interactive Learning – is series of video tutorial made for learning basics of Autodesk Inventor. Using this tutorials, users can view step-by-step examples for part modeling, creating assemblies, creating technical documentation and sheet metal working.

Using this principles, and CAD/CAM software, tutorial has been made in order to present machining of pump gasket. The purpose of this tutorial is to show a different way for exchange of knowledge between mechanical engineers for machining process.

In order to increase knowledge of engineer, tutorial of this type can be used to show them step-by-step machining of specific part that is needed in production. In that way the production technology of machine part can be presented and explained in detail. The goal is improving engineer's expertise, transfer of knowledge and, in the end better usage of available resources in production. The parts of tutorial are shown in figures 2-10.

Similar tutorial has been used to show faculty students what are the steps in machining of one part, and different machining technologies in order to improve the quality of education [6,7].
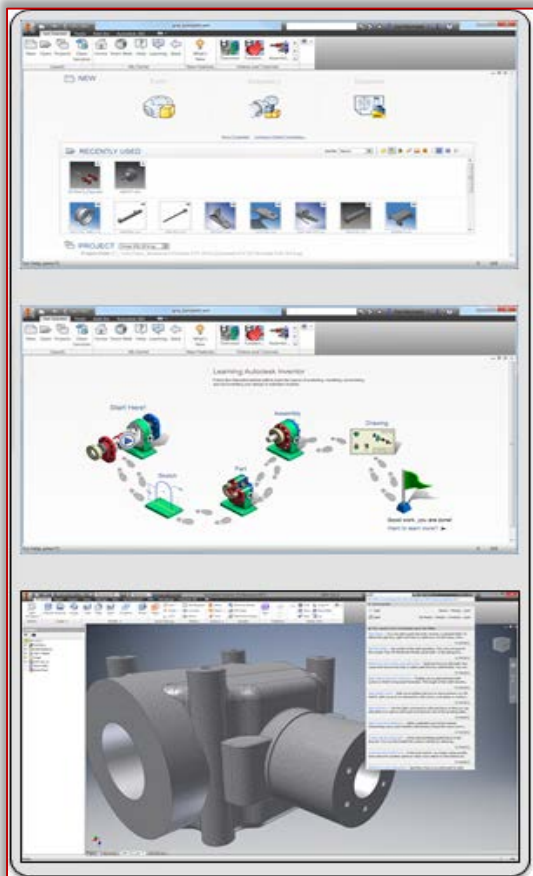
Figure 1. Different methods for learning functionality of Autodesk Inventor software
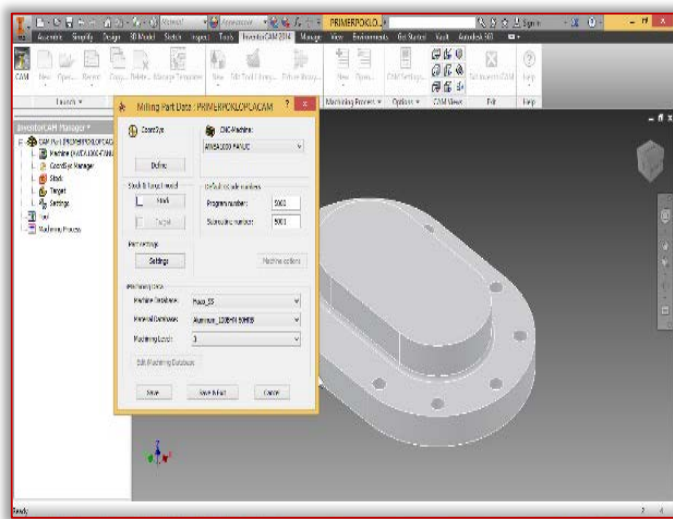

Figure 2. Settings of machining initial parameters

Figure 2 represents the beginning of part production. The first step is, after modeling the required part, importing the model in Inventor CAM module and defining the appropriate CNC machine and adjusting the coordinating system and part orientation.
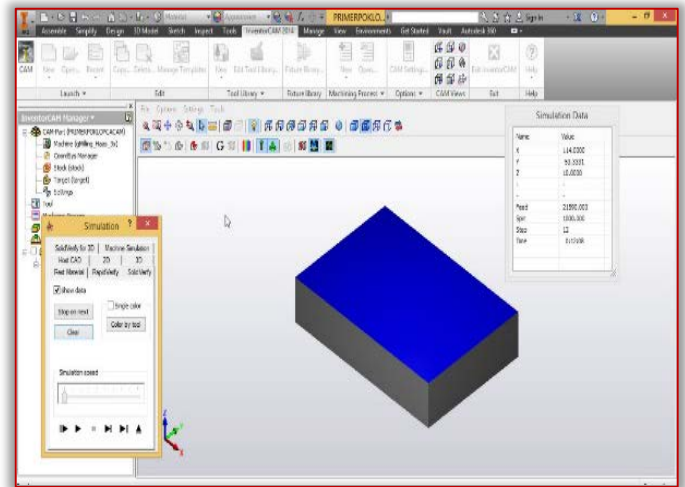

Figure 3. Face Mill simulation of upper surface

Figure 3 shows the next operation in machining of pump gasket, and that is the face milling of outside surface. The figure shows the animation of operation after the settings of operational parameters (the beginning position of tool, the type of tool and its characteristics, the tool path). After those settings, software have the possibility to animate the operation in which can be determined the errors of settings and visually see the operation (without direct operation on CNC machine).

The next operation is profile milling of outer side (Figure 4). Like the operation of face milling in this operation we also need to set operational parameters. The difference between these two operations, from the software point of view, is that it needs to be defined what is the type of milling (or machining operation) that is applying on part. The same procedure is used for milling of upper part in order to achieve the shape of gasket (Figure 5).
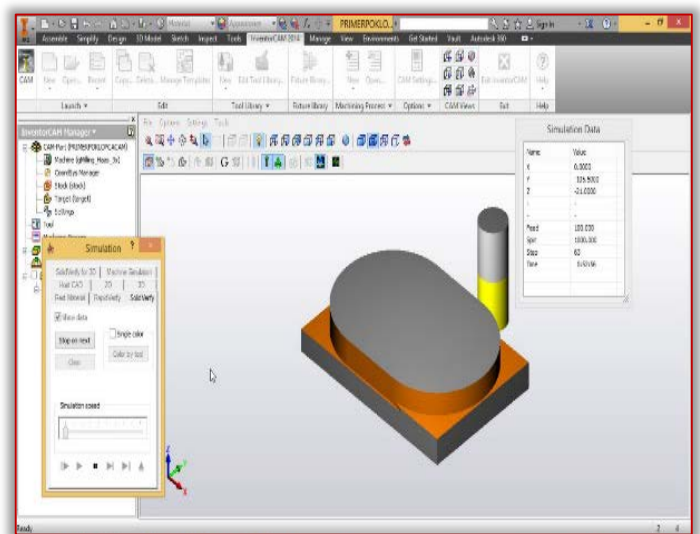

Figure 4. Simulation of profile milling of outer side

In order to produce the curve between two oval shapes, the operation of profile milling is applied to get the fine surface and required shape (figure 6).
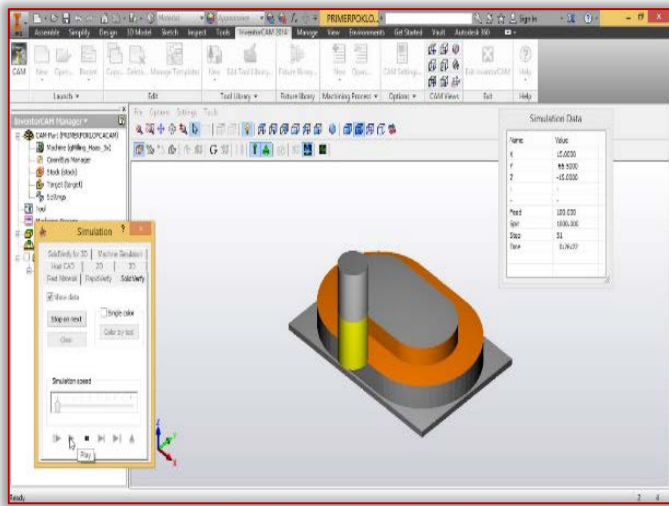
Figure 5. Simulation of profile milling of outer, upper side
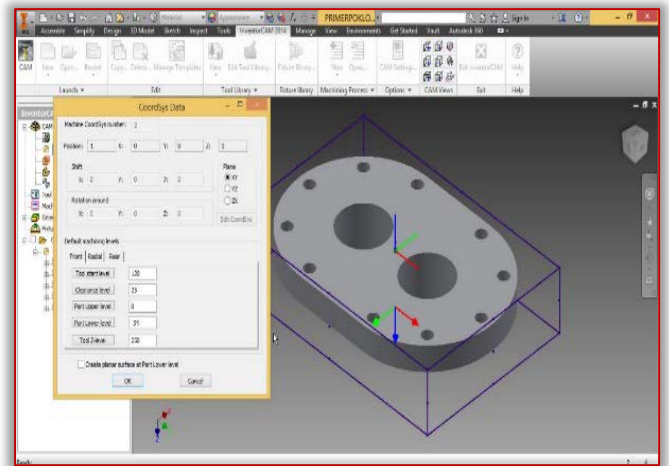

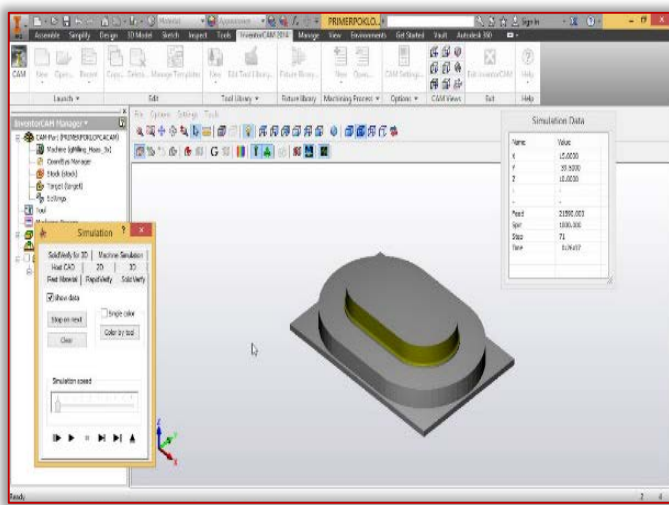Figure 8. Changing of view and defining new coordinate system for machining

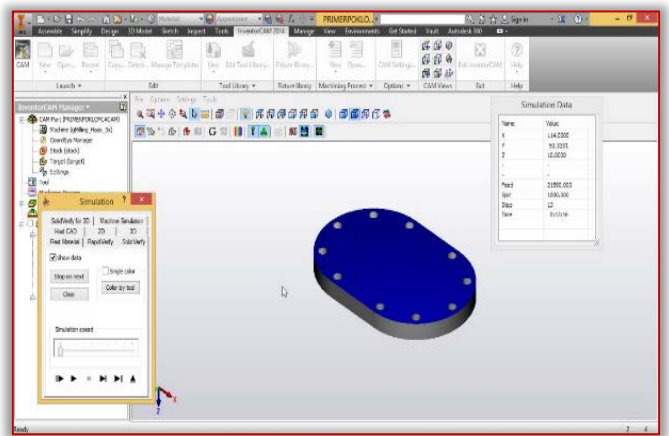Figure 6. Simulation of milling of upper curve between two surface
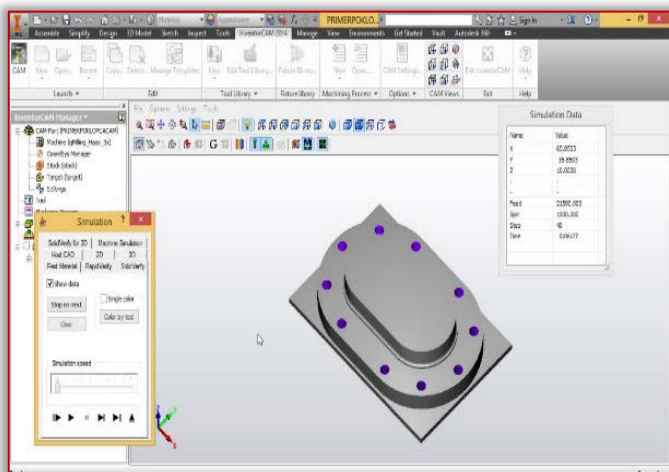

Figure 9. Face milling of bottom surface

Figure 7. Simulation of drilling through workpiece

On figure 7 is the last operation that needs to be done from that side of part, the drilling of holes used to connect the gasket to the pump using screws. For this it needs to be defined the characteristics of tool and the order of holes. When the drilling is finished the part needs to be repositioned (in this case turned over) and new coordinate system needs to be defined for the definition of space (Figure 8).
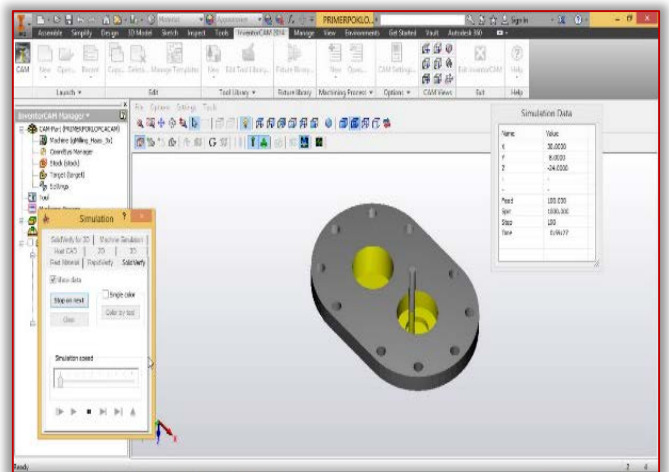

Figure 10. Pocket milling

Figure 9 and 10 presents the final two operations, the face milling of inner surface of gasket and the pocket milling of inner openings. The information and benefits of this types of tutorial are:
— Visual – complete 3D view of part, views from beginning to the end of machining, view of tool movement in process, information of type of tool and its characteristics, information on CNC machine that is used. It can even be seen possible errors in initial settings or tool settings
— Data – G – code can be presented for complete part machining.

All above informations presents valuable information in production, and can be used for education of engineers, for learning different production technologies in machining, for speeding up production process and better usage of raw material.

CONCLUSION

Improvement of production must be reflected in the improvement of production technology solutions, improvement of tools and improvement of the expertise of employees.

In this paper it was presented possible use of CAD/CAM software in knowledge exchange between engineers. The education can be through seminars, small courses, or online materials.

The benefits of these tutorials are:

— Constant learning and implementation of practical knowledge,
— Better usage of companies resources,
— Quicker adjustments of new engineers in their working places, and better understanding of specifics production technologies,
— Upgrade of production technologies by knowledge exchange.

This way of learning can be implemented through lifelong learning, not so much in areas of communication with others, but in two segments:

— *Learning to know* - mastering learning tools rather than acquisition of structured knowledge.
— *Learning to do* – equipping people for the types of work needed now and in the future including innovation and adaptation of learning to future work environments.

Note:

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