INTERNATIONAL JOURNAL OF INTERDISCIPLINARITY IN THEORY AND PRACTICE
ITPB - NR.: 12, YEAR: 2017 – (ISSN 2344 - 2409)

DIGITAL MODELS OF PRODUCTION WORKPLACES CREATION

Albert Mareš[1]

Abstract: *The creation of production workplaces digital models is the basis for the next phase of the concept called Factory of Future. This first step requires experience and training also. The bad model can be a source of considerable problems and failures in later stages. The article describes the possibilities of creating a digital model of the production workplaces.*

Keywords: CAD systems, 3D, production workplace, digitization

1 INTRODUCTION

At present, there is a growing trend towards digitization of all business activities [1]. This is linked to the manufacturing trends referred as Digital Manufacturing and Factory of Future. As the equivalent for the term Factory of Future, other terms are also used: „The Factory of the Future has an evolving definition, even different names. Some call it Smart Manufacturing, Industry 4.0 or the Digital Enterprise.“ [2] „Factory of the future, Industry 4.0, cyber-factory or connected factory: Regardless of what it is called, this transformation of industry represents a revolution in manufacturing processes based on new technologies and innovative concepts.“ [3]

The Digital Manufacturing concept is based on linking all the activities carried out in the enterprise with data in digital form. This also includes the creation of a virtual factory model to verify all important aspects of production, and if there is all right, real production will start.

Within Industry 4.0 concept, the priorities are assigned to five areas. One of these areas is also work, education and training. Within this area, attention is paid to the following tasks:

- Identification of business examples, instruments, methods, and best practices.
- Identification of the impacts of Industrie 4.0 on work and qualifications.
- Making of recommendations for action in the areas “roles, functions, job profiles”, “structuring and organization of work”, and “qualifications, apprenticeships and continuing education”. [4]

This implies that proper attention should be paid to training to ensure effective application of the Industry 4.0 concept in practice.

2 DIGITIZATION OF PRODUCTION WORKPLACES

The digitization of production workplaces has different forms. It can be a network connection between machines, conveyors and other equipment on the production site. Another form of digitization is the creation of a computer model of production workplaces to perform analysis, optimization and real-time management. Currently, 3D models of production workplaces are often used. CAD systems can be used to create these models (Autocad, Autodesk Inventor, CATIA, Creo, NX, SolidEdge, SolidWorks, etc.). Each of these systems allows the creation of 3D models. According to the purpose of analyzes and simulations, we need more or less accurate machine models. When existing workplace is digitized, it is possible to measure all of the equipment on the production workplace to obtain the necessary data for creating 3D CAD models. When a 3D scanner with the required range is available, it is possible to create a CAD model of an existing production workplace by scanning and processing the data acquired by scanning. However, if the production workplace does not exist and it is in the design stage, the situation is more difficult. The results of simulations and analyzes can be greatly distorted by inaccurate models.

In some cases, it is possible to obtain accurate 3D CAD models from the device manufacturers' web site. Furthermore, the more and more devices manufacturers and other equipment manufacturers’ already offer complete CAD models of their devices, because they realize that this service helps them to attract customers. If designers have ready-made CAD models, they do not have to create them, which greatly reduce the time they would need to create the accurate model. It is also probable that if they use the CAD model of a device and they design, analyze, simulate and optimize the production operation with this device, then the device will be purchased at the time of implementation. Manufacturers offering free CAD models of their devices include, for example, KUKA, ABB, Epson, Stäubli (robots); ROBOTIQ (robot grippers); Bosch Rexroth, Item (manual workstations and conveyor systems); AST Bearings (bearings) and a number of other manufacturers. Another option to acquire 3D CAD models is online databases aimed at providing such models operated by manufacturer-independent companies. The most significant of these

databases include Traceparts (http://www.traceparts.com), which contains over 100 million 2D drawings and 3D files, Thomas.net (http://cad.thomasnet.com/cadmodels.html), PART community (Https://b2b.partcommunity.com/community/), 3D ContentCentral (http://www.3dcontentcentral.com). There are a number of other databases, but their focus is on other areas, Architecture, design, furniture, etc. If the CAD model of the selected device is not available on either the device manufacturer's site or any of the available databases, you need to contact the device manufacturer directly.

The very creation of a digital model of a workplace consists in modeling and importing the models of individual devices into the assembly. If the model has been downloaded, it is likely that there will be need to convert it to the native format of the used CAD system. As mentioned above, there are a number of CAD systems available. CAD databases maker to ensure that their models will be possible to use in the larger number of CAD systems use universal file formats to store files. These are, in particular these formats: .Step, Iges, Sat, VRML and, most recently, the JT format, which is directly linked to the creation of digital models of workplaces for simulation and analysis. Although these formats are supported by most CAD systems, it is possible to encounter problems when opening such files (the imported object has errors). Depending on the error, it is then necessary to make corrections to make the final model fit for the next job. As already was mentioned, one of the areas where attention is paid in Industry 4.0 concept is education and training aimed at acquiring the knowledge and skills needed to successfully implement this concept in practice. As the first step of digitization is to create a digital workplace model, students are learning how to create such a model, including addressing possible errors caused by importing files from other programs. Sometimes, students underestimate the creation of CAD models, and then when they encounter some problem, they are not able to find solution. That's reason why problem situations are also applied in their teaching. The problem solving techniques are demonstrated by this way. In Fig. 1 is an example of a 3D CAD model of the milling workplace created in Autodesk Inventor by the student. This is a model of an existing workplace. Some parts of the workspace were modeled, others were imported from available databases.

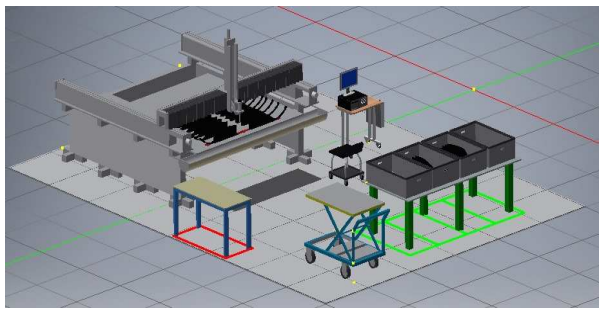

Fig. 1 3D CAD model of milling workplace [5]

3 ANALYZES AND SIMULATIONS

If a workplace model is created, it is possible to start analyzes and simulations to optimize the workplace. Workspace model can be created in any CAD system, but perform analysis and optimization no. CAD systems, even if they have modules for analysis and simulation, usually use these modules for design of parts e.g. strength analysis, analysis of deformations, flow, kinematics, etc. Exceptions are the CATIA, NX and Creo systems. They also have modules for ergonomic analyzes, planning layout solutions for workplaces, and so on. Fig. 2 shows an ergonomic analysis of the worker's work on the milling workplace.

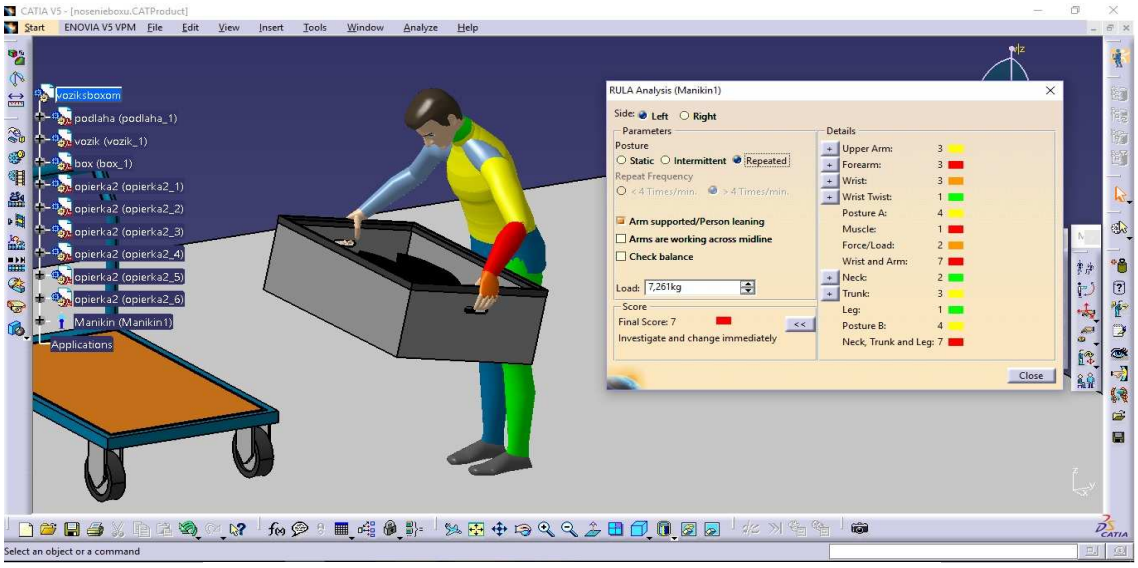

Fig. 2 RULA analysis of carried on work opperation [5]

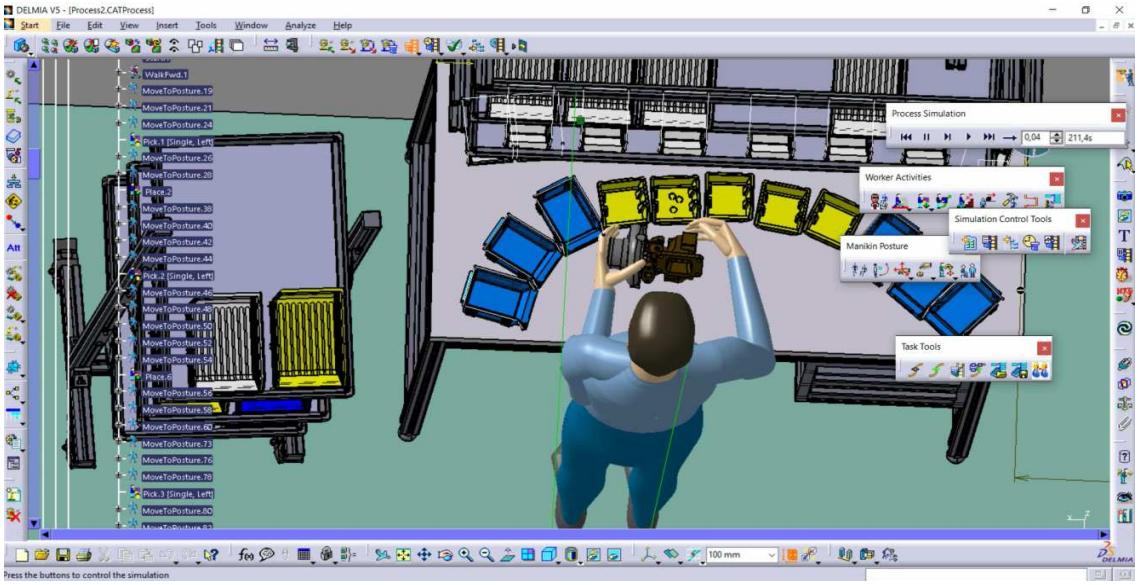

Fig. 3 Simulation of assembly operation in virtual environment [6]

The RULA analysis has shown that this position is unacceptable for the worker and therefore a change is needed to reduce the fatigue of on the worker. The proposed solution is to use a trolley with adjustable storage height. For other types of analysis and simulation of workplaces, it is necessary to use specialized software e.g. Delmia or Tecnomatix. These software are referred by their manufacturers as solutions for Digital Manufacturing. Before performing analyzes and simulations, it is necessary to import the workplace from the CAD system into the environment of the selected specialized software. Delmia directly supports Catie file formats and Tecnomatix uses JT format. Both systems also support universal exchange formats.

Again with this step, it is possible to encounter problems importing files. At this stage, it is especially important that any errors are removed, as they can affect the results of analyzes, for example, collisions of devices. In Fig. 3 is a simulation of a manual assembly operation performed in Delmia. During the simulation, shortcomings were identified and remedial action was proposed.

4 CONCLUSION

To successfully manage the digital transformation of enterprises, it is necessary to prepare future workers to solve the various problems and problems associated with digitization. The solution of the real tasks appears as very appropriate way of teaching. Students will test and verify their knowledge and experience.

We believe that such prepared students will be benefit for practice and help to successfully manage the transformation.

Acknowledgements: *This contribution is the result of the project VEGA VEGA 1/0853/16 – "New project technologies for the creation and implementation of future factories."*

REFERENCES

[1] Schulte M. A., 2016. Digital Transformation in the Manufacturing Industry [on-line]. Frankfurt am Main - IDC Central Europe. [viewed 1 February 2017]. Available from: http://branden.biz/wp-content/uploads/2017/01/IDC-Dassault-System%C3%A8s-White-Paper-Digital-Transformation-in-the-Manu....pdf

[2] Korak L., Apr 20, 2016. Preparing for the Factory of the Future [online]. IndustryWeek. [viewed 1 February 2017]. Available from: http://www.industryweek.com/emerging-technologies/preparing-factory-future

[3] Vinci-energies, Industry 4.0: The factory of tomorrow will be autonomous [online]. Vinci-energies. [viewed 1 February 2017]. Available from: http://www.vinci-energies.com/en/its-already-tomorrow/towards-smart-industry/industry-4-0-the-factory-of-tomorrow-will-be-autonomous/

[4] Federal Ministry for Economic Affairs and Energy, 2016. Digitization of Industrie – Plattform Industrie 4.0 [online]. Berlin: Federal Ministry for Economic Affairs and Energy [viewed 16 October 2016]. Available from: http://www.plattform-i40.de/I40/Navigation/EN/InPractice/Online-Library/online-library.html

[5] Dudžák G, 2016. Optimalizácia výrobného pracoviska z hľadiska produktivity a ergonómie obsluhy (Optimising production site in terms of productivity and operator ergonomics). Diploma thesis. Košice – SjF TUKE, 63 p.

[6] Baňas T., 2016. Viruálna montáž vybraného komponentu (Virtual assembly of choosen component). Diploma thesis. Košice – SjF TUKE, 66 p.

AUTHOR ADDRESS

1 Ing. lbert Mareš, PhD.

Technical University in Košice, Faculty of Mechanical Engineering, Mäsiarska 74, 040 01 Košice, Slovak Republic

E-mail: albert.mares@tuke.sk