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Selection of simulation software by algorithm

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Abstract. On the market a lot of performance products designed for the simulation of manufacturing systems is currently available. Some of them are designed exclusively for logistics, others are designed to simulate the robotic workplace and some of them allow simulation the entire virtual enterprise from its logistics to the entire workplace connected to the real system. The article describes the algorithm for choosing the most suitable simulation program.

Keywords: production system, simulation software, algorithm

1. Introduction

Nowadays, in industrial production prevails small and medium series production. This trend is due to individualization of consumers. Due to the globalization of the market, various customers' requirements can be very different. These requirements may depend on climate, cultural and other conditions in the customer's location. The manufacturer must be able to provide a wide range of products that can meet the current demands for these products and can quickly innovate and vary them. Forecasts and analysis of most experts emphasize a graduation of individualization in the future.

According to [1], the modern enterprise is forced to implement the progressive forms of organization of production, apply microelectronics to machinery and equipment and to use information technology throughout the company structure. This way is difficult due to the costs, human potential and in particular it does not automatically means success. It requires great effort and thorough analysis [2].

Increase of productivity, reliability and quality of components is possible via mechanization, automation and computer aided production engineering.

2. Analysis of production systems

In conventional design approaches used to deal with production systems, we can talk about their inefficient use of the service, their non-optimal design and very long periods of debugging at workplace [3]. Consequently in case of change of the production program at workplace or change of times of workplace occurs inefficiency. In order to minimise such inefficiencies it is useful to use virtual reality environments. This gives answers to several questions and ensures effective implementation in real production.

In practice, designers of robotic and handling workplaces use mainly heuristic procedures [5], which are transformed to the quality of the proposed project of automation workplace.

3. Problems of production system

In the production system emerge a number of problems, some of them can be removed by simulation. Simulation can be used for projection, but also in case for operation of the system.

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Problems which arise in the process:

- high traffic sites
- small capacity of stocks,
- lack of storage of containers,
- surplus or deficiency of staff,
- incorrect layout of workplaces,
- downtime,
- high defectiveness,
- insufficient maintenance,
- unavailability of workplaces during breaks,
- verification of functionality, reliability and performance,
- incorrectly planned progress of project operations,
- small or no reserve of project,
- no abstract logical model is created,
- and many others.

A lot of these problems can be eliminated by simulation. Correct and efficient simulation depends on the choice of simulation software, inputs of the production system and especially on experience and ability of human working with the simulation program.

4. Modelling and simulation of production systems

Experts in the field of computer support agree with statement that computer support in pre-production stages allows to model a component, to make different analysis (thermal, strength, vibration, etc.) to simulate a process of treatment of a part and to eliminate bottlenecks in production and organization before the production.

This allows at relatively low costs to change not only the structural design of components, but also to change a design and technology as well as an overall concept of components. Economic effect of such a solution is significant. The time needed for construction documentation is shorter.

For modern engineering company a computed support of pre-production stages is necessary, which allows the company to respond to changing customer requirements on time and economically. It is necessary to pay maximum attention to computer support of pre-production stages, because success of the enterprise depends on its precision.

We live in the age when computerization of society is very fast. Market produces a number of software products designed to simulate various processes and events (e.g. weather, production systems, the control of buildings under different conditions, etc.).

Special group of programs are programs used for programming and simulation of industrial robots at workplace environment. This includes software such as COSIMIR ® Robot (CIROS), Robot Studio, Easy Rob, Ropsim, Robcad, Kuka Sim, Fanuc SimPRO™, Workspace, eM-Workplace, Delmia V5 Robotics and others.

5. Comparison of simulation programs

Currently, on the market is a large number of software tools designed for modelling and simulation of virtual enterprise. Based on the analysis 13 available programs were compared. Due to changes and development in this field, the list of programs has to be periodically updated and innovated. The algorithm includes programs designed to simulate a robotic workplaces, to simulate a virtual enterprise and also to simulate the logistics of manufacturing systems. Selection of programs was made to cover all requirements for the simulation of logistics processes and virtual enterprises.

The following software was observed:

- Logistics: Arena, eM-Plant, Witness,
- the virtual enterprise: Cosimir Professional (CIROS Studio), Delmia-Quest, eM-Workspace
- for robotic workstation: Cosimir Robotics (CIROS Studio), Robot Studio, Easy Rob, Ropsim, Kuka Sim, Fanuc Sim Pro, Workspace.

Based on the analysis of programs, the algorithm was created. All programs for logistics allow import of CAD formats, programming in C++, real time simulation, elimination of errors during operation, statistical analysis (in the form of tables, graphs, computation of time, cost calculations), They are intended for project preparation in production for warehouse management, handling and distribution etc. In principle, they differs in - 2D or 3D environment and fastidiousness of work with the program, etc.

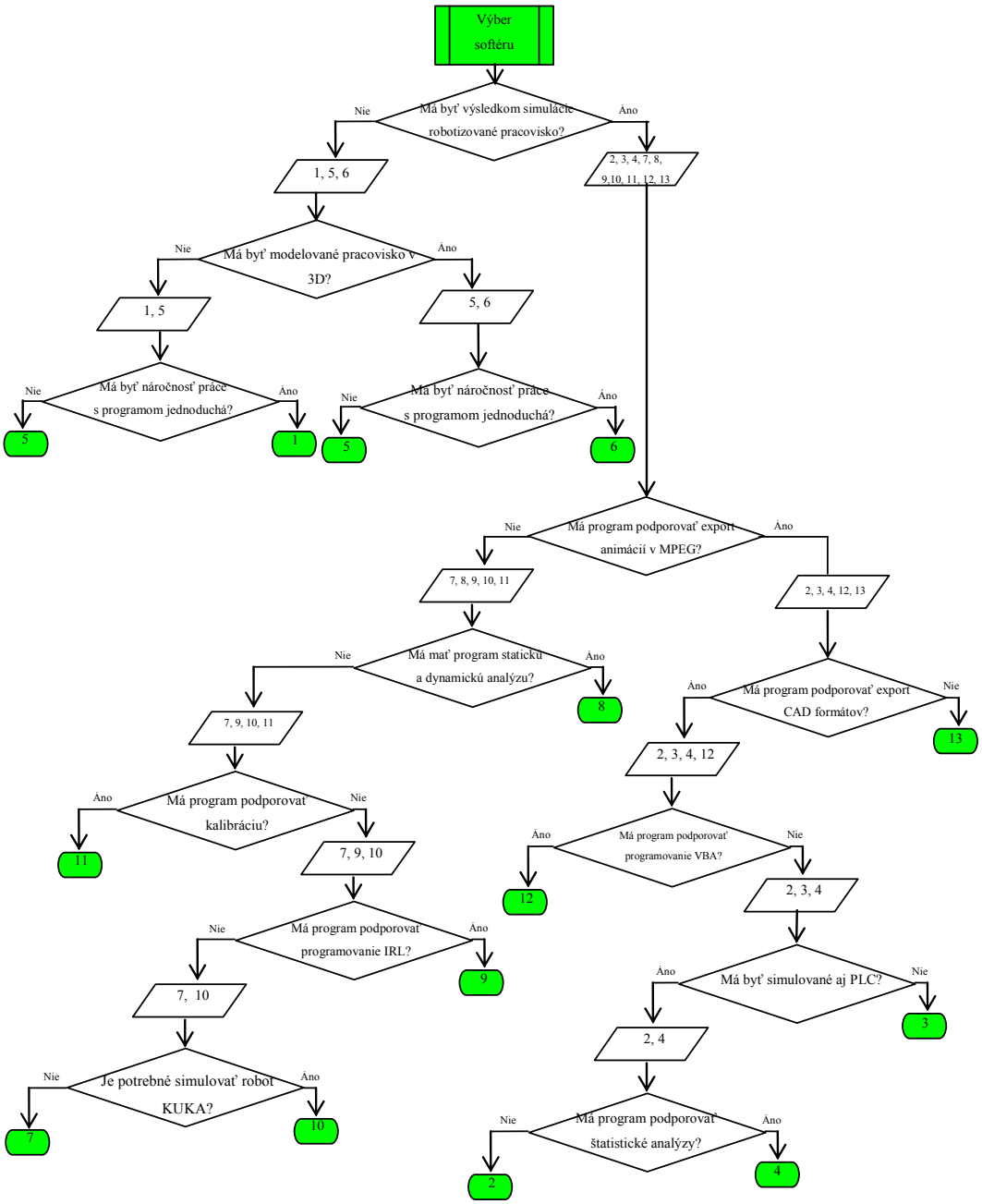

Fig.1: Example of algorithm

Simulation programs for virtual enterprise include robotic workspace, therefore they were considered together with programs designed to simulate a robotic workstation. Each of them had possibility to model

and simulate in 3D, to model a kinematic structure and mechanisms, show cyclical time, a library of application objects, import for CAD formats, detailed graphics processing, real-time simulation, elimination of errors during the program (debugging), process optimization for the production phase, the possibility of off-line programming of robots, collision detection, robots library, effectors, conveyors and other equipment, etc.

Programs differ in the possibility of simulation of different types of robots (Kuka, ABB, Fanuc, Mitsubishi, Reis and others), in programming (IRL and VBA), programming of NC and CNC machines. Further difference of programs was in a possibility of dynamic and static analysis, possibility of export into CAD and export of MPEG animation, programming in C++ and other languages, possibility of calibration, calculation times, HTML messages, etc.

6. Dialog windows

In order to ease a work with the algorithm was the proposed algorithm embedded in dialog windows. The windows were created in Microsoft Visual Basic. In Microsoft Excel were entered all necessary questions. Subsequently, dialogs were created by Microsoft Visual Basic macros.

The windows are divided into 3 parts: the top window title (Question, Recommendation), in the middle is icon (question mark, information (i), or cross) and the specific question of the proposed methodology, the dialog results are: Yes, No, OK.

Window labelled as "Question" contains a specific question from an algorithm, which has to be answered Yes or No. Box titled "Recommendations" contains a recommendation of simulator. Result of Dialog box labelled as “Recommendation” is OK button to confirm compliance with recommendations.

In each window is in the middle part the icon (question mark, information (i), cross). Using this icon, the user starts the Help section, which explains the sense of the window (question, explanation, etc.).

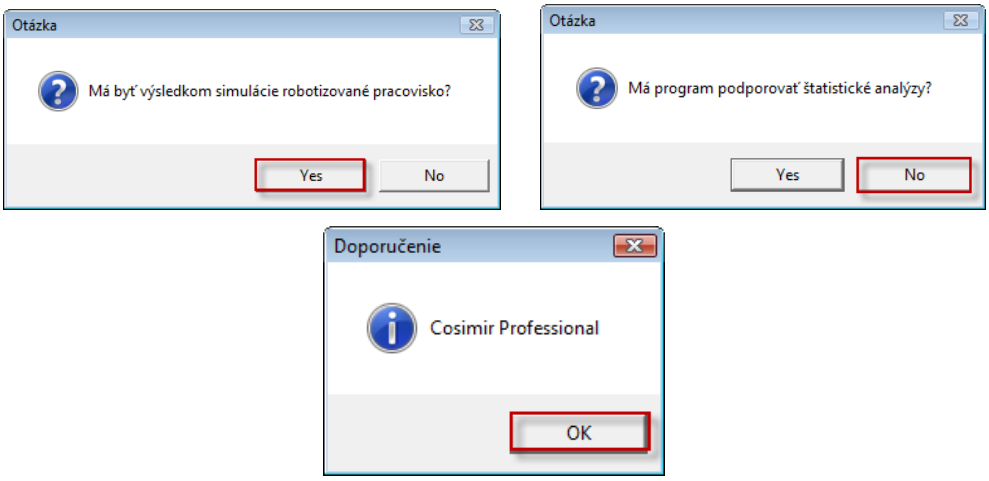

Fig. 2 Dialog windows

7. Conclusion

Nowadays, the design of manufacturing systems widely use modelling and simulation in virtual reality. This way of designing the production system is in most cases economic and less time consuming. But it needs a suitable simulation program and skilled worker. The market offers a wide range of programs to simulate manufacturing systems and there arises the problem of selection of suitable simulation program according to business needs. Therefore, in this article was proposed an algorithm for selection of simulation software.

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