NEW TOOLS OF ENGINEERING EDUCATION FOR LOGISTICS TRAINING

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Abstract *– Present engineering education requires new effective tools for engineer's' training because technical development is often faster than present possibilities of education tools. Many time finance means in technical universities are not allowed for efficient engineers' education and practical training especially. But they cannot confine to a theoretical knowledge dissemination they also have to enable students to decide about practical activities in enterprises and the decisions' effect analyses. It is hard to make possible for students to collate their theoretical knowledge with practical decisions in real circumstances because conceivable wrong decisions would be very expensive. Technical universities are looking for new cheap education tools to make possible effective students training.*
Logistics is one of the areas, where practical training can be almost impossible without new tools enabling students to decide for example in sphere of plant design, material flow design or production organization and analyses of those decisions' effects.
In this paper authors points on new tools used in logistics training. They present experience connected with applying DOSIMIS-3 package for material flow planning and simulation in logistics education. Authors consider use another tools for the logistics education effectiveness.

INTRODUCTION

Strong competition on the employment market causes that higher and higher demands are made for engineers of command and skills of theoretical knowledge application in practical activities. There are only a few problems with effectiveness of theoretical knowledge dissemination whereas teaching the problem solution skills shows much more difficult. The technical universities use high technology achievement in education to prepare the engineers for their future work better, to make education more attractive for students and because of it more effective.
In Technical University of Czestochowa at the Faculty of Management logistics has been one of the obligatory subjects for students for six years. According the logistics definition the students are taught the characteristics and rules of a process of planing, implementing, and controlling the efficient, cost-effective flow and storage of raw materials, in process inventory, finished goods and related information from point of origin to point of consumption for the purpose of conforming to customer requirements [1].
Students come to know logistics on the lectures in theoretical sphere and during the classes (they solve logistics problems, discuss the logistics cases or calculate and optimise the logistics costs). It is supposed that it has worked well with positive effects for students' knowledge. It was realised that this mode of teaching was not enough effective due to fast technology development, globalisation and still changing economical circumstances.
The scientific staff specialising in logistics started to look for new methods and tools that would allow for more attractive education within logistics and first of all for increase of teaching effectiveness. In effects the students' skills level of logistics problem solution should have risen. The program packages for the logistics education were sought because the faculty has some good equipped computer laboratories. Logistics goes in for many enterprise spheres and various enterprise activities therefore application of programs supporting logistics training in all aspects would be impossible because of limited financial means, mainly. It was decided to use Dosimis-3® program for a start. The chose was dictated by the necessity of fast deciding undertaken by engineers and connected with the production processes management.

DOSIMIS-3 PACKAGE CHRACTERICTICS

Dosimis-3 is a simulation package developed by SDZ® GmbH. It is interactive, objects, graphical simulator working with Windows 95/98/NT or UNIX. Package is a modular-oriented. The simulator works event-discrete and allows for simulation of time-discrete material flow systems possible. A simulated production process can be developed graphically interactive on the screen with no special knowledge in the area of computing necessary. Standard elements such as sources, sinks, work stations, buffers, vehicles etc., which in their structure represent essential modules from the material flow field, allow a rational layout by means of a menu-controlled user interface. Modules with several entrances and exits dispose of an intelligence over which local strategies such as FIFO, minimal occupation of the succeeding module etc. can be realised when controlling the object flow. Thanks to the modular concept there are theoretically no limitations to the scope and size of the simulation. Super-ordinated levels enable the planner to define failures and breaks or to simulate the deployment of workers in any number of freely-definable work sections [2].

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DOSIMIS-3 APPLICATION IN LOGISTICS EDUCATION

Why does one think that teaching using Dosimis-3 could be useful for engineers? Today high production systems flexibility is required because of shorter and shorter periods of order realisation or wide order diversity. Adequate work station planing and efficient internal transport can ensure the flexibility. The role of internal transport in logistics and production process management is extremely significant. The internal transport connects work stations and storerooms. It is also responsible for raw materials and products flow in plant. The aims of internal transport is delivering of particular sorts and quantities of raw materials, semi-manufactures articles and products in right time and right place of production system. The effects of badly working internal transport are:

- high transportation costs;
- wastes of time and transportation means;
- high level of inventories;
- ineffective work stations' operation;
- long time of order realisation;
- incomplete utilisation of production capacity.

Because of aforementioned factors engineers should be prepared for the internal transport system planning, analysis and development of existing transportation systems, production processes' management according to needs. Using Dosismis-3 students can learn to analyse internal transportation systems. Analysis carried out using the simulator shows components of transport system where the improvements are necessary. In this way students can learn:

- Organise the effective internal transport system;
- Find or avoid of disturbances in transport process;
- Improve of internal transportation effectiveness;
- Manage of raw materials or semi-manufactured articles supplies for the particular work stations;
- Establish the best parameters of production system operating;
- Eliminate or make shorter the interruption during the operations on the work stations;
- Minimise of internal transportation costs and production as a consequence.

Going into details, applying Dosimis-3 students can study many transportation alternatives in short time and their influences on effectiveness of production system and basis on this they choose the most suitable alternative for the production schedule. They can also optimise number and sort of transportation means, plan transportation routes or speed of transportation. Dosimis-3 allows students for evaluation the simulation results, it offers a variety of tables and graphics. A dynamic presentation of the transport system behaviour presented within the animation let students understand the production process mechanisms, better. Students can resort to a variety of module values and simulator functions so that tailored comprehensive control possibilities can be developed for any problem.

STUDENTS' WORK EXAMPLE

This is an example of production process improvement in the plant producing cans applying Dosimis-3.

The students researched real situation in plant on the begining. Then they described production process paying a special attention on number and type of operations, the operation parameters and sequence, type and parameters of machines. Next they systematised the necessary parameters of studied production process (Table 1) adapting them to the program requirements.

TABLE I
PARAMETERS OF THE SIMULATION MODELS

Elements of the model		Model elements parameters		
		Length [m]	Speed [m/s]	Efficiency [cans/min]
Phase I	Press	1.2	1.2	150
	Conveyor	27	1.0	920
Phase II	Bodymaker	1.5	1.0	150
	Conveyor	56	1.0	920
Phase III	Painter	19	1.0	136
	Conveyor	31	1.0	920
Phase IV	Necker	8	1.0	150
	Conveyor	7	1.0	920
	Out	5	1.2	160

They build the simulation model using the modules palette. It is easy cause Dosimis-3 screen looks very similar to standard MS Windows and it can be modify using the same procedures.

The simulation building process is consist of following stages:

- Introduction of modules to the Dosimis-3 window
- Modules parameters (data) introduction
- Modules connection according to the production process sequence
- Simulation parameters determination (time, pre-run time, statistic interval)

After those stages students obtain simulation model presented in program window (Figure 1)

Than students started statistic analysis of particular process element efficiency. They estimated what elements worked with full efficiency and what elements made the production process slower. Basis on statistic elaboration they changed model parameters to optimise the production process. The effects of the changes are presented in Figure 2

Students provided the process animation to find and understand the points in the system blocking the production before changes and after it to verify the changes accuracy.

The above mentioned students' activities shows the process of acquiring the skills of internal transport and production problems' solving. It also presents Dosimis-3 utility for the logistics training in this area.

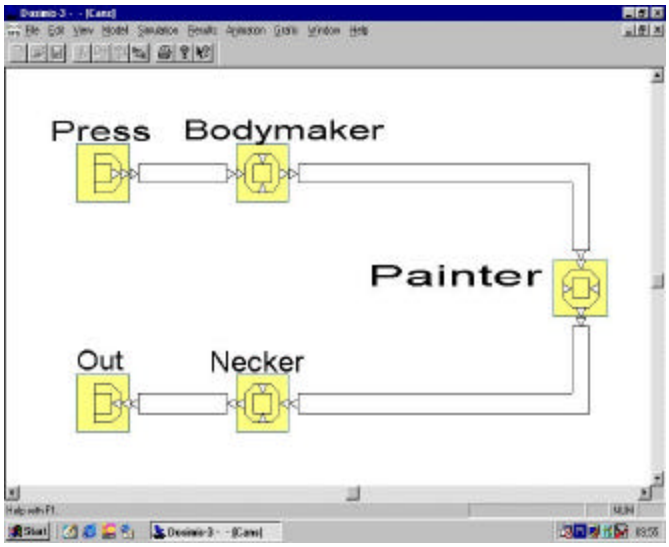

FIGURE. 1
DOSIMIS -3 WINDOW – SIMULATION MODEL

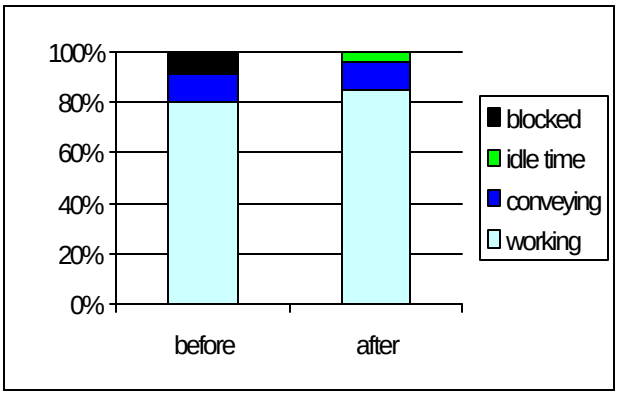

FIGURE. 2
PERCENTAGE UTILISATION FOR CHOSEN ELEMENT BEFORE AND AFTER THE PARAMETERS CHANGE

NEW TOOLS APPLICATION - FUTURE PLANS

Now the logistics scientific staff considers application some other tools for logistics training:
Well-known program packages as an Excel or CAD Systems have been noticed as a very useful for logistics education process.
1. Excel can be used in following logistics problem solution [5]:

- Linear optimisation;
- Multi-criteria optimisation;
- Transportation cases – network models;
- Logistics models construction and simulation.

2. CAD programs as a new medium of technical drawing with the very useful functions enabling making modifications and corrections can be apply for the plant planning. Especially 3d –CAD can be interesting because of various possibilities of presentation building structure, material handling system, machinery, supply an disposal technology.

3. Large screen projection as a visualisation technique for virtual reality can be used as tool for the plant planning. The example of application of the tool in education can be set for large screen projections in the Clausthal University of Technology. The set consists of simple flat projections, curved projections surfaces with a visual angle up to 180^{o} as well as systems with two or three side walls (C2/C3 systems up to completely closed projection room with six surfaces (C6) [4].

4. Build-It® - planning desk is also a tool supporting factory planning. It develops the skills of working in a group.
Students using the planning desk are sitting together at a conference table. On this table there is projected a layout of the factory for construction or equipping. Moreover user defined view is projected on the screen at the front side of the table this allows for 3d presentation and 2d planning simultaneously.
Students using small cubic parts of metal called “bricks” (it makes the interaction with digital model possible) can position objects in planed places. A special imaging system scans the table and detects the position and arrangements of the bricks [3].
The chose and application of above mentioned tools will be decided considering future benefits in logistics education but the crucial factor usually is financial means for this purpose.

CONCLUSION

Effective and successful engineering education requires very good skilled staff, curricula adjusted to market needs, efficient didactic methods and modern didactic equipment etc. Unfortunately there is no technical university can fulfil those requirements without financial means. All the time technical university management has to consider development through the new tools aplication on the one hand and limited financial means on the other hand.

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