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OPERATIVE MANAGEMENT OF PRODUCTION AND TECHNOLOGICAL PROCESSES

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ABSTRACT
Concerning current market economy principles, problems of operative management practice of controlling technological processes are integral to specification of production technologies and work organisation. They are usually problems of complex systems of operations that can take advantage of computer – aided tools of control. Therefore we decided to developed software for the reason of operative management and realized a simulation and animation program, which we called OCOW, for planning and control of technological processes aiming at efficiency increases and general monitoring.
Keywords: operative management, simulation, transport

1. INTRODUCTION
Deep coal mining operative control aims for optimum performances concerning daily production rates, maximum exploitation of net operational times of heading machines and mining machinery, and minimum unscheduled idle times. Also transportation tasks are inherent to objectives of operative management. For example as regards sub-systems of coal haulage, they are concerned with operative routing of underground transportation trains to loading points (underground coal bunkers) and after that to the skip hoisting loading station [1] so that non-technological stoppages are eliminated or minimised. The so called operative signs are characteristic for technological processes constituted by people and machines complex interactive network that functions as an idiosyncratic feature system. It is the goal of operational research in a quantitative mode to provide for objective and systematic analysis and interpretation of such system interrelations. Operative management represents a continuous process of making commands more accurate as they are on the way, or arise subject to changing demands. Operative management of mine technological process has to ensure both realisation of technical and operative modes and information provision of transportation systems and mining machinery.

2. EXAMPLES OF OPERATIONAL MANAGEMENT AT COAL DEEP MINES
Operative management concerns relatively stable subsystems (without variations of elements and their inter-relations), which relatively is defined by such timing horizons that do not imply disturbances or instability effected by aberrations of the system normal behaviour. Realisation of such control factually means the control oriented by system aberrations which at the same time takes into account all other dependences of current subordinate systems. On monthly basis, operative management of deep mining operations is defined by related technical and time-profile schedules of individual workplaces. Concerning both transporting of coal and mining equipments in 24 hour horizons, the control of mining transport is integral part of the production operations.

2.1. Operative management of selective mining

By methods of selective mining and homogenization of coal blends a dynamic adaptation of underground coal production is enabled to varying market conditions and demands. Such optimisation process is very complicated in all its implications and it has to be controlled.That is why we developed simulation programs for both analysis of coal blends development in all facilities of raw coal haulage (SIMDUL) [2] and operative management of the whole selective mining process and homogenization (OCOW).

2.2. Operative management of coalfaces supplying with materials

The essential goal of the operative management is to safeguard that necessary material and equipments would be delivered to coalfaces in given time period, with required assortment and necessary quantity, despite of down time effects of different influence [3]. If the needed materials are not disposal, this may cause the delay of mining sites development and due to economics wastes. The problems is featured by its complexity, and namely by the fact that from the viewpoint of the company's organizational structure a number of organizational centers take share on managing the whole logistic process, during which time they fall under various competencies of managing staff members. The material transport of both new and re-used materials or eventually of material destined for renovation has to be controlled by the help of simulation models. The simulation program OCOW is a very good tool for that.

3. SIMULATION ANALYSIS AND MODELLING

The modelling process of coalfaces supplying with materials is based on both transport structure analysis and management structure analysis. The transport structure analysis has to be supported by data of traffic parameters and management structure analysis includes the numerical characteristic of all actions. As a result is than an oriented network chart, which can be editing in the program OCOW.

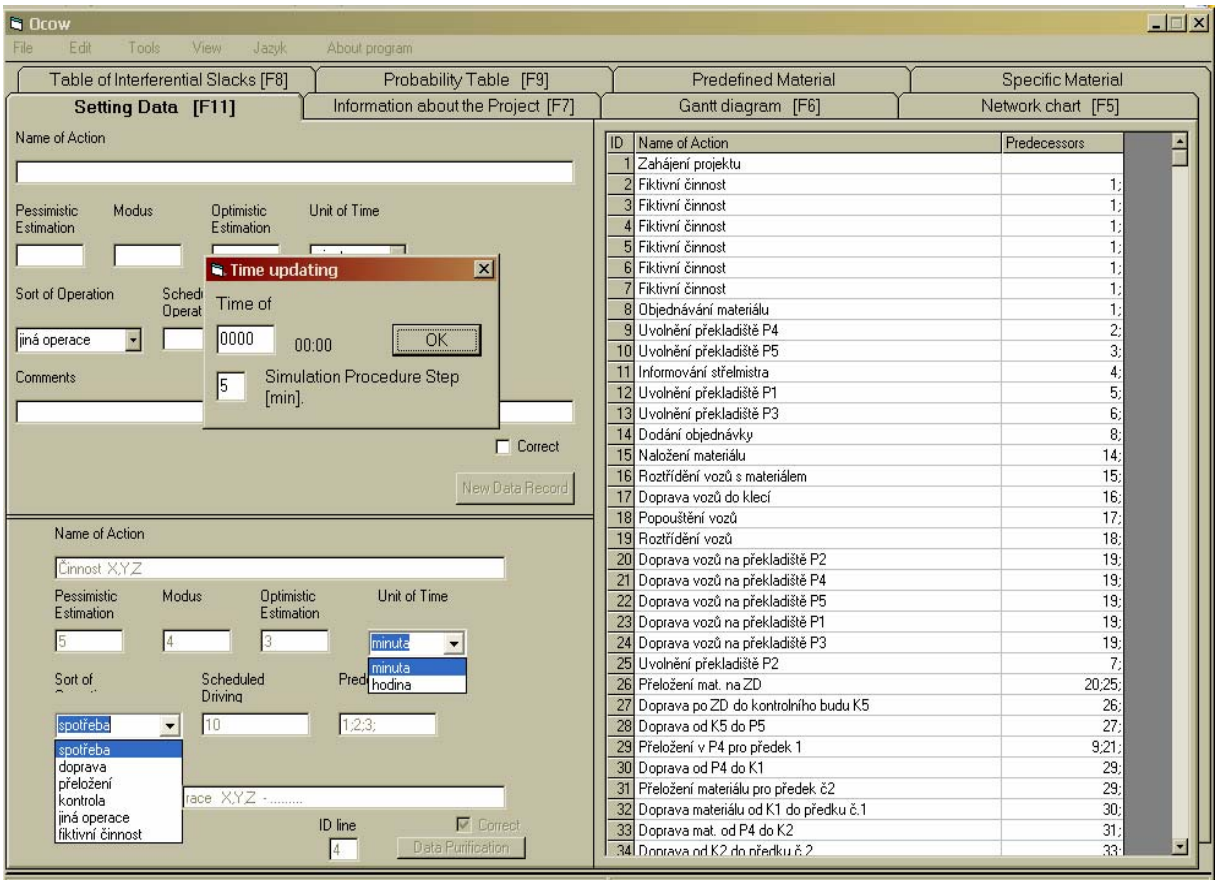
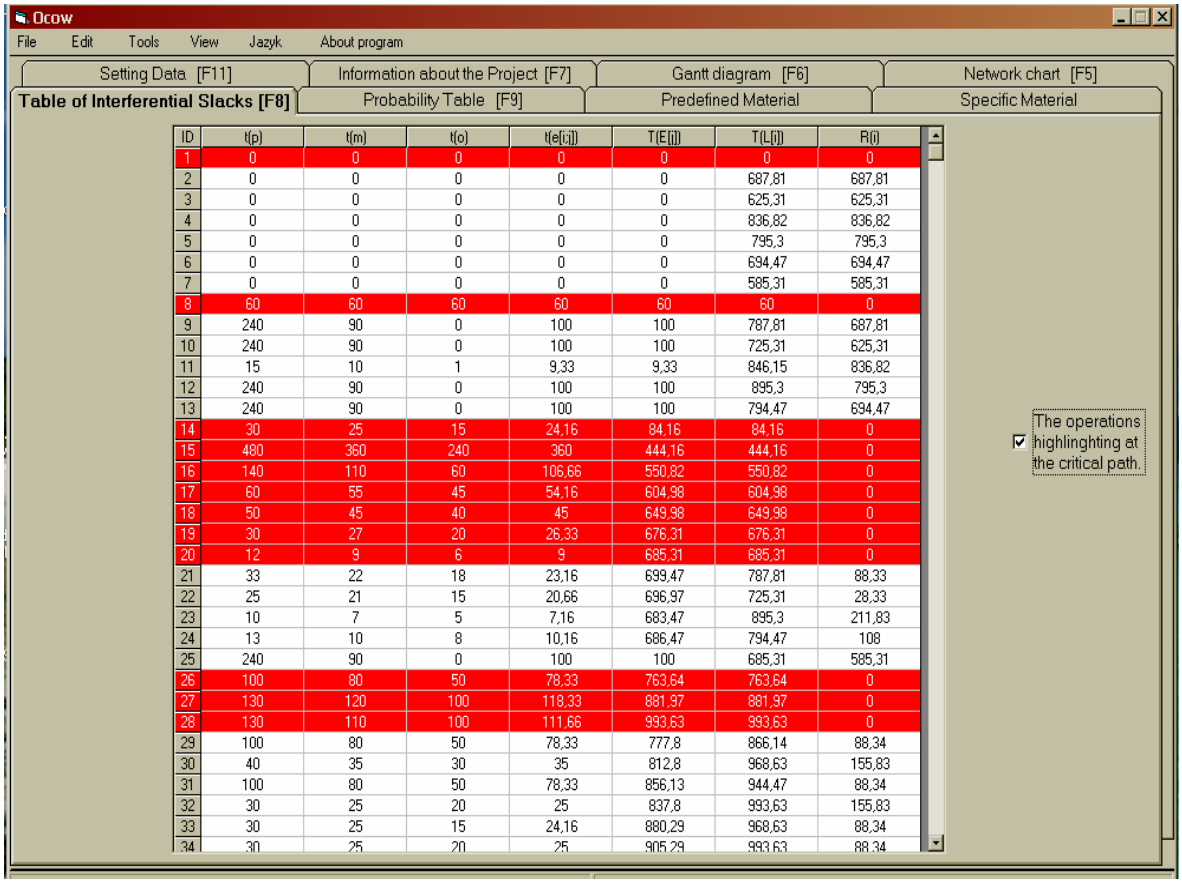


Figure 1. OCOW – Graphical user interface.

The program OCOW is based on the network oriented graphic environment. In regime – *Entering data,* are setting: the experts estimations of the tasks time duration, description of the tasks and also loaded and transported materials (see figure 1). The program enables simulation both static and dynamic properties of the whole process. The results of simulation can be presented both by means of tables and graphic presentation. The table F8 (see figure 2) includes both expert estimation of activity time duration and terms of nodes realization. Here are highlighted the operation lying on the critical path. The table F9 is then devoted to probability of nodes changes into the critical ones.



ID	t(p)	t(m)	t(o)	t(e[i,j])	T(E[j])	T(L[i])	R(i)
1	0	0	0	0	0	0	0
2	0	0	0	0	0	687,81	687,81
3	0	0	0	0	0	625,31	625,31
4	0	0	0	0	0	836,82	836,82
5	0	0	0	0	0	795,3	795,3
6	0	0	0	0	0	694,47	694,47
7	0	0	0	0	0	585,31	585,31
8	60	60	60	60	60	60	0
9	240	90	0	100	100	787,81	687,81
10	240	90	0	100	100	725,31	625,31
11	15	10	1	9,33	9,33	846,15	836,82
12	240	90	0	100	100	895,3	795,3
13	240	90	0	100	100	794,47	694,47
14	30	25	15	24,16	84,16	84,16	0
15	480	360	240	360	444,16	444,16	0
16	140	110	60	106,66	550,82	550,82	0
17	60	55	45	54,16	604,98	604,98	0
18	50	45	40	45	649,98	649,98	0
19	30	27	20	26,33	676,31	676,31	0
20	12	9	6	9	685,31	685,31	0
21	33	22	18	23,16	699,47	787,81	88,33
22	25	21	15	20,66	696,97	725,31	28,33
23	10	7	5	7,16	683,47	895,3	211,83
24	13	10	8	10,16	686,47	794,47	108
25	240	90	0	100	100	685,31	585,31
26	100	80	50	78,33	763,64	763,64	0
27	130	120	100	118,33	881,97	881,97	0
28	130	110	100	111,66	993,63	993,63	0
29	100	80	50	78,33	777,8	866,14	88,34
30	40	35	30	35	812,8	968,63	155,83
31	100	80	50	78,33	856,13	944,47	88,34
32	30	25	20	25	837,8	993,63	155,83
33	30	25	15	24,16	880,29	968,63	88,34
34	30	25	20	25	905,29	993,63	88,34

Figure 2 Presentation of the table appearance.

As was mentioned formerly, the program makes possible also simulation of dynamic properties, for the reason of operational management. The program makes it possible by the help of graphic illustration of icons varying the location in the modelled network chart, wherever are actions that have something common with materials (transport, loading, unloading, etc.). This move is possible on the base of interactive demand. Also a detailed table is shown with assortment and quantity of materials. For this, the program was completed with a database of materials (roadway arch, subsidiary materials, mine-timber, etc.) and the material quantity is calculated according expected daily progress of drifting. The illustration of time updating is also possible by Gantt diagram use, which shows all activity time periods duration with critical activities indication. The updating of just simulated activities is indicated by the vertical which crosses the given activities.

3.1. An example of modelling and simulation.

As an example, in this contribution, it is presented a model of coalfaces supplying with materials at deep mine Lazy in OKD district. Here the net chart has forty – eight nodes and sixty oriented edges including fictive ones. There are eight coalfaces, which six of them are equipped with the heading machines and two of them use blasting. The net chart contains both transportation activities (transport, loading, unloading, etc.) and controlling functions or staff work. This model is presented on all figures in this paper from one to three.

In addition to simulation and animation on the base of an interactive user request, the program makes possible also mode of movement demonstration. In this mode, the application changes fluently time updating according scheduled step, initiates the simulation and animation of the icons movement. In the presented example we can see the demonstration mode with detailed information of materials structure on the figure 3.

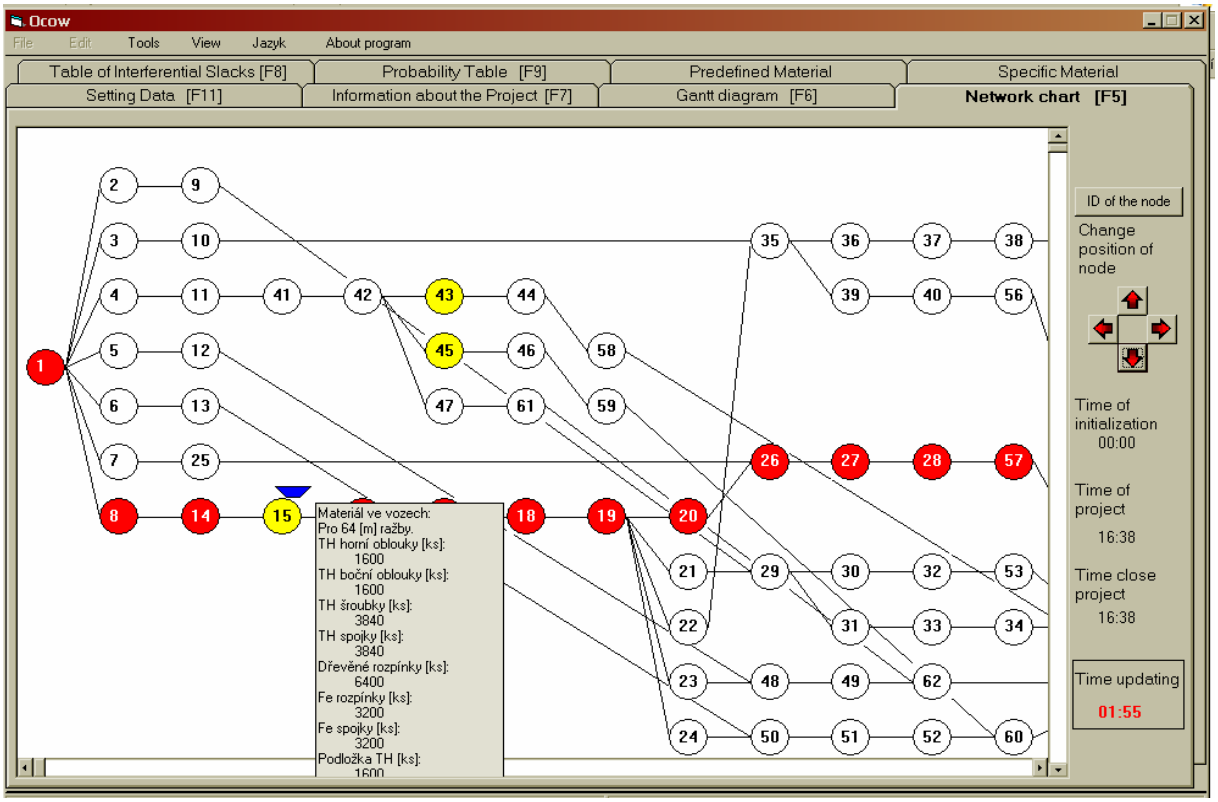


Figure3 OKOW – demonstration mode.

4. CONCLUSION

Operative management represents a continuous process of making working commands more accurate as they are on the way, or arise subject to changing demands. Operative management of deep mining operations has to ensure both realization of technical and operative modes and information provision as regards conditions of transportation and mining complexes. In the case of modelling process of coalfaces supplying with materials, which have been conceived as stochastic, and which have been based on actual deep mining operations, the simulation models will provide for verification of possible solution variants and they can also facilitate optimum design developments. The simulation models realized by the help of the OCOW program represent a tool that not only can be employed for computer models realising and simulation of optimum variants oriented on minimizing of non-technological stoppages, but also for purposes of operative management. The latter especially concerns interactive graphic presentation of locale variations as regards underground trains for material transportation, inclusive on demand information option concerning category and quantity of the material transported.

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