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USE OF SIMULATION PROGRAM FLEXIM AT OPTIMIZATION OF PRODUCTION PROCESS

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Abstract: One of the most modern techniques which to a significant extent contribute to increase of competitiveness and effective management of production enterprises is simulation. Simulation in a significant way assists at planning, management and continual improvement of production processes. Today there exists in the market a sufficient amount of simulation programs for various types of industrial enterprises and all managerial levels.
Keywords: simulation, simulation program Flexsim, optimization, production process

1. INTRODUCTION

Simulation at present ranks among key techniques of industrial engineering and has a wide scale of use. Also due to the increasing performance of hardware and simultaneously decrease of its price these are accessible for the majority of enterprises and their use contributes to increase of competitiveness and effective management. Simulation programs check fast and reliably the correctness of the proposed or the already existing system and process.

SIMULATION PROGRAM FLEXSIM

Simulation software Flexim is an object-oriented simulation tool for designing of models, creation of visualisations and simulations of various production processes, logistics, manipulation, checking of problems and variants. The main goal of the program at these problems is to optimize and decrease production costs.

In the program it is possible to create a three dimension model of the real system which can be analysed in shortened time and for much lower costs than the real system. Flexsim provides to the user visualisation of processes in 3D environment with statistical analysis of information. The programs ranks among discrete - event software, i.e. it is used for modelling of systems which in specific points and time change their status due to characteristic events. Simulation program Flexim is namely a universal tool with wide possibility of use in the following areas: [6]

- ✓ improvement of utilization of machines,
- ✓ elimination of supply problems,
- ✓ shortening of waiting time,
- ✓ minimisation of accidental statuses,
- ✓ determination of the most advantageous size of produced volumes,
- ✓ management of logistics of materials, goods, products and services,
- ✓ analysis of new investment ideas,
- ✓ decrease of costs,
- ✓ determination of throughput of systems,
- ✓ analysis of setting of times,
- ✓ elimination of problems at manipulation with material,
- ✓ training of operators.

The simulation software Flexsim became a dominant product in the market and is used by several worldwide recognized industrial enterprises. Its newest version offers simplicity of use, increase of 3D abilities, better performance and greater extendibility.

2. PROPOSAL OF SIMULATION MODEL FOR PRODUCTION OF SELECTED PRODUCT

The simulation model was made for the purpose of possible increase of production of industrial workplace for production of motor pistons, while the trial version of simulation Flexim 6.0.2 was used. By help of the program were created three variants – the first one simulated the contemporary status of production, the others were focused on increase of total production .

For creation of the simulation model it is necessary to be familiar with the technological process of production of product and also the parameters of machines which correspond with the real production process.

Technological operations at piston production are cutting, pressing, turning, drilling, milling and grinding. In the production workplace are located seven machines which are operated by 5 operators. The times of specific technological operations are given in table 1. [4]

Table 1. Duration of specific technological operations

Number of machine	Machine and number of operations	Duration of production cycle [s]	Time of manipulation [s]	Total time [s]	Number of operators
1	Saw / 1	5	2	7	1
2	Press / 1	3	5	8	
3	Lathe / 3	42,35,32	28,18,15	170	1
4	Drill press / 2	88,60	123,35	306	1
5	Milling / 1	47	45	92	1
6	Laser / 1	3	2	5	1
7	Sander/ 1	20	2	22	

2.1. Simulation model - variant 1

A specific model was created in order to show the significance and advantages of computer simulation for the given workplace. (Figure 1) The prototype for the model was the production of motor pistons, where the semi-product passes some production phases and the finished product is transported to the store. Due to the limitation of program Flexsim at designing of the model it was necessary to consider several simplifications.

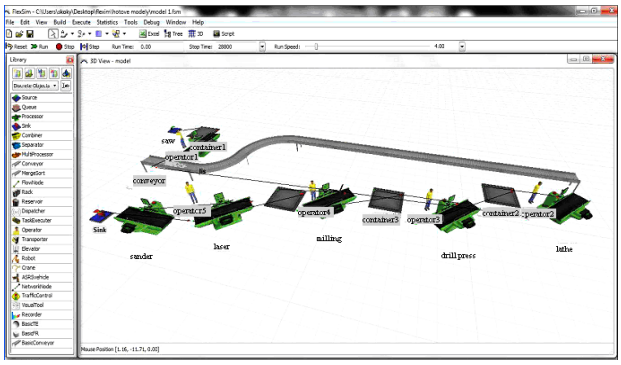

Figure 1. Simulačný model – variant 1 [4]

Since the production runs only in one shift, the model was running 28 800 seconds what represents 8 hour working time. After starting of simulation Flexsim collected statistical data, out of which it automatically formed charts. The sample is shown in figure 2.

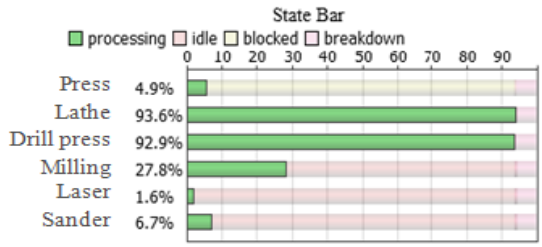

Figure 2. Activity of processors - variant 1

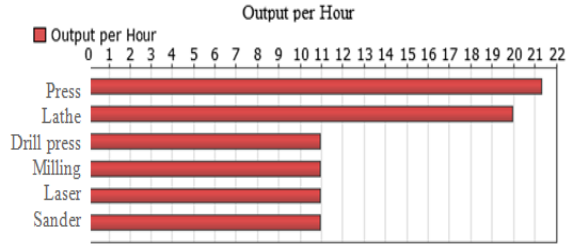

Figure 3. Outputs of machines for one hour

After investigation and analysis of statistical information, charts and simulation itself in the production process a bottleneck was detected. From charts which show the process time it is apparent that the most utilized machines are the lathe and the drilling machine. Even despite the fact that the lathe is utilized sufficiently, it does not represent in production process a bottleneck. The production is cumulated only beyond the lathe, what is also confirmed by the volume of material in container, on which was in one working shift accumulated 68 semi – products. The drilling machine has not managed to process these. This analysis is confirmed also by chart showing outputs for an hour on specific machines (figure 3).

2.2. Simulation model - variant 2

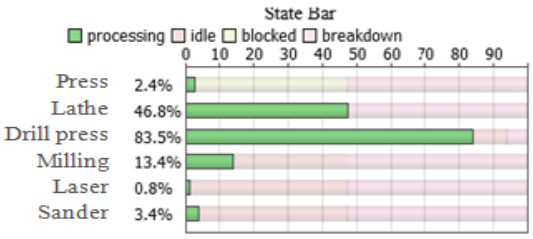

Figure 4. Activity of processors - variant 2

For the purpose of elimination of the bottleneck were made simulation models model 2 and 3. Simulation model 2 was made similarly as model 1. All machines and connections are set in the same way, the only difference is the time setting of the drilling machine. Since exactly the drilling machine represents the bottleneck, i.e. the place (machine), which does not manage to process the semi-products, the addition of one working shift was proposed. During this shift only the drilling machine will work and process semi-products from the container two, which it did not manage to process in the first shift. The thus adjusted model was started for the time of two working shifts and the acquired data are graphically represented in figure 4.

2.3.Simulation model - variant 3

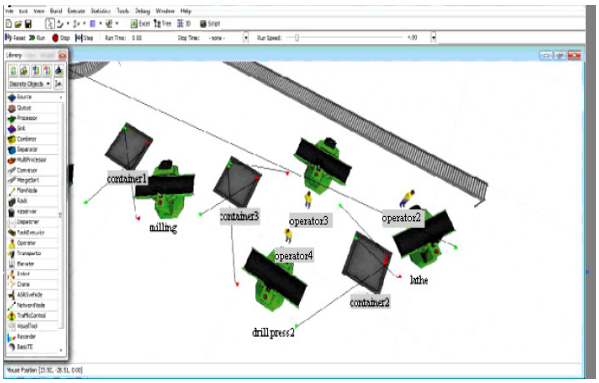

Figure 5. Distribution of machines – variant 3

In simulation model 3 the parameters are set in the same way as in the previous two. For the purpose of elimination of the bottleneck a new machine was added to the model - a drilling machine with the same parameters as that drilling machine which is already located in the workplace. The change of distribution of the machines is given in table 5. [4]

This model differs due to the fact that here are located two drilling machines which process the given semi-products simultaneously, they are both connected with container number 2 and with container number 3. For the second drilling machine were set the same parameters as for the original one. This means that the semi-product from container 2 is transported alternatively to drilling machine 1 and drilling machine 2. The processed source from both drilling machines is transported into container number 3. The first working break is set to the time of start 16 200 seconds and will last 1 800 seconds. The second is set to the time of start 28 800 second (end of one working shift) and the time of duration 57 600 seconds. The measured values and their graphical representation are shown in fig. 6.

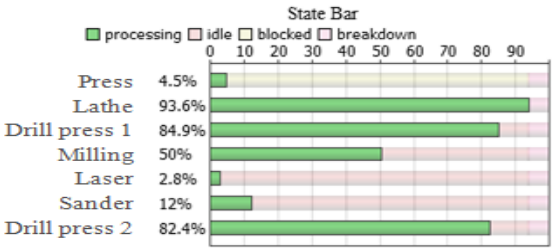

Figure 6. Activity of processors - variant 3

3. COMPARISON OF VARIANTS AND ASSESSMENT OF THEIR BENEFITS

For the better comparison of single variants are in table 2 (adjusted according to [4]) given data acquired by program Flexim. The evaluation and comparison of variants will be based on positive and negative knowledge, which the specific variants may bring.

At the first variant it is possible to produce during one working shift 87 pieces of products. In the second variant the measured values of processors were strongly influenced by working break (the second shift), during which only the drilling machine was in operation. Due to the fact that simulation put this time into the break of machines, the time of processing significantly decreased. The final production has the same value, 87 pieces. It is caused by the fact that in container number 3 remains after the end of the second shift the cumulated production of 70 pieces of semi-products. The processors which follow in the production process can manage to process the cumulated production on the following day together with the production of the given day. From this it was judged that if the production ran according to variant 2, the total production of the day would be 157 pieces of semi-products. The increase of costs would be in this case caused only by costs for

paying the wages of the new worker who would work in the second shift. At this variant the total production would increase by 70 pieces of products at low increase of operation costs. At the third variant the time of processing of some machines increases while the utilization of both drilling machines and lathe remains relatively on high level. Flexsim measured 156 pieces of the total daily production, what represents an increase by 69 pieces in comparison to the first variant. A shortage of this variant are increased costs for operation connected with the work force operating the second drilling machine and above all the not low costs for purchase of new drilling machine. The final result of simulation is the fact, that the most appropriate increase of production is achieved by introduction of the second variant while the production will increase by 70 pieces and the increase of costs will not be significant.

Table 2. Comparison of single variants

	Object	Idle [%]	Processing [%]	Blocked [%]	Break down [%]	Generating [%]	Output [piece]
VARIANT 1	Saw	0,00	0,00	88,21	6,25	5,53	218
	Press machine	0,02	4,60	89,12	6,25	0,00	167
	Lathe	0,18	93,56	0,00	6,25	0,00	156
	Drilling Press	0,82	92,89	0,00	6,25	0,00	87
	Milling machine	66,40	27,33	0,00	6,25	0,00	87
	Laser	92,25	1,48	0,00	6,25	0,00	87
	Sander	87,06	6,68	0,00	6,25	0,00	87
	Sink	0,00	0,00	0,00	6,25	0,00	87
VARIANT 2	Saw	0,00	0,00	44,23	53,13	2,65	219
	Press machine	0,01	2,35	44,23	53,13	0,00	168
	Lathe	0,10	46,78	0,00	53,13	0,00	157
	Drilling Press	10,28	83,47	0,00	53,13	0,00	157
	Milling machine	33,51	13,37	0,00	53,13	0,00	87
	Laser	46,09	0,79	0,00	53,13	0,00	87
	Sander	43,49	3,38	0,00	53,13	0,00	87
	Sink	0,00	0,00	0,00	53,13	0,00	87
VARIANT 3	Saw	0,00	0,00	88,24	6,25	5,51	221
	Press machine	0,02	4,54	89,18	6,25	0,00	170
	Lathe	0,17	93,58	0,00	6,25	0,00	159
	Drilling Press 1	8,82	84,93	0,00	6,25	0,00	79
	Drilling Press 2	11,35	82,40	0,00	6,25	0,00	78
	Milling machine	43,70	50,05	0,00	6,25	0,00	156
	Laser	90,98	2,77	0,00	6,25	0,00	156
	Sander	81,72	12,03	0,00	6,25	0,00	156
	Sink	0,00	0,00	0,00	6,25	0,00	156

4. CONCLUSIONS

From scale of simulation software's for the given process the program Flexsim was used, which together with its extension Flexsim Chart is a tool for modelling and simulation offering many functions. At realisation of change in technological process of production of motor piston it would be possible to increase production at low increase of costs. Simulation in this case was helpful at decision making process and choice of appropriate change in the process.

The simulation software is an appropriate solution for all enterprises which want to improve continuously and follow the conditions of the market. Simulation is becoming an important assistant to increase efficiency, productivity and flexibility of production processes.

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