Management modelling of the natural resources extraction station by agency modelling means

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Abstract. The article discusses the model of the conveyor in an open section including various controls for it, in particular oil injection stations. Based on the analysis of models, it is possible to measure the following parameters: the number of products manufactured for a certain time; the right number of controllers or workers; time calculation for fixing broken systems and others. Also presented is a model of the work of the oil of the injection station and the interface of the model’s work according to statistical data in the context of various parameters - time, orders and material, as well as statistics on the storage of materials. The model allow changing parameters of speed, workers and controllers. The developed system gives the operator the ability to monitor the process of the conveyor, in addition to other levels of control allow predicting breakdowns and analyse the economic side of the simulated processes.

1. Introduction

Simulation is a research method in which a model is a system under study that accurately describes a real system [1]. Experiments to obtain information about the studied system are carried out using this simulation.

Discrete event modelling uses an approach that proposes to consider only the main events of a simulated system that reflect the sequence of changes in system states over time [1].

System dynamics, this type of modelling is utilised in building a model of business processes, production models and social complex systems [2]. In this type of modelling, diagrams of cause-effect relationships and parameter interactions over time are built, while not paying attention to small details (individual properties of certain objects, events, and people).

The third type of modelling is agent-based modelling. This direction is used in the considered experiment, namely in constructing a conveyor model in an open section that includes various controls for it, in particular oil injection stations (OIS). The essence of agent modelling is to obtain information about the behaviour of agents and the system as a whole, while their tendency to function is determined by the individual behaviour of it is individual active objects and the interaction of these objects in the system.
Process modelling is an important and relevant part of already existing theoretical knowledge. Since it is a powerful tool for predicting and solving business processes in the face of uncertainty. Therefore, this method will help learn how to set up conveyors in how much to buy products, controllers and hire workers, it is worth creating the desired model, which will help indicate the presence of qualities and shortcomings. Attempts to launch an object without using a model can lead to unplanned spending of existing material resources. Therefore, this type of modelling will help increase economic efficiency and reduce risks in decision-making.

Also, there is always the possibility of the impossibility of production on a planned scale, which is influenced by various factors: non-compliance with quality standards of work performed; breakdowns; marriage in the extracted raw materials [3, 4].

The model supports the ability to indicate the time taken to fix problems. The bulk of the supply of enterprises falls on the following areas: sales to retail and wholesale consumers; security of consumers in need of products; provision of own needs.

The tasks to be solved in the simulation of the conveyor in an open section and it is various nodes are [5, 6]:

- Optimizing the work process.
- Predicting the breakdown of the oil distillation system in the OIS.
- Analysing the economic component.

The tasks of this work include:

- Automation and control of the conveyor, which will ensure the possibility of uninterrupted supply of products to consumers, which will increase profit [7].
- Minimization of stops in the operation of the conveyor, which will reduce the employment of employees and repairmen, as well as reduce the need for overpayment of wages to employees for unused hours.
- Forecasting system breakdowns, operators will be able to pre-receive information about possible breakdowns in the near future from the latest controllers, which will affect the accelerated decision-making [8].

2. Description of the object of study

The object of the study is a section on the extraction of natural resources with the presence of several conveyors operating on the basis of oil injection stations.

The model can be viewed in 3D, 2D, logic and statistics. Figures 1 and 2 show a 3D and 2D model of a section of a mine for the extraction of natural resources with the presence of several conveyors operating on the basis of oil injection stations that deliver products to the loading point.

![Figure 1. 3D view of the production model.](image-url)
Figure 2. 2D view of the production model.

The simulated section zone consists of the following zones:

- Transportation and loading of raw materials onto the conveyor.
- Supply of packages.
- The creation of a conveyor from raw materials of goods, which after production is packed by employees.
- The stage of packaging and quality control (if the stage is not passed, then there is a return to stage 3).
- Quality control by workers.
- The stage of unloading the goods from the tape and leaving the system.

You can also change the initial parameters of the system before starting the research model by changing the following parameters:

- Minimum quantity of goods in the order.
- The maximum quantity of goods in the order.
- The level of replenishment of the order for the customer.
- The time of receipt of the order.

Figure 3 shows a window in which user can make adjustments to the initial parameters of the system before starting the study model.

Figure 3. Setting the initial parameters of the model.
During the operation of the model, user can study its indicators, which is shown in Figures 4-7. Also, from statistics, user can find out information about the number of products produced both in general and over time, based on the given production values.

![Figure 4. Statistical data of the model.](image1)

In Figure 4, the diagrams show that there is no waiting time for the goods in front of the conveyor. The distribution of orders does not occur evenly, as does the distribution of processing time for a full order.

![Figure 5. Statistical data of the model (orders).](image2)

Figure 5 contains a graph of the processed orders per minute and a diagram showing the number of orders in the product.

![Figure 6. Statistical data of the model (product).](image3)
Figure 6 shows graphs depicting an unacceptable product, storage of unreserved goods and ore in the processed order by type.

Figure 7 shows the state diagrams of stored goods per minute and the distribution of the storage time of goods.

3. System description
The oil pump station, which has a tank with oil and an engine, is utilised for ensuring uninterrupted lubrication of conveyor bearings. In turn, the oil is chased according to the system (Figure 5).

Each tank under it is production belt separately delivers oil in accordance with the process. Pressure monitoring in tanks is carried out by manometers. If the oil limit is greatly reduced or increased, the fuse system is activated and the system shuts down forcibly. The oil station is controlled by relay blocks, in particular electromagnetic relays, designed to adjust the station's processes.
At present, the "GRANIT" telecommunication complex is widely utilized for transmitting, receiving, processing, and displaying information in telemechanical automated process control systems. It combines two types of devices:

- Control points, in which a microcomputer is integrated, providing software processing, reception, transmission and display of information.
- Controlled elements providing input, output, relay of heterogeneous information.

In the model shown in Figure 5, the amount of oil distillation can be changed, which will affect the speed of the conveyors. You can also see on the model the possible situations of system failure, which will highlight the system in a red color scheme, which will go out after repair by the station masters.

4. Conclusion

As a result of this experiment, a work model for the extraction of natural resources with the presence of several conveyors operating on the basis of oil injection stations and a work model of the OIS were implemented. The model is based on agent-based modelling, the main advantage of which is the ability to model complex adaptive systems. The developed project improves the operation of the section, predicts system breakdowns and allow analysing the economic side of the simulated processes.

It is allowed to say that the constructed model showed good results for the campaign of the experiments, and there is also a justification for the implementation and obtaining the best indicators for the enterprise.

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