1 Introduction

At present, using computers and specialized software is essential component of the manager as well as members of his team. The main prerequisite are the modern information technologies to enable rapid exchange of data and information, creation of documentation, archiving and sharing prior knowledge. Computer simulation is now used in several disciplines such as physics, chemistry, economics, but also psychology, sociology, and other operational research. The paper will focus entirely devoted to computer simulations.

The main aim of this paper is to highlight the possibility of using simulation as a support tool in the management and transport. Practical applications of simulation in transportation to serve as a practical tool for decision making at various stages of management of transport company, as well as the transport itself. The aim is to give instructions transport manager for the successful use of simulation methods.

Solution of the examined issues in the paper requires the use of several methods depending on the character of each part of the solution. For the acquisition and collection of information were used method of analysis of documents (when analyzing current and historical data relevant to the issue). For solve of the problem were used methods of induction, deduction, synthesis, abstraction and modelling.

2 The analysis of the examined issue

According Všetečka (2007) a simulation is support tool that allows testing the effects of different decisions on the simulation model. The principal value of simulation lies in its ability to reduce risk through the possibility of examining the behaviour of the system after the implementation of measures, respectively after applying the changes. Based on this insight into the future can be removed in advance of any problems.
The basic principle of the simulation is to simplify the real system by creating a simulation model describing the specific characteristics of the real system that are the subject of simulation. The implementation of simulation experiments occurs after authentication and verification of validity of the simulation model. The results of these experiments will bring improvements to the possibility of different simulated systems and verify their impact on the modelled system. Achievements of the experiments are re-applied to the real system to improve its properties. Fig. 1 presents some definitions of simulation.

**Fig. 4 Some definitions of simulation**

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<th>Author(s)</th>
<th>Definition</th>
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<td>Jerz (2011)</td>
<td>Simulation allows to create a model of system, respectively process that provides information about the behaviour of system in time, to experiment with it using a computer and an analysis of the results of experiments to answer questions like &quot;how the system will behave if we do a particular change.&quot;</td>
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<td>Dlouhý (2005)</td>
<td>Simulation is a numerical method of complex stochastic dynamical systems using probabilistic experimenting with computer models.</td>
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<td>Paholok (2008)</td>
<td>Simulation is a scientific method, as it constitutes a way of gaining knowledge in the world. At a certain level of simplification to it can be said that a simulation represent an experiment with the model.</td>
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Source: [5, 8, 11]

Všetečka (2007) mentions the following reasons, which show an advantage of simulation learning experience before experimentation in real life:

- Lower financing costs,
- Speed (simulated time can run much faster than real time),
- Simulation of a very wide variety of options,
- Security (can be simulated catastrophic variant),
- The possibility of analyzing and planned systems that do not exist.

When using computer simulation is necessary to realize what it can achieve, where can be using this tool as a support, and conversely where the method fails. Strengths and weaknesses of computer simulations are presented in Fig. 2.
The main phase of simulation studies are:

1. Definition of the problem,
2. Create a simulation model,
3. Specification values of variables and parameters,
4. Simulation (calculation results),
5. Proposal (requirement) of new experiments.

**Fig. 2 Strengths and weaknesses of computer simulations**

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<th>Strengths</th>
<th>Weaknesses</th>
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<td>• The possibility of solving analytically intractable tasks</td>
<td>• The disadvantages of the commonly known problems using the model</td>
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<td>• Facilitate the solution of difficult resolvable tasks</td>
<td>• The possibility of failure in the process simulation of extreme events,</td>
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<td>• Standardization of some quantitative parameters,</td>
<td>• The possibility of manipulation</td>
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<td>• The process of creation model help to discover and specification of new facts,</td>
<td>• Methodological complexity methods</td>
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<td>• Extension of the prediction even in areas where there is a fair use of deductive methods and deterministic models.</td>
<td>• The method is not general,</td>
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<tr>
<td>• And others.</td>
<td>• And others.</td>
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The simulation model differs from other methods that must be precisely designed for each problem situation. Its core simulation is providing a combination of values of input variables to generate possible outcomes. Chromjaková (2011) points out that the simulation is a tool that will directly get the optimal solution. It is rather a support tool that helps the manager to test effects of their decisions on the simulation model.

It also draws attention to two basic rules which apply in the application of simulation:

1. The benefits obtained by applying the simulation should be greater than the costs necessary to carry out simulations and improvements in system,
2. Simulation should be used in the early stages of processing the project.
3 The application of simulation in management and managerial decision making

Simulation models have a wide range of practical uses in management, economics and finance. In the following, attention will be devoted exclusively to the management.

In the management process a manager often must decide in difficult situations. In particular, decision-making under conditions of uncertainty and risk requires the application of computer simulation.

The first area is the area of the utilization logistic management, specifically in determining the optimal number of stocks. Impact on it several factors. The incidence of demand and its size and the size of supply is a random variable, inventories consist of many products from different vendors and products to the manufacturing process assemble, stocks degrade over time and under.

The second area is the use of computer simulation of its application in queuing theory. This theory reviews process, which leads to the accumulation of the requirements of the limited capacity of the operator. Computer simulation is used mainly in cases where the service time is a random variable, there are many different types of requirements, the intervals between arrivals of requests is a random variable, parameters of the distribution of random variables during the simulation may vary, and so on. [11]

Computer simulation can also be used in the process of product management, especially in the case of complex production processes where it is necessary to determine the optimum order in which products will be on the production process equipment. [12] According Chromjakova (2011) computer simulation of production is actually a "test factory" on a computer, for example, which helps verify the effects of different management strategies.

Area of financial planning also provides many opportunities for the application of computer simulations in particular because of the significant number of situations where certain, where the randomly inferior process can affect the future financial indicators of business (e.g. staff leave, the level of demand, etc.). As an example, the method of Cash Flow at Risk, where the simulation can be made that at a certain level of likelihood of Cash Flow shall not exceed a certain level.

Very significant utilization has computer simulation also in the process of project management, especially for critical path method - CPM (deterministic duration of the
periods of activities) and methods of PERT (stochastic time duration of the activities). These methods provide a time analysis of the project by the cash flow analysis, cost and resources. Dlouhý (2007) points out that normally the compilation of three possible scenarios, and optimistic, most probable (typical) and the pessimistic version.

Computer simulation is widely applied in the risk management. Managers must often decide in terms of risk, while it increased responsibility lies with the administrative decision. It is through computer simulation manager can detect the possibility of unexpected events, take a view of the severity of catastrophic scenarios, and so on. Computer simulation is now an irreplaceable position in particular in managing financial risks. [11]

Jerz (2011) is devoted to possibilities of using simulation to improve business processes. Simulation experiment as a tool for process improvement provides information on the use of individual elements of the system, as well as the whole process, for example the intermediate times of products, costs, number of products and so on. Jerz (2011) points to the undeniable benefits of simulation in the form of authentication options due to the change attribute of the element or attribute activities, i.e. measures in a particular system to run the system as a whole, respectively process.

Computer simulation has its application in the case of management of the transport company, whether management of the traffic. The following section of the paper is focused to just possible applications of computer simulation in terms of traffic.

4 Using the simulation in traffic conditions

In the planning process of traffic systems is using of simulation tools much more important. Nowadays any important decision can’t be realized without detailed modeling using computer simulation. Utilization of computer simulation mainly depends on concrete kind of problem about which it is needed to decide. Frequently it’s used by infrastructure reconstruction, supposed increasing the traffic and verifying crisis scenarios.

Between basic possibilities of using the computer simulation in traffic belong:

- Container terminals,
- Marshalling yards,
- Traffic in industrial facilities (e.g. Steel mill),
- Stations for passengers,
- Passengers movement,
- Service centres (e.g. Train Care Centres),
- Road traffic,
- Airports.

Of course the possibilities of using depend on the concrete place, which is operated by a manager. Developing the simulation study gets the management of the company many informations, that weren’t originally required. These informations are often important. Simulation studies are mostly made complex, thus many areas are optimized simultaneously (personnel, technological processes, traffic infrastructure) (Fig. 3 and Fig. 4).

Fig. 3 Graphical protocol from detailed simulation run

Source: [3]
Between the basic possibilities of simulation using in the companies belong:

- The decision about building suitable traffic infrastructure with sufficient capacity,
- Verifying possibilities of existing infrastructure of supposed increasing requests,
- Testing the crisis management (f. e. the evacuation of population),
- Finding the insufficient using of resources (personnel, cars, locomotives, wagons…),
- Finding the bottlenecks in the traffic,
- Optimization of moves and technologic processes.

In container terminals, for management it’s important to determine the structure and count of employees. With the assistance of detailed microscopic simulation models it is possible to recommend for the management the count of drivers of cranes, container manipulators, locomotives etc. Modern simulation tools allow modeling also the work shifts and their work pause. Obtained informations allow management projecting work shifts. Also it is important to determine the count, structure of storage capacity and their deployment. Not used the storage capacities increase the operation cost for container terminal. The containers are often stored on each other. For the removing the bottom container it is necessary to transfer all containers stored above it.
Using the right method of container storing can be the count of redundant crane moves significantly decreased.

In the marshalling yards and container terminals there are for the management important the decisions about the count and position rails. In the history was the needed count of rails estimated using mathematical methods. Created yard had a large capacity reserve. The consequence of this was a lot of ineffectively invested money. The results of simulation studies allow very precisely modeling many variants of yard and to choose the most effective variant. The financial save of non-using switches and tracks is giant. If we suppose the traffic capacity increases, it is needed to determine how many infrastructures must be constructed. Possible saving costs are greater, because the building costs are saved. Using the simulation we get also the informations about using the individual tracks. The management of company gets the possibilities for qualified decision about the most effective variant.

In industrial facilities the management of the company has to decide many questions related to traffic infrastructure. It’s necessary to specify position and parameters the infrastructure. Also it is needed to choose technological processes of individual traffic elements transfer. The optimization of moves can bring the saving costs. There aren’t any easier and more precise possibilities to get these informations, than using the computer simulation. The price of specialized transport equipment is very high and the mathematical approximation of the required count is inaccurate. For example the steel mill, where the separately steel rolls are transported using specialized cars. These cars are made to order. The move of these cars is automatic. The simulation results are the informations about the necessary count of the cars and also about the suitable method of automatic move control.

By buildings projecting for many people (underground stations, rails stations, shopping centers) it is necessary to determine, whether the projected capacity is sufficient, whether the parking places for customers will be enough, whether long lines in front of lifts won’t be created.

In the area of road traffic there are lots of possibilities how to use the computer models. The road simulations are used especially in planning road construction, but also in planning of new buildings construction, where we suppose traffic increasing (shopping centers, large companies, distribution centers and storages). This is much more difficult creating the simulation models. Many simulation tools don’t have support for the simulation the road traffic. A lot of complications implicate a lot of collision places, a lot of road rules and human factor in driver decision. Insufficient verifying of capacity possibilities in traffic infrastructure can cause the traffic jam after
finishing roads creation. The solution requires additional construction work. With helpful simulation study it is often possible to realize fully functional solution without increased cost. Traffic jams would be detected already in the phase of simulation model creation and the project would be revised. The costs for computer experiments are with building costs negligible (Fig. 5).

Fig. 5 Simulation run of road traffic

In the air transport simulation models are mainly used for verifying capacity possibilities of airport. The management of airport often asks, whether investment in new runways will be returned, whether they are really needed.

5 Creation of simulation models of transportation systems

If the management of company decides, to use computer simulation, it has two possibilities how to do it. The study can be created by specialized consultation company or the company buys needed software and the study will be created by its own employees. The choice depends mainly on how quickly the company needs to get the informations, how much can it pay, but also on the company size.
On the market place there are many consulting firms, that supply complete simulation study. When selecting a suitable company should be especially important for the management of the references already made contracts.

At the process of creating of simulation studies should to be partially involved employees of the company. They provide all necessary information and with their help the results may be relevant and useful.

The process of creation the simulation study can be divided into several phases:

- Collecting information about decisions, which are required. Collecting input data and informations about the company operations.
- Preparation of the simulation model. Programming activities.
- Verification of simulation results.
- Creating the simulation study and results

The management gets in a very short time a large amount of useful information. Often the results about possibilities for savings are surprising. This procedure is suitable for businesses that need urgent simulation studies, haven’t their own IT department, or don’t plan in the future to use the simulation in its decision.

In the event that the company has its own IT department and in the future it plans using simulation models, may be better for it to purchase the necessary software and to educate its own staff. First it needs to choose a suitable simulation tool. The next step is a good staff education. Employees will be able to create the required simulation models. This procedure is much more difficult in time, but cheaper and in the long time more advantageous for the company. Nowadays it is possible to purchase many simulation tools (Arena simulation software, VisSim, FlexSim, Plant Simulation...). They differ mainly in visualization capabilities of the simulation run, in detailed simulated environment and price. For simple simulations is suitable "Arena simulation software", which allows to model the individual processes. Can be used for partially optimizing the process of storage and working. Its use for road transport is very limited. For more detailed simulation it is necessary to use more tools sophisticated (VisSim, FlexSim, Plant Simulation…). Working with these tools requires a technical educated people. They must learn to work with this tool.

According to requirements of the management it is possible, that the company orders its own simulation software. This software will be specifically tailored to its needs. Thus created a simulation tool will be very easy to use and allows in the future creating additional simulation models. The production process of simulation tools is time-consuming as all the details have to be negotiated (method of control, simulation
input parameters...). This solution is also expensive. The software can be used also by less technical educated people and it is the company's significant investment in the future.

In the recent past the simulation results were important. Nowadays it is almost always required the visualization of the simulation run. Visualization can be schematic, 2D (Fig. 6) and 3D (Fig. 7). Schematic visualization provides only basic visual information about processes during the simulation run. Using 2D visualization is possible to see the exact location of individual transport elements in space. It is often used, for its simplicity and clarity. The most ideal is 3D visualization, when the user can see every single detail of running simulation. Although it is most detailed it often provides less information simultaneously. In the simulation model it is not appropriate to use only 3D visualization. 3D visualization is only complementary to 2D visualization. If the 3D visualization is necessary, it’s better to use an external company that created many 3D simulation models before.

*Fig. 6 2D visualization of simulation run*

Source: [3]
6 Conclusion

Manager using the simulation models getting into the hands a very effective tool for decision making, particularly in terms of risk and uncertainty. Computer simulation is widely used in the management and transport.
Currently, there is the creation of procedures, methods, support tools and software products that enable and accelerate the optimization process to improve the exclusion of humans from the process, automating or at least some activity. However, the role of man and continues to play an important role.

It also leads to extension of the traditional application areas of simulation in the following directions (Chromjaková, 2011):

- Tool for analyzing and improving production
- Tool for investment decisions,
- Tool for communicating, explaining and teaching,
- Tools for promoting thinking and decision making.

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References


[3] All figures are from simulation tool Villon (developed by Simcon s.r.o.)


Resume

The paper deals with analysis of the possibilities of using computer simulation methods in management. A substantial part of the paper is devoted to specific applications, especially in management and transport. Gradually, in the paper are the definitions of terms the simulation and management, showed application areas of the simulation in conditions of management and transport.

Key words

Simulation, management, transport, method
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