1 Introduction

Currently, traffic engineers face the challenge of increasing complexity of transport systems. Their main aim is to ensure safe, efficient and reliable transportation while minimizing its negative impact on the environment. Traffic engineers must solve several problems. In particular it is about the unreliability and poor road safety, capacity problems, environmental pollution and wasted energy. The transport problems come to being by their very nature and structure of transport systems. These are complex systems involving many different components and participants who have different and often conflicting objectives.

Transport problems exhibit a number of features that allow the application of methods and tools of artificial intelligence. First, include both quantitative and qualitative data. Transport systems can often be very difficult to simulate the traditional approach, mainly because of interactions between different elements of the transport system. In the transport problems often have to solve difficult optimization problems that cannot be fully met by using traditional mathematical programming methods.

At present, rail transport obtains increasing importance in the national economy. It is about the security and facilitates the movement of more goods over longer distances at relatively low costs, that the transport of other modes of transport would be too costly and inefficient. Rail transport therefore plays an important role in economic and regional development. Rail transit systems offer opportunities for travelers to avoid traffic congestion in large urban areas [5]. The success factors in the transport sector can be speed, capacity, level of safety and service quality.

The development of artificial intelligence, information and communication technologies allow for the interconnection and integration of these advanced technologies into the current state of rail transport in order to create a new generation of rail transport [7]. The application of intelligent transport systems in terms of rail transport to fully exploit its potential in all its areas.
The main aim of the paper is to acquire new knowledge in the field of intelligent systems focusing on the area of transport and logistics. 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 was used method of analysis of documents. For solve of the problem were used methods of induction, deduction, synthesis, abstraction, simulation and modelling.

2 Using the intelligent systems for transport and logistics

In management of traffic systems, there are now widely used automation and intelligent control based on sophisticated algorithms. High performance of computers allowed a high degree of optimization of traffic management. The solution of need of rational use of resources and capacity was the introduction of intelligent systems. Intelligent systems are systems that have elements of artificial intelligence. It is necessary to provide a sufficient amount of input data and to design models, respectively algorithms of behaviour and learning of the system. From the technical side it is essential to secure especially the information-communication system, communication and data servers. In a few examples we will be shown the possibilities and benefits of this form of management.

In traffic we may be encountered especially with intelligent controlled crossings. Although in Slovakia continues the effort to promote roundabout in solving the problematic crossings, the fact is that the intelligent control of the light crossing has greater throughput than a roundabout. To obtain the data needed in management of crossing are used more types of sensors. Optical sensors of the route presence of the car are placed in the road surface, possibly are used the magnetic loops. The disadvantage of these sensors is the need to place them even during the construction of communication. Cameras, radars and optical sensors used to ascertain the number of cars on a particular stretch, eventually the traffic density are usually placed directly on the existing traffic light poles, buildings, or other suitable places. The advantage is the possibility of fitting later. It makes it possible to implement intelligent control also into existing junctions. To obtain information of the movement and a number of cars from camera recordings, is used the sophisticated analysis. In then analysis of the camera images are applied several methods based on the image analysis. Based on this data it is possible to evaluate well the current traffic situation and to adjust the phases of traffic lights in order to ensure the greatest possible throughput of crossing.

Nowadays is promoted building of comprehensive transport system, so that the information from them maybe used also by users of transport infrastructure. For example, the information about the traffic jams, accidents and detours are sent directly
to the GPS navigation and they automatically provide the conversion of the fastest route to your destination. For wider dissemination of such technologies it is needed to secure especially the infrastructure for collecting, processing and storing data so that people can see the true potential of these technologies in everyday life. A similar development is moving towards in automobile manufacturers when they focus on the security of automobile communication. Cars can send the information to each other about sudden braking, standing, or driving slowly in a column. Such an ad hoc created intelligent system consisting of several cars can significantly reduce the risk of an accident as it can warn the driver of immediately approaching danger.

In traffic management are often used electronic variable traffic signs, which can also be controlled automatically. In large cities is also beneficial building the information systems that provide to drivers actual information about the traffic situation using large information boards. Thus, the advantages of intelligent systems can be used also by drivers without navigation. Alternatively, can be automatically changed direction signs to the targets (e.g., ward) according to the traffic situation. Automation is often used for maintenance of roads secure. E.g. in detection of ice on the way is automatically reduced the speed limit and simultaneously starts spraying antifreeze on the road bridge, thereby the traffic safety is improved.

The advantages of this control are:

- reduction of the number of traffic accidents,
- increase of the traffic flow,
- fuel savings (reducing the amount of greenhouse gases emitted),
- time savings (the transport comfort),
- to avoid blocking traffic facilities (bridges, crossings ...) by traffic jam.

3 Using the simulation in building of intelligent systems

In building of some intelligent transport systems the simulation is essential. It allows verifying the behaviour of a number of variants of management and algorithms. The benefit is also a very accurate estimate of the impact of building of intelligent infrastructure. Computer simulation is an excellent tool for a detailed comparison of the existing transport solution to the state after transition to the new specific management model. Based on this data it is possible to competently decide, taking into account the cost of system building and the expected benefits. The costs for simulation verifying of the traffic situation are negligible compared to the cost for building,
eventually rebuilding of the traffic infrastructures. In the concrete example a wide range of simulation using will be shown.

Fig. 1 Simulation run of marshalling yard

In large companies with the extensive rail infrastructure (e.g. large chemical companies BASF) it is necessary to ensure the most efficient service of the rail network. To the company come every day dozens of trains and each of the wagons has its end destination. Because the production and its requirements are constantly changing, the functioning according to fixed rules is not effective in terms of downtime and costs for car moving. A much better solution is to build an intelligent system of movement control of trains and especially grading of wagons in the marshalling yard (figure 1). And just in the design of algorithms of primary and secondary sorting, transfers of wagons and trains is the simulation irreplaceable.

First, the entrance inputs have to be thoroughly found out, so the trains coming into the company, requirements for addition of specific wagons in production and so on. Because the trains do not arrive according to a fixed order and time, but ad hoc according to needs of the company and customers (subscribers), it is advantageous if data of the status quo at least for a few months are available. Based on these data it is possible to create an initial simulation model that will be based on the reactive management of train movements. All decisions will be therefore in the process of simulation performed regardless of the future and past events. Each request is served
immediately, regardless of the consequences of such action. The initial simulation model will be obviously inefficient and in particularly inflexible (it does not allow the selection of variants of behaviour in a particular time).

Then it is possible to look for the appropriate control algorithms. Known methods of secondary sorting, neural network for controlling the movement of trains and times of departure may be used. Based on the many simulation runs it is possible to find out many at first sight undetectable patterns of system behaviour. Reactive control in the simulation is gradually substituted by a predicate. Predicate method takes into account the current method as well as expected (future) state of the system. Thus, in this case it means the expected future arrivals of trains in the near future. The information about train arriving into the company is available a few hours before and it can play a key role in decision.

In transport processes the robustness of the overall transport management has a great importance. The robustness is a property of the plan (the process control), which indicates its resistance to changing external conditions. For each plan (schedule, algorithm…) is thus possible to determine its robustness. The more is the plan robust, the use of resources largely reduces. But the management of companies are not always fully aware of. Often, in the creation of a management plans a certain degree of robustness is required, although its increase and more effective management are two conflicting requirements. The result of simulation can be a plan with the required level of robustness.

Regardless of chosen management methods the simulation will help us with their detailed comparison. Based on this knowledge the most advantageous variant of algorithm or technique of the rail network operation may be chosen. A side effect is reaching a large amount of information about the operation of company traffic, infrastructure reserves, the real need of workers, costs of operation and so on.

The last step is to build a very intelligent transport system of the company. The information and management system will be built and the collection of data will be ensured. The result is a sophisticated system that can save money costs on operation, accelerates sub-contracting processes and avoids deadlocks. The financially and ecologically effect is appreciable.
**Fig. 2** Detailed simulation run with 3D visualisation

![Detailed simulation run with 3D visualisation](image1)

*Source: [4]*

**Fig. 3** Simulation run of chemical industry

![Simulation run of chemical industry](image2)

*Source: [4]*
4 Conclusion

Modernisation of railways and application of intelligent transport systems in terms of rail transport may not only represent the development of this mode, but also increase the competitiveness of railway undertakings in the market. The formation of ITS is necessary based on the principle: ITS systems cannot be bought, but can be purposefully built [12]. Intelligent transport systems are widely used in logistics. Increasingly are the requirements for intelligent logistics and construction of new modern logistic centres. The most common techniques for logistics include Global Positioning System (GPS), Geographic Information Systems (GIS) and advanced information systems [14]. In real time, can be watched the movement of vehicles and containers, enabling more effective planning (for more [6]; [13]).

Level of development and transport infrastructure were among the key prerequisites for economic development in the region. IDS through the application of advanced communications, information and electronic technologies solve problems in the field of transport such as congestion, road safety and efficiency, environmental protection.

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References


Resume

At present it is often said about the new generation of transport, which will allow greater speed and capacity, a higher degree of safety and service quality. The paper
deals with using the intelligent systems for transport and logistics. This paper describes the using the simulation in building of intelligent systems.

Key words

Simulation, intelligent systems, management, transport, logistics, method

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