Chapter

The Methodological Standard to the Assessment of the Traffic Simulation in Real Time

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Abstract

The quantity of goods transported in the transport sector is increasing every year. As a result of the increase, the number of means of transport increases. The most popular sector is road transport, which is also referred to as the most dangerous in terms of safety. The assessment of the traffic situation on the planned route does not take place during its implementation. The consequences of long reaction times on emerging or already occurring incidents affect safety. This phenomenon can also trigger crisis situations in other critical infrastructure sectors. In more serious events, a cascading effect can occur between critical infrastructure elements that could lead to a domino effect. This phenomenon could be likened, for example, to *blackout* in power engineering. The conclusion of the chapter will include a case scenario as to how a methodological standard for traffic assessment should work on real-time crises.

Keywords: critical infrastructure, transport, road transport, crisis situations, traffic, evaluation criteria, traffic modeling

1. Introduction

The chapter is focused on the issue of crisis situations in the transport of material in road transport. The most important elements in transporting transport units are time and money at the moment. Time is taken from the point of view of when and where to pick up the shipments. Of course, time-related information is important where and when to ship the shipment to the destination. Based on this information, a preliminary cost calculation can be performed. The financial valuation depends not only on the distance to which the transport is carried out. Another important information is whether it is a special transport unit and whether special measures or training are needed to transport it (e.g., transport of dangerous substances—transport of ADR in road transport), etc. transport units to quantify the real costs of transporting a transport unit from point A to point B [18, 19].

Thousands of tons of material are shipped around the world every day. The first part of the book is focused on the development of transport units in individual transport sectors in the Czech Republic. In this chapter, we will learn not only the most popular transport sector for transporting transport units. Based on developments in the years, it will be possible to prepare preventive measures to minimize risks. Risks in transport are understood to be situations disrupting the transport

process. Risks can be characterized as influenced or unaffected. The proposed tool should work with both to be an effective tool for both planning and solutions in the ongoing transport process [11–13, 15].

In the conclusion of the thesis, a case study is described. The case study focuses on preventive measures before the emergence of a crisis situation. The proposed tool should be capable of timely response to the tool operator. Based on the information obtained, the tool suggests options for solving crisis situations before and after its creation. The proposed tool works with input data throughout the process. The aim of the instrument should be to prevent but also respond to crisis situations [11, 12].

2. Transport unit in transport

Transport units in transport can be divided into two parts. The first part is focused on the transport of people, which is not so important for the solution of crisis situations. The number of passengers carried varies across countries. Priority for public transport is preferred for passenger transport in developed countries. This situation in the Czech Republic is rather the opposite, and passenger traffic wins over the public. The trend transferred from abroad in the form of limiting the parking of cars in the centers, and their close surroundings began to be introduced in the Czech Republic. These limitations come under the name of a parking zone in cities. With the help of parking zones, however, the problem is gradually delayed, not the solution. This idea does not lead to the solution of the problem and can result in overcrowding of the periphery of the city [16].

2.1 Transport of people

In **Table 1**, we captured the number of passengers carried in years in each sector. The table shows the development in individual sectors and at the same time presents their popularity. Water transport in the Czech Republic has no representation in passenger transport. For this reason, no measurable data is recorded when transporting people.

The table shows us the downward number of passengers. We will present this fact in **Figure 1**, which presents a downward trend since 2015.

In **Figure 1**, we can observe a downward trend that started in 2015 and will probably not be different in 2018 and 2019. This fact shows us the decreasing popularity of public transport in passenger transport. This phenomenon is mirrored in popularity and preference by our own means of transport. At the same time, this figure highlights the increasing number of cars on the roads. As a result of the increasing number of cars on the road, there is also a higher density and thus an increased risk of crisis.

Passenger transportation (in thousand)	2014	2015	2016	2017
Road transport	349,515	350,920	332,763	329,733
Rail transport	176,051	176,624	179,171	183,024
Air transport	5623	5393	6000	6657
Water transport	—	—	—	—

Table 1.
Passenger transportation in the Czech Republic [1].

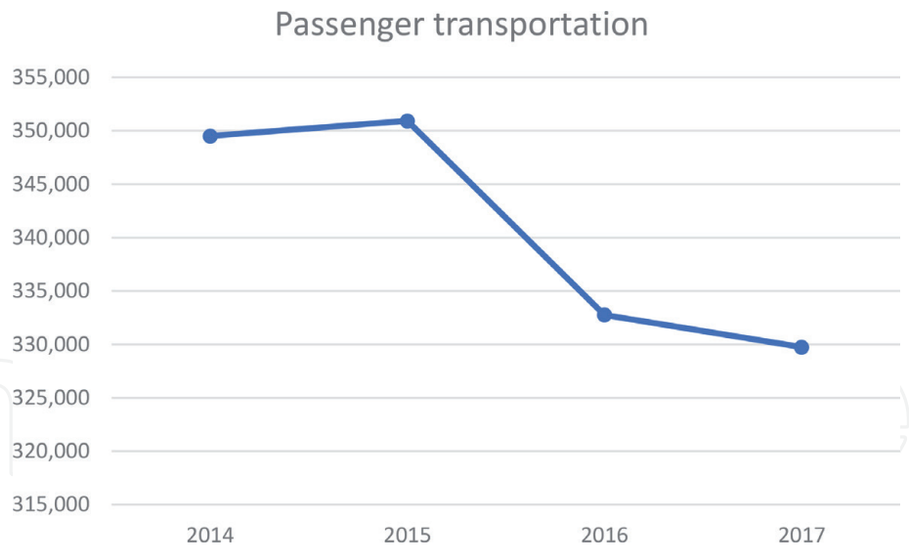

Figure 1.
Graph of development of transported persons in the Czech Republic [1].

Thinks (in thousand)	2014	2015	2016	2017
Road transport	386,243	438,906	431,889	459,433
Rail transport	91,564	97,280	98,034	96,516
Air transport	9057	5790	5632	6362
Water transport	1780	1853	1779	1568

Table 2.
Amount of transported material in the Czech Republic [1].

The chapter in the book is mainly devoted to the second part. The transport of material is more popular every year, and this is confirmed by the fact how much material is transported every year.

2.2 Transport of material

In **Table 2**, we can see statistics from the transport sectors. These data capture the number of transported transport units in each transport sector. Water transport is also one of the transport sectors. This sector is used for transporting material but not for transporting people due to watercourses on which people could be transported [1, 2].

Table 2 shows the dominance of road transport in material transport. Road traffic is the only increase. Other sectors are stagnating. This phenomenon can be seen in **Figure 2**.

Material transport is specific not only to the customer but also to the carrier. The growth in the transport sector is due to the fact that as the only transport sector, material from point A to point B can be transferred. Other sectors except the road sector have transport from terminal to terminal.

In conclusion, when observing statistical data, it can be stated that road transport is the busiest transport sector. At the same time, heavy road traffic increases the risk due to the number of vehicles traveling. The increasing number of means of transport during the most popular times increases the possibility of traffic accidents, which considerably complicate the process of material transport [3, 4].

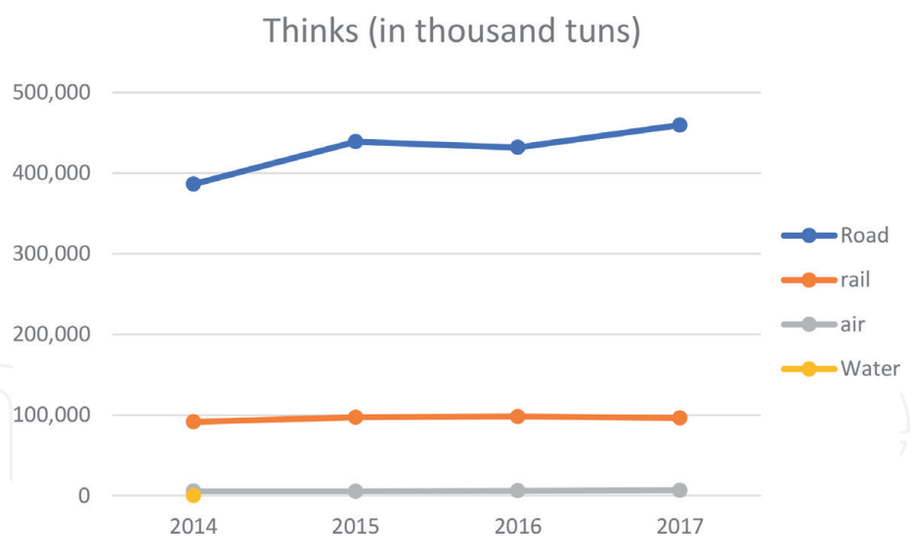

Figure 2.
Development of transported goods in the Czech Republic in individual transport sectors [1].

3. Transportation

The material is transported in each transport sector. As presented in point 2.2, road transport in the amount of transported material is clearly determined. From the point of view of the most popular form used to transport material, our tool is also focusing on this sector. The risks associated with the transport of material are largely predominantly in terms of responding to a new crisis situation [5].

The shortcomings of the present are seen not only in terms of transport planning but also during the entire transport process. The planning process does not work with many dynamic data that can greatly affect the process. These data include, for example, weather development, traffic density on a planned route, road reconstruction, risks associated with traffic accidents, etc. [14].

3.1 Current status

The current state of the planning phase does not work with a great deal of substantial information present. Common shipping cost calculations are:

- Distance
- Amount
- Price

With the above data, market demand is created. This demand has, in the final analysis, a predominantly price criterion. The cheaper the more interesting for customer.

3.2 Application of the proposed tool

Input data is important for each tool or software. He should work with a lot of data for our material transport management tool. This process makes it a dynamic tool that can work and respond in real time to crisis situations. Crisis situations can emerge until extraordinary events, which in turn cripple other elements of critical infrastructure [6, 7] (**Table 3**).

Type of transport unit	• Valuables • Fragile • People • Oversized cargo • Dangerous cargo • Others • Food • Prisoners • Combination
Standardization of the type of transport unit	• Yes • No
Disposition of the transport unit	• Solid • Liquid • Gaseous
Dimension of goods	• Height • Width • Length • Weight • Quantity
Transport packaging	• Palette • Wooden barrel • Canister • Box • Bag • Fine metal bag • Combination of packaging
Packaging characteristics and restrictions	• The ability to pile packages on each other • Standardized package size • Number of packages
Categorization of the transport environment	• Dry environment • No limits
Choice of means of transport	• Motorcycle • Car • Truck
Other specifications and numeric operations	• Transport from A to B • Transport performance • Utilization of driving • Maximum carrying capacity of the vehicle • The size of the cargo area • Loading time • Vehicle emission class

Table 3.
Software input data [2, 8].

Setting the correct input data to be untidy for the setup is an important element. Its setting is narrative from the point of view of discussions with practitioners. Entering large amounts of input data discourages operators and dispatchers from using the tool. By defining only the most important input data, it will be possible to prevent the dangers of diversion of hazardous materials to cities, so as not to endanger the health and life of the population [9, 10].

Setting up input data can also lead to a reduction in the number of lorries or vehicles when transport units are combined. In the case of a combination of transport units that would be acceptable, two costs can be achieved by completing one transport which satisfies two requests. This model has been operating in America for many years. When merging transport units, you can not only reduce the number of cars but also reduce the CO2 share. This merging process has many other advantages, but we can also find disadvantages that are not as discouraging as possible. The more common input data can be avoided by jeopardizing the diversion of hazardous materials into cities to avoid threats to the health and life of the population [9, 10, 17].

Next, we will focus on a case study that will consist of the functionality of the proposed tool. The case study will describe how the proposed tool should function at each stage of the shipment. The description of each of them will outline what it should be most focused on at the same time to increase security and not create additional risks.

4. Case study

The case study focuses on the road transport sector. Because of the annual rise shown in **Figure 2**, this is the most important sector to minimize risk. At the same time, as the number of transported goods increases, there is an increase in risks as the number of means of transport also increases. Means of transport are a tool for the realization and fulfillment of customer requirements. Customer requirements are essential data for the proposed tool. Meeting the requirements is the most important point before starting the entire transport process.

4.1 Planning phase

In **Figure 3** we can see two points. Point A indicates where the transport unit is to be picked up. Point B shows us where it is necessary to transport the transport unit.

After entering the entry point to load the shipping unit and then determine the delivery location, the route selection will come in line. This phenomenon is shown in **Figure 4**.

Figure 4 shows the route options from which we can choose the most suitable for us. The tool works as a regular map, giving you the shortest route choices, the fastest or the alternative. The tool does not work based on common data such as a common map or navigation. By setting the input data of the so-called customer requirements, there is a direct definition of the routes that can be implemented in the transport process.

Based on dynamic functionality, the tool marks not only risks but also various constraints on routes, which could limit or disrupt the entire transport process. Reconstructions are usually given in advance together with a possible surface change. All this data is important to the functionality of the tool in order to be able to respond to columns and possibly a large delay on a planned route.

Figure 3.
Planning phase.

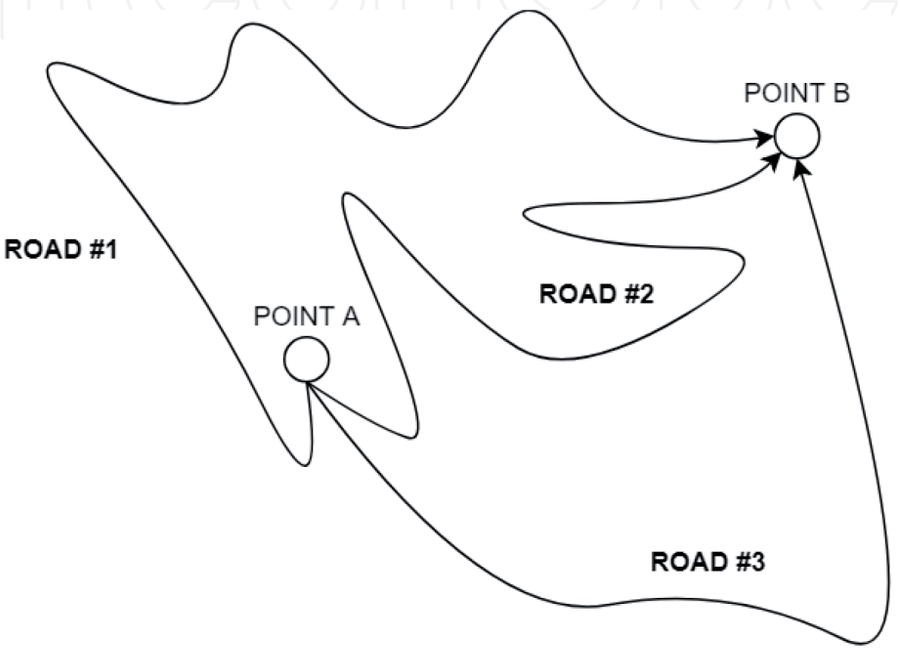

Figure 4.
Select the appropriate route.

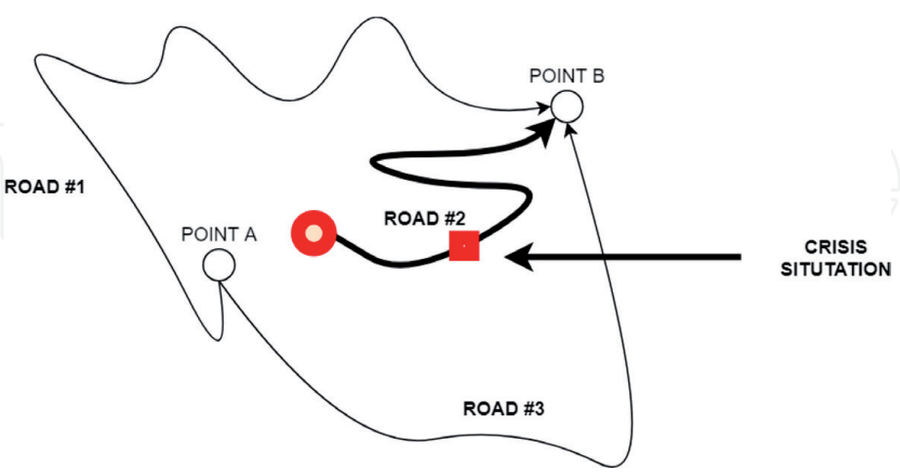

Figure 5.
Real phase during transport.

4.2 Real phase during transport

In this section, we will discuss the functionality of the proposed tool when working in real time. In **Figure 5**, we can see a situation that jumps to the operator during the transport process. The vehicle picked up the shipment or material and took the chosen route.

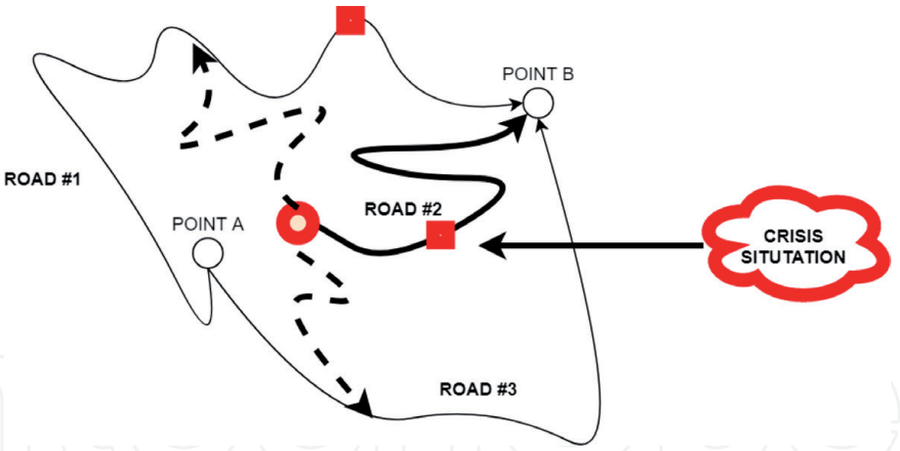

Figure 6.
Alternative solution to the situation.

During the transport process, a traffic accident occurred on the route. A traffic accident writes a delay of 4 hours in navigation. On the basis of the event, traffic is diverted to alternative routes using the police. Police divert traffic irrespective of material being transported in trucks. The categorization of cargo in this respect is not taken into account and thus endangers human health.

Immediately after the obstacle on the planned route, the operator or dispatcher using the software receives a problem report on the route. This phenomenon is shown in **Figure 6**.

After receiving a crisis situation, the operator receives a solution to the most appropriate solution to the traffic diversion. A diversion to alternative routes is to arrive at point B at an agreed time and to complete an alternative route so as not to pose a threat or other risks in the environment where the means of transport moves with the transport unit. All alternative solutions will alert us to the risks associated with the settings that were set at the input. In case we have marked the height of the means of transport by 3 meters on the routes, this will indicate I risk places in the form of a very small difference in the form of our possibility of limiting or creating another obstacle.

As the input data confirms, they can specify the entire transport process to create the most realistic and acceptable environment possible.

5. Conclusion

Material transport is important for every country. The interconnection of critical infrastructure elements points to prevention in each sector intertwined with another element. Prevention is an essential thing for a quick solution to an emerging or already occurring event in order to minimize the consequences. In case of minimizing the consequences, it is also necessary to think about the recovery time.

There is a wide range of risks that can be influenced or negligible. Impossible risks can include risky places from the point of view of traffic accidents, restrictions on a planned route, etc. Natural phenomena such as seasons, weather, and more are unimaginable.

It is not possible to predict possible crisis situations in the form of traffic accidents, traffic density, or weather. In planning, a route can be planned with the option of alternative, but dynamic driving during transport will deliver transport efficiency.

The dynamic part of the proposed tool works with input data but also with real data. Real data works at a time when the entire transport process takes place. Dynamic steering starts from the actual loading of the transport units to the means of transport.

The proposed instrument is still under development. All substantiated claims are supported by experts in this field. The number of transports increases every year, and this trend needs to be responded to avoid oversaturation of roads or other transport sectors. Road transport is the most popular, but, at the same time, it can be described as the most dangerous.

Another objective of the proposed tool should be to work with a large amount of data in the form of clustering based on traffic density, depending on their speed in the monitored area.

The risk of the functionality of the proposed tools is predominantly in its load. Working with large amounts of data could slow down the proposed tool considerably. Another risk in the form of use is seen in the form of input data; if there is a large amount of input data, it will potentially discourage potential users from using it.

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