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REACTIVITY TO CRISIS SITUATIONS IN THE TRANSPORT SECTOR

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ABSTRACT
The article deals with the response to crisis situations in road transport. Crisis situations are recorded in every critical infrastructure sector. Road transport is no exception. The material transported annually records the growth. The planning of the transport does not take into account the risk of the planned route or the categorization of the transport unit. When categorizing the transport unit the limited choice of suitable routes. The article is focused on real-time responsiveness to crisis situations. The purpose is to minimize next risks that could result in more and more serious events when one crisis situation arises.

Keywords: Critical infrastructure, traffic, Transportation, Transport Management, Risk Management, Incident Modeling, Accident Modeling.

1. INTRODUCTION

International transport is as important as domestic transport across Europe. Shipping material is important to ensure the functioning and proper functioning of the state. Critical infrastructure elements are protected. Each country ensures its correct functionality and safety. Every element of critical infrastructure is important to every state and a response is important in the event of an emergency. Minimizing the consequences and timely response can prevent this event from spreading to a larger part of the territory.

Critical infrastructure elements are important to all. Each country has different priorities for each infrastructure element. Some elements of critical infrastructure also interact in a crisis. The crisis can turn into a critical event and cripple the whole country. A country can become paralyzed to neighboring states or other countries that have a link with a paralyzed country.

The normal transport process is set up where we want to transport the shipping unit and deliver it. Currently, this information is insufficient. The transport unit category should be taken into account when scheduling shipments. Risk shipping units are moving around us. These transports threaten the lives and health of the population, as well as critical infrastructure elements. Traffic management should create a safe environment where people move. It is also necessary to avoid further crisis situations, whereby these decisions increase the risk of their occurrence. Minimizing risk will increase security and ensure state functionality.

The case study is divided into two parts. The first part focuses on the possibilities of the tool in the planning phase. The second part focuses on the response to events during the real-time transport process. The proposed instrument describes a real-time response to crisis situations. Prevention management during the transport process minimizes risks and consequences. In response to ongoing crisis situations, customer requirements can be met with the proposed tool. During the transportation process, the route is rescheduled and diverted to an alternative route. This diversion should ensure a safer route without much delay.

2. CRITICAL INFRASTRUCTURE

Critical infrastructure is handled according to Act No. 240/2000 Coll. on crisis management. Critical infrastructure is composed of elements that are important for everybody. Each element must meet certain requirements to be identified as a critical infrastructure element.

Critical infrastructure elements are assessed on the basis of cross-cutting criteria. After meeting the cross-sectional criteria, they are classified into individual sectors, which are currently outlined. These branches will be discussed in the next subchapter.

2.1 Critical infrastructure element

The elements of critical infrastructure are mainly construction, equipment and means of public structure. Critical infrastructure elements are determined according to sectoral, cross-cutting criteria. These criteria are described in Government Order No. 432 / 2010sb.

Critical infrastructure sectoral criteria are divided into nine sectors. Every sector is important for every country.

- Energy,
- Water management,
- Food and Agriculture,
- Healthcare,
- Traffic,
- Communication and IT systems,

- Financial market and currency,
- Emergency services,
- Public administration.

The sectors are interconnected via links. These links show which elements are dependent on each other from a certain perspective. Thus, any crisis in one sector can affect other critical infrastructure sectors as well. This phenomenon may result in the influence or creation of a crisis in sectors with which this sector has no direct link. for example, transport and energy have a direct link to traffic and public administration Based on these events, we divide links into:

- Direct binding.
- Indirect coupling

Any direct link is important not to interfere with the proper functioning of other sectors of critical infrastructure elements. Cross-border connections are more important in crisis prevention and management. Elements that are indirectly linked to the paralyzed sector can also be protected if timely reactions occur and minimized consequences.

3. STATISTICAL DATA

Table 1 shows the statistics of the transport sector. The transport sector is divided into four sub-categories. These categories include:

- Road transport.
- Rail transport.
- Air transport.
- Water transport.

Categories are popular among residents. The data in the table shows the popularity of each subcategory. This data shows the number of transported units in each transport sector. Water transport is also one of the transport sectors. This sector is used for the transport of materials, but not for the transport of persons as a result of watercourses on which people could be transported.

Table 1 Amount of transported material in the Czech Republic.

Thinks (in thousand)	2015	2016	2017
Road transport	438 906	431 889	459 433
Rail transport	97 280	98 034	96 516
Air transport	5 790	5 632	6 362
Water transport	1 853	1 779	1 568

Table 1 shows the dominance of road transport in popularity.

Popularity is represented by the amount that is transported each year in each transport sector. A large amount of material transport increases the number of risks due to the increasing number of means of transporting the material. Increasing the number of risks reduces the security of the state as a result of a crisis or emergency situation. Other sectors tend to stagnate. The popularity of road transport is becoming increasingly popular every year. This phenomenon can be seen in Figure 1.

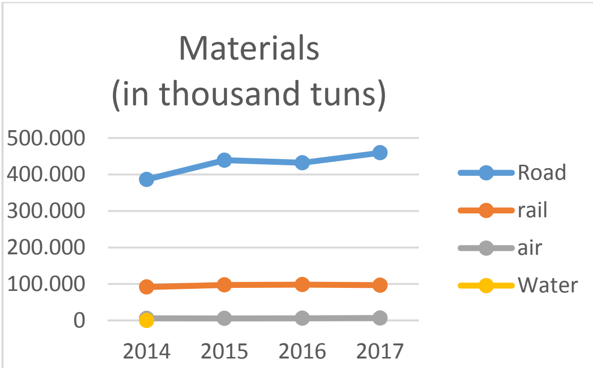

Figure 1: Development of transported goods in the Czech Republic in individual transport sectors.

Material transport is specific not only to the customer but also to the carrier. For the customer, the price and the date of delivery are important. For transporters, there are customer requirements to satisfy their needs. The growth in the transport sector is due to the fact that it is the only way to get material from point A to point B. the more material that is transported, the more means of transport we need. In order to reverse this trend, we are working on a tool that will reduce the number of means of transport, thereby increasing the safety.

4. CASE STUDY

The case study is focused on describing the phases on which the tool is built. The first phase is transport planning. Transporting transport units is a very static function during the planning phase. During planning, it is possible to respond to already planned reconstructions, closures or transport of oversized cargo, which restrict traffic on the routes on which they move. The planning phase is important for each shipment to meet customer requirements, but at the same time, the cost of the successful completion of the transport route and the goal is calculated.

The second phase is called the transport process. The second phase is more interesting because it works in real time. It responds to incidents or crisis situations that have not yet occurred or are already on the planned route. The instrument should evaluate incidents or crisis situations that may arise based on the information obtained, eg traffic density, average speed, etc.

4.1 Planning phase

The planning phase is at the very beginning of the process. The planning phase is an important step towards the entire implementation of the transportation process. When planning, we set up input data that is an essential part of the functionality of the proposed tool.

Currently, we are working on improving the amount of input data that the tool operator should set. The current data in the proposed tool are as follows:

- Type of transport unit.
- Standardization of the type transport unit.
- Disposition of the transport unit.
- Dimension of goods.
- Transport packaging.
- Packaging characteristics and restrictions.
- Categorization of the transport environment.
- Other specifications and numeric operations.

After registering the input data in the planning phase of the tool, options are displayed. The situation is similar to the route planning for navigation. The big difference is the need to register a larger amount of input data in order to avoid complications such as a lower underpass, a bridge that does not meet the weight of the means of transport or navigation around water tanks in a dangerous transport unit.

The options are shown on figure 2. From the selected options, we will choose the most suitable solution. For our case study, we chose ROAD # 2.

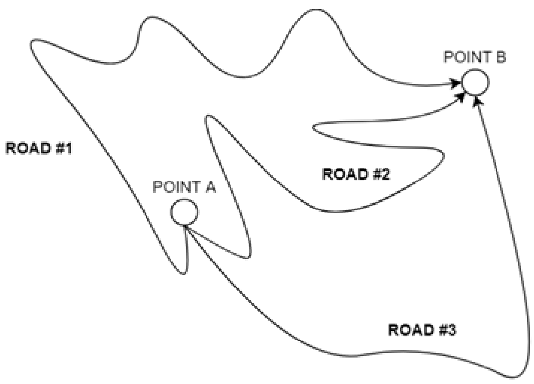

Figure 1 Select the appropriate route.

The picture shows that there were more options and it is purely up to the operator which route they choose as the most suitable. In the planning phase, there are possible routes on which there may be no restrictions but vice versa. There may be some restrictions on each route that is acceptable and it is up to the operator to evaluate it correctly. After evaluating and selecting the route to be completed, we will proceed to the next point. At this point, we manage the real-time shipping process.

4.2 Real-time transport management

In this section, we will discuss the functionality of the tool. The tool monitors and displays the route selected to complete the route. During the transport process, the operator is exposed to risks on the route and, if necessary, opens up other options for switching to another route. Figure 3 shows a situation that alerts the operator during the transport process. The vehicle picked up the shipment or material and chose the chosen route. During the transport process along the selected route, a crisis situation arose. This situation occurred on the planned route.

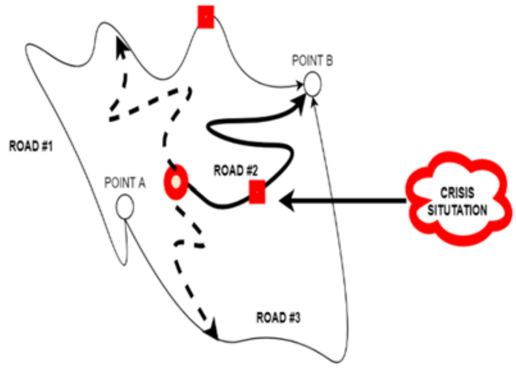

Figure 2: Alternative solution to the situation.

A road accident occurred during the transport causing a 2 hour delay in navigation. Based on this event, traffic is redirected to alternative routes. These routes do not take into account the characteristics of the transport units. There is a diversion regardless of the material transported. Therefore, categorization of cargo is not taken into account, which can endanger human health and the proper functioning of critical infrastructure elements due to increased risk of crisis situations.
Immediately following an obstacle on new route, the operator or dispatcher receives a problem report via the system. This phenomenon is shown in Fig. 3.

Upon receiving a crisis alert, the operator receives a solution to the most appropriate diversion solution. The turn to alternative routes is to reach point B. Customer input requirements are a priority in making decisions. The aim is to keep the deadline when the transport unit is to be in point B in spite of a crisis situation. When creating solutions and designing alternative routes, all input data are taken into account. The aim is to avoid threats or other risks in an environment where the vehicle will move with the transport unit..

All alternative solutions draw attention to the risks associated with input settings. If we have used a means of transport greater than 3 meters at the entry, this will be risk points. Due to the small difference in our ability to reduce or create another barrier.
Accurate specification of input data, as far as possible, will help the system to create the most appropriate and acceptable way to deliver successfully.

CONCLUSION

The amount of material that is transported daily increases every day. Transport of material by road is necessary not only for import and export of goods. Entrepreneurs increase their profits by means of transport and at the same time the situation in the territory in which they do business is improved. Transport-based residents have the possibility of commuting to work, various leisure activities and school responsibilities. Given the wide variability of road transport, this trend will not change and dynamic management should ensure greater safety for the population.

Critical infrastructure elements provide comfort not only for the population but also for the whole country. Each of the elements is included in the list of critical infrastructure elements that meet the sectoral and cross-cutting criteria. Every critical infrastructure sector is important to the state. Its functionality and safety assure the population a normal life without the occurrence of an extraordinary event. If one sector fails, another sector may become paralyzed and linked to each other by direct or indirect links. These links are important in reactivity to prevent eventual minimization of the consequences of a crisis or emergency.

Critical infrastructure elements are interconnected. In the event of a crisis situation, this risk may increase and threaten another element. This phenomenon can spread through a domino effect such as Blackout.

The proposed system should be able to respond to a large number of crisis situations in real time. The proposed system should be able to respond to incidents or crisis situations at both the planning and transport stages. Reacting in real time increases the security of the state and of the population. Its advantage is to create a safe environment after which a particular transport unit will be transported. By setting the correct and comprehensive input data, it is possible to react quickly to crisis situations in real time. The response will ensure that additional risks are minimized and could be further aggravated.

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