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Significance Criteria for Types of Transport in the Zlín Region

Adam Malatinsky^{a*}, Martin Hromada^a

^a*Department of Security Engineering, Faculty of Applied Informatics, Tomas Bata University in Zlín, 760 05 Zlín, Czech Republic*

Abstract

Critical infrastructure is extremely important for the proper operation of the functioning of the state as a whole. In the Czech Republic, critical infrastructure covers nine sectors. The article is specifically about the transport sector of critical infrastructure. Specifically, it is an analysis followed by an evaluation of the criteria of the essential elements of the modes of transport for the Zlín region.

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1. Introduction

As one of the main elements of critical infrastructure, transport is the basis of proper functioning in the state. The article analyses the most critical elements of the types of transport in the Zlín region with the subsequent determination of criteria. The first chapter characterises critical infrastructure and its cross-sectional and sectoral criteria. The following chapter deals with the impact criteria specifically focused on the transport sector, where the criteria for individual types of transport are characterised. The next chapter is the statistics of the number of passengers for comparison in the Czech Republic and the Zlín region for individual types of transport, with a percentage ratio for comparison. The next chapter is about the elements of transport in the Zlín region, where the essential transport links are described from each primary type of transport (road transport, rail transport, air transport and water transport). This chapter evaluates transport in the Zlín region with a calculation.

* Corresponding author.

E-mail address: a_malatinsky@utb.cz

2. Critical infrastructure

Critical infrastructure means production and non-production systems and services, the limitation of which would seriously impact the security of the state, the economy, public administration and the provision of basic life needs. Elements of critical infrastructure have cross-sectional and sectoral criteria. (Bansky, T., 2013)

2.1. Cross-sectional criteria

Cross-sectional criteria are a set of criteria with threshold values that are applied cross-sectionally in determining elements of all sectors. The cross-sectional criterion for determining the element of critical infrastructure is the point of view of victims with a threshold value of more than 250 dead or more than 2,500 persons with subsequent hospitalization for more than 24 hours, economic impact with a threshold value of economic loss higher than 0.5% of the gross domestic product and impact on the public with a threshold value of a large-scale restriction of the provision of essential services or severe other interference with daily life affecting more than 125,000 persons. (Government regulation no. 432/2010, 2010)

2.2. Sectoral criteria

The type of service, entity and unique criteria of the type of entity determine sectoral criteria. Sector criteria also include impact criteria, which will be addressed explicitly in the chapter "Impact criteria for types of transport in the Czech Republic."

There are nine primary sectors of critical infrastructure in the Czech Republic. These sectors include:

- **energy** – electricity, natural gas, oil and oil products, central heat supply,
- **water management** – water supply, water treatment, hydraulic structures,
- **food industry and agriculture** – plant production, animal production and food production,
- **healthcare** – provision of medical supplies, production of medicinal preparations,
- **transport** – road transport, rail transport, air transport, inland water transport,
- **communication and information systems** – technological elements of a fixed network of electronic communications, technological elements of a mobile network of electronic communications, technological elements of networks for radio and television broadcasting, technological elements for satellite communication, technological elements for postal services, technological elements of information systems, the field of cyber security,
- **financial market and currency** – the performance of the activities of the Czech National Bank while ensuring the mandate established by law and the provision of banking and insurance services,
- **emergency services** – integrated rescue system, radiation monitoring, forecasting, warning and notification service and internal security,
- **public administration** – public finances, social protection and employment, other state administration, intelligence services. (Government regulation no. 432/2010, 2010)

3. Impact criteria for types of transport in the Czech Republic

The impact criteria are part of the sector criteria of critical infrastructure elements. As part of the research, it is specifically about the transport sector, where the impact criteria for road transport, rail transport, air transport and inland water transport are characterized. It is about determining specific values within individual sectors.

3.1. Road transport, rail transport and inland water transport

The impact criteria of road transport, rail transport and inland water transport include severe limitation or disruption of the type of service affecting more than 50,000 persons, severe limitation or disruption of another basic service or

limitation or disruption of the operation of a critical infrastructure element, an economic loss higher than 0.25% of GDP, unavailability of a type of service for more than 1,600 people, which cannot be replaced in another way without incurring high costs, casualties with a limit value of more than 100 dead or 1000 injured persons requiring medical treatment and disruption of public safety in a significant part of the administrative district of the municipality with extended scope, which could require the execution of rescue and liquidation work by the components of the integrated rescue system. (*Ministry Decree no. 437/2017, 2017*)

3.2. Air transport

The impact criteria of air transport include severe limitation or disruption of the type of service affecting more than 50,000 persons, severe limitation or disruption of another basic service or limitation or disruption of the operation of a critical infrastructure element, an economic loss higher than 0.25% of GDP, unavailability of a type of service for more than 1,600 people, which cannot be replaced in another way without incurring high costs, casualties with a limit value of more than 200 dead or 1000 injured persons requiring medical treatment and disruption of public safety in a significant part of the administrative district of the municipality with extended scope, which could require the execution of rescue and liquidation work by the components of the integrated rescue system. (*Ministry Decree no. 437/2017, 2017*)

4. Passenger statistics

This chapter is focused on the number of passengers for individual types of transport within the Czech Republic and the Zlín region. In both cases, the data is from the annual report of the Ministry of Transport of the Czech Republic. The number of passengers is from 2021, as the final data on the number of passengers for 2022 is not yet available. Figure 1 shows the list of types of transport from which the statistics are compiled.

4.1. Passengers in the Czech Republic

For clarity, the number of passengers is expressed in Tables 1 to 3.

Table 1. Type of transport – Czech Republic

Type of transport	Number of passengers (in thousands)	Number of passengers per day (in thousands)	Relative value of passengers
Road transport	4 523 142,7	12 392,2	97,039 %
Rail transport	135 317,8	370,7	2,903 %
Air transport	2 074,8	5,7	0,045 %
Water transport	600,0	1,6	0,013 %
Total	4 661 135,3	12 770,2	100 %

Table 2. Road transport – Czech Republic

Road transport	Number of passengers (in thousands)	Number of passengers per day (in thousands)	Relative value of passengers
Public bus transport	251 642,7	689,4	5,563 %
Individual car transport	2 800 300,0	7 672,1	61,911 %
Urban public transport	1 471 200,0	4 030,7	32,526 %
Total	4 523 142,7	12 392,2	100 %

Table 3. Urban public transport – Czech Republic

Urban public transport	Number of passengers (in thousands)	Number of passengers per day (in thousands)	Relative value of passengers
Tram	483 700	1 325,2	32,878 %
Trolleybus	162 200	444,4	11,025 %
Metro	237 900	651,8	16,171 %
Bus	587 400	1 609,3	39,926 %
Total	1 471 200	4 030,7	100 %

The tables show that individual car transport is the most used within the Czech Republic. Water transport is the least used. (Slaba, R., Houst, R., 2021)

4.2. Passengers in the Zlín region

The types of transport in the Zlín region are the same as in the Czech Republic, except for the tram and metro, which are unavailable in the Zlín region.

For clarity, the number of passengers is expressed in Tables 4 to 6.

Table 4. Type of transport – Zlín region

Type of transport	Number of passengers (in thousands)	Number of passengers per day (in thousands)	Relative value of passengers
Road transport	200 722,8	550,0	98,241%
Rail transport	3 562,0	9,76	1,743%
Air transport	23,0	0,06	0,011 %
Water transport	10,0	0,03	0,005%
Total	204 317,8	559,85	100 %

Table 5. Road transport – Zlín region

Road transport	Number of passengers (in thousands)	Number of passengers per day (in thousands)	Relative value of passengers
Public bus transport	15 653,7	42,9	7,799 %
Individual car transport	159 169,1	436,1	79,298 %
Urban public transport	25 900,0	71,0	12,903 %
Total	200 722,8	550,0	100 %

Table 6. Urban public transport – Zlín region

Urban public transport	Number of passengers (in thousands)	Number of passengers per day (in thousands)	Relative value of passengers
Trolleybus	17 100	46,9	66,023 %
Bus	8 800	24,1	33,977 %
Total	25 900	71,0	100 %

It is clear from the tables that within the Zlín region, individual car transport is also the most used. Water transport is the least used. (Slaba, R., Houst, R., 2021)

To compare the ratios of types of transport in the Czech Republic and the Zlín region, railway transport is used

more in the Zlín region than in the Czech Republic, air transport in the Zlín region is one-third compared to the Czech Republic due to the absence of an international airport, public transport in the Zlín region is half that of the Czech Republic and municipal public transport in the Zlín region does not operate tram and metro travel.

5. Elements of transport in the Zlín region

The chapter is divided into four parts: elements of road transport, elements of rail transport, elements of air transport and elements of inland water transport.

5.1. Elements of road transport

The most critical road in the Zlín region includes highway D1, highway D55, first-class route 49, first-class route 55, first-class route E50 and European route E442.

Another possible type for determining the criterion is public bus transport. Among the elements of public bus transport are the most important bus stations in the Zlín region.

Table 7. List of bus stations in Zlín region

Bus station	Number of passengers per day	Relative value of passengers
Zlín	7 422	23,939 %
Uherské Hradiště	6 988	22,540 %
Uherský Brod	4 278	13,799 %
Kroměříž	4 192	13,521 %
Vsetín	4 105	13,241 %
Valašské Meziříčí	4 018	12,960 %
Total	31 003	100 %

Passenger numbers are based on the number of rides from or to a given station. The list of the bus mentioned above stations contains 72,26 % of the number of passengers from all bus stations in the Zlín region. (*Buses – links, 2022*)

5.2. Elements of rail transport

Among the elements of rail transport are the most important train stations.

Table 8. List of train stations in Zlín region

Train station	Number of passengers per day	Relative value of passengers
Otrokovice	1 769	22,016 %
Staré město near Uherského Hradiště	1 751	21,792 %
Valašské Meziříčí	1 546	19,241 %
Uherský Brod	1 167	14,524 %
Kroměříž	1 030	12,819 %
Zlín – center	772	9,608 %
Total	8 035	100 %

The number of passengers is also expressed based on the number of rides from or to a given station. The list of train stations mentioned above contains 82,31 % of the number of passengers from all train stations in the Zlín region. (*Trains – links, 2022*)

5.3. Elements of air transport

Kunovice airport is among the most important airports in terms of air transport. This airport is a non-public international airport. The operating time is 8 hours a day. The airport has around 230 operating days during the year. It currently has no scheduled or charter flights. (*Kunovice airport, 2022*)

Other less essential airports include Otrokovice airport, Strážnice airport, Kyjov airport, Boršice airport, Bánov airport, Bojkovice airport, Luhačovice airport, Kroměříž airport, Slušovice airport and Zlín Štípa airport. (*Airport, Zlín region, 2022*)

5.4. Elements of inland water transport

Smaller rivers and streams flow through the Zlín region, transporting people recreationally. One of the streams is the Bata canal, which flows from Skalica (Slovakia) to Otrokovice. It is mainly used during the summer months. (*Bata canal, 2022*)

6. Evaluation of criteria

The evaluation of the criteria of the type of transport elements is for public bus transport, individual car transport and rail transport. Air and water transport is very little used in the Zlín region. Therefore, there are no established criteria for these types of transport.

6.1. Public bus transport

The arithmetic average of the number of passengers per day from all the most crucial bus stations is used to calculate the criterion. The result is rounded up to hundreds for clarity. All bus stations with a number higher than the resulting criterion belongs to the group of essential elements of critical infrastructure. Data are from Table 7.

$$\text{bus station criterion} = \frac{1769+1751+1546+1167+1030+772}{6} = \frac{8035}{6} \cong 1339 \quad (1)$$

The resulting criterion is 1400 after rounding. The bus stations that meet this criterion are Zlín bus station and Uherské Hradiště bus station.

6.2. Individual car transport

For calculating the given criterion, it is impossible to evaluate the number of cars on the given traffic roads. Therefore, only the most significant roads can be included in the elements of critical infrastructure: the D1 highway, the D55 highway, the first-class road 49, the first-class road 55, the first-class road E50 and the European road E442.

6.3. Railway transport

The arithmetic average of the number of passengers per day from all the most important railway stations is used to calculate the criterion. The result is rounded up to hundreds for clarity. All railway stations with a number higher than the resulting criterion belongs to the group of essential elements of critical infrastructure. Data are from Table 8.

$$\text{train station criterion} = \frac{7422+6988+7278+4192+4105+4018}{6} = \frac{34003}{6} \cong 5167 \quad (2)$$

The resulting criterion is 5200 after rounding. The railway stations that meet this criterion are Otrokovice railway

station, Staré město near Uherského Hradiště railway station and Valašské Měziříčí railway station.

7. Conclusion

Every sector within the critical infrastructure is significant for running and operating a properly functioning state. The article specifically dealt with the transport sector. The first chapter described critical infrastructure, where specific cross-sectional and sectoral criteria were described. The next chapter dealt with impact criteria meant for specific types of transport. The following chapter shows the statistics of the number of passengers in the Czech Republic and the Zlín region for individual types of transport, with a percentage ratio for comparison. The next chapter was intended for the elements of transport in the Zlín region, where the essential transport links were analysed and determined from each primary mode of transport. The last chapter evaluated the transport elements in the Zlín region, where the resulting criteria were determined using the arithmetic mean. All elements that met these criteria belong to the essential elements of soft targets in the framework of transport in the Zlín region. Since road and rail transport is the most used in the Zlín region, the criteria were evaluated primarily for these types of transport. Specifically, numerical criteria for bus and railway stations in the Zlín region were evaluated. The criterion for the bus station in the Zlín Region was set at 1,400 passengers per day. This criterion is met by two bus stations: Zlín and Uherské Hradiště. The criterion for the railway station in the Zlín Region was set at 5,200 passengers per day. Three railway stations meet this criterion: Otrokovice, Staré město near Uherské Hradiště and Valašské Měziříčí.

The limit of the evaluation is air and water transport, which are used minimally in the Zlín Region. Future research could focus on other territorial units in the Czech Republic, where all types of transport are used more, such as Prague, the South-Moravian Region or the Moravian-Silesian Region.

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