THREATS TO TRANSPORT SYSTEMS CATALOGUE

KATALOG ZAGROŻEŃ SYSTEMÓW TRANSPORTOWYCH

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Abstract: *The article describes basic assumptions and standards of law acts concerning crisis management and critical infrastructure protection, covering one of its more important parts – transport systems. Transport systems' threats codification has been proposed, which, being significant part of crisis management essential phase, is demanded for proper performance of all activities concerned with it.*

Keywords: *crisis management, critical infrastructure, threats to transport systems identification*

Streszczenie: *W referacie przedstawiono podstawowe założenia i normatywy aktów prawnych dotyczących zarządzania kryzysowego i ochrony infrastruktury krytycznej, której bardzo ważnym elementem są systemy transportowe. Zaproponowano kodyfikację zagrożeń dla systemów transportowych, która, będąc bardzo istotnym elementem pierwszej fazy zarządzania kryzysowego, warunkuje poprawną realizację całokształtu pozostałych działań z nim związanych.*

Słowa kluczowe: *zarządzanie kryzysowe, infrastruktura krytyczna, identyfikacja zagrożeń w systemach transportowych*

1. Introduction

Rapid development of technical civilization, taking place in XX century, resulted with growing societies' dependence on particular activities areas, associated with alterations of point of view on infrastructure and threats definitions, coming out of their potential malfunctions. Earlier infrastructure definitions appearing in literature, specify one as: "basic facilities, installations and services of key importance for communities and societies functioning, including transport and communication systems, water and energy supplies, and public institutions controlling education, postal services and penology" [1],[3]. At the end of 20th century, infrastructure was described as wide class of objects necessary to ensure public services and to support private entrepreneurs activities (roads, bridges, water and sewage systems, airports, harbours, public administration and education facilities, health services, prisons, energy, fire protection, wastewater treatment, and telecommunication) [7].

Evolution of communication and information technologies resulted with new areas of infrastructure, which in case of failure, can cause serious disruptions and damages concerning societies functioning. Mutual relations, taking place among different information exchange systems, made these systems very sensitive for wide area of disruptions, caused by environmental disasters, human and technology errors, and different forms of cyber-attacks [4]. Especially latest ones mentioned are achieving serious meaning, in relation to information technologies used within transport control and traffic management systems.

Transport systems are ones of key importance for efficient functioning of public administration, and economic and safety systems. Ensuring of proper level of transport system functioning parameters is a key condition to ensure appropriate performance effectiveness factors of related external systems. One of the main directions of activities, leading to counteract disruptions to transport systems functioning, is anticipating of potential threats, then formulating of procedures aiming to prevent them, and appropriate responding to threats, in case of their appearance. All mentioned activities are covered by **Crisis Management** phrase. The systems specially sensitive for threats, being of key importance for proper functioning of external systems, are named **Critical Infrastructure**.

2. Importance of crisis management to transport systems

Last years, within many areas of our everyday life, significant increase of crisis management related activities can be observed. This is coming out of increasing menace of terrorist attacks on one side, and on the other side of increasing number of different kinds of elemental disasters taking place in the near past.

Significant incidents, that have shown the need to initiate various activities, aiming to resist crisis situations, were: terrorist attacks (United States of America – 11.09.2001, Spain - 11.03.2004, United Kingdom - 07.05.2005), earthquakes resulting with tsunami waves, causing huge destructions of large areas, including sensitive objects placed inside them (Fukushima, Japan - 2011), and floods caused

by tropical cyclones (Katrina – New Orleans 2005, Sandy – New York 2012). Accidents having taken place in Poland, that should be pointed, are: devastating series of floods in 1997, which killed 55 humans and caused enormous damages, Katowice International Fair's roof collapse on 28.01.2006 (65 casualties), and train crash near Szczekociny on 03.03.2012 (16 persons killed).

Most of above mentioned facts took place, or was related to transport systems. Transport means were used as resources to perform terrorist attacks for external systems, causing significant destruction escalation, or were targets of attacks themselves. Catastrophes taking place within transport systems, are often bringing extensive damages to surrounding systems, and significant human losses. Elemental disasters taking parts within transport systems surroundings, are disrupting their functioning, or making it impossible.

Thus, crisis management activities, understood as: *public administration authorities functions, being an element of managing national security management system, which consists of preventing crisis situations, preparing to take control over them by way of planned activities, responding in case of emergencies, removal of their effects and the reconstruction of the resources and critical infrastructure* [6], must cover transport systems within their range. Transport means are convenient target for potential terrorist attacks, as destruction of one is usually concerned with big number of human casualties. Transport means can be also good resources for devastation of other objects or external systems. Accidents and catastrophes taking place in transport systems can cause huge damages to surrounding infrastructure, industry and natural environment.

3. Transport systems as component of critical infrastructure

As mentioned earlier, some systems, including transportation ones, are highly sensitive to threats, and on the other side, their independent functioning is of key importance to ensure efficient functioning of public administration authorities, institutions, safety systems and enterprises. These systems must be highly protected, because if affected by crisis, its consequences can be very extensive and cause heavy losses. The systems are, for some time already, defined as critical infrastructure. According to [6], critical infrastructure is understood as systems and mutually bound functional objects contained therein, including constructions, facilities, installations and services of key importance for the security of the state and its citizens, as well as serving to ensure efficient functioning of public administration authorities, institutions and enterprises.

Critical infrastructure is including following systems:

- energy, fuel and energy resources supply,
- communication,
- IT networks,
- financial,
- food supply,
- water supply,

- health protection,
- transportation,
- rescue,
- ensuring the continuity of public administration activities,
- production, storing and use of chemical and radioactive substances, including pipelines for dangerous substances.

In 2008, *European critical infrastructure* notion has been implemented, due to fact that some activities related to its protection, in some circumstances must be coordinated by two or more countries [2]. Highlighted subsystems of European critical infrastructure are electricity, oil and gas supply systems, and **transportation systems**, proving that systems mentioned are specially important elements of critical infrastructure, demanding of special care.

European critical infrastructure is defined as: systems and mutually bound functional objects contained therein, including constructions, facilities and installations of key importance for the security of the state and its citizens, as well as serving to ensure efficient functioning of public administration authorities, institutions and enterprises, designated in the systems within the scope of electricity, oil, gas, road, rail and air transport as well as inland waterways transport, ocean and short-sea shipping and ports, located in Member States of the European Union the disruption or destruction of which would have a significant impact on at least two Member States.

Consequently, transport systems are one of highly important objects for widely understood safety of state and its citizens. Thus, they must be specially prepared for resisting and responding to crisis situations.

Following provision of law concerning critical infrastructure should be also quoted: “Both sole and dependent owners and holders of objects, installations or critical infrastructure facilities are required to protect them, particularly through the preparation and implementation, according to the anticipated threat, of critical infrastructure protection plans and holding their own reserve systems ensuring security and maintaining the functioning of the infrastructure until it is fully recovered. The owners must also designate bodies responsible for keeping continuous contact with public administration concerning critical infrastructure protection” [6]. The meaning of mentioned note indicates the necessity to implement appropriate crisis management procedures for selected transport enterprises. In addition, transport companies qualified as critical infrastructure objects, must be ready for crisis management related cooperation, with state administration bodies.

4. Identification of threats – the first phase of crisis management

Activities conducted within crisis management frames, are usually divided into four following phases [5]:

- Prevention – analyzes of potentially possible crisis situations, and undertaking activities lowering probability of their appearance,

- Preparation – planning of actions (procedures), that should be performed in case of appearing of foreseen crisis situations.
- Responding – undertaking of previously planned, coordinated activities, leading to stop crisis situation expanding, support casualties, and restrict damages and losses.
- Reconstruction (Recovery) – restoration of conditions from before crisis situation.

All above mentioned phases are illustrating whole range of activities, proper performance of which is a condition to minimize losses and disruptions associated with crisis situations. Base condition to achieve this result is proper and accurate analysis of potential crisis situations, defined as identification of threats, being basic part of crisis management first phase. Complex performance of other phases is impossible without proper completion of potential threats for particular system. Crisis situations responding procedures, or restoration of conditions from before ones, cannot be drawn up for unidentified earlier threats.

The result of threats identification for particular system, is usually so called ***threats catalogue*** – including register of potential threats coded in special way. The catalogue is a groundwork for further steps – formulating of appropriate procedures to be performed in case of potential crisis situations.

5. Threats to transport systems catalogue

The authors' main intention is to propose some way of threats to transport systems codification. The top-down approach has been used, meaning pointing some general groups of threats as a first step, and then identifying itemized categories within them. The general groups of threats, have been specified according to their source, as follows:

- **threats generated by natural environment**: all abnormal environment conditions, having negative impact on transport systems,
- **threats generated by transport system surroundings**: incidents taking place outside one – within external systems – having harmful influence on transport system,
- **inner threats**: generated by subsystems of transport system, and their operators,
- **terrorist threats**: pointed as a separate group because of their special importance.

Within above mentioned general groups, following particular categories have been identified:

Threats generated by natural environment (elemental disasters):

- floods: partial or total flooding of transport system functioning area, caused by increased level of waters, disrupting its functioning or making it impossible,

- earthquakes, including ones causing tsunami waves, resulting with devastations of transport means, transport infrastructure, systems and objects belonging to surroundings of transport systems within large areas,
- heavy rainfalls, snowfalls, hailstorms, strong winds, causing, among others, lowering of transport means movement velocities, as a result of system functional parameters decreasing, including meteorological visibility,
- icings of contact wires, road surfaces, transport means (especially severe for sea and river ships, and airplanes),
- long-term heat, dry weathers, frosts, lowering functional parameters of transport systems.

Threats generated by transport system surroundings:

- social threats (public safety and regularity disruptions): manifestations, roadblocks, strikes, organized by various organizations and institutions, disorganizing and destabilizing functioning of transport systems,
- contaminations (radioactive, chemical, biological) of natural environment within transport systems functioning area, caused by various types of external systems and objects damages,
- epidemics within operational areas of transport systems, resulting with various types of restrictions concerning transport operations (i.e. necessity to use additional protection resources, and different neutralization treatments for transport means,
- technical damages to cargo loading and unloading systems,
- technical damages to energy, oil, gas and information systems,
- thefts of transport infrastructure elements (i.e. railway contact wires),
- fires of systems and objects within transport systems surroundings, especially ones resulting with heavy devastations (refineries, electric power plants, chemical plants).

Inner threats (generated by transport subsystems and their operators):

- strikes organized by transport enterprises employees, destabilizing functioning of transport systems,
- human errors - underestimating of threats, disregarding of procedures – by transport means operators and transport control systems operators,
- technical damages to transport mean, resulting with restrictions, or total loss, of control on its movement (i.e. damage to brake system),
- technical damages to transport system control or monitoring systems,
- technical damages to transport infrastructure elements,
- collision of transport mean with another one,
- collision of transport mean with external system element or external object (i.e. sea or river ship grounding),
- fire of transport mean or carried cargo (especially severe when concerning transport of inflammable materials or explosives),

Terrorist threats:

- hijacks of transport means (with cargo and/ or hostages), aiming to obtain the ransom for their return,
- hijacks of transport mean, aiming to use it for devastation of other, bigger object or system,
- destruction of transport mean or other part of transport system (setting the fire, explosives detonation, shooting down),
- destruction of transport infrastructure elements,
- attack with use of chemical or biological weapons (i.e. spraying of harmful gas).

6. Summary

Crisis management is a new element, concerning for relatively short time, significant number of public institutions, public administration authorities and enterprises. A few facts given in section 2 of this article indicate however, that the element is very important, and its role is continues to grow.

One of basic crisis management issues is protection of critical infrastructure objects. Terrorist attacks and most of other facts mentioned at the beginning of the article, were concerning transport systems – meaning ones belonging to critical infrastructure. Transport systems must then be covered by special protection, because disruptions of their functioning, caused by crisis situations, become severe problem for themselves and surrounding systems and objects.

Threats to transport systems catalogue proposed in section 5 above, stands for preliminary, quite general approach to threats to these systems identification problem. It can however be a base for formulating of wider, more precise codifications, taking into account also specific features of different modes of transport.

As the summary, following research directions can be pointed, that can be performed basing on codified threats catalogue:

- further, more detailed identification of threats to transport systems, considering them as objects of critical infrastructure,
- monitoring of transport systems threats, and standards for alterations of their level controlling,
- formulating of responding procedures, to be performed in case of crisis situation appearance, caused by abnormal increase of threats level,
- planning of transport subsystems recovery procedures allowing to restore them to their state from before crisis situation.

7. References

- [1] American Heritage Dictionary. <http://www.ahdictionary.com>.
- [2] European Council Directive 2008/114/EC on the identification and designation of European critical infrastructures and the assessment of the need to improve their protection

- [3] Młyńczak M.: Pojęcie, klasyfikacja i historyczna ewolucja pojęcia infrastruktury w prawodawstwie USA (in Polish). XLI Winter School on Reliability – Reliability of Critical Infrastructures, Szczyrk 2013.
- [4] Moteff J., Parfomak P.: Critical Infrastructure and Key Assets: Definition and Identification. CRS Report for Congress, The Library of US Congress 2004.
- [5] Siergiejczyk M., Dziula P.: Selected aspects of acts of law concerning crisis management and critical infrastructure protection. Journal of Konbin, 2 (26), 2013.
- [6] Polish Parliament act of 26 April 2007 on Crisis Management, final version 31.12.2010, including amendments.
- [7] Vaughan R., Pollard R.: Rebuilding America, vol. I, Planning and Managing Public Works in the 1980s. Council of State Planning Agencies, Washington DC. 1984.

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