RISKS IN PASSENGER TRAFFIC

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Abstract: Transport security is one of the conditions of complex society development. Risk management includes the measures that are necessary to be introduced to ensure the transport security. Submitted paper deals with classification of the risks that can result in crisis events in transport and their analysis, too. Factors influencing risks of passenger transport. Means of transport. Road and surrounding environment as risks factor.

Keywords: security, transport, risk, risks analyses, crisis events in transport, risks of passenger transport

1. CLASSIFICATION OF RISKS IN TRANSPORT

Since year 1999 the Faculty of Special Engineering of the Žilina University has been solving a lot of research projects aimed at the problems of transport organization in crisis situations. From the original model, so called Integrated Transport System, we have come to the system of so called Crisis Transport Support. At present we are dealing in detail with technology of individual types of transport whereby the accent is put on the railway transport eventually on the city mass transportation. The important part of these projects presents solution of the problems of increasing the transport security including risk analysis and realizing preventive measures to prevent crisis events.

Security of society including the transport is a part and one of the basic conditions of positive future development of the human society. These mentioned problems are based on stable international relations but its complex and system understanding require research of all parts of societal, political, economic, natural, technical and technological environments including transport. At present security includes defence against external threat, protection against natural disasters and industrial accidents as well as achieving required level of internal security in a state and its regions [5].

In the process of achieving required security level the emphasis is put on the abilities of security system to counter a broad range of non-military threats threatening the state, its inhabitants and material resources as well as the nature and that can cause crisis events. The security phenomenon of the present days are not only natural disasters and industrial accidents but in recent years also the international terrorism in all its destructive forms. Transport, because of its specific attributes, became the target and also the tool of the terrorists. They threaten transport process, transport objects and equipments since they form the space of great people concentration and they are also hardly renewable resources from the time, technological and economic point of view. Terrorists also use means of transport to perform the most different form of terrorist attacks.

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Transportation and transport infrastructure of the Slovak Republic cannot also avoid the negative impacts of the possible crisis events. Ministry of Transport, Posts and Telecommunication of the Slovak Republic, as the central body of the state administration in the field of transport but also in the field of post and telecommunication services, has to give adequate attention to preparedness for solving the crisis events in transport that can be the consequences of natural disasters, industrial and ecological accidents, terrorist attacks, organized crime, large migration waves or information systems violation. From the general view, corresponding preparedness for solution of crisis events is the task of public administration and it has this task - to protect the lives and property of inhabitants and the state as a whole- established in the Slovak Republic. The Slovak Republic is preparing new model of security system that responds to changed security situation in the world, new risks and threats and also respects new situation after the Slovak Republic accession to the European Union and NATO.

1.1. RISKS AND THEIR CLASSIFICATION

Risk is most often defined as the danger of failure, unsuccess, loss or damage and always connected with specific event. Risk is quantitative and qualitative expression of hazard, degree or margin of hazard. It is probability of a negative event occurrence and its consequences. Because none of human activities is absolutely secure, certain risk rate, called acceptable risk, is permitted. The residual risk presents the fact that in the process of designing, production and operation of technical equipments the certain risk rate cannot be completely eliminated [5].

Social processes, nature, technical equipments and technological processes include minimum events that are realized in conditions of certainty. The bulk of events have uncertain character and their result is connected with certain risk. Risks are caused by the man and his activities, technique and technological processes, nature and its inscrutability. Generally the risks can be classified to two basic groups:

- anthropogenic risks:
  - risks emerging from society,
  - risks emerging from technique,
  - combined risks,
- risks independent on human activity:
  - natural risks:
    - tectonic,
    - telluric,
    - topological,
    - meteorological,
  - risks emerging from cosmos.

Transport defined as a move of means of transport on transport roads or function of means of transport that move something or somebody around is connected with a lot of risks that endanger performance of a contract of carriage between carrier and customer. Structure and character of the risks affecting the transport are very varied which results from the nature of the transport, transport business and transport processes. The most important specialty of transport is the movement of people and goods from one place to another that are the sources of external risks. These risks are usually independent on the carrier's will that can only minimally eliminate them. On the other hand there are many risks in transport that are connected with form of transport, its character and quality of technological processes organization. Transport business is also affected by risks that are specific for any type of business [5].

Above mentioned risks cannot be expressly allocated and sharply separated. They are blending together, connecting and increasing what can result in synergic effects or so called "domino effect". Risk analysis in transport and specifically in individual forms of transport is complex process that presents multicriterion probability function of breaking continuity of transport process and also performance of transportation plan.

Transport and the transferring processes became necessary for human development and increasing the standard of living. They are exposed to the same risks as any of human activities. On the other hand many risks in transport and transferring processes are multiplied because the internal

and external conditions inclosing transport are much complicated than e.g. in manufacturing processes [5].

It is indicated by many facts that include:

- distance carried (extent in kilometres and thousands of kilometres):
  - differences in internal and external conditions in the place of consigner and consignee,
  - time factor (transport distance),
  - changes in transport conditions during transport (transit across other countries, change of mode of transport, …),
  - weather influence,
  - character of transport:
  - passenger,
  - freight,
  - transport of dangerous goods,
- transport technology (split according to form of transport and character of transport).

Risks, influencing transport business and transport processes, can be derived from risks currently affecting society, human activities, material values, living environment and also the human life and health. These risks include:

- risks of non-military character:
  - risks from development in the world and foreign policy,
  - risks of the home policy including political risks,
  - social risks,
  - risks of demographic development,
  - economic risks,
  - technical and technological risks,
  - information risks,
  - risks of energy and raw material shortness,
  - risks of shortage of basic necessaries of life,
  - health risks,
  - risks of national, race, religious, ideological and cultural intolerance,
  - risks resulting from criminality growth,
  - risks from deterioration of natural environment,
  - risks of natural disasters occurrence,…
- risks of military conflict occurrence, etc.
- combined risks.

It is evident that the risks are generally very varied. They are existing in all spheres of human activities and natural environment. The sources of risks and risks factors that can cause crises events are also varied [5].

At present there is no generally binding or internal legal rule that would define kinds of risks and enable their analysis and evaluation. If we want to perform this task there are many variants and different views of evaluation. In the first place risks in transport can be classified as:

- risks of transport business,
- risks of transport technologies,
- risks of transport infrastructure,
- risks resulting from transport character.

Decisive source of risks in transport is just the man. He can be in various positions in relation to transport. He can be:

- transport operator,
- participant in transportation processes,
- a man wilfully endangering transport and transportation process,
- a man outside transport and transportation process who can danger it through his activities realized in consequence of emergency event.

1.2. RISK ANALYSIS IN TRANSPORT

Risks analysis and their quantitative evaluation are integral part of transport enterprises management and the competent bodies of state administration. This process cannot be successfully realized without perfect knowledge of transport processes and their technology, transport requirements and transport environment. Risk quantification requires complex database that completely describes transport, allows carrying out sequence of generalizations and assess the probabilities of crisis events occurrence. Generally we can say that at present there are only minimum presuppositions of military conflict at our territory but the probability of transport accidents and their seriousness are increasing. For this reason it is necessary to carry out preventive measures to prevent crisis events in transport and prepare conditions for minimizing the impacts of occurring crisis events.

On the other hand it is necessary to respect the particularities of respective types of transport. Railway transport is one of the most used types of transport in the field of passenger and freight transport. It is ground type of rail transport that is characterized by the range of specific properties but also the risks threatening transport security and transportation plan. The basic risks in railway transport include: risks of traction vehicles and railway carriages reliability, risks of technical conditions of railways and track lead, risks resulting from technology of railway transport, risks connected with type of transported goods, risks of failure of communication and error protection equipments, risks of failure of information and communication systems, risks of terrorist attacks and risks of military conflict occurrence [6].

Road transport is now the most used type of individual and public transport. Unlike the rail transport it is relatively independent on traffic road which means advantage in term of its availability but on the other hand it increases the risk of accidents. The basic risks in road transport include: risks of automobile technology reliability, risks of insufficient technical conditions of roads and highways, risks resulting from technology of automobile transport, risks connected with type of transported goods, risks of terrorist attacks and risks of military conflict occurrence.

Air transport is progressive type of transport for large and middle distances. It is connected with quantity of specific risks that are in connection with use of air corridor. The basic risks in air transport include: risks of aeronautical techniques reliability, risks of air-navigation systems reliability, risks resulting from technology of air transport, risks connected with type of transported goods, risks of threat to air transport due to extreme climate conditions, risks of terrorist attacks and risks of military conflict occurrence.

Water transport is influenced by the risks that are connected with specialities of water transport and also the risks that are typical for all types of transport. They include: risks of vessels reliability, risks of water road conditions, risks resulting from operating objects and equipments on water road, risks from technology of water transport, risks connected with type of transported goods, risks of failure of information and communication systems, risks of terrorist attacks and risks of military conflict occurrence.

Crisis events in transport, initiated by impulses outside transport system, cause events that require special measures for ensuring transport services (extensive emergency situations or crisis states, state of emergency, state of exception, state of war or war). Transport operates in special regime and according to the state administration bodies' decision it is instructed by crisis plans. Crisis events in transport, due to impulses within transport system, result in transport accidents, design failures, technological accidents and failure of information systems. The basic sources and initiators of these crisis events can be:

- man (as operator of means of transport and information carrier),
- mean of transport (its technical condition),
- transport road (technical condition, carriage ability),
- transport technology,
- transport information (delayed, bad content, incomplete),
- combination of these factors.

Transport system is like other systems influenced by its environment. Impulses resulting in crisis events can act from the transport system environment as well as its inside. For transport system is specific that crisis events within this system can result in crisis state of other objects and systems. It

is valid also vice-versa, crisis event in non-transport systems can cause crisis within functional transport system [5].

The negative crisis events in transport result in disturbing means of transport operation, transport systems, damage or destruction of transport roads and transport buildings. This results in endangered human lives and health, material values or living environment. Relevant degree of crisis event in transport can be characterized:

- **Accident state** in transport occurs after crisis event of smaller extent (e.g. after current transport accident). Its extent significantly disturbs traffic continuity or requires acceptation of special operating measures (e.g. it can be caused by unfavourable atmospheric effects, ecological aspects etc.).
- **Crash state** in transport results in crisis event of great extent (e.g. bulk transport crash, crash during transport of dangerous goods, etc.). This crash results in breaking transport road. For the normal traffic recovery, forces and means for service and recovery of the traffic route in cooperation with forces and means of integrated rescue system are sufficient.
- **Crisis state** in transport is caused by crisis events of great extent (e.g. natural disasters – floods, earthquakes, etc.) Function of the transport is disturbed in certain region or in the territory of the whole country. Recovery of traffic route is not possible without special forces and means and resources given in the crisis plans (e.g. subjects of economic mobilization of the transport, posts and telecommunication branch and other branches).

1.3. FACTORS INFLUENCING RISKINESS OF PASSENGER TRANSPORT

Human skills, scientific-technical and technological progress bring also a lot of risks and dangers. Transport is one of the human activities that are continually developing. Transport problems have all-society character since the transport is service for society; it underlies existence of society in cityized area and affects human mobility in positive and negative way, too [7].

Growing importance of personal and freight transport result in increasing cars production as well as road network spreading. This process is often called as motoring expansion. Road transport is connected not only with manufacturing and working human activities but also with the way and style of the life. Rapid growth of motoring enables people almost unlimited possibilities of move, flexibility and freedom. However, each of technical equipments performs its function only if it is used in accordance with the rules of producers and companies, in contrary case, the negative aspects can become evident. The most important negative events accompanying road transport are as follows:

- hazardousness of each transport mode (motoring, cycling, walking) that means for all traffic participants,
- negative transport impacts on natural environment in form of air pollutants, solid wastes, vibrations and also the results of road accidents such as leakage of driving fuels, dangerous substances, etc.

Hazardousness of transport is indicated especially by road accidents. Road accident is event in road traffic resulting in killing or injury of person or property damage in direct connection with driving. Road accidents are caused by a lot of factors:

a) human factor,
b) means of transport,
c) road and surrounding environment.

1.3.1. Human factor

Statistical surveys of accident rate expressly show that human factor especially driver and his behaviour are the main reasons of the road accidents. Human failing in road traffic causes more than 90% of all road accidents. The main reasons are disobedience to maximal allowed speed, non-usage of signalization, disobedience to cross walk, infringement of safe distance between cars, infringement of right of way, disobedience to STOP or danger overtaking.

The behaviour of the drivers in critical situations is different. This is connected with their temperament according to which we can distinguish these types of drivers:

- serene driver, who does not think about his personal problems during driving, he drives his car responsibly and with pleasure, he is able to relax during driving,
- un-serene, anxious driver is constantly unsatisfied, his uncertainty is increasing in situations that make demands upon his person (driving in unknown terrain, in convoy, in peak time, etc.),
- driver insensible towards anxiety who does not sense danger and therefore often causes transport collisions and by his ill judged acts endangers other participants of road traffic,
- aggressive driver – his behaviour can be compared with " animals fight for own area".

However, we must take into consideration that also serene driver can change to aggressive driver or driver insensible towards anxiety after consuming some psychotropic substances (alcohol, drugs) that cause expressive changes in his behaviour. Some medicines are also important, e.g. sedatives, antihistamines, etc. as well as the actual health and psychical condition of driver that have impact on the length and stability of driver response time.

At present the mobile phones are not only fashion but also one of basic elements for speedy and reliable ensuring of every day human needs. This fact is unfavourably shifted to transport, too. Driver has to know to distinguish when the phone performs its task and when it is the reason of possible bodily injury. Telephoning during driving takes away the driver attention and can cause road accident. Therefore the Law of the NC SR (National Council of the Slovak Republic) 315/1996 Z.z. on road traffic prohibits to driver "during driving to manipulate with mobile phone or carry out similar activity that is not connected with driving".

Another phenomenon that influences the driver abilities in personal mass transport is passenger. Passenger can hinder the driver in view from the car and can also disturb his attention due to his questions or unsuitable behaviour [7].

Especially in autumn, when in the morning the visibility is reduced for longer time and dark comes sooner, transport police records notable growth of transport accidents with participation of non-motor participants of road traffic especially in town residential areas.

Drivers often do not respect the rights of pedestrians on the cross walks and do not anticipate enough their behaviour, especially near by cultural centres, schools and bus stops. On the other hand, the most frequent pedestrian distcityce is unexpected entry to the road closely in front of the car and driver has no chance to stop the car.

Transport accidents are considerably caused also by bikers. Their collision with car usually results in death or serious injury of biker. Especially during night the bikers are high risky factor, mainly if their dress is dark and they do not use the light. Bikers should respect the rule "to see and to be seen".

1.3.2. Means of Transport

Motor-car moving in environment, controlled by driver, is dynamic system with three mutually connected and inseparable parts: driver, motor-car and environment. Driver is controlling member and his controlling inputs (driving wheel, accelerate and brake pedal) are dependent on his will, environment conditions and motor-car properties.

Motor-car safety must be seen as its most important operating property because human lives and health as well as transported materials are dependent on it. Motor-car safety is one of the basic factors for evaluation of transport quality by passenger in mass personal transport. Motor-car safety consists of three parts: active safety, passive safety and ecological safety.

Active safety includes technical solutions and measures that enable the driver to prevent occurrence of such situation that can give rise to transport accident. They have preventive character. The sooner the driver sees some obstruction the better he can face to possible danger. Good visibility is the first safety factor. Great glass surfaces offer broad visibility and enable good peripheral vision. We cannot forget that 30% of road accidents happened during night what presents 50% of road accidents victims. Therefore motorcar lighting is very important aspect of active safety, especially meeting lights that enable better illumination of the road and so higher ability to notice details and contrasts. Safety motor car must "be able" to reduce speed as soon as possible especially in case of unexpected situation on the road. Four electronic systems are used to improve ability and intensity of braking: Automatic Braking System ABS, Electronic Brake Distribution EBD, Anti-Slip Regulation

ASR (especially suitable in rain), Break Assistant Systems in emergency BAS and Electronic Stability Program ESP [7].

Passive safety uses all accessible means and equipments for ensuring passengers protection during accident. Fixed motor-car frame, program deformable motor-car body, more efficient safety belts, airbags, head restraint and catching systems are the most famous instruments of passive safety. Their aim is to absorb crash energy in a maximum extent and protect persons in the car from its effects. Risk of death is 6 times higher for passenger who is launched from the seat in comparison with person belted up. But in mass transportation every passenger does not have his own seat. Therefore these means of transport have to be equipped with sufficient holder bars that are mounted in such height enabling to hold for all groups of passengers.

Except the elements of passive safety ensuring protection of persons in-motor-car there are also elements of passive external safety that reduce the accident impacts on other traffic participants. For this reason the motor-cars have round edges, deformable mirrors. Freight vehicles have barriers against motor-car underruning the vehicle axles, etc.

Ecological safety is the same importance and is divided into noise and toxic safety. The elements of toxic safety are e.g. catalytic converters, double casing of fuel tank, etc.

1.3.3. Road and surrounding environment as risk factor

According to opinions of transport experts the residential areas – towns and villages- are the most frequent places of road accidents.

Transport processes make high demands on quality of sense cognitional processes of all traffic participants. Traffic participants must continually perceive various shapes, sizes, distances, colours, motion, speed, noise, various sounds, etc. and react on noticed transport situation. Driver, biker and pedestrian must continually perceive information necessary for identification of surrounding environment and its possible changes, identification of transport situation, self-locating, locating of surrounding motor-cars, pedestrians, bikers, barriers, road signs and other circumstances.

Driver and his behaviour are affected by number of internal and external factors connected with variable conditions on the road. The external factors include weather conditions (driving during night, in smog), road quality (adhesive properties) and behaviour of other traffic participants (so called dazzle of driver by oncoming vehicle, child run into road, etc.) and also collisions with animals The internal factors affecting driver performance include noise, cabin clime, driver seat, passengers, etc.

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