CRISIS AND RISK ENGINEERING FOR TRANSPORT SERVICES

Collective monograph

Edited by Nataliia Chernova, Konrad Lewczuk

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Materials of scientific and practical research within the framework of the implementation of the project of the program of the European Union Erasmus+ «Crisis and Risks Engineering for Transport Services» (CRENG) are presented in the monograph.

Issues of the impact of crisis situations on the work of transport enterprises and ways to increase the efficiency of the functioning of transport and logistics systems in conditions of crises and risks are considered.

The publication is intended for scientific and pedagogical workers, graduate students and students of higher education, as well as managers and specialists of industrial enterprises and business structures, who are interested in the current state and prospects of the development of scientific research.

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HEALTH, SAFETY & ENVIRONMENTAL MANAGEMENT SYSTEMS

Valerii SAMSONKIN
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FOREWORD

In recent decades, attention to the issue of safety, in general, has been increasing, and in particular to safety management. The implementation of the results of the scientific and technological revolution (computerization, travelling speed, fundamentally new possibilities of transport) has made significant changes in the life of human society, the risk of traffic accidents with serious consequences has increased significantly resulting in the need to develop and implement additional measures to ensure the safety of traffic of all types of transport. Safety is the main system-forming factor in the activity of transport and the most important social factor. The strategic task of the state is the safe development of the transport system and ensuring its stable functioning. And first of all, the safety of human life has come to the fore in understanding society.

A century ago, the relative underdevelopment of the transport system and the low mobility level had a minor negative impact on the environment. But with the development of the transport system and the awareness of the negative impact of human activity on the environment, as well as to regulate this impact, it became necessary to study the comprehensive relationship between transport and the environment.

LIST OF ABBREVIATIONS

ECI — European critical infrastructure
ALARP — As Low As Reasonably Practicable
TS — traffic safety

RTA — road traffic accident
FS — flight safety
IMO — International Maritime Organization
STI — state technical inspection
EU — European Union
ESCAP — Economic and Social Commission for Asia and the Pacific
SPECA — The United Nations Special Programme for the Economies of Central Asia
SDGs — Sustainable Development Goals
CFE — Connecting Europe Fund
WGT — Working Group on Taxonomy
MSD — Method for identifying hidden regularities
HRGC — Highway-rail grade crossings

8.1. Transport system safety and threats on transport

Transport accidents are a reflection of transport risk. Over the past 15-20 years, there has come an awareness of the stochastic nature of this problem associated with the human factor and requiring the use of the achievements of computer technology.

Sources of threats on transport can be divided into:

1) threats of a sociogenic nature (unlawful interference in the functioning of transport, terrorism, theft, hooliganism, blocking of tracks and vehicles, violation of the rules for operating vehicles, imperfection of these rules and legislative framework, etc.);

2) man-made threats (poor quality of the material and technical part, insufficient qualification of service personnel, etc.);

3) natural threats (floods, landslides, earthquakes, snow and sand drifts on the roads, tsunamis, geo-anomalous zones, typhoons, etc.)

Transport system safety is the ability of the transport system to:

a) work within the specified limits of parameters that ensure the performance of transport work and minimize the level of disruption, which is a potential or realized threat to the life and health of people, the safety of transport, freight and the environment;

b) the ability to change its parameters in the case of a potential threat aimed at preventing at preventing the threat's further development.

The most serious problem around the world is road traffic accidents (RTA) — collisions between cars and trains at highway-rail grade crossings (HRGC). Figure 1 shows the number of fatal and serious injuries from 2006 to 2016 at HRGC in 28 EU countries. The data show that the number of accidents fell by about 34% and the death rate by 37%. Despite the downward trend in the number of accidents with HRGC in the EU, the actual numbers, as well as the economic consequences, are still quite high. The UNECE has identified four main safety issues [1]: (1) the presence of many passive and poorly protected active HRGCs, where it is too expensive to propose any technical solution; (2) lack of evidence regarding the problem, causes and associated costs of HRGC due to lack of proper collision investigation and availability of statistics; (3) lack of effective risk assessment and management due to lack of know-how, capacity and related methods; and (4) poor safety environment due to lack of understanding of the root causes of collisions, responsibility of road users and inadequate investigation of collisions.

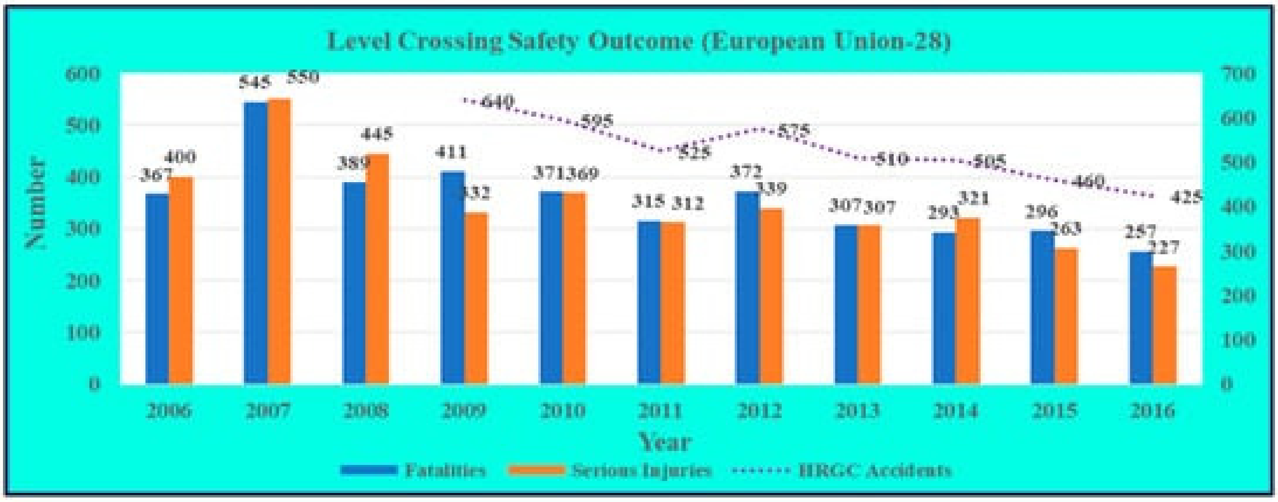


Figure 8.1. Number of fatal and serious injuries at level crossings in 28 EU countries from 2006 to 2016 [Source: UNECE. Statistical Data on Level Crossings and on Their Safety in EU Countries. 2018. Available online: https://unece.org/DAM/trans/doc/2018/wp6/4d_EUAR_LC_safety_stats_June_2018.pdf (accessed on 10 May 2021)]

Following the Guide «Road Transport Safety Management Systems» [2], we give the meaning of the main terms used in the theory of risk on transport:

− *Hazard* — a condition that could lead to an accident;

− *Hazard identification* — the process of finding, listing and characterising hazards;

− *Hazard record* — the document in which identified hazards, their related measures, their origin and reference to the organisation, which has to manage them are recorded and referenced;

− *Risk* — the frequency of occurrence of accidents and incidents resulting in harm (caused by a hazard) and the degree of severity of that harm;

− *Risk analysis* — systematic use of all available information to identify hazards and to estimate the risk;

− *Risk assessment* — the overall process comprising a risk analysis and a risk evaluation;

− *Risk management* — the systematic application of management policies, procedures and practices to the tasks of analysing, evaluating and controlling risks;

− *Risk evaluation* — a procedure based on the risk analysis to determine whether an acceptable level of risk has been achieved;

− *Road haulier* — an economic entity that has a license to conduct economic activity on services rendering of transportation of passengers and (or) cargoes by road;

– *Safety* — freedom from unacceptable risk of harm; достижение системой конечной цели функционирования с минимальным отклонением от норм исполнения, за минимальное время и минимальными материальными затратами;

– *Safety management system* — a structured and documented system of interconnected and interacting elements of a road haulier, an economic entity maintaining vehicles in terms of traffic safety management in order to establish policy, objectives and respective processes of these objectives' attainment;

– *Safety measures* — a set of actions either reducing the frequency of occurrence of a hazard or mitigating its consequences in order to achieve and/or maintain an acceptable level of risk;

– *Safety requirements* — the safety characteristics (qualitative or quantitative) of a system and its operation (including operational rules) and maintenance necessary in order to meet legal or company safety targets.

– *Safety rules* — all rules containing road transport safety requirements established by applicable legal acts, as well as regulatory and technical documentation, the fulfillment of which ensures safety of road transport.

8.1.1. Transport safety measurements

The main task of the safety service is to identify and assess operational errors that create the possibility of accidents.

A fundamental point in creating an effective system of transport safety is an unambiguous interpretation of the term «transport safety». In the countries of the European Union, the term «transport safety» was introduced by EU Directive 2008/114 of December 8, 2008 [3, pp. 74-82]. Each state, depending on various factors, independently determines the number of ECI facilities and makes a preliminary assessment of their «criticality». A four-step algorithm of actions of the states on ECI detection, and also a set of obligatory data for the description of these objects was established.

The safety level is used for numerical safety assessment. This value is determined differently in different countries.

The ALARP (As Low As Reasonably Practical) method has become widespread in many Western European countries. The level of risk is determined in the form of a relationship

$$\rho = \frac{k}{V} ,$$

where k — is the number of human casualties;

v — general indicator of the volume of traffic (more often — passenger traffic).

The essence of the ALARP method is to define areas of transport risk:

$\rho < \rho_1$ — corresponds to an insignificant level of risk and is explained by the objective nature of transport risk;

$\rho \to 0$ — is the desired level of risk, but the situation $\rho = 0$ is almost unattainable;

$\rho_1 \le \rho \le \rho_2$ — is an area of reasonable risk;

$\rho > \rho_2$ — is inadmissible for a society and additional expenses for transfer of system in area of reasonable risk are necessary.

In different countries, this concept varies in the values of ρ_1 and ρ_2 (table 8.1)

Table 8.1. Examples of margin evaluation of risk

State	Margin evaluation of risk	
	ρ_1	ρ_2
Switzerland	Incident with a frequency 10^{-9} with the number of victims — 1000 per hour	Incident with a frequency 10^{-3} with the number of victims — 10 per hour
The Netherlands	-	for passengers — 0.15 fatalities / on 1,000,000,000 passengers per year; for staff — 0.25 / per 10,000 employees per year
England	1 victim per 100,000 insured workers and passengers per year	1 victim per 10,000 insured workers and passengers per year

Accidents on various modes of transport are classified as follows:

(a) Automotive:

✓ material damage;

✓ minor injuries;

✓ moderate and severe injuries;

✓ death of the victim;

✓ especially severe consequences (4 or more people died or 15 or more people were injured).

(b) Aviation:

✓ catastrophe

✓ accident

✓ serious incident

✓ incident

(c) Railway:

✓ catastrophe;

✓ accident;

✓ incident.

(d) Marine:

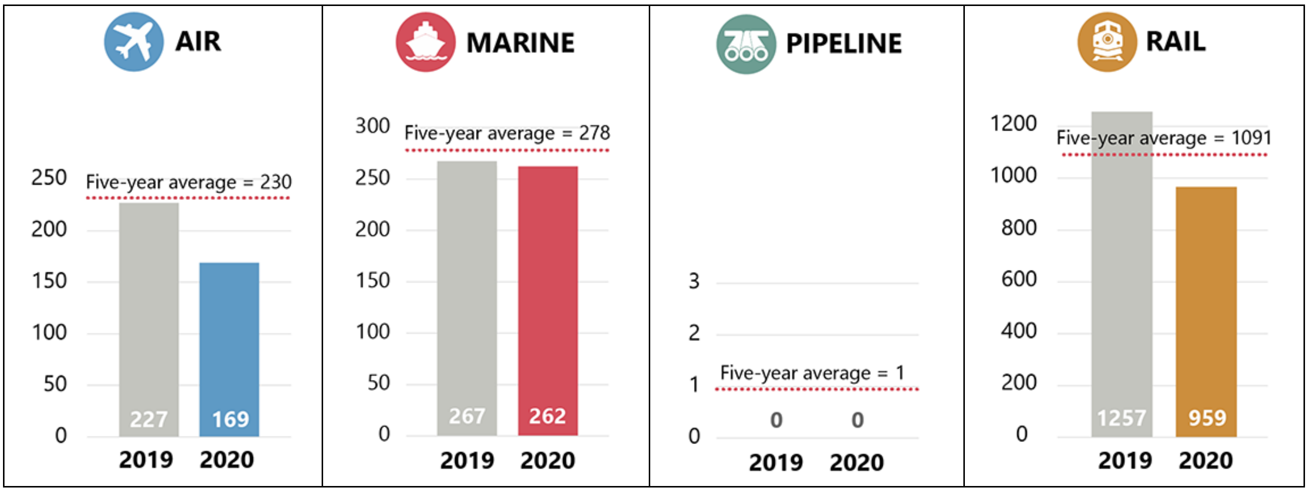
✓ catastrophe;

✓ serious accident;

✓ incident at sea.

In 2019, the Italian region of Lombardia had the highest number of passenger cars (6.2 million) across the regions of the EU. Among EU regions, Province Luxembourg in Belgium had the highest incidence of fatalities in road accidents in 2019, at 171 deaths per million inhabitants. Building on the prelimanary statistics published in February 2021, the Transportation Safety Board of Canada (TSB) today released its 2020 annual statistical summaries on transportation occurrences in the air, marine, pipeline, and rail sectors. The table 8.2. shows the number of reported accidents.

Table 8.2. Transportation accidents reported to TSB (2020)



[Source: https://www.canada.ca/en/transportation-safety-board/news/2021/06/-transportation-safety-board-of-canada-releases-2020-transportation-occurrences-statistics.html]

8.2. Safety regulatory framework

Traffic safety management, as a kind of technological process, cannot take place without an appropriate legal framework. The content and structure of the legislation in the field of traffic safety are aimed at ensuring and controlling the traffic safety of trains. Under the management of transport safety is understood a) the organization of traffic safety, b) regulatory support, c) regulation of functions and tasks of the organization, coordination, prevention and investigation of violations of traffic safety.

The UN Conference (1978) adopted the Convention on Standards of Training, Certification and Watchkeeping for Seafarers (STCW-78) [4], which was subsequently revised in 1995 (STCW-78/95). Through this Convention, the International Maritime Community seeks to establish a uniform standard for the training of marine professionals and to restore confidence in the authenticity of diplomas and certificates regardless of the countries that issued them.

The obligation of States to investigate marine casualties is enshrined in international legal instruments such as the International Convention for the Prevention of Pollution from Ships, 1973 (MAR-POL 73/78), the International Convention for the Safety of Life at Sea, 1974 (SOLAS 74/78), the International Convention on the Trademark 1966 UN Convention on the Law of the Sea 1982.

In 1992, representatives of 30 countries with 3/4 of the world's fleet established the International Forum for the Investigation of Marine Casualties, the main purpose of which was to unify the investigation and identify all the causes of maritime adventures. Representatives of the Forum created a draft Code for the Investigation of Marine Accidents and Events [5].

8.2.1. Emerging challenges and safety performance management

In the 80s. of the XX century Dan Petersen's safety philosophy [7], related to the study and prevention of casualties and accidents and adopted in civil aviation, gained popularity. D. Peterson's concept includes ten principles:

1. Dangerous act, condition, and accident — symptoms of something wrong in the company's management system.

2. Forecasting the severity of safety breaches and paying attention to them does not allow to reduce their number due to the frequency of inspections.

3. Safety needs to be managed, efforts must be made to ensure it, and achievable goals must be planned, set, and organized.

4. Control and reporting procedures are the key to effective safety.

5. The safety function is to pinpoint and identify technological errors that lead to accidents.

6. The causes of the dangerous course of technological processes can be identified and classified.

7. In most cases, dangerous human behavior is normal behavior as a result of a reaction to the environment. The task of management is to change the environment leading to dangerous behavior.

8. When building an effective safety system, it is necessary to consider three main subsystems: physical, managerial, and behavioral.

9. The safety system must be in line with the culture of the organization.

10. There is no single right way to achieve safety in an organization. For this system to be effective, it must meet certain criteria.

There is no absolute safety in transport systems. We can only talk about relative safety or the level of safety. The vast majority (87%) of accidents on railways are the two most dangerous types: collisions and train collisions — 61%, plus accidents at railway crossings (accidents) — 26%. To reduce them to the traditional measures ensuring the safety of trains additional ones were used: new types of rolling stock designs and infrastructure structures, expanding of the program of testing and entry control, ensuring of the life and health of passengers [8]. Separate measures were required to ensure adequate behavior of representatives of key professions: locomotive driver, station attendant, train dispatcher, etc.

Safety management strategies for flights, train, and ship traffic include:

– Traditional Retroactive (Reactive) strategy — prevention of aviation events, which is based on strict compliance with regulatory requirements and the implementation of preventive measures developed as a result of the investigation.

– Modern — proactive (Proactive) strategy — prevention by identifying hazardous factors and taking measures to reduce the level of risk.

– Highly effective — predictive (Predictive) strategy — fixing the performance of the system in a normal state in real-time and identifying potential problems in the future.

The increased attention to the issues of accidents and the investigation of accidents at sea is explained by the need to identify the causes of death of people, ships, and cargo at sea and to develop measures to prevent or reduce the number of accidents. According to IMO data, approximately 80% of all accidents at sea are caused by human factors: errors of navigators, pilots, operators, dispatchers, and other persons; The London Mutual Insurance Club for Maritime Ships cites a figure of 70% [9]. The safety of navigation and the protection of human life at sea depends to a greater extent on the training and qualifications of the ship's crew than on the specific characteristics of the ship itself, the cargo, and the state of the marine environment. IMO attaches great importance to the education and training of shipboard personnel.

The reasons for sea adventures include: *navigation* (landing on the ground, collision, bulk, loss of stability / buoyancy, storm, ice), *technical* (damage to the main engine, damage to the propeller-rudder complex, damage to auxiliary mechanisms, damage to the hull, damage to ship devices), *explosions* and *fires* [10,11, 12].

There are different approaches to assessing the state of transport safety in different countries and companies. In addition, these assessments are constantly updated. For example, the following sequence of formation of safety assessments is implemented in the EU railway transport: collection of statistical data on safety (CSI data in 2014/88 / EU); changes to the collection of statistics foreseen by the fourth EU rail package; railroad indicators ERA.

This is how the CSI structure looks like [13]:

1. Indicators of accidents

– Significant accidents: train collisions, train derailments, accidents at level crossings, rolling stock collisions with people, fires in rolling stock, others.

– The total number of seriously injured and fatalities in road accidents by category: passengers, personnel, users of level crossings, bystanders, others.

2. Indicators of dangerous goods transportation: total and relative (in relation to train-kilometers) number of accidents during transportation of dangerous goods.

3. Suicide rates.

4. Indicators of the identified prerequisites for accidents: total and relative (to train-kilometers) number of damaged rails, fastenings, signaling systems, hazard indicators, wheels and axles on rolling stock in operation.

5. Indicators for calculating the economic impact of accidents (in euros): the number of deaths and serious injuries multiplied by the prevention factor (VPC); the cost of damage to the environment; cost of material damage to rolling stock or infrastructure; the cost of traffic delays as a consequence of accidents.

6. Indicators of technical safety of infrastructure: percentage of tracks with worn-out automatic protection (ATP), percentage of trains using existing ATP systems, number of ground crossings (total, per kilometer of the track).

7. Indicators related to safety management: internal audits ...

8. Definition: general definitions of CSI and methods for calculating economic impact.

Method of hidden regularities by Samsonkin V.M. and Druz V.A. (MSD) is designed for process safety management [14]. This theory is based on a statistical management approach and represents an efficient approach to managing complex systems in real-time. The input information for MSD is statistics of traffic safety violations: traffic events, failures, errors, train delays, etc. The way out is to support decision-making in the field of safety. In fig. 8.2 the scheme of operations of the Method is presented.

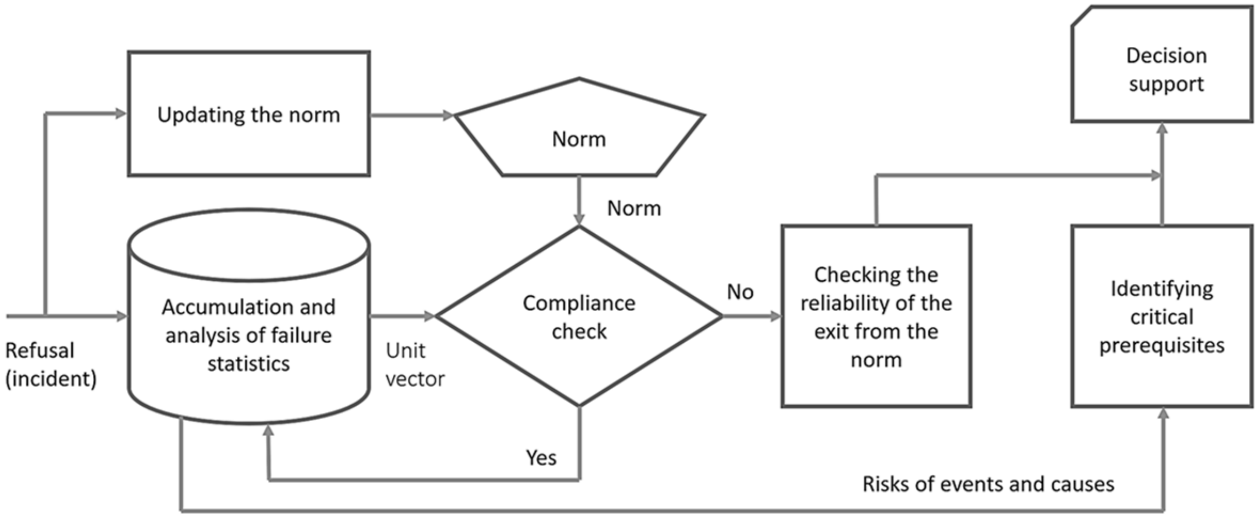


Figure 8.2. Sequence of steps in MSD

The theoretical basis of MSD belongs to the theory of self-organization.

8.2.2. Safety models. Human factors

The desire to find some kind of regularity in the causes that lead to accidents and catastrophes gave rise to several models of causation [15]. The most famous models are Heinrich's pyramid (1931) and «Swiss cheese» by James Reason (1990).

According to Heinrich's accident rate model (Figure 8.2), a catastrophe is preceded by a number of events, first of all, these are incidents that have not been given importance (up to 300), significant breakdowns and personnel failures (29), and, finally, the top of the pyramid is «crowned» by a major accident or catastrophe. There are modifications of the Heinrich pyramid, where the number series starts from 3000 and even from 30,000 and reaches 1 (Fig. 8.3).

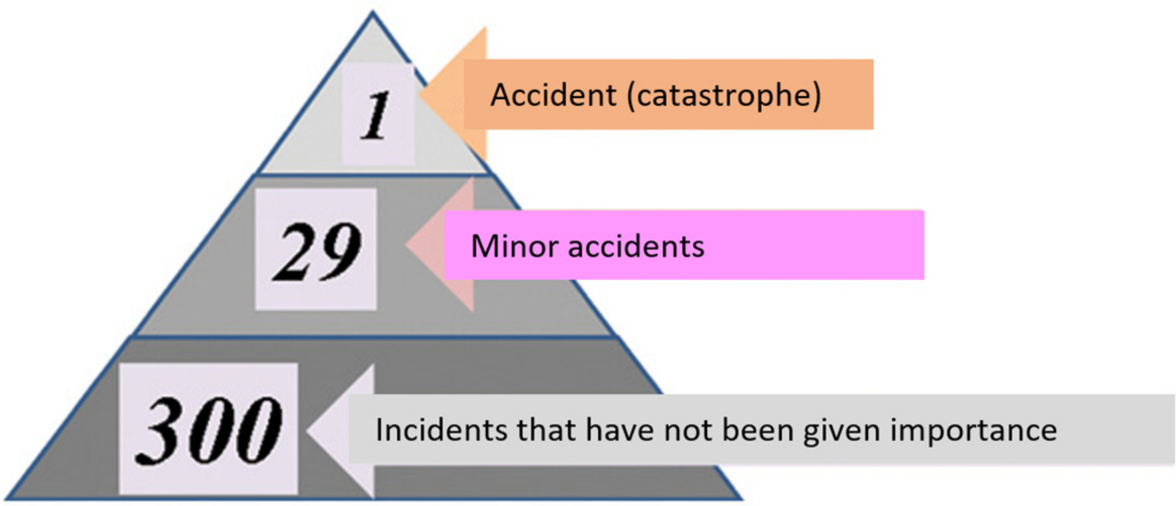


Figure 8.3. Heinrich's pyramid

There is a vulnerability in this model — how to explain disasters like the «Titanic», when a modern at that time ship dies on the very first voyage? Similar situations are encountered in aviation and astronautics.

James Reason came up with an ingenious metaphor for a series of mistakes that lead to a catastrophe: «Every hole in a piece is a separate mistake. Such «holes» in any system are a lot at each of the levels, they are located in different places and have different degrees of potential destructiveness. However, the next slice level, in which there is no problem in the same place, protects the entire system from epic fail» (if fail is a common failure, bad luck, then epic fail is something much more tragic and large-scale, in this situation it is a catastrophe).

This metaphor is well known to risk management professionals and has found applications in aviation, healthcare, and engineering (Figure 8.4).

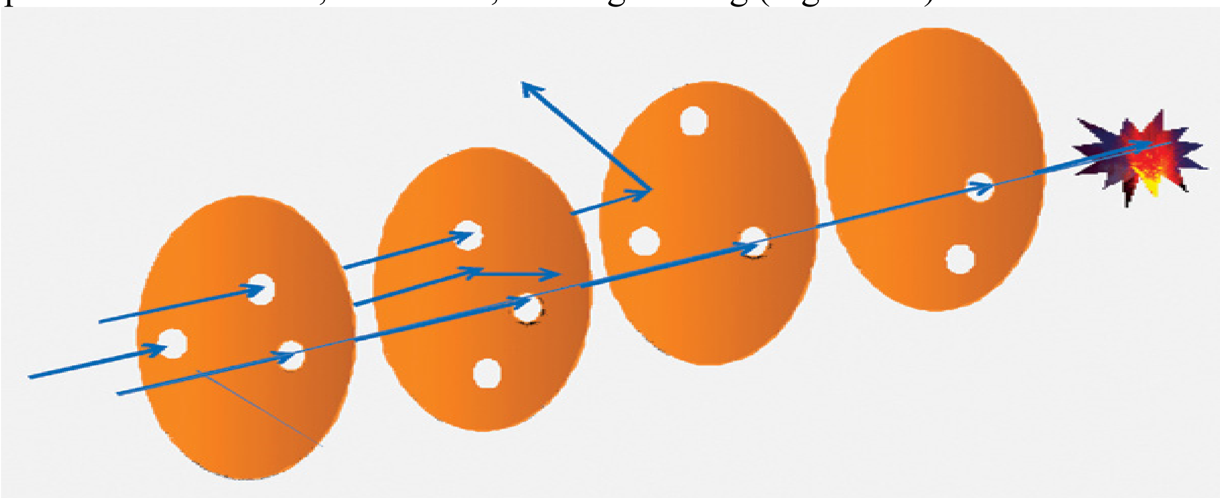


Figure 8.4. Model «Swiss cheese»

Accident rate matrix. When investigating accidents, experts are guided by the linear dynamics of the vessel and are ready to trace the entire dynamics of an event, while events develop in most cases nonlinearly. The sailors noticed this long ago: «when there is a fire in the sea, they give a lot of wise advice on the shore.» An accident rate model based on a system of differential equations describing the behavior of the «ship — person — external influences» system is proposed.

Moving towards each other, two people collide, although there seemed to be no reason for this, because they were perfectly oriented in space and predicted the development of the situation. When a «jump» occurs, there is a transition from a linear (predictable) situation to a nonlinear (unpredictable) one. The result is an «accident».

In retrospect, the Statistical theory of train traffic safety by V.M. Lisenkov should be noted [16]. From the set of technological processes of railway transport, the author singles out a class of responsible for critical technological processes (CTP), in which the parameter values go beyond the permissible limits leads to material losses, the creation of a threat to the health and life of people, and irreparable harm to the environment. CTP is characterized by three states: (a) normal — the process develops in accordance with its algorithm; (b) safe emergency — failure leads to a decrease in the efficiency of the technological process; (c) dangerous emergency, which certainly leads to an accident. The reasons for the occurrence of dangerous situations are failures of technical equipment, dangerous errors in the design and operation of systems, actions of the operator, driver, service personnel.

The human factor is understood as an integral characteristic of a person (or a team) as a subject of professional and labor activity, which includes parameters of professionally important qualities (PIQ), mental states of an employee (adaptation, fatigue, interference of skills, end impulse, frustration, tension, etc.)), driving forces of behavior (motives, interests, relationships) and other social-role functions (formal and informal), provided for by the staff position and due to the personal qualities of the subject of activity or the characteristics of a particular situation. Management decision-making is influenced by the amount of information provided, which is often redundant. And due to a person's limited ability to process a large amount of information (from five to nine sources), taking into account the time constraints when selecting the most important ones due to the dynamics of replacing information with one another and understanding it, a person falls into a tight time frame.

The influence of the human factor on safety in production systems and processes is dealt with by ergonomics. One of the approaches to in-shift monitoring of the condition of a locomotive driver in real-time is based on MSD and is presented in [17].

Numerous applications of the problem of control of the human factor in road transport are presented in [18].

8.3. The interaction of transport and the environment

Transport activities support the growing demands on the mobility of passengers and freight, while at the same time transport activities are associated with environmental impacts. In addition, environmental conditions affect transport systems in terms of operating conditions and infrastructure requirements such as construction and maintenance.

The growth of passenger and freight mobility has expanded the role of transport as a source of pollutant emissions and their repeated impact on the environment. These effects fall into three categories:

− *direct impacts*. Immediate consequences of transport activities on the environment (emissions of noise and carbon monoxide).

− *indirect impacts*. They often have higher impacts than direct impacts and are more difficult to identify. For example, particulate matter, which is mainly the result of incomplete combustion in an internal combustion engine, is indirectly associated with breathing and cardiovascular problems.

− *cumulative impacts*. Climate change with complex causes and consequences is the cumulative impact of several natural and anthropogenic factors, in which transport plays a certain role.

Comparative characteristics of the harmful effects of transport on the environment according to one of the burning parameters — greenhouse gases — is shown in Fig. 8.5.

The transport sector is often subsidized, especially through the construction and maintenance of road infrastructure. If the owner and the regulator are from different branches of government, then there is a risk that the regulations will not be effectively enforced. Failure to take into account the real costs of transport can explain a number of environmental problems. If environmental costs are not included in this estimate, vehicle use is accordingly subsidized by the community and costs accumulate as pollution. This requires due attention, since the number of vehicles, especially automobiles, is steadily increasing [20].

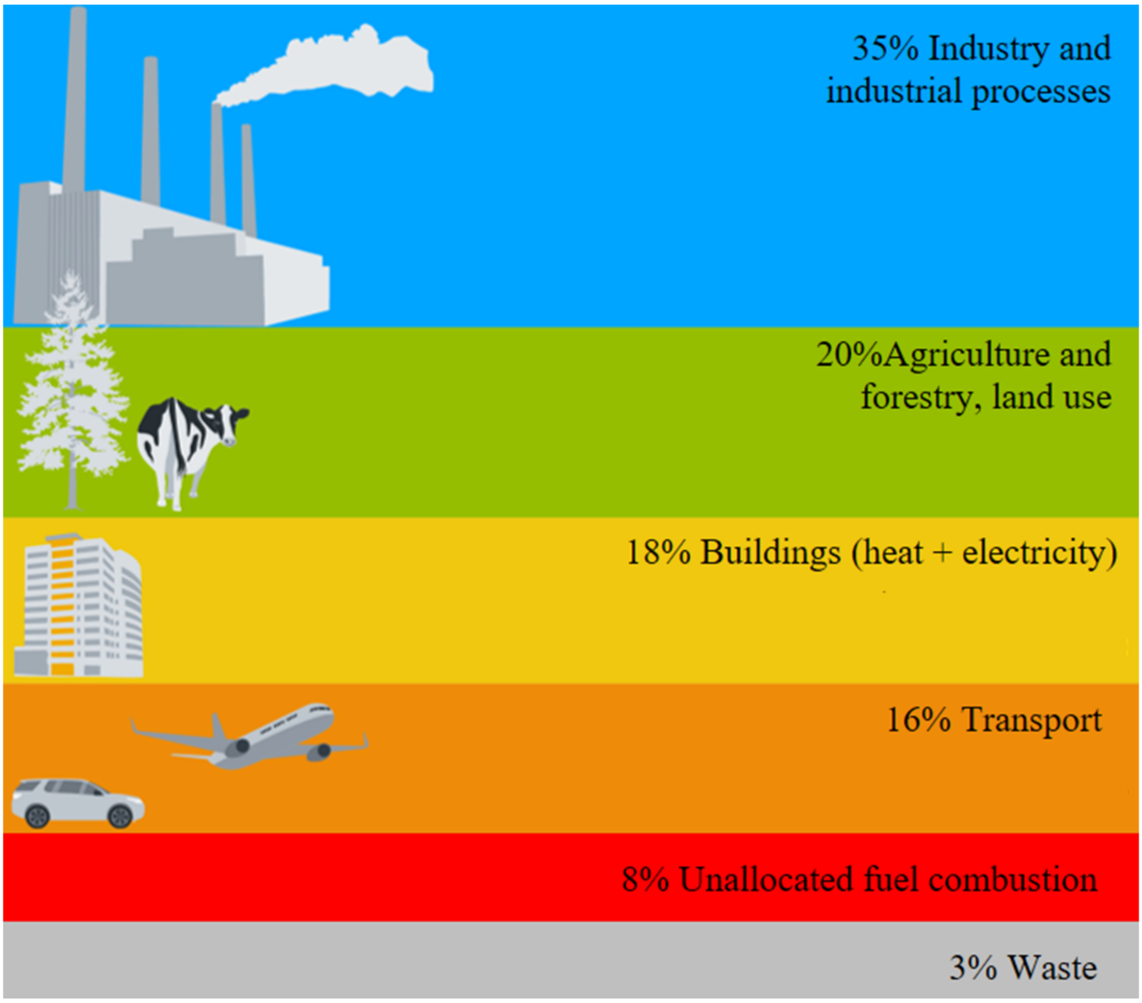


Figure 8.5. Greenhouse gas emissions by sectors

The interaction between transport and the environment is also complicated by two observations:

Impact level. Transport activity contributes to environmental problems, along with other anthropogenic and natural causes, directly, indirectly and cumulatively. In some cases, they may be the dominant factor, in others — insignificant.

The scale of the impact. Transport activity contributes to the emergence of environmental problems at various geographic scales (Figure 8.6), ranging from local (noise and CO emissions) to global (climate change), not excluding the problems of continental / national / regional (smog and acid rain).

In addition to these environmental impacts, the economic and industrial processes that support the transport system should be considered.

The costs of external environmental factors can be viewed from economic, social and environmental points of view. The main types of transport externalities associated with the environment relate to air pollution, water pollution, noise and hazardous materials. The definition of a quantitative assessment of the impact is currently not defined.

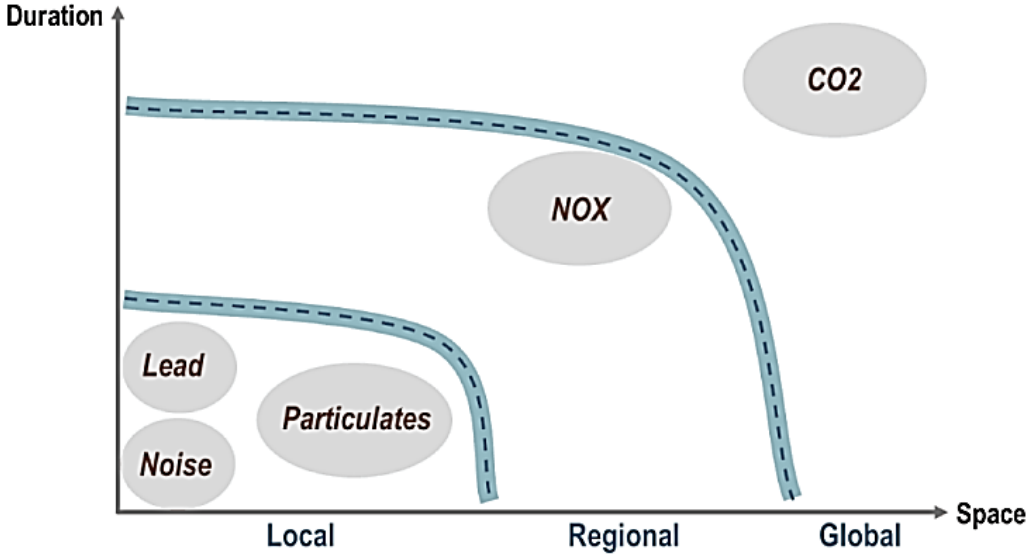


Figure 8.6. Spatial and temporal environmental effects of transport activities

[Source: George Mason University Center for Transport Policy, Operations and Logistics]

Sources of pollution (emissions) are rarely responsible for this. This has several implications. When it comes to road transport, users only take into account the direct costs of ownership (vehicle, fuel, insurance, etc.). Society typically takes on the role of providing and maintaining infrastructure and other indirect costs such as damage to structures and infrastructure, loss of productivity, cleanup, health care, and damage to ecosystems. The geographic distance between sources and victims is often a sharp controversy. Acid rain and climate change are prime examples. At the local level, noise levels can have a much greater impact on society.

There is a trend towards a shift from direct to indirect environmental impacts. For example, the absolute level of emissions of pollutants into the atmosphere has dropped significantly in developed countries. The problem of reducing sources of pollution from transport was solved as it was a direct cause of emissions. An attempt to reduce the economic costs of ecology will lead to a decrease or to a deterioration in the social and ecological channels of human life. Today, society is less willing to bear costs and endure the effects of external factors for various reasons: awareness, quality of life, high health care costs, etc.

Air pollution is the most important source of environmental factors of transport due to the rapid and all-round spread of pollutants. While the nature of air pollutants is well defined, the magnitude of their impact on the biosphere is a matter of controversy. On the positive side, emissions of the most harmful air pollutants such as carbon monoxide and volatile organic compounds (VOCs) have declined despite significant increases in the number of vehicles, indicating an increase in vehicle environmental compliance. Carbon dioxide emissions have increased in proportion to the increase in transport use.

There are two main groups of factors that contribute to air pollution in urban areas:

structural factors — the level of the economy. Income and education are generally proportional to emissions;

behavioral factors — individual consumption and transport preferences. The car is systematically preferred even when other modes of transport are available.

In general terms, the costs of air pollution associated with transport can be grouped into economic, social and environmental costs.

External factors associated with water pollution are almost all indirect.

Noise emissions can be thought of as point (vehicle), linear (highway), and surface (multi-street) sources. The source is vibration. Noise can create unreasonable risks to human health, safety and property. The best vehicles can have positive economic, social and environmental impacts.

Earlier in Israel, there were often major accidents at level crossings. A decision was made: to make all intersections of road and railways multi-level. In 3-4 years, 20 new interchanges were built and the problem was resolved. All traffic infrastructure facilities meet strict standards — traffic is organized according to scientific calculations, and pedestrian crossings are specially equipped for increased safety.

There are proven mechanisms by which you can reach statistics of the EU countries in road traffic — no more than 3 fatal road traffic victims per 100,000 of population:

1 — the availability of the political will of the government,

2 — the course for the reform of the road traffic system should be stably held for a long time, subject to its funding;

3 — a necessary interdepartmental coordinating body that will be responsible for road safety and introduce new mechanisms.

8.3.1. Sustainable financing

In May 2018, the Commission of the Foundation for the Connection of Europe (CFE) presented a package of measures to create a unified European classification system for sustainable economic activities («taxonomy»). The ultimate goal is to develop a system that provides clarity on what activities are considered environmentally sustainable. A Taxonomy Working Group (WGT) was established to recommend technical criteria for assessing the economic sustainability of activities that may be included in this taxonomy.

In the first phase, WGT for Transport worked on the segments of the transport sector that have the highest share of total CO_2 emissions — land transport. An open consultation was held to receive comments on activities that contribute significantly to climate change mitigation.

In June 2018, the European Commission presented an EU action plan to improve the safety of passengers and railway personnel in the EU by creating new agreements for cooperation and coordination. The goal is to increase the effectiveness of measures to prevent and respond to possible terrorist attacks by creating an effective environment for cooperation.

Transport authorities and transport operators in the EU have long been tackling safety risks, but the new environment is forcing them to develop adequate responses. However, measures taken unilaterally by individual Member States can create barriers, be ineffective and lead to cost losses. In this regard, the Action Plan foresees the creation of an EU Platform for Rail Safety. EU road safety statistics show a reduction in fatalities of about 2%.

The mobility package aims to implement a new industrial policy strategy adopted in September 2017 and completes a process that was launched under the 2016 Low Emission Mobility Strategy and previous European mobility packages. For example, the Connecting Europe Fund (CFE) has supported over 690 transport projects with EU funding of € 23 billion, which equates to a combined EU transport infrastructure investment of € 48.3 billion. All of these initiatives form a coherent set of strategies that cover multiple interrelated aspects of the transport system [23].

As part of the Decade of Action for Road Safety, ESCAP is working towards the global goal of stabilizing and reducing predicted road traffic deaths. The overall goal is a 50% reduction in road traffic deaths and serious injuries in Asia and the Pacific. ESCAP is conducting research on the two main causes of road accidents: (a) speeding and (b) driving under the influence of alcohol and drugs, with the aim of developing appropriate recommendations for member countries. In this regard, in April 2019 in New Delhi, and in October 2019 in Baku, Regional Workshops were held. Subsequently, ESCAP organized a similar Workshop for the North and Central Asia subregion. At these meetings, the conceptual framework of statistical geospatial indicators and indices of SPECA countries for monitoring and reporting on progress towards the implementation of the Sustainable Development Goals (SDGs) was discussed.

The proposed framework and indicators helped policymakers and experts from SPECA countries to develop more effective strategies and measures to reduce disaster risks and prevent or mitigate human, economic and environmental losses.

The proposed measures contributed to improving the statistical accuracy of the already established SDG indicators of the Asia-Pacific Plan of Action for Sustainable Development 2018-2030, the development of the ESCAP Regional Roadmap for the SDGs and the UN global system (programs such as the UN Global Statistical Geospatial Framework).

8.4. The concept of an automated system for accounting and analysis of accidents

The main task of accounting and analysis of accidents remains the full and effective use of information obtained during the investigation in order to prevent further accidents on the same or the same type of equipment.

Accident investigation is a step-by-step solution of a sequence of tasks:

1. Collecting factual information about the event and operational actions of the personnel, visual inspection of the place and object of the accident.
2. Study of the technological and technical characteristics of the accident object.
3. Analysis of the history of the facility (similar accidents, maintenance and repairs carried out).

4. A clear definition of the object, additional research as needed (if additional research refutes the hypothesis, a new one is put forward, the reliability of which is tested).

5. Determination of the causes of the accident, accompanied by technical factors, the culprits (development of a confirmed working hypothesis).

6. Development of emergency response measures.

7. Monitoring the implementation of emergency measures.

The use of modern developments in the field of artificial intelligence is promising. Existing solutions have already found application in medicine, geology, etc.

An enlarged diagram of the proposed system is shown in Fig. 8.7.

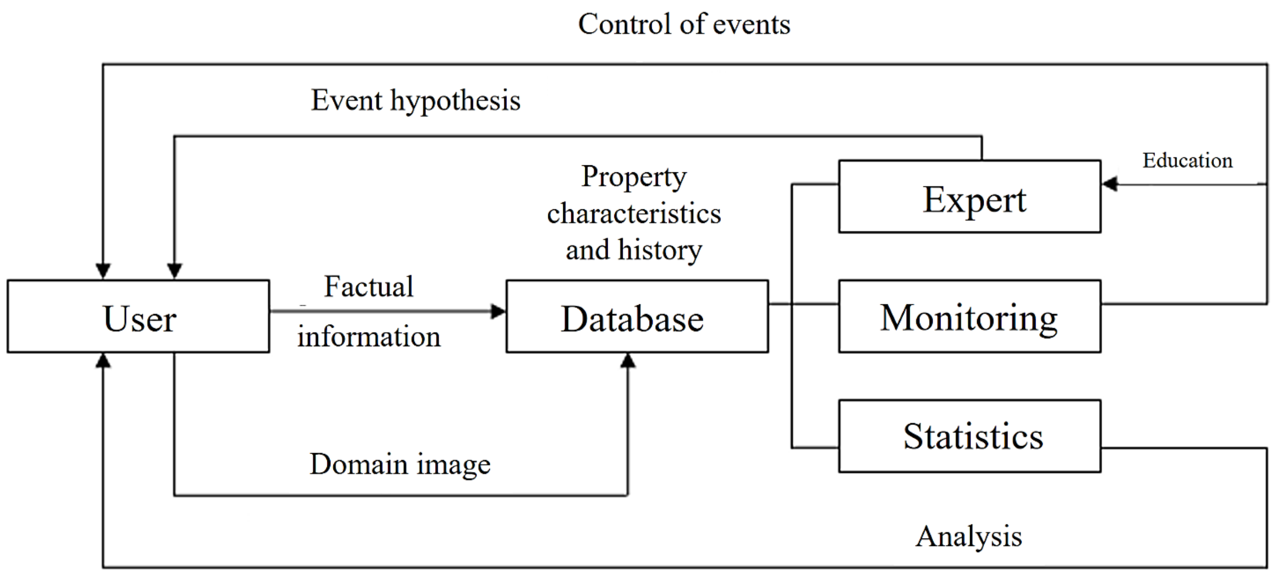


Figure 8.7. Accident accounting and analysis system

8.4.1. General methodology for conducting an examination of the state of traffic safety and making managerial decisions

The method of expert systems / assessments is a method of predicting and evaluating future results of actions based on the forecasts of competent specialists. When applying the method of expert assessments, a survey of a special group of experts (5-7 people) is carried out in order to determine certain variables necessary to assess the issue under study. The main methods of conducting expert assessments: individual, interviewing, analytical method, Delphi method, brainstorming method, conference of ideas.

It is advisable to use this methodology when the following factors complicate making the best decision:

- there is an impossibility of accurately predicting the consequences of the decision;
- absence or incompleteness of statistical information on the basis of which a decision is made;
- the presence of factors that cannot be controlled by the decision-maker;
- the presence of several options for solving the problem and the need to choose one of them;

– the uniqueness and impossibility of experimental verification of the predicted course of events and the results of the processes of solving the problem.

The competence of experts is carried out using one of two methods of assessing the competence of experts: objective and subjective ones. The essence of the individual method lies in the fact that each expert gives his/her own assessment independently of the others, and then these assessments are combined using statistical methods into a common one. To form the final assessment of a group of experts, the average values are most often used — the arithmetic mean or the median, for which such an assessment is taken, in relation to which the number of large assessments is equal to the number of smaller ones.

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