

## TRANSPORT SYSTEM INTEGRATION - A CHALLENGE OF OUR TIMES

**Ryszard Krystek**

*Gdańsk University of Technology  
Department of Civil and Environmental Engineering  
Narutowicza Street 11/12, 80-952 Gdansk, Poland  
tel.: +48 58 3471147, fax: +48 58 3471250  
e-mail: rkrystek@pg.gda.pl*

**Lech Michalski**

*Gdańsk University of Technology  
Department of Civil and Environmental Engineering  
Narutowicza Street 11/12, 80-952 Gdańsk, Poland  
tel.: +48 58 3471147, fax: +48 58 3471250  
e-mail: michal@pg.gda.pl*

**Joanna Żukowska**

*Gdańsk University of Technology  
Department of Civil and Environmental Engineering  
Narutowicza Street 11/12, 80-952 Gdańsk, Poland  
tel.: +48 58 3486133, fax: +48 58 3471250  
e-mail: joanna@pg.gda.pl*

### **Abstract**

*Each day more than 3,000 people are killed in the transport system worldwide, most of whom are victims of road accidents. Poland, just like the other EU countries, experiences a disproportion between the number of road accidents and other transport accidents. Each mode has a different safety management system with different databases, transport infrastructure authorities and accident investigation bodies, systems for tracking the movement of vehicles, trains and ships. Although significantly dissimilar, transport modes and their safety management systems can be improved through integration and the use of good national and international practice in the entire transport sector. This is in line with the European Union's policy, which in its 2001 White Paper encouraged member states to undertake work on a European methodology of independent transport safety investigation. ZEUS Project with its aim to build a structure of integrated transport safety system in Poland is an example of the work. International experience shows that an independent investigation agency working across all modes of transportation can most effectively improve safety. An intermodal agency provides economy of operation, transfer of safety lessons between different modes of transportation, the advancement of new and innovative investigation techniques and the ability to focus on key issues of concern in all modes. It is therefore suggested that serious consideration be given to a unified independent agency wherever it is feasible.*

**Keywords:** *transport, transport safety, integration, accidents investigation, independent investigations*

### **1. Introduction**

Demand for transport is one of the basis of man's social and economic activity. Each expected need for moving people, shipments and information carries a specific economic, social and integrating significance. How big the needs are depends on the sources of traffic with their varying place in space, volumes, time and impacts. The needs are addressed to the entire transport system

or its component parts: the modes, systems and forms of transport. While the costs and side effects of their operation differ, when combined all these parts establish the safety conditions of transport as a whole. The ability to influence the causes of transport needs and how they are met is and in many cases should be the basic planning tool for reducing transport risks.

From the standpoint of risk management and use of preventive and corrective measures, each of the modes' safety systems has its strengths that the entire transport system should incorporate and weaknesses that can be mitigated or eliminated using the experience of the other modes. Despite the numerous dissimilarities in how the transport modes operate, there is a strong potential for improving these systems through integration and use of common experience and improving transport safety, especially [7].

Today's efforts to improve the quality of transport infrastructure are designed to pursue the policy of sustainable development. What this means for transport is building an efficient, safe and economically viable system creating new jobs without distorting the balance in the environment and culture, respecting non-renewable resources and acceptable standards. The efficiency of transport systems has become a key factor of quality of life. Sadly, there are vast differences across the world today. For example Western Europe, United States or Australia have made great progress. Over the last 30 years they have undertaken systemic measures that have produced a permanent downward trend in accidents and casualties. But there are countries, which have not coped with the problem of rising transport demands and their citizens are paying a high price for mobility.

## 2. Transport safety

Transport accidents are a serious economic problem and a component of total social costs of transport, especially if the external costs are included (air pollution, noise, accident costs, loss of space). In general the external costs of transport are those costs paid by the public, which do not stem from the materials losses caused by the accident. These are the costs incurred by administration, justice, health and social insurance system, and loss caused by reduced production and consumption.

Attempts to assess the external costs come across a number of difficulties. This is because of the variety of study methods used, the current understanding, database quality or public awareness. But even the roughest calculations made for EU countries in the early 1990s identified the very high external costs of motor transport, especially for passenger transport. Almost half of the costs are made up by the external costs of car accidents [2].

The annual number of fatalities in the enlarged EU is about 50.000. Poland's contribution with about 5.500 people is sadly quite significant. The losses caused by accidents in Poland represent more than 2.0% of the GDP. These figures only confirm that there is a serious social and economic problem and fully justify the need for transport safety improvement [11]. Compared with the other modes, the figures in road transport are the most alarming. Each year 97% of all transport fatalities are victims of road accidents. Road accidents in the EU cost more than congestion, pollution, heart conditions and cancer. Their costs represent 93% of the costs of all transport accidents. The indicators of killed per 100 million person - kilometres or person-hours (Tab. 1) clearly show that water, air and rail transport only represent a small fraction, unlike road transport with the highest risk involved in using motorcycles [4].

## 3. Integration of transport safety worldwide

The United States. In 1966 president Lyndon Johnson said: „America today lacks a coordinated transportation system that permits travellers and goods to move conveniently and efficiently from one means of transportation to another, using the best characteristics of each”. Subsequently he created National Transport Safety Board (NTSB). In 2007 NTSB celebrated 40<sup>th</sup> anniversary. Its experience clearly shows that the most effective and efficient way to improve

transportation safety is to have one independent agency responsible for investigating transportation accidents and studying transportation safety problems in all modes of transportation including aviation, marine, highway, rail and pipeline. This allows for the sharing of safety information, accident investigation techniques, and the more efficient use of technical experts. The US President and the Congress appoint chairmen of NTSB. The procedure guarantees the total independence of the body from the governmental administration [10].

Tab. 1. Fatalities per 100 mln person - km and person - hours [4]

	Fatalities per 100 mln person - hours	Fatalities per 100 mln person - km
Roads	28	0.95
including: motorcycle/moped	440	13.8
on foot	75	6.4
bicycle	25	5.4
car	25	0.7
bus	2	0.07
Ferry	16	0.25
Civil aviation	8	0.035
Rail	2	0.035

The benefits of an independent agency are made plain every time NTSB issues its findings or recommends changes to improve transportation safety. And, as transportation becomes more and more an international industry, autonomous, objective and professional investigations become even more important, not just for the United States, but for countries all over the world. When accidents happen in the transportation system, the companies involved as well as the travelling public must be assured that the findings of any investigation are not influenced by outside pressures. This autonomy lends credibility to the investigation in the eyes of the public and the policymakers who must act to correct deficiencies revealed by the investigation. Without support from the public, including the news media, the changes necessary to improve safety are often difficult if not impossible to achieve [9]. NTSB has issued about 12 thousand of recommendations in the period of the last 40 years, which is a clear evidence of the great influence the research has on the transport quality and safety.

Other countries have realized the benefits of this system and have established their versions of NTSB-like agencies. Australia, Canada, Sweden, Norway, Finland, New Zealand and the Netherlands are the countries that have set up such independent, multimodal organizations. Aviation and marine are the modes most often selected by governments for independent accident investigation. However, because of the large number of fatalities and injuries, the biggest payoff can come from investigations in the highway mode and in the rail area. That fact should not be overlooked when plans are made for the establishment of a multimodal accident investigation agency [9].

The Netherlands. The NTSB provided assistance to a number of countries as they worked to establish independent, multimodal accident investigation agencies. Most countries' attempts were met with resistance from those working in the various agencies and departments that would be brought together, requiring difficult negotiations and many years of delay. Accidents in each mode were looked at from different perspectives and in some instances different regulatory schemes were in place. In the mid 1980s Pieter van Vollenhoven (today President of Dutch Safety Board) first came to the NTSB to discuss his vision for a Dutch Transport Safety Board. It wasn't until 1992, that his vision became reality. Today the Netherlands has one of the best transport safety records and has even superseded the United States in its integration efforts to improve the safety of

the public, a country they modelled themselves on. In 2005 the Dutch Safety Board was established by the Parliament with responsibility for not just transport safety but also for all aspect of human life, ranging from health to risks in industry or construction disasters. The Board investigates all cases where people's lives are at risk.

Sweden. Sweden is another example of a country aiming to integrate the systems of transport safety. In 2007 the Swedish Parliament received a proposal to combine the existing transport inspectorates - the Civil Aviation Authority, the Rail Agency, the Maritime Safety Inspectorate and the Road Traffic Inspectorate - into one Traffic Inspectorate. The Swedes have found that an inspectorate covering the whole transportation sector surely would strengthen the development of the safety work, especially in the road traffic sector. The exchange of information and experiences between the four sectors would be easier and the development of working and investigation methods would be more efficient. In April 2008 Swedish government decided to establish this new inspectorate. Thereby Sweden has taken an important step forward to maintaining a leading role in transportation safety in Europe.

One important task for the new inspectorate in Sweden is to push forward the development of a common safety culture in the whole transportation sector. In civil aviation, safety is a prerequisite for the use of the system and every measure to increase capacity or to shorten travelling time is made under strong safety regulations. In the road traffic sector safety is too often regarded only as a restriction on capacity and travelling time. The frequent use of cost-benefit calculations makes safety to a factor with a price like any of the other traffic policy objectives. It must be noted, that the Swedish decision on Vision Zero, covers all transport modes. Thus the basis for safety work among the system designers and the service providers must be the same, independent of transport mode [1].

The European Union Approach. The EU's 2001 White Paper „*European Transport Policy for 2010: time to decide*” expressed a need for independent safety investigation of transport accidents. Next in June 2003 the European Union established the Group of Experts to advise the Commission on a strategy for dealing with accidents in the transport sector (EC/425/2003). Its main task is to create uniform procedures across all EU member states for investigating accidents in all modes as a basis for a pan-European system. It is in line with the main goal of EU transport policy „To decrease the number of fatalities by 50% during the 2001-2010 decade”. Today in the second half of the decade it is known that the goal will be achieved only by three of the European countries: France, Luxemburg and Portugal. Nevertheless the remaining countries still do their best to reduce the divergence between the plan and the actual results (Fig. 1). One of them is Poland with its National Road Safety Programme GAMBIT 2005 and its aim to reduce the number of fatalities by 50% [5]. The stake is very high. Each year the EU loses over 200 milliard of Euro - that is more than the annual Commission's budget.

The Commission reminds that independent investigations should make it possible to improve the current legislation and practices. They should be carried out at national level on the basis of a European methodology and their findings should be communicated for assessment by a group of experts meeting within the Commission. These investigations, relating to a limited number of accidents will supplement the general road accident statistics and the detailed accident case studies carried out by multidisciplinary teams [3].

The suggestions of the European Commission have been incorporated in the SafetyNet project (2004-2008) with one of its Work Packages designed to develop recommendations for transparent and independent accident investigation activities in all Member States according to a common European investigation methodology. These activities would be referred to as the European safety oriented road accident investigation programme. A safety oriented road accident investigation aims to identify accident causes and contributing factors; injuries, injury mechanisms and injury

outcomes; and how the accident and injuries could have been prevented [8].

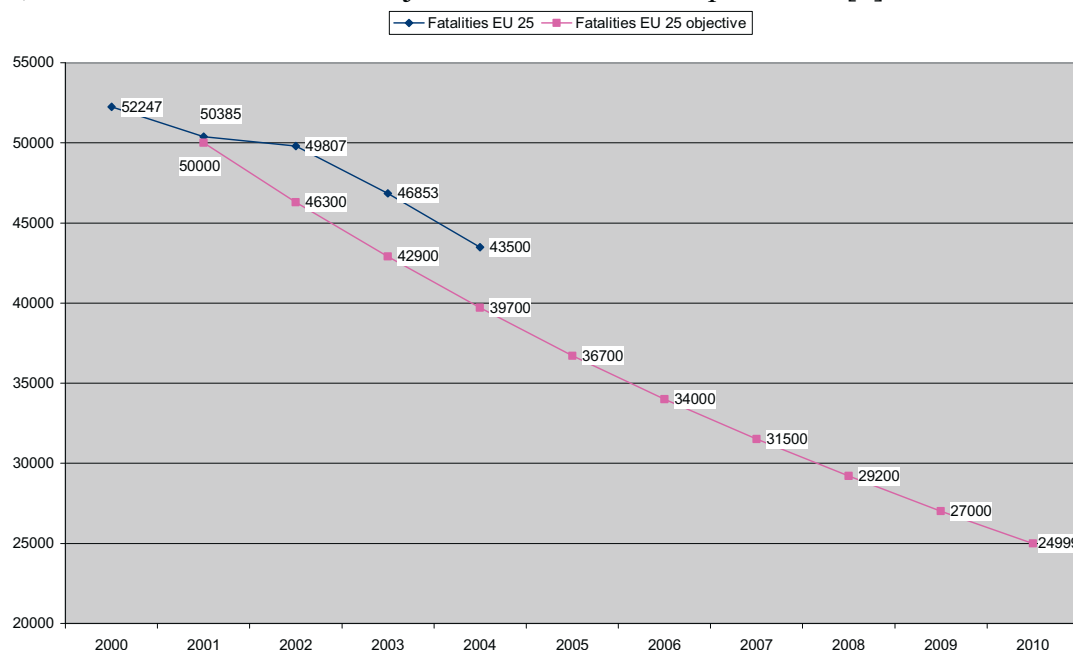


Fig. 1. The actual number of fatalities in EU-25 compared with the EU goal [8]

#### 4. ZEUS project and expected outcomes

In 2005, as a result of many transport safety experts' efforts, the subject matter of transport safety was introduced into a long-term Framework Programme of Research in Poland, approved by the Polish Government. Thereby, safety transport was put in an important position on the list of Polish research priorities. It is among nine most important areas such as: microbiology, nanotechnology, ecology, etc.

On 10 May 2007 the Polish Minister of Science appointed Gdańsk University of Technology the main contractor of a research project entitled: „Integrated System of Transport Safety - ZEUS”. The main objective of the project is to build a model of an integrated system of transport safety. It will be based on foreign good practices as well as Polish experiences. Poland aims to be among the several countries worldwide, which have built and are operating integrated systems of transport safety and thereby contribute to the European system of transport safety.

To carry out this project a Consortium, which represents 4 branches of transport was established. The members of the Consortium are the Gdansk University of Technology (road transport) - Prof. R. Krystek - the project leader, Silesian University of Technology (rail transport) - Prof. M. Sitarz, Air Force Institute of Technology (air transport) - Prof. J. Żurek and Maritime Academy of Szczecin (water transport) - Prof. S. Gućma.

The Project consists of 4 modules:

Module 1. Develop methods to study the differences and interrelations between the systems of road, rail, air and water transport safety in Poland and Europe, including urban and regional transport.

Module 2. Develop proposals for integrating the safety systems of Poland's transport modes.

Module 3. Develop models and carry out simulation tests of the integrated system of transport safety management, including human and technology factors and the environment.

Module 4. Develop a national system of monitoring and organisational and medical prevention to take account of the human factor in the area of transport safety.

Module 5. Develop - using IT and telecommunications - the structure of an organisational model of a national transport safety management centre to include all types of transport,

including crisis management.

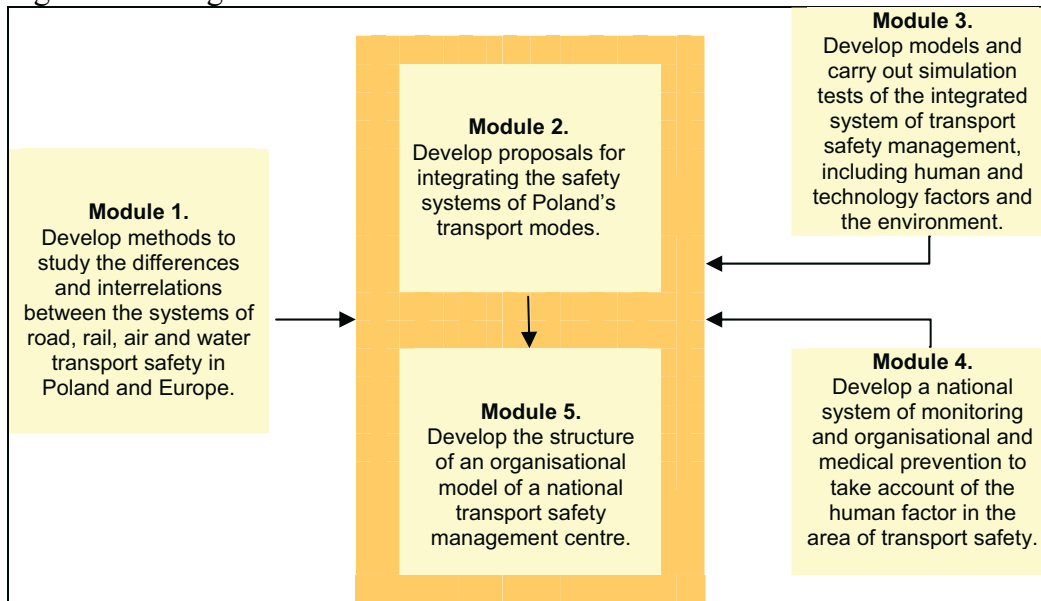


Fig. 2. The structure of the development of the Integrated Transport Safety System project

The main objective of the project is to build a model of an integrated system of transport safety that can be used by policymakers as a tool to make decisions to build and develop infrastructure and means of transport and by specialists implementing the decisions. Today's transport is a complex activity and one that requires politicians, policymakers and specialists to integrate goals, strategies and resources to ensure that transport safety needs are met. The success of a transport policy depends on how well it has defined its vision, main goal, objectives and safety performance indicators. If Poland is to integrate its transport safety system it must combine the component parts of the system's structure, i.e. the functional, informational, organisational, legal, technical, spatial and human resource factors. Models must be built and the integrated safety system must be tested to ensure that all the human, environmental and technical aspects have been included.

The integrated system of transport safety will prevent undesired incidents and risks, and when they happen, it will reduce the effects. Transport risk can be prevented from happening by identifying threats, minimising them and ensuring an efficient emergency system. The project will identify how different transport management systems should be integrated at the central, regional and local level. The ultimate target is to develop a transport safety strategy to feed into work on new legislation, which would define the structure and operation of a crisis management system.

The first phase of the Project has helped the Consortium to formulate the following conclusions, which will guide the project team in their further work [6]:

- The system of national transport safety boards in all European Union member states must be harmonised; as a result, there should be a gradual integration of the national commissions responsible for different modes to form a single body.
- In Poland the first step could be to combine the State Air Accident Investigation Commission with the State Rail Accident Investigation Commission.
- Europe should follow the Dutch model - the Dutch Safety Board - the official partner of ZEUS - for changing the structure of transport safety investigation bodies.

## 5. Conclusion

International experience shows that an independent investigation agency working across all modes of transportation can most effectively improve safety. An intermodal agency provides economy of operation, transfer of safety lessons between different modes of transportation, the

advancement of new and innovative investigation techniques and the ability to focus on key issues of concern in all modes. It is therefore suggested that serious consideration be given to a unified independent agency wherever it is feasible. Based on the NTSB's 40 years of experience, one of the best and most efficient ways to improve transportation safety is through the lessons learned from independent accident investigations and safety research. The organization responsible for these investigations should ideally be completely independent from other governmental and judicial organizations and should be responsible for investigation in all modes of transportation.

Poland needs a uniform system of transport safety management. Uniform means harmonised laws and traffic control procedures and consistent accident investigation methods when a transport disaster occurs. This is in line with the EU policy as well as with the final recommendations of the SafetyNet project supporting efforts to build an integrated system of transport safety in Poland.

## References

- [1] Bergfalk, L., *Swedish Road Transport Inspectorate*, SafetyNet Workshop, www.erso.eu, Brussels 2007.
- [2] *Socio - economic cost of road accidents*, COST 313, Cost Transport Publications, Brussels 1993.
- [3] *Transport Policy - time to decide*, EC, Bussesl 2001.
- [4] *Transport Safety Performance in the EU. A statistical Overview*, ETSC, ETSC, European Transport Safety Council 2003.
- [5] *National Road Safety Programme*, National Road Safety Council, GAMBIT 2005, Warsaw 2005.
- [6] Krystek, R., Gucma, S., Sitarz, M., Żurek, J., *Integrated System of Transport Safety*, The 5<sup>th</sup> International Conference on safety and Reliability, ITWL, Wroclaw 2008.
- [7] Michalski, L., *Differences and mutual connections of the transport safety systems*, The 5<sup>th</sup> International Conference on safety and Reliability, ITWL, Wroclaw 2008.
- [8] *European Road Safety Observatory*, SafetyNet, SafetyNet Project, www.erso.eu
- [9] Sweedler, B., *Improving Transportation Safety - The Integrated Multimodal Approach*, Integrated System of Transport Safety Workshop, Pultusk 2007.
- [10] Vollenhoven van, P., *Independent accident investigation. Every citizen's right, society's duty*, 3<sup>rd</sup> European Transport Safety Lecture, European Transport Safety Council, Brussels 2001.
- [11] Żukowska, J., Krystek, R., Popiel, J., *Badania losów osób poszkodowanych w wypadkach drogowych w Polsce*, Międzynarodowe Seminarium Bezpieczeństwa Ruchu Drogowego GAMBIT 2008. Politechnika Gdańska 2008.

