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INFLUENCE OF SOCIETY CHANGES ON THE MODEL OF HAZARDOUS GOODS ROAD TRANSPORTATION

ABSTRACT

The transportation of hazardous goods represents an economic activity whose consequences can have serious impact on the safety of transportation, the environment and human health. With the aim of reviewing the elements that affect the activity, this article presents a model for the transportation of hazardous goods of which, generally, there are two forms: the theoretical model for the transportation of hazardous goods, which represents the goal for the establishment of relations on the transportation of hazardous goods services market; and the real model for the transportation of hazardous goods, which represents an adaptation of the theoretical model to the status in a specific localised region. The research, which was conducted as part of the principal author's Ph.D. thesis, illustrates the exceptional influence of the society changes within a specific country. The theoretical model for the road transportation of hazardous goods is transposed into the real transportation services environment in Slovenia and it presents its transition and incorporation into the common EU transportation service market.

KEYWORDS

transportation policy, model of the road transportation of hazardous goods

1. INTRODUCTION

The transportation of hazardous goods is an important part of the road transportation subsystem. Because of its complexity and potential hazards that can have a serious impact on people and the environment, it is regulated by a series of acts that cover both technical and environmental aspects. An appropriate legal definition of such transportation is the only acceptable and sufficiently successful precondition for achieving the ultimate goal, namely, ensuring road safety. In addition to the existing legal system that regulates the road transportation of hazardous goods, it is necessary to successfully and effectively translate these requirements into the real transportation environment in order to ensure a suitable level of road safety. In this respect, we must place emphasis on familiarity with and implementation of safety requirements at all levels of organising and implementing the road transportation of hazardous goods.

Its interdisciplinary nature and infiltration of the reproductive chain of several economic sectors means that the transportation industry is sensitive to society changes. The latter exert a strong influence on the manner of its development. Because of this, the discussion of such a subject as complex as the road transportation of hazardous goods during a period of significant social changes in a country represents a field of research that can offer new insight based on real experience. The research was conducted for the requirements of the author's Ph.D. thesis.

The problem of research: Road transportation of hazardous goods is characterised by wide numbers of different fields which are reflected in many professional and scientific areas. In general, the most important impact is determined by the global, European and national legislation. Local national characteristics of economic sectors (current organisation of road transport of hazardous goods), existing transportation technology and other local aspect are also important. Because of the great impact of road transport of hazardous goods into the transportation infrastructure, traffic and transportation safety and security and into the possibility to restore sustainable transportation system it is important to determine all system elements, elements characteristic and inter elements connections to recognize the most important characteristics of the system of road transportation of hazardous goods. Problem of the research was to determine and to recognize all mentioned system characteristics with

the aim to be possible to assure sustainable development of road transportation system.

Based on represented problem of *the research scientific hypothesis* was determined as followed: *The level of the social environment changes and the development of transportation infrastructure and suprastrukture as a whole have a crucial impact on the model of road transportation model of hazardous goods and its dynamics of change in technological and organisational terms.*

The purpose of research was to recognize and determine the essential correlation between the elements of the model of the transportation of hazardous goods, and to recognize the impact of the social environment on transition the theoretical model of the transportation of hazardous goods into a real environment.

The objective of research was to gain, on the basis of past experience, sufficient knowledge to ensure the safety of the road transportation of hazardous goods and to assure sustainable development of road transportation system.

2. METHODOLOGY

The theoretical model of road transportation of hazardous goods was established based on detailed legislation analyses, knowledge of the causes and consequences of certain real events[1], and the consequent adoption of appropriate legal regulations in the field of road transportation of hazardous goods. The detailed analysis covers a period from the collapse of the Socialist Federal Republic of Yugoslavia, through Slovenia's independence in 1991, up to her accession to the European Union in 2004. This period underwent changes that had a significant impact on road transportation and, consequently, on the transportation of hazardous goods.

The established theoretical model of the road transportation of hazardous goods was applied into the real environment in the specific case of the regulation of the road transportation of hazardous goods in Republic of Slovenia. Based on such approach the specific actions and measures are possible for advance development of the road transportation system of hazardous goods in Republic of Slovenia.

3. THE EFFECT OF SOCIAL CHANGE ON THE DEVELOPMENT OF THE TRANSPORTATION OF HAZARDOUS GOODS

3.1 Traffic safety and road transportation of hazardous goods

The overview and analyses of the road safety status vis-à-vis the transportation of hazardous goods represents importance of this area and its impact into the possibility to assure sustainable transportation system.

The average annual transportation of hazardous goods amounted to 100 trillion ton-km for EU member states between 1994 and 2006, and 620 million ton-km for Slovenia in 2005 (of this, almost 427 million ton-km from ADR group 3). On the roads of Republic of Slovenia, during the same period there was an average of 37 road traffic accidents happened per year where vehicles transporting hazardous goods (*Figure 1*) were involved. Important decrease of the annual number of road traffic accident with hazardous goods vehicles was shown in the year 2000 when validity of the new national legislation started. In the period of 1992 to 2006 annual average volume of spill hazard-

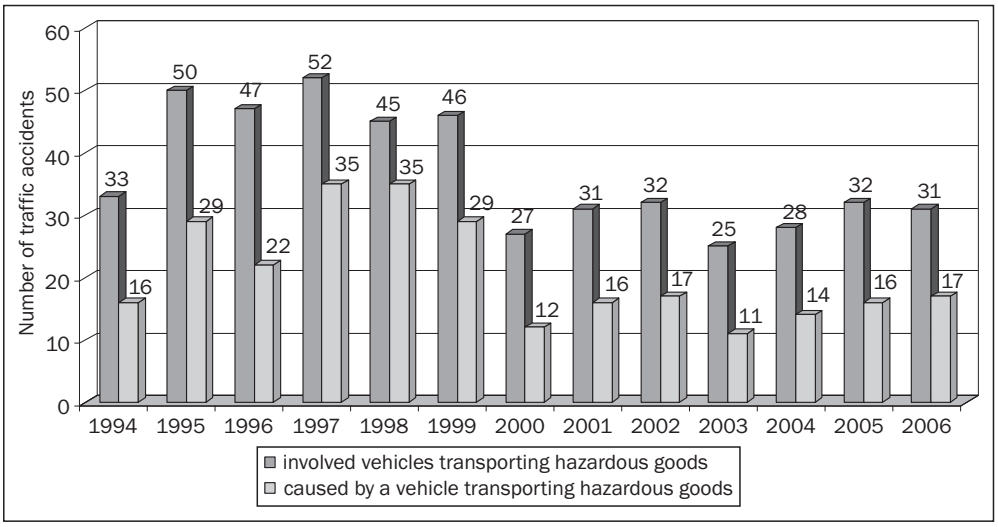

Figure 1 - Number of road traffic accidents where vehicles transporting hazardous goods were involved between 1994 and 2006 in the Republic of Slovenia

Source: Ministry of Internal Affairs

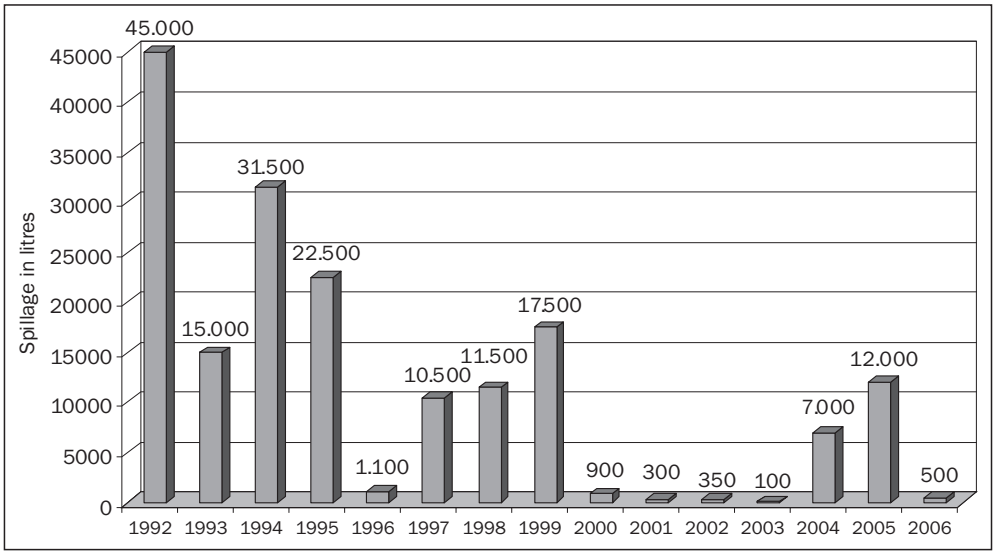

Figure 2 - Volumes of hazardous goods spills in road traffic accidents in which vehicles transporting hazardous goods were involved between 1994 and 2006 in the Republic of Slovenia

Source: Ministry of Internal Affairs

ous goods (*Figure 2*) was 228 litres per traffic accident where vehicles transporting hazardous goods were involved. The same characteristic was 378 litres per traffic accident before the year 2000 and 100 litres per accident after the year 2000 (decrease of 73%).

3.2 Traffic system development in SFRY

Following the World War II, the Socialist Federal Republic of Yugoslavia (SFRY), as a newly formed country, differed from the Kingdom of the Serbs, Croats and Slovenes, its forerunner, in several social, political and economic aspects, as well as in the development policies of the restructured state under the new political situation of the time [2]. It was known around the world for its unique political system based on socialist values and the role played by the communist party in the political leadership of the country. It was also known for its planned economy, under which the levers of market economy were unable to operate. Such characteristics had a determining influence on the adoption of strategic guidelines in the development of transportation systems.

Characteristically, the mechanisms subject to market economy did not function under the planned economy; rather, the economy was directed by the state through a series of plans based on political decisions and was not subject to economic rules. Planned economies did not have a transportation services market or a free choice of transporters [1]. In such an environment, there was no need for a special transportation policy and, consequently, the matter was not subject to much discussion. Furthermore, because the field was regulated by mid-term plans as part of general social and economic policy, the concept of transportation policy had been non-existent in Yugoslavia until 1975. This meant that, in practice, the transportation system developed elementally and was subject to the conditions of the economic management of individual sectors. In 1978, the Social Agreement on the Transportation Policy of Yugoslavia intended to elevate transport and communications to the same level as the rest of the economy, was adopted. The policy was also intended for ensuring equal working conditions for all the transportation sectors.

The Social Agreement on the Transportation Policy of Yugoslavia was a political compromise of sorts among the constituent republics and not entirely suitable to any of them (including Slovenia). This meant that the republics were not overly enthusiastic about implementing the policy [1].

The republics, as independent constituents of the Federation, had a degree of autonomy in regulating certain internal affairs, including the regulation and building of infrastructure that had direct influence on the development of transportation systems.

3.3 Traffic system development in the Republic of Slovenia

The regulation of transportation subsystems in Yugoslavia could not be said to have been enviable. This characteristic was inherited by the new state of Slovenia following the collapse of the Yugoslav federation. There was a continued lack of appropriate government papers and legislation for the regulation of the sector. During the period between her independence in 1991 and her entry into the EU in 2004, Slovenia failed to draft a suitable transportation policy paper for the development of transportation systems based

on the positive experience of her neighbours and the guidance of the professional community. The timeline in *Figure 3* shows the milestones in the development of the road transportation system for hazardous goods in Slovenia.

The Safety and Quality Assessment System (SQAS) is a uniform, internationally recognized system for the assessment of quality and environmentally friendly service providers, who supply the chemical industry in the first place. Within their commitment to the Responsible Care Programme, the major chemical plants as customers of these services are interested in safe transportation of chemicals to reach their buyers. Special means of transport are indispensable for such transportation, offered by specialized carriers only, so they were using their own evaluation systems. To be able to do that, they needed to employ specialists who were working with audits of suppliers on a permanent basis. That meant additional cost in the production.

For the providers of transport services, that procedure was very time-consuming and expensive, after all, the need to prove the quality level of their services to each customer separately and accordingly, ascertain their eligibility as a provider in the logistical chain of ADR transports.

In order to avoid the above indicated operating and cost-related difficulties, the European Chemistry Industry Council (CEFIC) developed a uniform system for the assessment of suppliers within the standard issues defined. All the elements involved in the transport of chemicals (dangerous substances) and providers thereof are checked in this way. In addition, a detailed insight into the Provider's capability to assure the required quality and implementation of logistics services (transportation of chemicals), safe for human health and environment, can be obtained. This in turn facilitates the chemical companies to select the Contractors for placing orders for logistics.

There can be no doubt that the social changes after 1991 influenced the drafting of a new transportation development strategy. The establishment of a market economy demanded a new approach to the development of the transportation sector.

The first step for the approximation of Slovenia to Europe was the signing of the transportation agreement with the European Community in 1993. The agreement regulated the free transit of goods and harmonised the development of transportation in Slovenia with that of the EU. More intensive activity only began after 1998, when the Ministry of Transport and Communications began preparation for the harmonisation of Slovene legislation with that of the EU. By then, further direction of Slovenia's political development and her position in Europe's integration process-

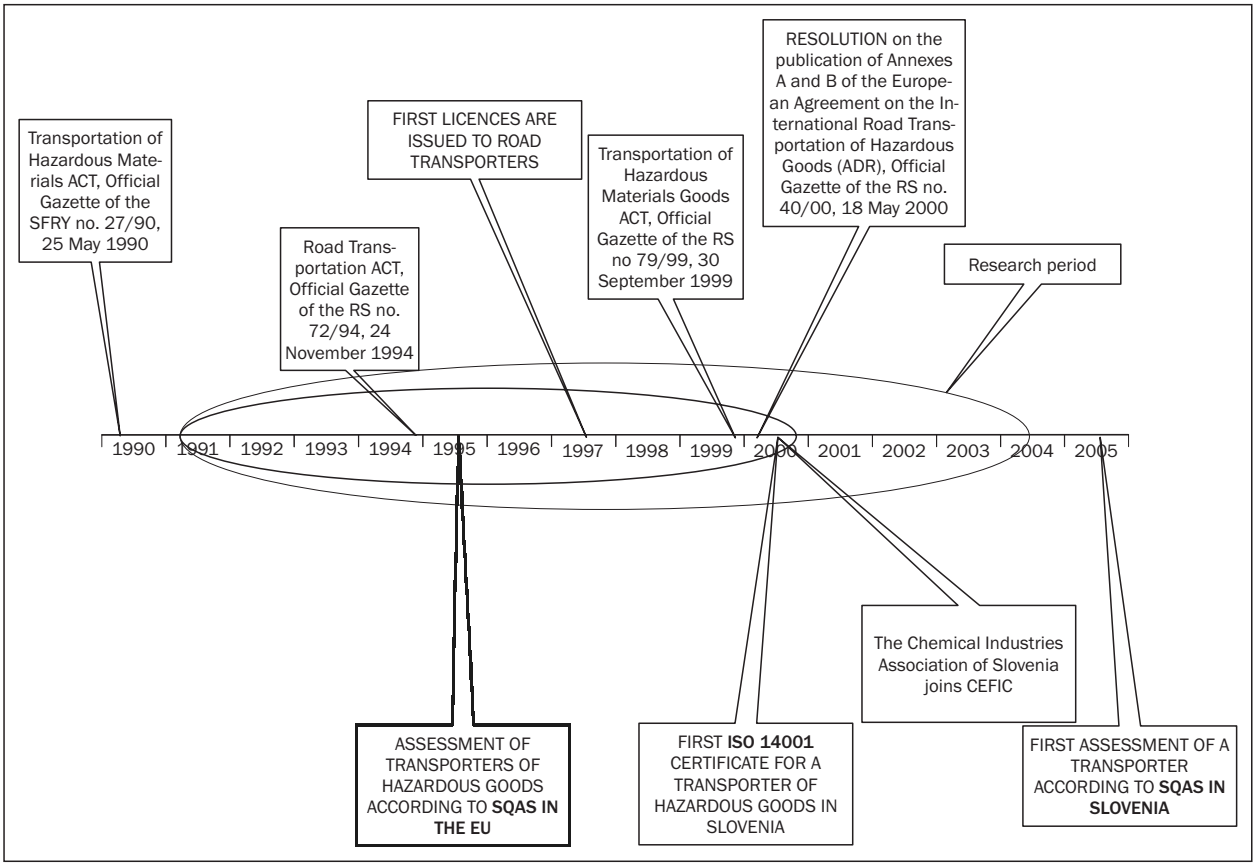

Figure 3 - Milestones in the development of road transportation system for hazardous goods in Slovenia between 1990 and 2005

es had been drawn. Following the establishment of the new authorities in independent Slovenia, the drafting of a transportation policy became and remained the homework of each respective transportation minister. The proposed Transportation Policy Resolution (Predictably into a Common Future) was only adopted by the government of the time in the second half of 2004, after Slovenia joined the EU.

Slovenia harmonised its legislation up to the level that allowed her to join the EU within the specified period. This is confirmed by the fact that it joined the EU as one of the most developed candidate countries. However, the fact remains that, between the time of independence in 1991 and the adoption of the guidelines after Slovenia joined the EU, there existed a vacuum, a lack of strategy that would, if there had been the political will, systematically regulate the entire field of transportation on a professional level. The main problems that characterised the field of road transportation at the time were:

- an 85% reduction in transportation works between 1990 – 1996 (this is also a consequence of inappropriate statistical data management at state level), whilst the number of transporters increased by 60% at the same time;
- increase in the number of first-time registrations of goods vehicles by a factor of 2.16;
- decline in the level of employment in the transportation sector and an increase in unemployment;
- inappropriate or delayed legal bases and inappropriate monitoring and sanction measures;
- lack of a common approach by transporters due to conflicting interests;
- inappropriate method of distributing international road transport permits;
- devaluation of transportation rates and disadvantaged position of the sector vis-à-vis other sectors of the economy;
- employment of pensioners as active transporters, and
- use of restricted types of fuel for the purpose of lowering costs.

Undoubtedly, the state's wanting measures with regard to regulating the sector are a result of objective reasons. The first steps taken by the new state were initially focused on solving other issues that probably weighed more heavily than the regulation of the road transportation sector. Sadly, the problem is not only limited to the delayed adoption of laws and by-laws, but to their slow implementation in practice. The latter requires a broader political will that would, with systematic supervision and sanctions against offenders, result in greater order.

It is a thankless task to attempt to guess how matters might have evolved had Slovenia not had the courage to decisively join the currents of European integration and had not been required to harmonise its legislation with that of the EU. However, it can be said without doubt that the preparatory period for accession to the EU was additional motivation, indeed, a requirement for the elimination of many a legal drawback.

The key developments, mistakes and dilemmas that occurred during the development of the road transportation system for hazardous goods in Slovenia have been considered in the establishment of an appropriate model.

4. MODELLING THE ROAD TRANSPORTATION OF HAZARDOUS GOODS

Road transportation of hazardous goods is a sensitive and demanding field, and its regulation requires a more thorough legislation than general road transportation. The field is not only regulated by the ADR Convention but also by broad national legislation covering different fields whose purpose it is to ensure that such transportation is as safe as possible. During the period under discussion, Slovenia lacked appropriate legislation for regulating road transportation in general. It can therefore be concluded that a more complex field was even more wanting. Because of its complexity and interdisciplinary nature, it would be expedient talk about an integrated process of road transportation of hazardous goods, which discusses the responsibilities and activities of the participants at all stages of transportation. The purpose of modelling the transportation of hazardous goods is to gain explicit and complete insight into the field, the procedures, and their structure and functions, in order to carry out such transportation in an optimal fashion, and in consideration of potential unfortunate events and their consequences.

Such an explicit review of the field reveals that there is not a single, unitary model for the transportation of hazardous goods but that, because of the influencing elements as presented below, there are in fact two models:

- the theoretical model for the transportation of hazardous goods, and
- the real model for the transportation of hazardous goods.

The real model is implemented in the real environment as a consequence of the theoretical model. Their interdependence and transition from one to the other is a matter of proper legal regulation and the general social characteristics of the country in which the model is being implemented. The transformation of the theoretical model into the real model is a complex social process that starts with the adoption of legislation and continues with its enactment in practice.

The process of implementation and improvement can expect to face opposition from individual parties with conflicting interests, and these affect the timeline and the implementation of the real model in practice.

4.1 Theoretical model for road transportation of hazardous goods

Over time, each guided process undergoes improvement and moves to a higher level. This can be seen as improved quality, lower operating costs, improved safety, etc. Scientific achievements and social changes contribute towards the improvement and formation of individual models which, in theory, have been perfected in every detail under the given circumstances. Road transportation of hazardous goods can be classified as such. Considering its complexity, and on the basis of safety and technological principles that guarantee the reliability of transporting hazardous goods and the safety of all participants, the establishment of a theoretical model for such transportation is wholly justified. Such a theoretical model is undergoing continual improvement with new innovations and scientific developments in the following fields:

- progress in the technical field,
- practical experience and business requirements, and
- general social changes and trends (globalisation, environmental awareness, safety, sustainable development).

In recent decades, the technical field has witnessed major advancements. Useful and applicable inventions have directly influenced the development of new technologies and have brought changes to practically all aspects of the industry. Road transportation has been enhanced with environmentally friendly engines and equipment that facilitates a simpler and quicker manipulation of cargo, enables more efficient exploitation of transportation resources, reduces the burdening of the environment, etc.

Practical experience provides positive or negative information about a specific innovation. It highlights the deficiencies observed in practice and guides the professionals to seek solutions for improving individual processes and technologies.

To cooperate with specific economic operators, certain requirements must first be met. In most cases, such requirements involve stricter conditions that are intended to improve the quality of services. In recent years, the development of human society has become increasingly important, and the tendency is to avoid the hazards resulting from mere quantitative and material development, the exhaustion of natural resources and pollution of the environment. So-called sustainable development is expected to meet the requirements of the current generation without threatening the future of generations to come. This is a rather comprehensive and broad orientation and touches on economic and social development as well as the protection of the environment.

Figure 4 shows the most important elements that influence the formation of the theoretical model for road transportation of hazardous goods. It is in urgent need of improvements that would ensure simultaneous application of innovations and the development of transportation of hazardous goods sector.

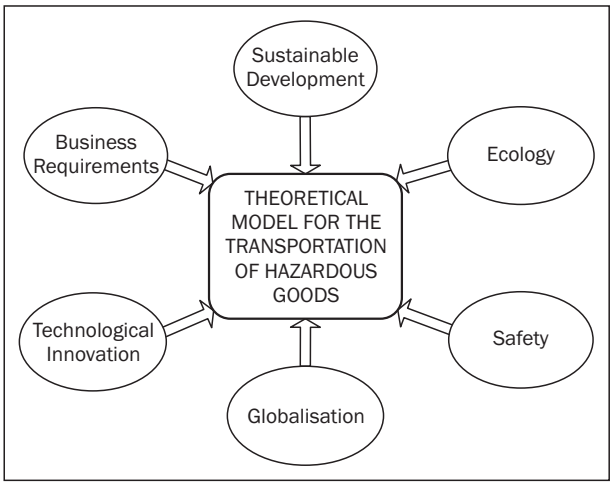

Figure 4 - Elements of the theoretical model for the transportation of hazardous goods

The theoretical model is not a model unto itself; rather, it forms the basis for the practical implementation of expertise. *Figure 5* illustrates the dependency between the development of the theoretical and real models. The degree of regulation of the theoretical model is shown by the line which illustrates the improvement and development. The trend is growing as new and improved legislation, as a result of the evolution of the social environment, guarantees more safety and care for the environment. The theoretical model for the transportation of hazardous goods is a goal for the real model, which developed in the real environment. The real model is approaching this goal and, indeed, could attain it; however, this is a hypothetical wish rather than a real possibility.

4.2 Real model for road transportation of hazardous goods

The legal regulation of a specific country is oriented towards transforming the theoretical model into the real model in a real environment. By adopting specific legislation, legislators express their will and interest vis-à-vis regulating individual areas. This notion is based on specific scientific and practical experience arising from the theoretical model and represents the desired final state that the legislator aims for.

Time-wise, the amendment of legislation regulating a certain field is based on the level of development of the theoretical model, and thus directly influences the improvement of the real model in practice. The complexity of the gears of state is the crucial factor that transforms the original, ideal model into the real model in a real environment.

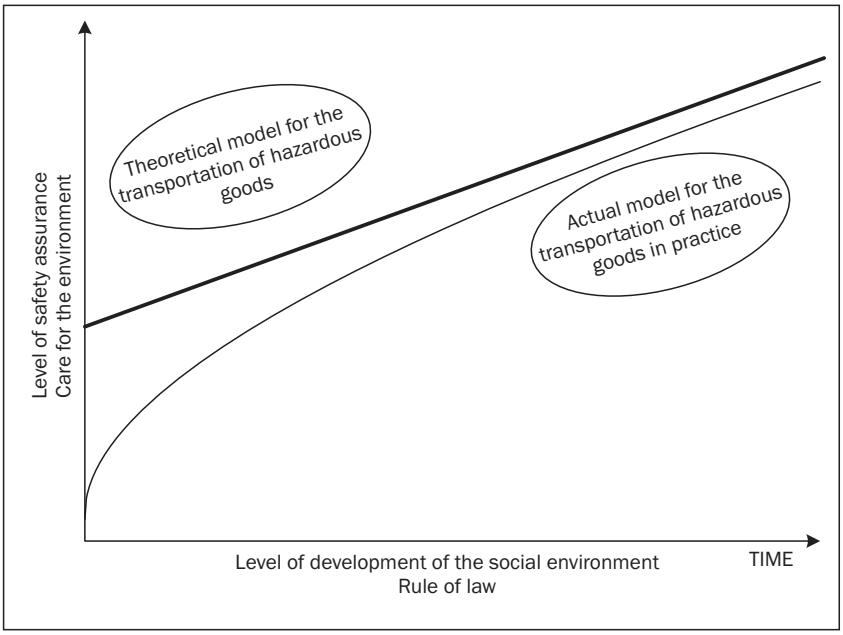

Figure 5 - Theoretical and real models for the road transportation of hazardous goods and their dependence on the level of development of the social environment

The path from blueprint to actual implementation depends on several elements, each of which contributes to or impedes the implementation of changes. Sadly, experience shows that the impediments are prevalent. There are many possible reasons for this; fear of the new and unknown, and even more so, the fear of losing certain privileges. A great deal of effort must be invested for a positive, high-quality jump. Experience shows that maintaining a certain level does not exist in practice. If a system is left unto itself, without guidance, it will not maintain its level of quality but will regress. Organisation is an artificial entity that is inclined towards disorganisation [3] unless it is constantly encouraged to maintain a desired equilibrium. The indicator of the degree of disorganisation and chaotic activity within a field is entropy. The latter is in constant opposition to the system's orientation towards its goals, hinders communication and the creation of positive functions, and works towards its destruction [4,10].

Freight forwarders have a great role in the implementation of laws and regulations in the transportation of hazardous goods. Acting as logistics operators (MTO – Multimodal Transport Operator) they issue FIATA-FBL (FIATA – Multimodal Transport Bill of Loading) and FIATA-SDT (FIATA – Shippers Declaration of the Transport of Dangerous Goods) and thus have a significant and direct influence on the security, rapidity and rationalization of international transportation of hazardous goods [8,9].

The elements of the real model for the transportation of hazardous goods are shown in *Figure 6*. An analysis has shown that, in this specific case, the transfer of the theoretical model to a real model plays a crucial role in the importance of global environment factor. In the specific case, it was found that, more often than not, Slovenia did not regulate the situation because it wished to raise the level of safety and regulation, but because it was pressured to do so from abroad (EU).

Individual elements of the model for the transportation of hazardous goods have had different effects at different times. Individually and in combination with each other, they have influenced the moulding of an integral model for the transportation of hazardous goods in the real environment. As seen in *Figure 7*, well-organised transport service providers exerted major influence on the model for the transportation of hazardous goods in Slovenia between 1991 and 1994. Following their initial involvement in the regulation of

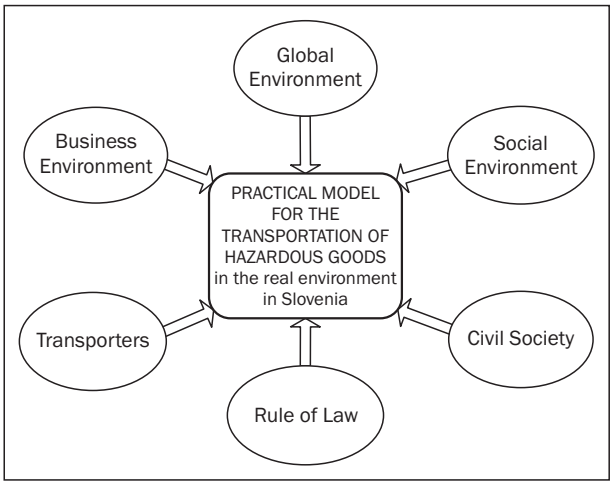

Figure 6 - Elements of the model for the transportation of hazardous goods in the real environment in Republic of Slovenia

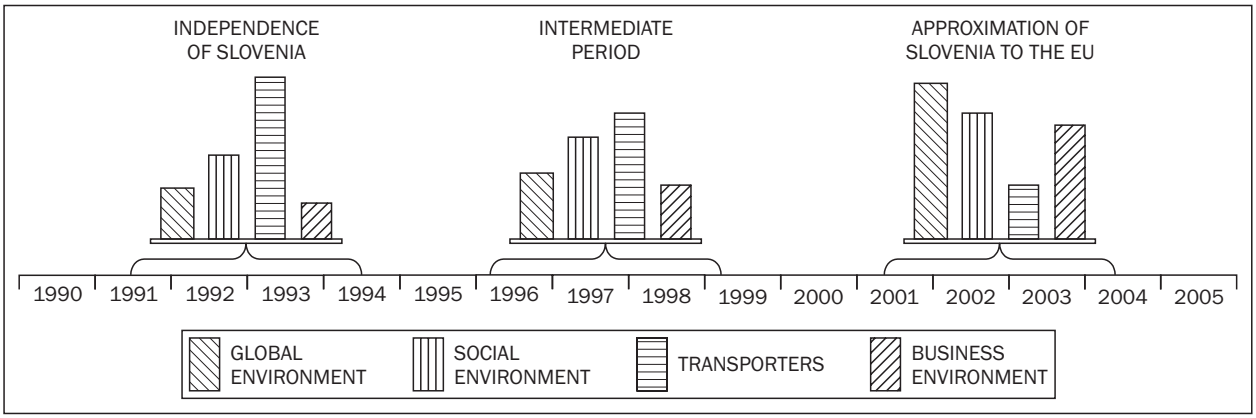

Figure 7 - Changing influences on the model for the transportation of hazardous goods in the real environment between 1990 and Slovenia's accession to the EU

legislation and their attempt to regulate the business environment during the intermediate period between 1995 and 2000, their influence gradually decreased. The period of Slovenia's approximation to the EU heralded the significance of the global and business environment and the establishment of the rule of law.

The global environment (harmonisation of national legislation with EU requirements) facilitated changes to the social environment in Slovenia. It has been found that external influences to a large degree facilitated positive changes. In recent times, the role of the business environment has also become more influential as it gained in significance with the standardisation of economic operations and care for the environment.

Figure 7 illustrates the general trend of individual elements of the model for the transportation of hazardous goods in the real environment, which is based on the practical experience of the authors and other information gained through surveys and analyses. The trend of the change is positive, and this is directly expressed in the efficiency of the model for the road transportation of hazardous goods and the higher road safety level, as well as in the higher level of general state organisation as an equal member of the EU.

The transformation path of the theoretical model for road transportation of hazardous goods, from the drafting of national legislation to its implementation in the real environment, is illustrated in *Figure 8*. The real model for road transportation of hazardous goods, based on practical experience, depends on the expertise of the groundwork based on the theoretical model for the transportation of hazardous goods, through the intermediate area characteristic for a specific country (level of development of the social environment, functioning of state institutions), to the real model for the transportation of hazardous goods that emerges in practice.

4.3 Improvement of the model for road transportation of hazardous goods in Republic of Slovenia

The different models for the transportation of hazardous goods that have been presented are dynamic systems whose form and content depend on the global environment (EU transportation policies and regulations), local regulations (national legislation) and time. In general, it has been found that the effectiveness of individual models for the transportation of hazardous goods directly depends on the level of development of

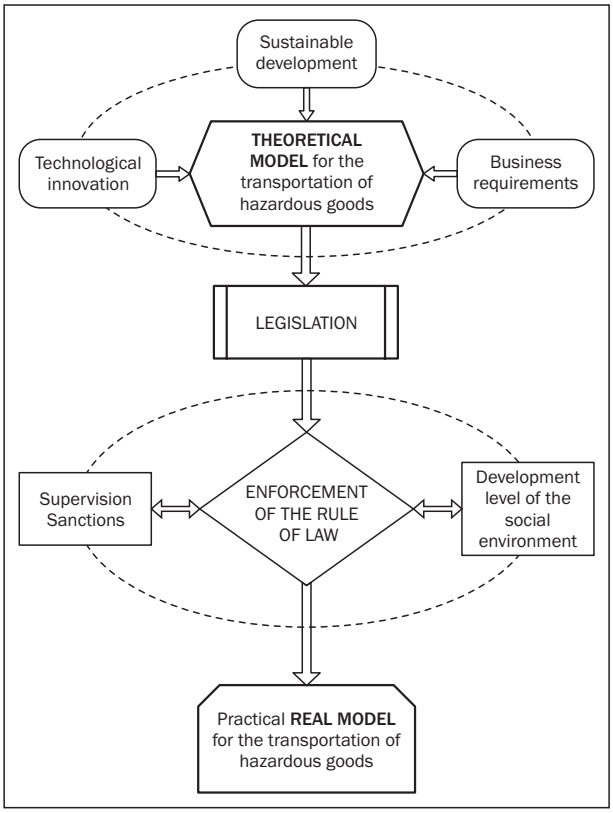

Figure 8 - Transformation of the theoretical model to the real model for the transportation of hazardous goods in real environment

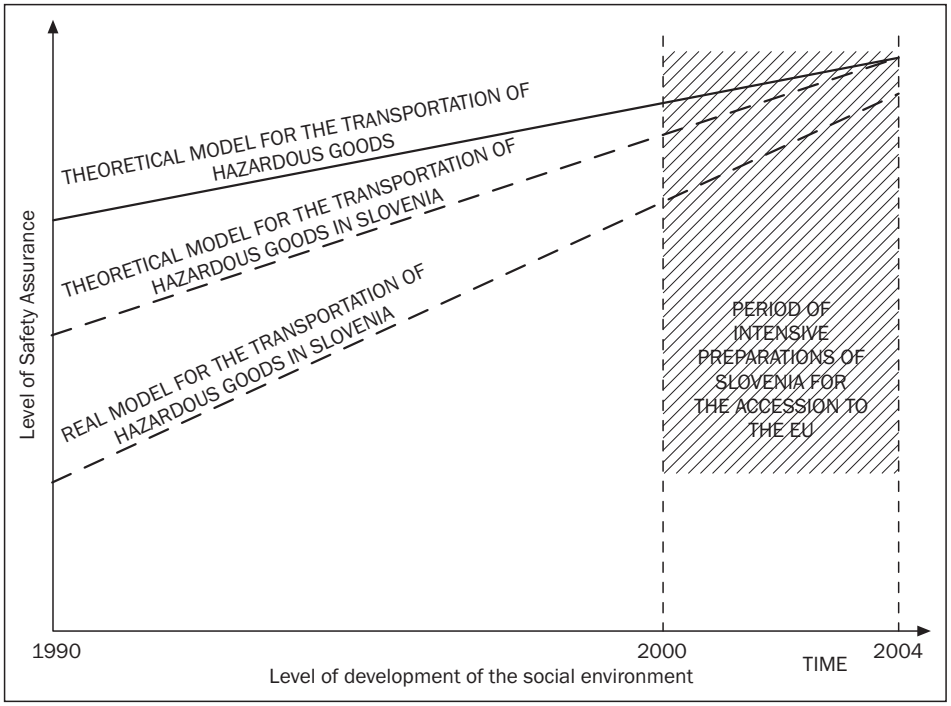

Figure 9 - Improvement of the model of road transportation of hazardous goods in Republic of Slovenia between 1990 and 2004

the social environment, which in turn directly depends on the safety level of road transportation of hazardous goods.

Figure 9 illustrates that most of the changes to the theoretical and real models of the road transportation of hazardous goods in the Republic of Slovenia were implemented during the period when Slovenia was getting ready for the European integration. This social change resulted in positive improvements to statutory regulations much sooner than if these external requirements for change had been absent. It is because of this that positive changes were implemented in such a short time.

By opting to join the European Union, Slovenia adopted a clear vision for its future development. In order to achieve its desired goals, it activated all state institutions and available human resources. This is yet another confirmation of the importance of identifying long-term goals, which can be achieved through a combination of will and knowledge. Such long-term and strategically defined goals in different fields were in short supply in the years following Slovenia's independence. Among these were the drafting of a transportation policy that would set the long-term development of transportation subsystems. A ready range of measures based on the long-term goals would certainly positively influence the creation and operation of a road transportation system.

5. CONCLUSIONS

The transition of the Slovene society from a planned economy, through liberalisation, to the establishment of a transportation services market between 1991 and the present has pointed at the pitfalls of the non-professionalism of certain state institutions in the development of economic activities (the development of road transportation of hazardous goods, for example). It has been determined that the situation deteriorates in the absence of appropriate legislation and supervision. In the specific case of Slovenia, this was expressed in the lack of regulation of the transportation services market, increasing social problems (unemployment, illegal work), growing crime rates (extortion, use of restricted fuels), all of which had an effect on the efficiency and environmental acceptability and safety of a relatively dangerous activity such as the transportation of hazardous goods.

A review of the conditions resulted in demands for the establishment and testing of a model for the road transportation of hazardous goods. It turns out that there are two different models - the theoretical model for the transportation of hazardous goods represents the goal of the regulation of the transportation of hazardous goods services market, whilst the real model for the transportation of hazardous goods represents its adaptation to the situation in a specific area. Both models are stochastic and dynamic, and are subject to change as a result of development in the science and technology of transportation. It has been determined that the global environment is of crucial importance,

which, as a rule, results in positive changes. The scientific hypothesis presented in the introduction addressing the latter has been proven.

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POVZETEK

VPLIV DRUŽBENIH SPREMEMB NA RAZVOJ MODELA CESTNEGA PREVOZA NEVARNEGA BLAGA

Prevoz nevarnega blaga predstavlja gospodarsko dejavnost katere posledice lahko bistveno vplivajo na prometno varnost, okolje in zdravje ljudi. S ciljem proučiti ključne vplivne elemente te dejavnosti je v pričujočem članku predstavljen model prevoza nevarnega blaga, ki se v splošnem pojavlja v vsaj dveh oblikah – kot teoretični model prevoza nevarnega blaga, ki predstavlja ciljno raven vzpostavitve odnosov na trgu storitev prevoza nevarnega blaga ter dejanski model prevoza nevarnega blaga, ki predstavlja prilagoditev teoretičnega modela na stanje v določenem omejenem lokalnem območju.

Opravljene raziskave v okviru doktorske disertacije prvo navedenega avtorja so pokazale, da ima razvitost družbe določene nacionalne države pri tem izjemen vpliv.

Teoretično predstavljen model prevoza nevarnega blaga po cestah je prenesen v realno okolje trga prevoznih storitev Republike Slovenije. Prikazan je prehod modela iz sistema planskega gospodarstva do njene liberalizacije v okviru enovitega trga prometnih storitev Evropske Unije.

KLJUČNE BESEDE

prometna politika, model cestnega prevoz nevarnega blaga

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1. A special quality of research is the fact that during the period under study, the author was actively involved in the transition processes at the largest company for the transportation of hazardous goods in Slovenia. He thus directly applies his personal professional experience to the science and evaluates them uniquely.

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