

# MODEL FOR IMPROVING SAFETY IN TRANSPORTING DANGEROUS GOODS FOR THE SERBIAN ARMY

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## *Abstract:*

*Design and improvement of the safety of transport of dangerous goods is a multidimensional and dynamic process which can be implemented using several different methods and techniques. In defining the model of improving the safety of transport of dangerous goods for the purposes of the Serbian Army, the Deming's approach to quality management system has been used. The analysis of the existing organization of transport of dangerous goods in the Army of Serbia has established the basic causes that affect the reduction in security as well as specific measures to be taken to improve the safety of transport of dangerous goods in the Serbian Army. The benchmark concept, widely used in the world, especially among organizations dealing with the same kind of logistic services, has been applied to identify measures to improve the safety of transport of dangerous goods in the Serbian Army.*

*Key words: transport safety, dangerous goods, model, corrective measures, Deming's approach, the concept of benchmark.*

## Introduction

The increasing presence of dangerous materials in production causes the increasing participation of vehicles transporting dangerous goods (DG) in overall transport. Staff handling dangerous materials in packing, unpacking, loading and unloading may be at risk as well as drivers and others who find themselves in the vicinity of dangerous goods during transport. Resources and the environment in which dangerous goods are transported may be at risk as well.

Problems in working with dangerous materials are far more present in the Serbian Army (SA) due to the very purpose of the military and the environment in which tasks are executed. In order for the transport of dangerous goods to be safe for humans and the environment, starting from the preparations

to the unloading and storage of dangerous goods, it is necessary to constantly monitor, analyze and improve the existing method of transport execution [1].

Safety of transport of dangerous goods is a complex, specific system which includes several sub-systems.

Safety of transport of dangerous goods, generally speaking, is a characteristics that determines the possibility or probability of execution of all activities without negative consequences for the lives and health of all participants in the process, and without any financial and other damage. The existence of problems and imperfections of the system are the cause of unsafe transportation.

In order for transport of dangerous goods to be safe, it is necessary to define which preventive measures should be taken in all activities (before, during and after transport execution) in case of possible risks in the transportation. Preventive measures include measures aimed at the prevention of negative effects or consequences and the creation of such conditions that such effects do not occur.

The final goal in defining the overall transportation system management is to improve the safety of transport of dangerous goods while not hindering its development. This takes into account the risk in transport, normative regulations and a transportation system as a whole.

## Monitoring and safety management of transport of dangerous goods for the Serbian Army

By signing and ratifying the SEECAP Declaration (Declaration South East Europe Common Assessment Paper on Regional Security Challenges and Opportunities, 2001), Serbia took over the duties in the field of safety assessment of possible risks, dangers and challenges, and the prevention of possible threats to regional security as well as accidents and disasters. According to the document "Strategic Framework and the key priorities of the Stability Pact for South Eastern Europe" in 2001, it is essential that the national systems of South Eastern Europe meet the appropriate requirements for the timely prevention of emergency situations and timely action in case of accidents [2].

Also, the entry into force of the new Law on transport of dangerous goods [3] and adopting the Law on Ratification of ADR (European Agreement concerning the International Carriage of Dangerous Goods by Road) [4], has created the need for security monitoring and management of transport of dangerous goods, both in society and in the SA.

The problem of safety of transport of dangerous goods is not only resolved by the subsequent description and interpretation of the causes of these problems, but by preventing such situations. One way is based on the pursuit for predictability and certainty in respect to the execution of transport, i.e. reducing or annulling the existing risks [5].

The existence of the risk of accidents in the transport of dangerous goods imposes a need to take timely measures to prevent or reduce the emergence of risks and consequences they may cause.

Safety of transport of dangerous goods is the absence of risk or the risk reduction to a tolerable level or the allowed degree of freedom from unacceptable risk that some event or process can be implemented in full and without harmful consequences [6].

Risk management can be defined as an activity aimed at the identification and analysis of different scenarios of damage from danger to which some of the processes can be exposed and at determining the best way of eliminating the consequences of such damage.

Risk management objective is to ensure the execution of transport of dangerous goods without any financial losses that may be caused by a realization of the potential risks during transport.

In order to manage security of transport of dangerous goods, or more precisely the risks during the implementation of transport, it is necessary to constantly monitor the security of transport of dangerous goods. Condition monitoring is a set of methods for monitoring risks during transportation in order to identify, analyze and rank the activities according to risk, the potential of improving the security of transport of dangerous goods and the savings in the costs of traffic accidents and accidents involving dangerous substances.

The basic idea of management is to reduce, preferably eliminate the risk from the transportation system.

Managing security of transport of dangerous goods and reducing security risks involve a complex process implemented through the following phases:

1. Risk identification,
2. Risk analysis,
3. Risk assessment, and
4. Dealing with risk and risk control (determining how to remove its effects).

In order to successfully apply all the stages in the process of safety management of transport of dangerous goods, it is necessary to [6]:

- know the current situation,
- define the projected state, and
- select control measures that will change the current situation into a desired one.

Besides the current facts, defining the current situation involves the prognosis of development occurring on the basis of existing conditions.

In defining the desired state, we should define the vision and management objectives. Visions are defined without time limits and without concrete values (for example, a vision is technically correct and safe vehicles, training of personnel to carry out transport of dangerous goods, etc.). Objectives are more specific, time-limited and usually defined by certain values (for example, that in the next 3 years the number of drivers with a certificate will increase for 10% of the total number of drivers, or

that in the next 5 years a fleet will be completed with a specific number of motor vehicles for transporting dangerous goods, etc.)

When a deviation between the current and the projected situation is noticed, certain preventive (corrective) measures lead to the elimination or reduction of negative causes (risks), and thus to the improvement of the safety of transport of dangerous goods.

The safety level of transport of dangerous goods results from each stage in the transport process. When high-quality activities in the transport process take place without flaws, weaknesses, mistakes, etc., at a high organizational, technological and safety level, then the safety of transport of dangerous goods is at a high level.

### *Deming's approach to managing the security of transport of dangerous goods for the Serbian Army*

One possible approach to improving system management and security of transport of dangerous goods is a well-known Deming's (W. Edwards Deming) approach to the science of quality. Japanese scientists have called this access "Deming cycle" or PDCA (Plan-Do-Check-Act), which includes the following processes [7]: planning, implementation, monitoring (checking) in order to observe the execution risk and implementation of corrective measures (Fig. 1).

Planning includes the development and implementation of the preparation method of transport of dangerous goods. The implementation of transport means immediate execution of all activities in the transport process [8]. Control is used to check the quality of the preparations and the direct implementation of transportation, as well as to establish risks which have an impact on the reduction of the level of safe transport and on the occurrence of hazardous events.

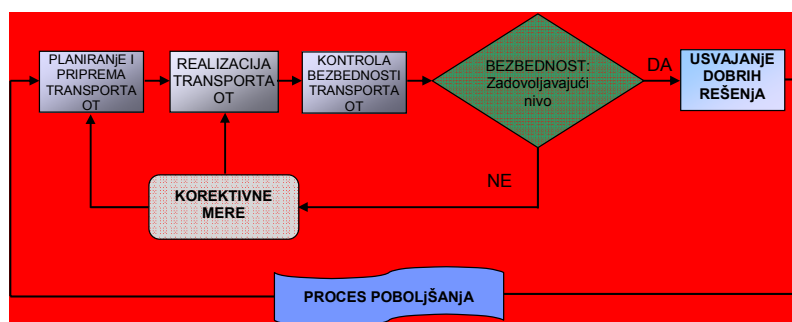


Figure 1 – Diagram of the "Deming cycle" management and improvement of safety of transport of dangerous goods for the Serbian Army [9]

Slika 1 – Dijagram „Demingovog ciklusa“ upravljanja i poboljšanja bezbednosti transporta opasnog tereta za potrebe Vojske Srbije [9]

After the control, the failures are studied and analyzed, conclusions are drawn, determining to what extent the objective has been achieved, what is not fulfilled, and the causes of this condition. Based on the analysis results, new corrective measures are determined to correct the identified weaknesses.

In the end, good measures and solutions leading to the improvement of the existing modes of transport of dangerous goods and the level of security are adopted and introduced as standards. For the adopted solutions and changes, the cycle is repeated continuously, thereby improving safety of transport of dangerous goods.

The process of transport of dangerous goods can be viewed as a set of interconnected and arranged subprocesses and activities that receive inputs and convert them into outputs. Security in the transport of dangerous goods can be viewed as a kind of **service**. The service itself (security) is the result of a series of synchronized and coordinated activities related to transport and the process directly depends on the quality of the process, i.e. security or its individual activities [1].

Determining the level of security (quality measurement), i.e. measuring the quality of the phenomena that reduce security, represents a basic prerequisite for improving the safety of transport of dangerous goods.

Through a measurement system, it is necessary to identify problems that impair the safety of certain activities in the transportation process and to focus on solving key problems. These are the most common problems related to the unsatisfactory state of material facts on which depends the safety of transport of dangerous goods (handling of materials, method of transport, adequate selection of vehicles, etc.) and that can cause major negative consequences.

The quality-safety problem of transport of dangerous goods means the difference between the projected (desired) and the real state of security (determined by the implementation of transportation control). A comparative analysis of these conditions leads to the detection of security problems of transport of dangerous goods and determination of corrective measures to be taken.

Quality management-security transport of dangerous goods includes the following processes: planning, provision and improvement of safety (Fig. 2).

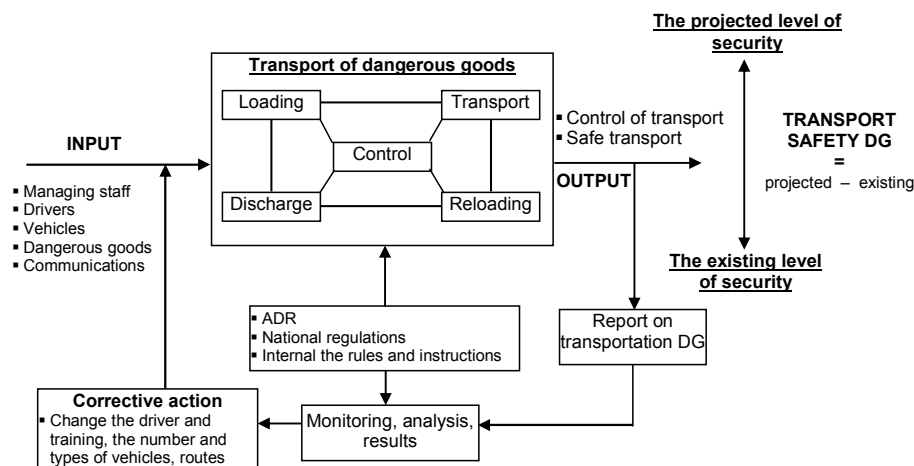


Figure 2 – Managing security of transport of dangerous goods for the Serbian Army [9]  
 Slika 2 – Upravljanje bezbednošću transporta opasnog tereta za potrebe Vojske Srbije [9]

To solve the security problem of transport of dangerous goods, it is necessary to identify causes, to make their classification and to determine cause-effect relationships. Eliminating or mitigating the impact of certain causes leads to the improvement of security of transport of dangerous goods.

## Model of safety management of transport of dangerous goods for the Serbian Army

The process of securing the projected state of security of transport of dangerous goods is achieved through the preparation, implementation of transportation, supervision, monitoring of implementation and elimination of causes that can lead to unwanted deviations. In order to ensure the implementation process, it is necessary to register and monitor indicators of external and internal security.

The external indicators include the security attributes that users-recipients require and expect (time, reliability, availability, documentations, communications, etc.), and the indicators of internal security are the attributes in a unit that implements transport (training of drivers, vehicles and the adequacy of resources, utilization of capacity, etc.).

Improving the safety of transport of dangerous goods is a continuous process implemented in determined cycles. The task of the improvement function is raising the level of security, but also the effectiveness and efficiency of certain activities in the transportation process.

The proposed model for improving the safety of transport of dangerous goods involves certain steps related to transport planning, its execution, check control of compliance with laws and regulations, the selection of adequate vehicles, the choice of road and improvement of the quality of training of drivers and other personnel (Fig. 3).

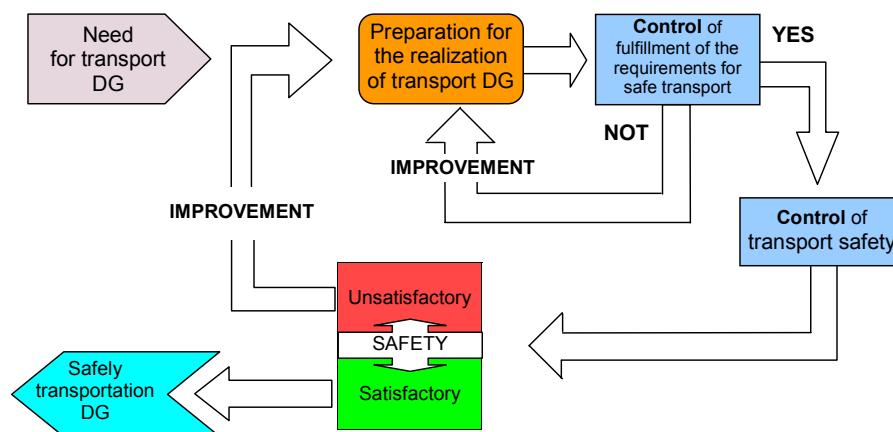


Figure 3 – Model to improve the safety of transport of dangerous goods for The Serbian Army [9]

Slika 3 – Model poboljšanja bezbednosti transporta opasnog tereta za potrebe Vojske Srbije [9]

Transport of dangerous goods, based on the order of the superior command, can be done:

- for unit's own use, or
- for other units.

After receiving requests from subordinate units or superior command orders for transportation of dangerous materials, the execution of transport is prepared.

The preparation includes:

- selection and preparation of the driver,
- determining the person responsible for the execution of the transport,
- selection and preparation of vehicles, and
- drawing up orders and other documentation preparation.

After the preparations made by a professional person in a unit that realizes the transport, the control is carried out about the quality of readiness of personnel and vehicles for safe transportation of dangerous goods.

If the control confirms that all requirements for safe transport are fulfilled, a permit for the execution of the transport of dangerous goods is issued and a vehicle, with a driver and a person in charge, is sent to the place of loading.

If the control shows that there are one or more requirements which are not met, then the defects are corrected using the procedure which incorporates projected corrective measures.

The process of improvement involves defining corrective actions and solutions which act on the causes of deviations from the actual quality of the planned transport-level security.

In the process of removing the causes of discrepancies from the planned quality, there should be identified:

- improvements that should be urgently implemented (which elements of the security are to be given more importance in order to improve the quality of preparation),
- improvements that depend on the environment (conditionality of communications and facilities, the existence of adequate vehicles to execute transport, etc.),
  - continuous improvement activities,
  - drawing up orders and preparation of other documents,
  - non-emergency activities, and
  - a system of rational use of available resources and potentials (vehicles and drivers and other personnel in the transportation process).

Design and improvement of the safety of transport of dangerous goods involves a multidimensional and dynamic process which can be implemented using several different methods and techniques (models, concepts), such as:

- six sigma methodology – concept of finding and eliminating errors and their causes,
- QFD (Quality Function Deployment) method – oriented to quality planning requirements,
- process-mapping method – identification and analysis of key processes and activities, and,
- cause and effect diagram (Ishikawa diagram, "fishbone") – analysis of all possible causes that affect a phenomenon (error, activity, process),
- FMEA (Failure Mode and Analysis) method- analysis of the impact, causes, consequences and errors,
- analysis of tree defects (FTA-Failure Tree Analysis) – identification, analysis and debugging,
- method of experimental design – Taguchi method-application of statistical techniques to assess the effect of different parameters,
- other statistical methods: methods for extracting and displaying data, charts and statistical process control.

In addition to these methods, in this case, the benchmark concept can be used to improve the safety of transport of dangerous goods for the SA.

For the purpose of conducting the benchmark method, data is collected about the methods of transport of dangerous goods in foreign ar-



mies, the processes implemented by applying accepted international regulations for the safe and secure transport of dangerous goods as well as the experiences of civilian companies in the country dealing with the transport of one or more kinds of dangerous substances [6].

The essence of this method is to make comparisons among them and to trace the activities and processes which are considered better than the existing ones in the SA and to transfer such experience and practice adapting them to the real conditions of transport of dangerous goods for the SA.

### *Benchmark concept*

Benchmark is a designed system approach to the improvement of processes and activities in the organization (enterprise, company, etc.). It is based on the comparison of an organization with the similar ones, i.e. their leaders, as well as on the comparison of the processes and subsystems within the organizations-companies.

The key is to find the processes that are objectively considered to be the best, no matter where they occur, and to transfer these best practices and adapt them to real conditions in the organization.

The Benchmark terminology foundation consists of three distinctive concepts: benchmark, benchmark facility and benchmark process [7].

The term benchmark means a standard, a value, a reference point or a benchmark against which to measure or compare different values (template or standard for comparison).

The Benchmark object is an object that should be improved. This may be an activity, process, function, subsystem or a complete company.

The procedure involves a meticulous benchmark study, in-depth understanding of the process in its own organization as well as the selection and the transfer of knowledge and experiences into their own work.

The benchmark concept is defined in different ways. According to the American Productivity & Quality Center (APQC), a benchmark is defined as "systematic and continuous process of measuring and comparing an organization's business processes, in relation to the business process leaders anywhere in the world, to gain information that will help the organization to take action to improve its performance" [10].

One of more complete definitions was given by Harrington H.J. and Harrington J.S., and it follows [7]: "Benchmark is a continuous process of identifying, understanding and adaptation of products, services, equipment and procedures, companies with best practices to improve their own business." This process incorporates [7]:

– comparison of companies (organizations) and their parts with the best ones, not limited to the same activity,

- comparison of production and other activities of the company (organization) with equivalent activities or the same activities in order to extract the best,
- comparison of company's products and services with the products and services of leading competitors – comparison of company's technical solutions in order to select the best equipment,
- the best use of a defined business process,
- planning future directions for the development and active adaptation to new trends,
- meeting and surpassing consumer expectations.

In general, we can say that the benchmark is a continuous process of comparing products, services and processes in relation to the strongest competitors or those that are known to the world leaders in this field. The benchmark allows businesses to learn the experience of others [11].

The essence of the benchmark is to understand how to achieve better results and adjust the way our own organization functions in order to achieve the same.

## Corrective measures to improve the safety of transport of dangerous goods for the Serbian Army

The remedial measures include the measures, procedures and activities for eliminating the cause of the existence of differences between the actual and the projected state of the process being analyzed.

Corrective measures include identifying problems, taking corrective actions and monitoring the effects of corrective actions. Corrective actions involve changing one or more activities in the reporting process.

In this case, the development and implementation of corrective measures aiming to improve the safety of transport of dangerous goods for the SA should be carried out as follows [9]:

- Identifying safety of transport of dangerous goods for the SA in relation to transport of other armies and companies,
- identifying the factors that reduce the safety of transport of dangerous goods for the SA,
- selecting and applying appropriate corrective measures (actions) to reduce or completely eliminate the negative impact of perceived causes,
- defining criteria for evaluating the effects of implementation of corrective measures,
- analysis of the level of safety of transport of dangerous goods after the application of corrective measures,

– continuous application of corrective measures that have led to improved levels of security.

In order to define corrective actions better, it is necessary to analyze the attributes and factors of safety of transport of dangerous goods (Table 1).

In the analysis of the existing organization of transport of dangerous goods for the SA [9], the following factors, mutually intertwined and affecting the correctness and security during the entire transport process, are distinguished:

- rules-regulations,
- qualified staff (a driver, a dangerous substance operator, a person responsible for the realization of transportation, a person in charge of control),
- a vehicle (a means of transport of dangerous goods),
- dangerous goods, and
- road (communication).

The existing regulations governing the transport of dangerous goods for the SA do not define a mode of transportation, which directly affects the security, and are reflected in the following:

- non-compliance with ADR,
- non-compliance with the existing national laws and the rules,
- incompletely defined conditions to be met by vehicles, drivers and other persons involved in the transport of dangerous goods,
- inadequate documentation for the transport of dangerous goods.

Table 1  
Tabela 1

Factors of safety of transport of dangerous goods for the Serbian Army  
Činioci bezbednosti transporta opasnog tereta za potrebe Vojske Srbije

| Group factors         | Factors of the safe transport of DG   | Current situation in the SA |                |
|-----------------------|---|-----------------------------|----------------|
|                       |   | Partially satisfactory      | Unsatisfactory |
| The rules-regulations | compliance with ADR   |                             | X              |
|                       | compliance with national regulations  |                             | X              |
|                       | definition of driver training and other personnel in the transport of DGs     |                             | X              |
|                       | conditions of transport vehicles for DGs required to be met                   | X                           |                |
|                       | documentation for transport of DGs  | X                           |                |
| qualified staff       | number of people in superior command and control planning of transport of DGs |                             | X              |

|                 |   |   |   |
|-----------------|---|---|---|
|                 | number of people to control the execution of safe transport of DGs  | X |   |
|                 | number of drivers who possess a certificate                         | X |   |
|                 | number of qualified people to manipulate DGs when loading-unloading | X |   |
| Vehicle         | certificate   |   | X |
|                 | equipment on the vehicle  | X |   |
|                 | vehicle marking   |   | X |
|                 | degree of charge  | X |   |
| Dangerous goods | marking   | X |   |
|                 | instructions for the special security measures                      |   | X |
| The road        | choice of roads   | X |   |
|                 | alternative routes  |   | X |

In the human factor (human resources) analysis, a number of shortcomings can be seen, directly reducing the safety of transport of dangerous goods for the following reasons:

- lack of obligation to have a certificate for the vehicle that transports dangerous goods,
- the existence of a small number of drivers with a certificate,
- lack of training of other people involved in the transport of dangerous goods.

When it comes to the vehicle, a means by which the transport is directly executed and which, besides the driver, directly affects the safety of transport due to its characteristics, its impact on the reduction of the safety of transport of dangerous goods in the SA is expressed in several ways:

- SA fleet is outdated (the average age of vehicles is over 28 years),
- in the existing structure of SA vehicles, a small number of vehicles is designed for transport of dangerous goods (these are mainly tankers for fuel transporting, which are also unsatisfactory in terms of age),
- there is no obligation for the realization of special technical checks of test conditions to be met by vehicles for the transport of dangerous goods,
- related equipment on vehicles that transport dangerous goods is not in line with the transport of dangerous goods,
- vehicles for the transport of dangerous goods are marked only with a signboard, mostly on fuel tanks during transport, while other vehicles that transport dangerous goods are rarely marked,

– there is not a calculation done on the amount of cargo that can be transported with the use restrictions for mixed cargo and transport under the regime of "small quantities".

Dangerous goods, i.e. dangerous substances are transported by the SA own vehicles and kept in special storage facilities where the regulations about storage, handling and responsible storage professionals are complied with. Responsibility can be also in hands of individuals who are additionally trained to perform these activities. In military warehouses, goods are kept in original packaging used for transportation as well. As far as marking is concerned (class 1), tags are used to describe the type and the series of ordnance production while marking according to relevant national laws and regulations of ADR is not applied in full (labels).

During the transport of these substances, drivers do not apply user-specific security measures in case of an accident which they should apply, in accordance with the provisions of ADR.

Communications affect the safety of transport of dangerous goods due to their characteristics, such as road conditionality for movement of vehicles, road quality, road category affecting whether or not the movement of vehicles is allowed, the route (through a part of a settlement or an area where the transport of dangerous goods is banned), etc.

During the realization of transport of dangerous goods for the SA, it is typical, prior to transport (in preparation), not to choose a route in accordance with the above characteristics, but to use generally established routes. Alternative routes are also not determined in case of impossibility to use the existing route.

### *Definition and implementation of corrective measures to improve the safety of transport of dangerous goods for the Serbian Army*

The results of the analysis of the defined factors (Table 1) are the basis for the definition and selection of appropriate corrective measures.

On the basis of the actual conditions of transport of dangerous goods in the SA, the following corrective measures [9] are defined:

1. Harmonization of military rules, guidelines and regulations with national regulations, defining at all levels:

- structure of personnel who must be involved in the transport of dangerous goods,
- requirements for the vehicle that transports dangerous goods,
- training type, the test procedure and the certificate issuance procedure,
- type and characteristics of transportation, reloading and manipulative devices,

– the types of vehicles and dangerous goods,  
– the method of realization of technical inspection and certificate issuance for vehicles,

– mandatory documents for transport realization,  
– general conditions that must be met to start the execution of transport.

2. Establish a list of security data (identification and characterization) of dangerous goods transported for the SA.

3. Introduction of a road safety adviser for the brigade commands and controls at the operational level.

4. Instructions on introducing special security measures for substances transported for the SA.

5. Renewal of a fleet of transport vehicles for transporting dangerous goods.

6. Informing drivers about roads and types of dangerous goods, prior to transport execution.

7. Choice of vehicles and other means of handling and transport of dangerous goods must be carried out by qualified personnel in the unit (safety advisor, a person qualified to perform the tasks of transport, etc.).

8. Selection of roads and alternative routes, in accordance with the characteristics of dangerous goods that are transported.

9. Choice of the types of containers for the transportation of dangerous goods (tanks, boxes, containers, bottles, barrels, buckets, bags).

10. Providing conditions for monitoring the transport of dangerous goods in real time and space.

Corrective measures can be classified in two groups:

– short, and  
– long term ones.

Short-term measures belong to a group of operational measures and their implementation is possible in a short period of time. This group includes:

1. Establishing a list of security data (identification and characterization) of dangerous goods transported for the SA.

2. Instructions on introducing special security measures for substances transported for the SA.

3. Informing drivers about roads and types of dangerous goods, prior to transport execution.

4. Choice of vehicles and other means of handling and transport of dangerous goods must be carried out by qualified personnel in the unit (safety advisor, a person qualified to perform the tasks of transport, etc.).

5. Selection of roads and alternative routes, in accordance with the characteristics of dangerous goods that are transported.

6. Choice of the types of containers for the transportation of dangerous goods (tanks, boxes, containers, bottles, barrels, buckets, bags).

Long-term measures are those that require a longer period of time. These include:

1. Harmonization of military rules, guidelines and regulations with national regulations.
2. Introduction of road safety adviser for the brigade commands and controls at the operational level.
3. Renewal of a fleet of transport vehicles for transporting dangerous goods.
4. Providing conditions for monitoring the transport of dangerous goods in real time and space.

Given the time required to implement corrective measures, a more detailed analysis of the impact assessment of their application can be carried out through a special investigation.

### *Assessment of the effects of the application of corrective measures to improve the safety of transport of dangerous goods for the Serbian Army*

Checking the safety of transport of dangerous goods is an important prerequisite in the preventive of safe transportation. Systematic and independent research is done in order to determine whether activities that affect the safety give satisfactory results, in line with the planned target.

The system checks for the security of transport of dangerous goods are based on the list of questions (check list), and the survey questionnaire, filled in by a trained and certified evaluator (auditor) of "security" transport of dangerous goods. The results are evaluated according to a pre-defined schedule and are registered in the form of indicators.

The main stages in the implementation of testing (project) are (Fig. 4):

1. preparation (planning),
2. implementation, and
3. valuation.

In the planning phase, a general catalog of questions is formed. Forming a question can be done for the whole process of transport of dangerous goods or for any single factor that determines the level of security of transport of dangerous goods and services.

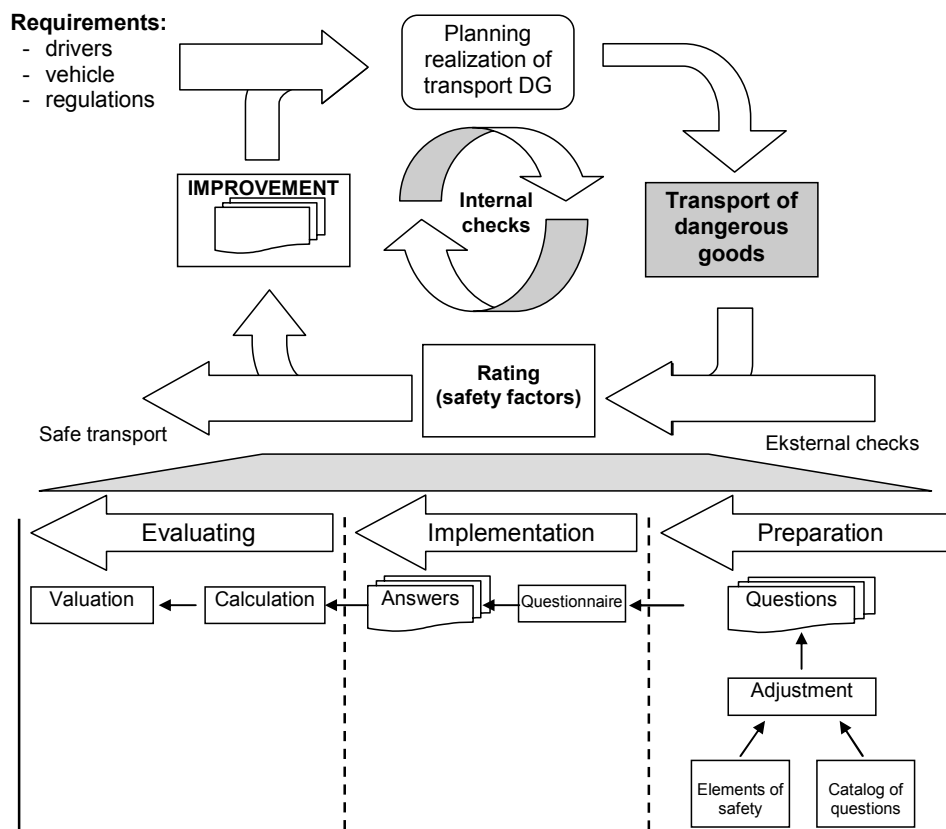


Figure 4 – Concept of safety checks of transport of dangerous goods for The Serbian Army [9]

Slika 4 – Koncept provere bezbednosti transporta opasnog tereta za potrebe Vojske Srbije [9]

In the implementation phase, interviewing (survey) is carried out while evaluating the results.

The evaluation, or quality control, can be internal and external.

Internal checks are carried out within the unit (the organization) by a qualified person, with the aim of initiating long-term cycles of improvement. In doing so, the responsible person plans to conduct a review of the subprocesses in the transport of dangerous goods. Evaluation leads to the conclusion which weaknesses reduce the security of transport of dangerous goods and which measures are necessary to improve it.

External testing is performed by a certified group of experts in the fields that are assessed (e.g evaluation bodies: military police organs, civilian police, companies involved in the technical inspection of vehicles, etc.).



The list of questions should include the questions defining the deviation between the set requirements for the safe transport of dangerous goods and the actual conditions in which the transport of dangerous goods is run. It is based on the principle of a closed system of asking questions, i.e. an adequate number of responses, selected by the assessor, was developed for each question.

### *Valuation of the safety of transport of dangerous goods for the Serbian Army*

The main objective in evaluating safety of transport of dangerous goods by checking is to determine the degree of matching the actual situation with the planned requirements, due to which the obtained answers are subjected to the analysis on the basis of a defined evaluation scheme.

Table 2  
Tabela 2

The scheme of evaluation of dangerous goods transport safety for the Serbian Army [7]  
Šema vrednovanja bezbednosti transporta opasnog tereta za potrebe Vojske Srbije [7]

| Number of points | Established secure transport system | Proven efficacy      | Explanation  |
|------------------|-------------------------------------|----------------------|--|
| 10               | yes                                 | yes                  | Regularly applied<br>Very good results<br>Documented procedures and flows    |
| 8                | not                                 | yes                  | Irregularly applied<br>Very good results<br>No documentation                 |
| 6                | yes                                 | predominantly<br>75% | Irregularly applied<br>Good results<br>No documentation                      |
| 4                | not                                 |                      | It exists and it is applicable<br>Satisfactory results<br>No documentation   |
| 0                | yes/not                             | not                  | Does not exist<br>Unsatisfactory results<br>Independent of the documentation |

Different situations are possible during evaluation. If the calculation includes all safety factors of transport of dangerous goods, then the requirements are met to the general degree (Table 2). Otherwise, the degree

of fulfillment of requirements can be determined for each of the factors of safety of transport of dangerous goods, while the evaluation scheme is adjusted to the predefined questions. The evaluation is based on the gradation of responses (a two-point step), to which points are assigned. A satisfactory outcome is measured with four or more points, to a maximum of ten points.

In addition to evaluating the individual subprocesses, it is necessary to conduct a complete evaluation of the process of transport of dangerous goods. The results of evaluation are indicators showing the degree of the deviation of the performance from the projected qualitative requirements (degree of satisfaction of requirements).

### *Implementation of safety checks in transport of dangerous goods for the Serbian Army*

The implementation of safety checks involves a systematic review as a necessary procedure, where all steps must be pre-planned and prepared.

Therefore, the checking system should be structured as a project with Project Manager, project plan, tasks, deadlines and defined responsibilities.

The project starts with the decision to review the implementation of testing (Table 3), after which it is necessary to choose a competent assessor with good communication skills who should be an expert in the field of transport of dangerous goods and able to recognize the causes of errors quickly and easily and to remove them.

The following step is check planning which includes defining steps, identifying areas of research (the process of transport of dangerous goods or separately each of the safety factors), the distribution of tasks to co-workers.

The most important step is to identify problems and generate incentives for improvement.

Valuation checks end with the production and graphic reports containing an overview of improvement measures.

The evaluation is followed by the implementation of improvement measures in practice, which is not a part of the checking, but of the term plan, with the view of better applying the perceived improvements. Checking time is different and depends on the size and the number of units in which the project is implemented, as well as on the number of personnel engaged.

Table 3  
Tabela 3

Plan of the project for the implementation of safety checks in transport of dangerous goods for the Serbian Army [9]

Plan projekta sprovođenja provere bezbednosti transporta opasnog tereta za potrebe Vojske Srbije [9]

| The steps in the process  | CU - The command unit    | Time units |   |   |   |   |   |   |   |
|---|--------------------------|------------|---|---|---|---|---|---|---|
|   | TrOf - Transport officer |            |   |   |   |   |   |   |   |
|   | P - Processor            | 1          | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|   | G - Grader (auditor)     |            |   |   |   |   |   |   |   |
| <b>1. Decision-making</b>   | CU/TrOf                  |            |   |   |   |   |   |   |   |
| <b>2. Choice of evaluators</b>  | CU/TrOf                  |            |   |   |   |   |   |   |   |
| <b>3. Planning</b><br>- area of research<br>- elements of safety<br>- deployment of safety staff by elements<br>- specific requirements | TrOf/G                   |            |   |   |   |   |   |   |   |
| <b>4. Implementation</b><br>- interviews<br>- poor record places  | TrOf/G<br>or<br>P/G      |            |   |   |   |   |   |   |   |
| <b>5. Evaluation</b><br>- graphics, reports<br>- measures to improve<br>- reports, presentations  | G                        |            |   |   |   |   |   |   |   |
| <b>6. Implementation results</b><br>- implementation plan<br>- monitoring the implementation  | CU/TrOf                  |            |   |   |   |   |   |   |   |

## Conclusion

The increase of the safety of transport of dangerous goods in the SA is directly affected by the monitoring and application of modern technologies in transport of dangerous goods, which is reflected in the implementation of adequate legislation, organizations, vehicles, professional staff and expert management, i.e. rational use of human resources and transportation. In the SA, modern transport technology is not yet implemented, although the benefits of their introduction are significant. This is due primarily to obsolete vehicles and lack of financial resources.

In the organization of transport of dangerous goods, the most important is to notice problems or risks that affect the safety, to select adequate measures and to improve the existing level of safety to a higher or a desired level.

Preventive and protective measures at all stages of transport of dangerous goods for the SA are a prerequisite to safe transport and to the reduction of risks and accidents to the minimum, together with their effects.

Reviewing the process of transport of dangerous goods in the SA has identified gaps in the current method of execution of transport of dangerous goods for the SA, in terms of:

normative framework,  
capability and structure of personnel involved in the transport, and  
material resources.

The increase in the safety of transportation of dangerous goods in the SA is only possible if the weaknesses are identified and corrected; therefore, it is necessary to realize the following tasks and activities:

1) to define the place and role of the transport of dangerous goods in the SA transportation system, with clearly defined transportation tasks and carriers.

2) to define a vehicle fleet to be used for the transport of dangerous goods, based on the needs of subordinate units, and renew the existing fleet with suitable vehicles.

3) to define routes for the transport of dangerous goods for the SA, based on the existing storage of dangerous substances in the SA and the requirements of units.

4) to make the project of introduction of modern technologies in the transport of dangerous goods into the SA transportation system.

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## MODEL POBOLJŠANJA BEZBEDNOSTI TRANSPORTA OPASNOG TERETA ZA POTREBE VOJSKE SRBIJE

OBLAST: saobraćaj (bezbednost saobraćaja)

VRSTA ČLANKA: stručni članak

### Sažetak:

*Projektovanje i unapređenje, odnosno poboljšanje bezbednosti transporta opasnih tereta višedimenzionalan je i dinamički proces, koji se može realizovati primenom više različitih metoda i tehnika. U definisanju modela poboljšanja bezbednosti transporta opasnog tereta za potrebe Vojske Srbije korišćen je Demingov pristup sistemskom upravljanju kvalitetom. Na osnovu uzroka koji utiču na smanjenje bezbednosti određene su mere koje treba preduzeti da bi se poboljšala bezbednost transporta opasnog tereta u Vojsci Srbije. U određivanju mera za poboljšanje bezbednosti transporta opasnih tereta za potrebe Vojske Srbije korišćen je benčmarking koncept.*

Praćenje i upravljanje bezbednošću transporta opasnog tereta za potrebe Vojske Srbije

*Upravljanje bezbednošću transporta opasnog tereta, odnosno rizici-  
ma koji umanjuju bezbednost, složen je postupak koji se realizuje kroz sle-  
deće faze:*

1. identifikaciju rizika,
2. analizu rizika,
3. procenu rizika,
4. postupanje sa rizikom i kontrolu rizika (određivanje načina ot-  
klanjanja njegovih posledica).

*Da bi se sve faze u procesu upravljanja bezbednošću transporta opasnog tereta mogle uspešno primeniti, neophodno je da se [6]:*

- poznaje postojeće stanje,
- definiše željeno (projektovano) stanje,
- odaberu upravljačke mere kojima će se postojeće stanje približiti željenom.

Demingov pristup upravljanju bezbednosti transporta opasnog tereta za potrebe Vojske Srbije

*Demingov ciklus ili P-D-C-A (Plan-Do-Check-Act) obuhvata sledeće procese [7]: planiranje, realizaciju, kontrolu (provera) izvršenja radi uočavanja rizika i primenu korektivnih mera (slika 1).*

*Komparativnom analizom projektovanog (željenog) i stvarnog stanja bezbednosti dolazi se do otkrivanja problema bezbednosti transporta opasnog tereta i određivanja korektivnih mera koje treba preduzimati.*

Model upravljanja bezbednošću transporta opasnog tereta za potrebe Vojske Srbije

*Poboljšanje bezbednosti transporta opasnog tereta stalni je proces, koji se realizuje u određenim ciklusima. Pod upravljanjem kvalitetom-bezbednošću transporta opasnog tereta podrazumevaju se sledeći procesi: planiranje, obezbeđenje i poboljšanje bezbednosti (slika 2).*

*Proces poboljšanja podrazumeva definisanje korektivnih mera i rešenja kojima se deluje na uzroke odstupanja ostvarenog od planiranog kvaliteta – nivoa bezbednosti transporta.*

*Za poboljšanje bezbednosti transporta opasnog tereta za potrebe VS upotrebljen je benčmarking koncept. Suština te metode je u poređenju s drugim vojskama i organizacijama koje se bave transportom opasnog tereta i pronalaženju aktivnosti i procesa koji se smatraju boljim od onih koji se realizuju u Vojsci Srbije. Takođe, to iskustvo i praksa treba da se prenesu i prilagode realnim uslovima izvršenja transporta opasnog tereta za potrebe Vojske.*

Korektivne mere za poboljšanje bezbednosti transporta opasnog tereta za potrebe Vojske Srbije

*Pod korektivnim merama podrazumevaju se mere, postupci i aktivnosti za otklanjanje uzroka razlike između stvarnog i projektovanog stanja u procesu koji se analizira. Postoje kratkoročne i dugoročne korektivne mere.*

*Kratkoročne mere pripadaju grupi operativnih mera i mogu da se sprovedu u kraćem vremenskom periodu. U tu grupu spadaju:*

- 1. formiranje bezbednosne liste podataka (identifikacija i karakterizacija) opasnih materija koje se transportuju za potrebe VS;*
- 2. izrađivanje uputstva o posebnim merama bezbednosti za materije koje se transportuju za potrebe VS;*
- 3. informisanje vozača o putevima i o vrsti opasnog tereta pre početka transporta;*
- 4. izbor vozila i ostalih sredstava za manipulaciju i transport opasnog tereta koji mora da obavi stručno lice u jedinici (savetnik za bezbednost saobraćaja, lice koje je osposobljeno za obavljanje zadataka transporta i drugi);*
- 5. određivanje putnih i alternativnih pravaca prema karakteristikama opasne materije koja se transportuje;*
- 6. određivanje vrste sudova u kojima se mogu transportovati opasne materije, tj. teret (cisterne, kutije, kontejneri, boce, burad, kante, kese).*

*Dugoročne mere su one koje za čije je sprovođenje potreban duži vremenski period. U njih spadaju:*

- 1. skladištanje vojnih pravila, uputstava i propisa s nacionalnim regulativama;*
- 2. uvođenje savetnika za bezbednost saobraćaja u komandama brigada i komandama operativnog nivoa;*
- 3. završavanje dela voznog parka namenskim vozilima za obavljanje transporta opasnog tereta;*
- 4. obezbeđenje uslova za praćenje transporta opasnog tereta u realnom vremenu i prostoru.*

Ocena efekata primene korektivnih mera za poboljšanje bezbednosti transporta opasnog tereta za potrebe Vojske Srbije

*Provera bezbednosti transporta opasnog tereta važna je pretpostavka za preventivno osiguranje bezbednog transporta. Glavne faze u sprovođenju provere (projekta) jesu (slika 4):*

- 1. priprema (planiranje),*
- 2. sprovođenje,*
- 3. vrednovanje.*

Vrednovanje bezbednosti transporta opasnog tereta za potrebe Vojske Srbije

*Osnovni cilj vrednovanja bezbednosti transporta opasnog tereta putem provere postupka jeste utvrđivanje stepena podudarnosti stvarnog stanja sa planiranim zahtevima. Zbog toga se dobijeni odgovori podvrgavaju analizi na osnovu jedinstveno definisane šeme vrednovanja. Rezultat vrednovanja su indikatori, koji pokazuju stepen odstupanja performansi od projektovanih kvalitativnih zahteva (stepen zadovoljenja zahteva).*

Sprovođenje provere bezbednosti transporta opasnog tereta za potrebe Vojske Srbije

*Za sprovođenje provere neophodan je sistematičan postupak, u kojem pojedini koraci moraju prethodno da se isplaniraju i pripreme. Zbog toga sistem provere treba da bude strukturiran kao projekat sa: rukovodiocem projekta, planom projekta, zadacima, terminima i definisanom odgovornošću subjekata koji ga sprovode.*

*Dužina sprovođenja provere zavisi od veličine i broja jedinica u kojima se projekat sprovodi i od broja angažovanih lica (saradnici).*

Zaključak

*Preduzimanje preventivnih i zaštitnih mera u svim fazama transporta opasnog tereta za potrebe VS preduslov je za njegovu realizaciju, odnosno za svođenje na najmanju meru rizika od nastajanja nezgoda ili akcidenta i efekata njihovih posledica.*

*Povećanje bezbednosti transporta opasnog tereta u VS moguće je samo ukoliko se uočeni propusti prevaziđu i otklone. Zbog toga je potrebno da se realizuju sledeći zadaci i aktivnosti:*

1) da se definišu mesto i uloga transporta opasnog tereta u transportnom sistemu VS, pri čemu treba jasno definisati zadatke i nosioce transporta;

2) da se dimenzionira vozni park za transport opasnog tereta na osnovu potreba potčinjenih jedinica za takvim transportom i da se, u skladu sa tim, postojeći vozni park zanovi adekvatnim vozilima;

3) da se sagledaju, na osnovu postojećih skladišta opasnih materija u VS i potreba jedinica, tokovi tereta i definišu rute kojima bi se obavljao transport opasnog tereta za potrebe VS;

4) da se napravi projekat uvođenja savremenih tehnologija transporta opasnog tereta u transportni sistem Vojske Srbije.

Ključne reči: *bezbednost transporta, opasan teret, model, korektivne mere, Demingov pristup, benčmarking koncept.*

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