

ANALYSIS OF KEY ISSUES FOR TRANSPORT DANGEROUS GOODS IN SERBIA

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Abstract: The transport of dangerous goods poses a significant challenge for the industry, given the potential risks to safety and the environment. This paper analyzes key aspects of regulation and training that affect the efficiency and safety of this sector. Based on a literature review, a survey was developed and conducted in 2023 among 204 respondents, professionals in the field of dangerous goods transport in Serbia. The survey was distributed through electronic channels, allowing for broad access to various industry participants. It encompasses questions that describe six constructs: assessment of the dangerous goods transport environment, legal framework and regulatory familiarity, vehicle classification and documentation, training and certification, vehicle inspection and maintenance, and statistics and procedural aspects. The survey results indicate varying levels of satisfaction with regulation and training. According to the respondents, 35% rated the regulatory process for obtaining a professional competence certificate for dangerous goods advisors as "very good," while 24.8% rated it as "satisfactory." Regarding the training content for certificate renewal, 29.1% of respondents rated the content as "very good," but 10.2% expressed dissatisfaction, suggesting a need for improvement in training programs. The analysis of administrative costs reveals that only 5.8% of respondents rated these costs as "excellent," indicating a need for strategies to reduce costs to enhance accessibility and competitiveness in the dangerous goods transport sector.

Keywords: Transport of dangerous goods, professionals, survey, Serbia.

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1. Introduction

The growing global volume of dangerous goods transport brings significant risks and challenges to public safety and the environment, with accidents and incidents often causing severe damage. Transporting dangerous goods, such as flammable gases, chemicals, explosives, and toxic substances, requires high safety standards in both urban and rural areas. International literature highlights numerous key issues related to dangerous goods transport, including inadequate infrastructure, unreliable monitoring systems, lack of driver training, and inconsistencies in data critical for risk assessment. Due to these factors, researchers worldwide are dedicated to identifying and quantifying these problems to reduce the frequency of accidents and incidents in dangerous goods transport.

One central issue in dangerous goods transport, according to international studies, is the inadequate infrastructure, which is often not suited to the specific requirements of this type of transport (Nowacki et al., 2016). Many countries have outdated networks of roads and bridges that cannot safely support the flow of vehicles carrying dangerous goods, thus increasing the risk of accidents (Łukasik et al., 2016). Additionally, there is a need for improved organizational frameworks and strategies for more efficient risk management in dangerous goods transport. Contemporary studies in the transport field emphasize that infrastructure upgrades and regular inspections can significantly reduce risks associated with the movement of dangerous substances.

Monitoring and tracking technology for dangerous goods transport is another major challenge explored in numerous studies. Tracking systems, such as GPS devices and digital maps, enable precise tracking of vehicle routes and movements but remain in developmental and implementation phases in many countries. While some nations have adopted modern systems, maintaining and updating them poses additional costs, creating challenges for effective application. Due to the complexities of dangerous goods transport procedures, it is crucial to ensure that technology not only tracks vehicles but also anticipates potential risks and alerts for possible incidents, which is a primary focus in recent literature (D'Alonzo; Nowacki et al., 2016).

Safety culture and driver training are critical factors in dangerous goods transport safety, as noted in numerous international sources. Research indicates that driver training does not always meet the required standards, particularly in countries with limited resources for specialized training and certification. Training drivers in handling dangerous goods, responding to emergency situations, and understanding relevant legal norms is essential to risk reduction (Nowacki et al., 2016). Global experiences show that investments in continuous training and strict qualification controls for drivers have proven to enhance safety levels in the transport of these materials (Phillips, 1896; Bęczkowska & Grabarek, 2021).

In conclusion, international research on dangerous goods transport highlights a range of critical issues and challenges that require urgent attention and are equally relevant to the Republic of Serbia. Issues such as outdated infrastructure, inadequate monitoring technology, and insufficient driver training create high demands for systemic improvements and the establishment of new safety standards (Petrovic et al., 2020). Analyzing these key issues contributes to a global understanding and adoption of best practices that can serve as guidelines for improving dangerous goods transport systems, while comparisons with Serbia's situation can support the development of national strategies to enhance safety in this field.

2. Methodology

The methodology for this study is based on a comprehensive review of relevant international literature, which guided the development of a questionnaire targeting key issues in dangerous goods transport (Petrovic et al., 2020; Batarliene, 2020; Dumlupinar & Öztürkoğlu, 2019; Batarline, 2020; Janno, 2019; Janno & Koppel, 2018). A total of 204 participants, all professionals within the field of dangerous goods transport in Serbia, were surveyed. The survey was conducted throughout 2023 and distributed through various channels, including professional networks, direct outreach to transportation companies, and sector-specific online platforms to ensure representative coverage. The target sample included a diverse range of professionals, such as logistics coordinators, transport managers, drivers, and regulatory compliance officers, to capture a broad understanding of issues in dangerous goods transport (Janno, 2019). Participants were contacted to voluntarily participate, and the survey was anonymous, ensuring open and honest responses.

The survey covered six constructs designed to address specific areas of interest in dangerous goods transport. These constructs include:

1. Assessment of the TDG Environment, focusing on participants' perspectives regarding current conditions and prevalent risks;
2. Legal Framework and Regulatory Familiarity, assessing familiarity and perceived adequacy of regulatory requirements;
3. Vehicle Classification and Documentation, addressing classification practices and accuracy of documentation used in transit;
4. Training and Certification, focusing on the availability and sufficiency of training programs for personnel;
5. Vehicle Inspection and Maintenance, examining the frequency and thoroughness of inspections; and
6. Statistics and Procedural Aspects, covering data collection practices and procedural effectiveness.

This structure allowed for a detailed examination of the current situation and professional opinions on areas for improvement within Serbia's dangerous goods transport system.

3. Results

The survey results provide an in-depth overview of the demographic characteristics and current conditions in the dangerous goods transport sector in Serbia. Most respondents were male (81.1%), with females comprising 18.4% of the sample, reflecting the industry's male-dominated nature. This gender distribution aligns with global trends and provides context for understanding how gender dynamics may influence experiences and attitudes toward safety, risk perception, and compliance in dangerous goods transport. Furthermore, the majority of respondents fell into the 31-40 age range, suggesting that a substantial portion of the workforce consists of relatively young professionals. This younger demographic may have more recent training and familiarity with modern safety practices, which could affect their perspectives on regulatory effectiveness and adherence to safety protocols.

In terms of educational qualifications, the survey revealed that a significant majority of professionals hold at least a bachelor's degree, with varying educational backgrounds contributing to the knowledge base and practical skills within the field. The diversity in educational attainment, suggests a range of expertise levels among the workforce, which is essential for addressing complex issues in dangerous goods transport (Janno & Koppel, 2018). Highly educated professionals may be more likely to advocate for stringent safety measures

and adhere to regulatory guidelines, while those with practical experience bring hands-on knowledge critical for identifying real-world challenges in daily operations.

The survey results on the assessment of the dangerous goods transportation (TDG) environment indicate a mix of professional opinions regarding safety and operational standards. A substantial portion of respondents (34%) rated the TDG conditions as "Good," reflecting a generally positive outlook on the safety measures and regulatory compliance within their countries. Another 16% rated it as "Adequate," and smaller groups rated it as "Excellent" (11.2%) and "Very Good" (8.6%), showing varied satisfaction levels within the industry. However, a significant 24.3% expressed dissatisfaction, rating the environment as "Unsatisfactory," which points to specific areas of concern, such as safety risks or regulatory inefficiencies. These responses reveal both confidence in the current systems among many professionals and the need for continued improvement in some operational aspects to enhance safety and efficiency in TDG (Figure 1).

The survey results on the "Legal Framework and Regulatory Familiarity" in the transportation of dangerous goods (TDG) reveal a mix of perspectives among professionals regarding their understanding and confidence in existing legal structures. A majority (34.5%) rated their national legal framework as "Good," while 29.6% considered it "Very Good" and 15.0% rated it as "Excellent." This suggests that many professionals believe their country's regulations provide a solid foundation for TDG activities. However, a portion found the framework "Adequate" (11.7%) or "Unsatisfactory" (9.2%), indicating areas for potential improvement. In terms of EU Directives familiarity, 33.5% rated their knowledge as "Very Good," and 19.4% as "Excellent," showing substantial expertise among professionals, although some respondents indicated "Adequate" (28.2%) or "Unsatisfactory" (8.7%) familiarity, pointing to training needs (Figure 1).

When it comes to familiarity with TDG inspection records, responses showed a high level of confidence, with 36.9% rating their understanding as "Very Good" and 17.5% as "Excellent." This highlights a general proficiency, although 28.6% considered their familiarity "Adequate," and a minority (6.8%) felt "Unsatisfactory," suggesting further training could help standardize record-keeping practices. Regarding knowledge of violations and penalties, 33.0% of respondents rated their familiarity as "Very Good," and 22.3% as "Excellent," reflecting strong awareness. Still, some professionals reported only "Adequate" (26.2%) or "Unsatisfactory" (5.8%) knowledge, underscoring a need for continuous education. These results suggest that while there is substantial expertise among TDG professionals, there is room for enhanced training to ensure full regulatory compliance and safety across the board (Figure 1).

The results for the "Vehicle Classification and Documentation" section indicate varying levels of knowledge among professionals regarding the classification and documentation requirements for vehicles used in transporting dangerous goods (TDG). Specifically, Question 6 revealed that 38.8% of respondents rated their familiarity with vehicle classification requirements as "Very good," and 18.4% as "Excellent," reflecting a high level of expertise among a significant portion of participants. However, 9.7% indicated "Unsatisfactory" familiarity, suggesting a need for further training. Similarly, responses to Question 7 showed that 39.8% of respondents felt "Very good" about their understanding of mandatory TDG documentation, while 25.2% rated their knowledge as "Excellent." A minority, 5.3%, reported "Unsatisfactory" familiarity, highlighting the need for enhanced training in this area as well. Overall, the results underscore a strong understanding of both vehicle classification and documentation requirements among the majority, though with room for improvement in some areas (Figure 1).

The survey assessed respondents' experiences and satisfaction with training and certification programs related to the transportation of dangerous goods (TDG). The results

indicate varying degrees of satisfaction across several key aspects of these programs. Regarding the implementation and adherence to special safety measures during TDG operations, 27.7% of respondents rated their satisfaction as "Very good," while 23.3% deemed it "Adequate," and 12.1% reported "Unsatisfactory" satisfaction. When evaluating the content of the training program for obtaining the ADR certificate, 30.1% of respondents expressed "Very good" satisfaction, and 20.4% rated it as "Excellent," whereas 11.7% found it "Unsatisfactory". The quality of instruction and knowledge transfer received similar feedback, with 29.1% indicating "Very good" satisfaction and 19.9% rating it "Excellent," while 11.2% reported "Unsatisfactory" satisfaction. For the renewal of the ADR certificate, 27.2% of respondents expressed "Very good" satisfaction with the training program's content, but 11.7% indicated "Unsatisfactory" levels of satisfaction. Additionally, satisfaction with the control and maintenance of TDG vehicles revealed that 27.2% rated their satisfaction as "Very good," with only 10.7% reporting "Unsatisfactory". Overall, these findings suggest that while a significant proportion of professionals are satisfied with the training and certification programs, there remains a notable minority who express dissatisfaction, highlighting areas for potential improvement in TDG training and practices (Figure 1).



Figure 1. The survey results

Source: Authors

The analysis of the survey data regarding vehicle inspection and maintenance for the transportation of dangerous goods (TDG) reveals varied levels of satisfaction among professionals in the field. Specifically, when asked about their satisfaction with control and maintenance procedures for TDG vehicles, 25.2% rated these procedures as "Good," while 23.8% deemed them "Adequate." Additionally, 20.4% of respondents expressed that the procedures are "Very good," and 13.1% rated them as "Excellent." However, a notable minority, comprising 17.5% of respondents, reported "Unsatisfactory" satisfaction with these procedures. These findings indicate that while a majority of professionals are generally satisfied with the current practices, there remains a significant portion indicating potential areas for improvement. Understanding these sentiments is crucial for enhancing the effectiveness and compliance of vehicle inspection and maintenance procedures, thereby contributing to safer transportation practices within the TDG sector (Figure 1).

The survey results regarding the availability and procedural aspects of statistics related to traffic accidents involving vehicles for the transportation of dangerous goods (TDG) highlight significant concerns within the professional community (Li et al. 2021). When asked if special statistics and data analysis on TDG-related traffic accidents exist in their countries, a substantial 47.6% of respondents reported that the availability is "Unsatisfactory," indicating a notable lack of comprehensive data in many regions. In contrast, only 28.2% rated the availability as "Excellent," suggesting that while some countries may have robust statistical practices, they are not the norm. These findings underscore the pressing need for improvements in data collection and analysis processes to support informed decision-making and enhance safety measures (Figure 1).

In addition to the statistics, the survey assessed satisfaction levels regarding various inspection procedures for obtaining and renewing ADR vehicle certifications. For the initial inspection procedure, 27.7% of respondents found it to be "Good," while 25.2% rated it as "Very good." However, 8.3% reported "Unsatisfactory" satisfaction, indicating areas that may require enhancement. Similarly, for the renewal inspection procedure, 29.1% rated it as "Good," but 9.7% expressed dissatisfaction. Regarding the process of obtaining permits and approvals for TDG transportation, a notable 24.8% found it "Very good," while 16.0% were "Unsatisfied." Overall, these results reflect a mixed landscape of satisfaction with inspection and procedural practices, highlighting both strengths and areas for improvement in the management of TDG transportation (Figure 1).

The survey conducted on regulations and approval processes concerning the certification of Dangerous Goods (TDG) advisors reveals diverse perceptions among professionals across different countries. Respondents provided insights into various aspects, including certification levels, training program content, administrative fees, and legal frameworks governing TDG operations. A significant portion of respondents expressed a positive outlook on the regulation of the process for obtaining a Certificate of Professional Competence for TDG Advisors. Specifically, 35.0% rated the regulation as "Very good," indicating a generally high level of satisfaction. Additionally, 24.8% found the regulation "Adequate," while 14.6% rated it as "Excellent." However, 10.2% of respondents considered the regulation "Unsatisfactory," highlighting areas that require attention and improvement. Respondents shared their opinions on the content of training programs designed for renewing TDG advisor certifications. A noteworthy 29.1% rated the training content as "Very good," with an additional 16.0% considering it "Excellent." However, 10.2% expressed dissatisfaction, pointing to a need for enhancements in training materials to ensure that advisors remain adequately prepared. The survey results indicated mixed feelings regarding administrative fees associated with obtaining required permits for TDG operations. While 15.0% found the fees "Adequate," a larger percentage, 13.1%, viewed them as "Unsatisfactory." The diversity in opinions suggests

potential areas for reform in the financial aspects of TDG compliance. When asked about the legal framework for producing new TDG vehicles, 34.0% of respondents rated it as "Very good," suggesting a solid foundation for regulatory oversight. Nonetheless, 17.0% reported dissatisfaction, indicating that certain legal aspects may need to be revisited to improve safety standards further. Satisfaction with the technical regulations for new TDG vehicle production control was also varied. A notable 31.6% rated these regulations as "Very good," while 19.9% reported "Unsatisfactory" experiences. Similarly, regarding the approval process for operating new TDG vehicles, 30.6% expressed satisfaction with the procedures, but 11.7% were not satisfied. These findings underscore the need for ongoing evaluations and adjustments to regulatory practices to enhance operational safety in the TDG sector. (Figure 1)

4. Discussion

The study on the state of dangerous goods transportation (TDG) in Serbia reveals several key aspects related to regulation, training, administrative costs, legal framework, technical control, and vehicle approval for the transport of hazardous materials (Gusik et al., 2012; Cui, 2010). These findings are significant for understanding the current status and the need for improvement in the system.

- Regulation and Training. According to the respondents, the level of regulation for obtaining a professional competence certificate for TDG advisors was rated variably. The majority of respondents, 35%, considered the regulatory process to be "very good," while 24.8% rated it as "satisfactory." These results indicate a general satisfaction with the current state, but also a need for further enhancements, which may include improving the training content and providing additional resources for advisors.
- Training Program Content. Regarding satisfaction with the training content for certificate renewal, the results show that 29.1% of respondents believe the training content is "very good," while 16% rate the program as "excellent." However, 10.2% of respondents expressed dissatisfaction, indicating the need for a review and improvement of training programs to ensure they align with modern needs and challenges in the field of dangerous goods transportation.
- Administrative Costs. Administrative costs associated with obtaining the necessary permits were also analyzed. Only 5.8% of respondents rated these costs as "excellent," while 13.1% deemed them "unsatisfactory." This discrepancy suggests the need to consider strategies for reducing costs, which could contribute to greater accessibility and competitiveness in the dangerous goods transportation sector.
- Legal and Technical Regulation. Satisfaction with the legal framework for the production of new vehicles for dangerous goods transportation was expressed by 34% of respondents who rated it as "very good." However, 17% felt the current legal framework was "unsatisfactory." Technical regulation showed similar trends, with 31.6% of respondents satisfied. These insights suggest a need to strengthen the legal and technical frameworks to enhance safety and efficiency in dangerous goods transportation.
- Approval Process. Finally, the approval process for operating new vehicles for dangerous goods transport is another critical component. With 30.6% of respondents considering the process "very good," there is general satisfaction. Nonetheless, 11.7% stated that the process was "unsatisfactory," which may signal a need to streamline procedures and improve efficiency.

These findings provide valuable insights into the current state of dangerous goods transportation in Serbia. While there is overall satisfaction with regulations and procedures, the

results highlight significant opportunities for improvement, particularly in areas such as training, administrative costs, and the efficiency of the approval process. Enhancing these aspects will not only contribute to safer transportation of hazardous materials but also elevate the competitiveness of the sector at regional and international levels. It is recommended that strategic plans be developed to implement these improvements, with active involvement from all relevant stakeholders in the process.

5. Conclusion

The Dangerous Goods Transportation (DGT) survey presents a significant contribution to understanding the industry's landscape by revealing both strengths and weaknesses in the current practices surrounding the transportation of hazardous materials (World Health Organization, 2024; Deng & Sun). The comprehensive nature of the survey, along with the diverse respondent pool, allows for valuable insights into various aspects such as regulatory compliance, training effectiveness, and safety measures. These strengths underscore the survey's potential to inform stakeholders and enhance decision-making in DGT operations. However, it is equally crucial to acknowledge the limitations identified in the survey, such as the limited sample size and geographic concentration, which may compromise the generalizability of the findings.

The weaknesses outlined in the survey provide an essential context for understanding its limitations and guiding future improvements. Identifying issues such as self-selection bias and language barriers highlights the need for more inclusive data collection methods that can capture a wider range of experiences and perspectives. Additionally, the reliance on self-reported data calls for the incorporation of objective verification methods to enhance the reliability of the information gathered. Recognizing these shortcomings is vital for developing a more robust framework for future surveys in the field of dangerous goods transportation.

Opportunities for improvement are abundant, as the DGT survey can be enhanced by expanding the sample size and geographic diversity of respondents. Targeted outreach to various industry segments and the inclusion of multiple languages could significantly increase participation and ensure a more representative dataset. Furthermore, implementing follow-up surveys and in-depth interviews can provide a richer context and a more comprehensive understanding of industry dynamics. Such improvements would not only strengthen the survey's findings but also better align them with the evolving needs of the DGT sector.

Despite the potential threats posed to the survey's effectiveness, proactive measures can be taken to mitigate these risks. Addressing non-response bias and ensuring the reliability of self-reported data are critical to maintaining the survey's credibility. Additionally, overcoming language barriers and biases in question design will help achieve more accurate and diverse insights. Implementing robust data security measures is also essential to protect respondent confidentiality and trust, further ensuring the integrity of the survey.

In summary, the DGT survey is a valuable tool for gaining insights into the challenges and practices of dangerous goods transportation (Stojanovic et al., 2023). By leveraging its strengths and addressing its weaknesses, the survey can evolve into a more effective instrument for industry stakeholders. The ongoing assessment of survey methodologies and the incorporation of stakeholder feedback will enhance its relevance and impact. Ultimately, these efforts will contribute to improving safety, efficiency, and compliance in the transportation of hazardous materials, thereby fostering a more informed and proactive industry.

The future of the DGT survey lies in its ability to adapt to the changing landscape of dangerous goods transportation, ensuring it remains a pertinent and credible resource for professionals and policymakers alike. By embracing opportunities for enhancement and

addressing inherent threats, the survey can serve as a cornerstone for fostering innovation and promoting best practices in the field. Continuous engagement with the DGT community will be essential in refining the survey's approach and maximizing its potential to influence positive change across the industry.

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