DOI:10.32703/2617-9059-2024-43-10

UDC 656.25

Olena Bal[1], Volodymyr Tverdomed[2], Oresta Kovalchuk[3]

[1]Candidate of technical sciences, Associate Professor, Head of Department of Railway Transport, Lviv Polytechnic National University, Stepana Bandery str., 12, Lviv, 79000; Judicial expert, Lviv Scientific Research Institute of Forensic Science, st. Lypinsky, 54, Lviv, 79024. ORCID: https://orcid.org/0000-0003-2188-4098.

[2]Candidate of technical sciences, Associate Professor, director of the Kyiv Institute of Railway Transport, State University of Infrastructure and Technologies, Kyrylivska Str., 9, Kyiv, 04071. ORCID: https://orcid.org/0000-0002-0695-1304.

[3]Head of the sector, Lviv Scientific Research Institute of Forensic Science, st. Lypinsky, 54, Lviv, 79024; Postgraduate student, Kyiv Institute of Railway Transport State University of Infrastructure and Technologies, Kyrylivska Str., 9, Kyiv, 04071 ORCID: https://orcid.org/0000-0002-8570-313X.

***Corresponding author**: olena.m.bal@lpnu.ua

Innovative approaches to developing national railway safety policy and training safety leaders

The article is aimed at considering innovative approaches in the formation of the national policy on safety in railway transport and on the training of safety leaders in this strategically important field. Focusing on today's challenges and opportunities, the article aims to identify key areas of development where innovation can improve safety and improve leadership training. It assesses the impact of technological and innovative changes on railway safety. The research also examines mechanisms and methods for introducing innovations into national railway safety policy, focusing on best practices from other countries and analysing the positive outcomes of such implementations. Additionally, it evaluates the competencies and skills required for leaders in the rail safety industry, highlighting key aspects of a leadership approach to solving security problems and developing national strategies. Furthermore, the study aims to develop training programs for security leaders by identifying essential elements and directions for training and creating innovative methods for skill development that address modern requirements and challenges in railway safety. This research provides a roadmap for enhancing railway safety through innovation and effective leadership, proposing actionable solutions and best practices to improve safety standards in the railway sector.

***Key words**: Railway safety, national policy, safety leadership, risk factors, training programs*

Introduction. Maintaining public trust in the safety of the railway transportation system is crucial for the sustainable development of the industry. Transparent communication about safety measures, incident investigations, and corrective actions is essential for building and maintaining trust among passengers and stakeholders.

Modern railway transportation systems are characterized by increased volumes of passenger and freight traffic. Such a change in operational conditions places additional stress on railway infrastructure and operations, increasing the likelihood of accidents and incidents. Technological progress, such as automation and digitalization, opens new opportunities for enhancing railway safety but simultaneously creates new risks, particularly in the area of cybersecurity. Meanwhile, many railway transportation systems, especially in Ukraine, suffer from aging infrastructure, which poses safety risks due to deteriorating track conditions and outdated signalling systems.

It is worth noting that addressing environmental issues, such as climate change and pollution, is becoming increasingly important for railway safety. The implementation of environmentally friendly technologies and practices can reduce the impact of railway operations on the environment while simultaneously enhancing safety.

Railway networks often operate across multiple countries, requiring coordination and harmonization of safety standards and regulations. Enhanced cooperation between EU member states and neighboring countries, such as Ukraine, is crucial for ensuring consistent safety practices across borders.

Changes in the legal framework for railway safety, both in the EU and Ukraine, aim to raise safety standards and ensure compliance with international norms. However, effectively implementing these changes at all levels of the industry remains a challenging task.

The ability to effectively manage and respond to incidents, such as derailments or collisions, is crucial for minimizing their impact on railway safety.

The human factor continues to be a significant contributor to railway accidents. Ensuring comprehensive training programs for railway personnel, including drivers, maintenance workers, and signaling staff, is essential for mitigating risks associated with human safety [1-3].

Analysis of recent research and problem statement.

The research [1] conducted by the Institut pour une culture de sécurité industrielle (Icsi) focuses on enhancing safety improvements in businesses that have already made significant strides in the domain. The key focus of this study is on the Human and Organizational Factors of Safety, specifically the development of managerial leadership in safety.

The research emphasizes that managerial behavior has the most substantial influence on staff conduct. This finding underscores the critical role that managers play in shaping the safety culture within an organization (Fig. 1).

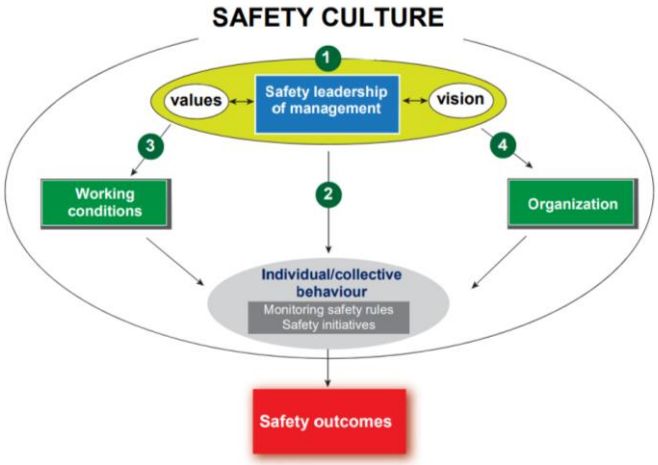

Fig. 1. **Safety leadership [1]**

Management is highlighted as pivotal in handling trade-offs between safety and other operational concerns. This role requires managers to prioritize safety without compromising other essential aspects of the business.

The study asserts that site safety cannot solely be the responsibility of Health, Safety, and Environment (HSE) specialists. Instead, it requires a broader involvement from all levels of management and staff.

The discussion group faced difficulties in making specific recommendations for establishing leadership in safety. This led to the formation of the “Leadership in Safety” Working Group to delve deeper into understanding the conditions that foster leadership.

The Working Group began by examining professions where leadership is critical, such as plant directors, construction managers, maintenance shutdown managers, and HSE actors. This approach provided initial insights but was deemed insufficiently comprehensive.

Recognizing the need for a broader perspective, the research expanded to include views from local supervisors, team leaders, and members of the Health and Safety committee. This inclusion aimed to develop a more grounded and practical concept of leadership.

The Working Group identified a set of broad leadership principles applicable across various professions and functions. These principles served as a foundation for further exploration.

This research underscores the indispensable role of managerial leadership in enhancing safety culture and practices within industrial settings. It highlights the necessity for inclusive and comprehensive approaches that involve various levels of the organization. The practical advice derived from the seminars and discussions aims to aid professionals in effectively implementing and improving safety leadership, thereby fostering a safer working environment.

The Leadership in Safety Working Group identified and described seven general leadership principles that are crucial for promoting safety in the workplace [1]. These principles were developed based on typologies used by the employers of the group members. Each principle was translated into concrete action axes, summarizing good practices and action principles aimed at safety leaders at all levels. Below is a detailed analysis of these principles (Table 1).

Table 1. **Analysis of safety leadership principles and action axes**

Principles	The name of the principle	Analysis
1	2	3
Principle 1	Create a safety vision coherent with management values and principles	A coherent safety vision aligns with management values, ensuring that safety is integrated into the core values of the organization. This principle emphasizes inclusivity and collective responsibility, involving all stakeholders in developing a shared safety vision. The action axes focus on establishing clear goals and fostering a culture of accountability.
Principle 2	Give safety its rightful place in the organization and management	This principle ensures that safety is embedded in the organizational structure and daily operations. It emphasizes clear role definitions, resource allocation, and proactive obstacle removal to facilitate a continuous focus on safety. Involving all stakeholders, including service providers, in safety monitoring fosters a comprehensive safety culture.
Principle 3	Share the safety vision	Effective communication is key to sharing the safety vision. Regular reminders, clear communication, and fostering a culture of trust and transparency are crucial. Encouraging risk observation and supporting initiatives help maintain high safety standards and collective responsibility.
Principle 4	Be credible and provide a coherent example	Credibility in leadership is vital for fostering a safety culture. Leaders must demonstrate expertise, fairness, and daily commitment to safety. Personal involvement in safety plans and the ability to challenge and question practices reinforce the leader's commitment and credibility.
Principle 5	Promote team spirit and horizontal cooperation	Promoting team spirit and cooperation is essential for effective safety management. Encouraging discussion, sharing tools, and fostering close relationships between safety officials and field workers ensure a collaborative approach to safety. Emphasizing collective responsibility and transparency enhances the overall safety culture.

Continuation of Table 1.

1	2	3
Principle 6	Be available on-site to observe, listen, and communicate	On-site presence and active listening are crucial for effective safety leadership. Regular field visits, meetings, and involving service providers enhance communication and understanding of safety issues. Highlighting successes and addressing challenges directly with stakeholders foster a proactive safety culture.
Principle 7	Acknowledge good practice and apply fair sanctions	Recognizing and rewarding good practices, while fairly sanctioning unacceptable conduct, reinforces the importance of safety. Transparent justification of sanctions and celebrating successes motivate employees to adhere to safety standards and foster a positive safety culture

The seven principles and their corresponding action axes provide a comprehensive framework for enhancing safety leadership in industrial settings. By emphasizing vision, integration, communication, credibility, cooperation, presence, and recognition, these principles aim to create a robust safety culture that permeates all levels of an organization.

The implementation of innovations in the formation of national railway safety policies in the European Union (EU) is based on various mechanisms and tools. Here are some of them along with examples:

1. *Creation of innovative programs and initiatives*. The EU actively promotes the creation of programs and initiatives aimed at supporting innovations in the railway sector. For example, the "Evaluation of Rail Innovation Programme" [4, 5] funds research and the development of new technologies and safety practices.
2. *Standardization and harmonization*. The EU encourages the standardization and harmonization of the regulatory environment to facilitate the implementation of innovations. For instance, Directive 2016/798/EC [6] on railway safety establishes common principles and safety requirements for EU railways.
3. *Establishment of innovative partnerships*. The EU actively supports the creation of partnerships between industry players, government bodies, and academic institutions for the joint implementation of innovative projects. An example is the Shift2Rail project [7, 8], a joint initiative between the EU and railway companies to develop new technologies and market solutions for railway transport.
4. *Funding of innovative projects*. The EU provides financial support for innovative projects in the railway sector through various programs and funds. For instance, the Horizon Europe program [9] finances research and innovation across all sectors, including transport.
5. *Stimulating the development of the innovation market*. The EU actively promotes the creation of a competitive market for innovations in the railway sector by ensuring equal access conditions for various suppliers and developing innovative market models.

An example of a successful EU innovative initiative is the Shift2Rail program, which aims to create new technologies and innovative solutions for railway transport to enhance the efficiency, safety, and sustainability of the system. This program unites the efforts of industry players and railway companies for the joint implementation of projects focused on the development of new technologies and innovative solutions [10].

The purpose and tasks of the study. The purpose of this research is to explore innovative approaches towards the establishment of a comprehensive national policy on railway safety and the cultivation of effective safety leaders within the railway industry.

Objectives of the study:

1. To study the mechanisms of introducing innovations into national policy. Consider various mechanisms and methods of introducing innovations in the formation of national railway safety policy, focusing on best practices from other countries. To analyse the positive results of the implementation of innovative approaches in national security strategies.

2.To evaluate leadership competencies in railway safety. Conduct an analysis of the competencies and skills needed by leaders in the rail safety industry. Identify the key aspects of a leadership approach to solving security problems and developing national strategies.

3. Develop training and training programs for security leaders. Identify the key elements and directions of the training and training program for leaders in the field of railway safety. To develop innovative methods of training and development of skills that will meet the modern requirements and challenges of railway safety.

Materials and methods of research. *Implementation of innovations in national policy for railway safety in Ukraine.*

The goal is enhance the safety and efficiency of Ukraine's railways through innovative approaches and align with international best practices and standards.

Mechanisms for introducing innovations is shown in the Fig. 2.

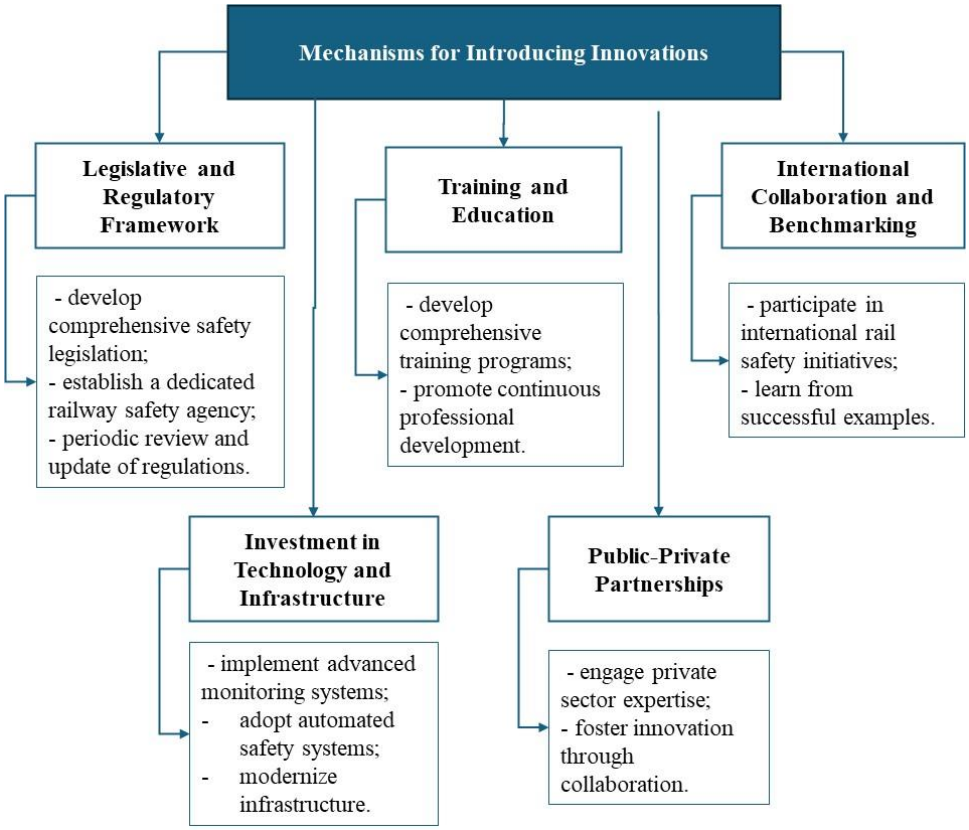

Fig. 2. **Mechanisms for introducing innovations**

Developing comprehensive safety legislation involves updating existing rail safety laws and ensuring compliance with European Union (EU) rail safety directives. An important condition is the creation of an independent body responsible for overseeing railway safety. Investments in technology and infrastructure should ensure the implementation of real-time monitoring systems for track condition, train operation and environmental factors. Predictive maintenance technologies must be used to identify and resolve potential problems before they cause incidents.

Development of specialized training programs for railway personnel incorporating the latest technology and safety practices is a necessity for the industry. Simulation-based learning to gain hands-

on experience is also important. Promotion of continuous professional development should encourage the improvement of skills and include certification of railway safety professionals.

Creating innovation hubs and collaborative platforms where government, industry and academia can work together on security projects is also important. The development and testing of new security technologies should be encouraged through pilot programs. International cooperation will make it possible to compare railway safety indicators in Ukraine with international standards, which will make it possible to adapt best practices in accordance with the specific conditions and needs of Ukrainian railways.

Practical examples of successful implementation:

1. *Japan:*
    - Shinkansen High-Speed Rail:
        - Uses advanced earthquake detection and automatic train control systems [11].
        - Achieved an unparalleled safety record with no passenger fatalities due to train accidents since its inception in 1964.
    - Key innovations:
        - Continuous track monitoring and maintenance.
        - Automated train protection systems and rigorous safety protocols.
2. *Germany:*
    - Deutsche Bahn's Digital Rail Strategy:
        - Implementation of the European Train Control System (ETCS) for standardized train control [12].
        - Use of digital technologies to enhance signaling, communication, and train operations.
    - Key innovations:
        - Predictive maintenance through digital diagnostics.
        - Enhanced safety through real-time monitoring and automation.
3. *France:*
    - SNCF's Safety Management Systems:
        - Comprehensive safety management systems integrating risk assessment, incident reporting, and continuous improvement [13].
        - Strong emphasis on staff training and safety culture.
    - Key innovations:
        - Implementation of advanced signalling systems like ERTMS (European Rail Traffic Management System) [14].
        - Proactive safety culture with regular safety drills and training programs.

Steps for implementing innovations in the formation of the national safety policy on the railways of Ukraine:

1. *Assessment of the current state*. A thorough assessment of the current railway safety situation in Ukraine needs to be carried out and key areas for improvement and potential for innovation identified.

2. *Development of a strategic plan.* It is necessary to formulate a strategic plan for the implementation of innovative technologies and practices and establish clear, measurable goals and time frames for implementation.

3. *Launch of pilot projects.* Pilot projects should be launched to test new technologies and approaches in selected regions or routes. This will allow you to evaluate the results and refine the implementation strategy based on the results.

4. *Expansion of successful initiatives.* In the future, it is necessary to gradually bring successful pilot projects to the national level and ensure constant monitoring and evaluation for adaptation to new challenges and opportunities.

5. *Involvement of interested parties.* It is important to involve all relevant stakeholders in the planning and implementation process, including government agencies, railway operators, industry experts and

the public. This will create a collaborative environment to ensure broad support and successful innovation.

Assessment of leadership competencies in the field of railway safety.

Railway safety leadership is a specific form of leadership focused on creating and maintaining a safe working environment in the railway industry. It includes management approaches, strategies and practices aimed at preventing injuries and accidents on the railway, as well as improving the safety culture among staff. Leadership in railway safety involves the active role of managers in setting safety standards, spreading safety skills and knowledge among employees, and establishing mechanisms for monitoring and controlling the implementation of safe work practices. Key characteristics of rail safety leadership include a commitment to safety, effective communication, the ability to make decisions in the face of uncertainty, and encouraging initiative and responsibility for safety in all employees.

Based on the analysis of the Leadership in Safety Working Group's principles [1] and their application to rail safety, here are seven principles specifically tailored for rail safety leaders (Table 2).

Table 2. **Seven principles specifically tailored for rail safety leaders**

Principles	The name of the principle	Action axes
1	**2**	**3**
Principle 1	Establish a Coherent Safety Vision	1. Develop a comprehensive rail safety policy aligned with management values. 2. Prioritize safety within the context of operational challenges. 3. Conduct regular safety assessments to set future goals. 4. Set specific, measurable, and achievable safety objectives. 5. Involve all stakeholders in creating and understanding the safety vision. 6. Use the vision to define accountability and expected conduct for all employees.
Principle 2	**Integrate Safety into All Levels of the Organization**	1. Embed safety practices across all organizational levels and departments. 2. Clearly define roles and responsibilities for safety among all staff. 3. Develop and implement an improvement plan that aligns with the overall safety vision. 4. Identify and mitigate obstacles to achieving safety goals. 5. Allocate necessary resources to support safety initiatives. 6. Make safety a daily priority and protect it from competing interests. 7. Involve service providers and staff in safety monitoring and improvement efforts.

Continuation of Table 2.

1	2	3
Principle 3	**Communicate and Share the Safety Vision**	1. Regularly communicate safety goals and expectations to all staff. 2. Reinforce safety messages to maintain vigilance and engagement. 3. Use clear, appropriate language to ensure understanding across all levels. 4. Create systems to identify and report safety risks, including weak signals. 5. Foster a climate of trust and transparency in safety communications. 6. Encourage and recognize good safety practices and initiatives. 7. Emphasize that safety is a collective responsibility.
Principle 4	**Demonstrate Credibility and Lead by Example**	1. Ensure all leaders have sufficient expertise in rail safety. 2. Exercise fair and honest judgment in safety matters. 3. Exemplify compliance with safety standards, even under challenging conditions. 4. Show daily commitment to safety through decisions and actions. 5. Be personally involved in implementing the Safety Action Plan. 6. Challenge and question safety practices, including those of senior staff. 7. Provide clear reasoning for safety decisions and ensure they are understood.
Principle 5	**Foster Team Spirit and Horizontal Cooperation**	1. Encourage team discussions to address safety issues and share best practices. 2. Implement coordination methods for a comprehensive view of risks. 3. Promote the sharing of safety tools and methodologies. 4. Strengthen relationships between safety officials and operational staff. 5. Ensure all team members feel included and share responsibility for safety. 6. Make teams accountable for each other's safety results. 7. Support transparency and collective progress in safety practices.

Continuation of Table 2.

1	2	3
Principle 6	**Be Present and Engage on the Ground**	1. Conduct regular site visits and establish clear safety requirements. 2. Hold frequent safety meetings with various departments. 3. Involve service providers in site visits and safety discussions. 4. Recognize and highlight positive safety practices. 5. Address and correct unsafe practices promptly. 6. Review field reports and follow up with relevant staff. 7. Meet with accident victims to understand issues and improve safety measures.
Principle 7	**Recognize Good Practices and Enforce Fair Sanctions**	1. Highlight and reward good safety practices and initiatives. 2. Offer incentives and raise safety awareness. 3. Celebrate collective safety achievements. 4. Select service providers committed to safety standards. 5. Define unacceptable safety behaviors and corresponding sanctions. 6. Analyze the context before applying sanctions to ensure fairness. 7. Transparently justify sanctions based on established safety rules.

These principles provide a comprehensive framework for rail safety leaders to cultivate a robust safety culture within their organizations. By focusing on vision, integration, communication, credibility, cooperation, presence, and recognition, rail safety leaders can effectively enhance safety standards and practices across all levels of their operations.

Competencies and skills needed by safety leaders in the rail industry.

Safety leaders in the rail industry require a diverse set of competencies and skills to effectively manage and enhance safety standards. These can be categorized into technical skills, interpersonal skills, strategic skills, and specific knowledge areas (Fig. 3-6).

Technical Skills

- *Risk Assessment and Management:*
  - Ability to identify, assess, and prioritize risks.
  - Proficiency in using risk assessment tools and methodologies.
- *Incident Investigation and Analysis:*
  - Competence in conducting thorough investigations to determine root causes of incidents.
  - Skills in applying analytical techniques to derive actionable insights.
- *Regulatory Compliance:*
  - Deep understanding of national and international railway safety regulations and standards.
  - Capability to ensure compliance with all relevant safety laws and guidelines.
- *Safety Management Systems:*
  - Expertise in developing, implementing, and maintaining effective safety management systems (SMS).
  - Knowledge of best practices in safety auditing and monitoring.

Fig. 3. **Technical Skills**

Interpersonal Skills

- *Communication:*
  - Strong verbal and written communication skills to convey safety policies and procedures clearly.
  - Ability to engage with all levels of the organization, from top management to frontline workers.
- *Leadership and Influence:*
  - Skills to inspire, motivate, and influence others to prioritize safety.
  - Ability to lead by example and foster a safety-first culture.
- *Conflict Resolution:*
  - Proficiency in addressing and resolving conflicts related to safety issues.
  - Capability to negotiate and mediate between different stakeholders.

Fig. 4. **Interpersonal Skills**

Strategic Skills

- *Visionary Thinking:*
  - Ability to develop a long-term vision for railway safety and align it with organizational goals.
  - Competence in setting strategic safety objectives and creating a roadmap to achieve them.
- *Change Management:*
  - Skills in managing and leading organizational change to improve safety culture and practices.
  - Ability to handle resistance to change and ensure smooth transitions.

Fig. 5. **Strategic Skills**

Specific Knowledge Areas

- *Human Factors:*
  - Understanding of how human behavior impacts safety and how to design systems that minimize human error.
  - Knowledge of ergonomic principles and their application in the railway environment.
- *Emergency Preparedness:*
  - Skills in planning and executing emergency response drills and procedures.
  - Capability to develop and maintain robust emergency preparedness plans.
- *Technological Innovations:*
  - Awareness of new technologies and innovations in railway safety.
  - Ability to evaluate and implement technological solutions to enhance safety.

Fig. 6. **Specific Knowledge Areas**

The importance of a leadership approach to solving railway safety problems and creating a national strategy is based on:

1. *Coordinated efforts and consistency.* A leadership approach ensures that safety initiatives are consistently implemented across the entire railway network. This coordination helps in avoiding fragmented efforts and ensures uniform safety standards.
2. *Strategic alignment.* Leadership is essential for aligning safety objectives with the broader goals of the railway industry. It ensures that safety is integrated into all strategic decisions and operational plans.
3. *Cultural transformation*. Effective leadership drives cultural change within organizations, promoting a safety-first mindset. Leaders can influence attitudes and behaviors, fostering a culture where safety is a shared responsibility.
4. *Enhanced communication and collaboration.* Safety leaders play a crucial role in facilitating communication and collaboration among various stakeholders, including regulatory bodies, railway companies, and the public. This collaboration is vital for addressing complex safety challenges.
5. *Proactive risk management.* Leadership enables proactive identification and management of risks. Leaders can anticipate potential safety issues and implement preventive measures before they escalate into serious incidents.
6. *Adaptability and innovation.* Leaders are pivotal in promoting and adopting innovative solutions to safety problems. They can drive the adoption of new technologies and practices [15, 16] that improve safety outcomes.
7. *Regulatory and public trust.* Strong safety leadership enhances compliance with regulatory requirements and builds public trust in the safety of the railway system. This trust is crucial for the continued growth and success of the railway industry.

Safety leaders in the rail industry need a comprehensive set of competencies and skills, spanning technical expertise, interpersonal abilities, strategic vision, and specific knowledge areas. A leadership approach to railway safety is critical for ensuring coordinated efforts, strategic alignment, cultural transformation, enhanced communication, proactive risk management, adaptability, and innovation. By fostering strong safety leadership, the railway industry can effectively address safety challenges and create a robust national safety strategy that protects both passengers and employees.

Key elements of an education and training program for rail safety leaders.

1. Program overview.

- Objectives:
  - Develop a comprehensive understanding of rail safety principles.
  - Equip leaders with skills to manage and improve rail safety.

- Foster a safety-first culture within the organization.

2. Curriculum design.
- Core Modules:
  - Introduction to Rail Safety:
    - Overview of rail safety principles and regulations.
    - History and evolution of rail safety standards.
  - Risk Assessment and Management:
    - Techniques for identifying and assessing risks.
    - Strategies for mitigating and managing risks.
  - Incident Investigation and Analysis:
    - Methods for investigating rail incidents.
    - Root cause analysis and reporting.
  - Human Factors and Ergonomics:
    - Understanding human error and its impact on safety.
    - Designing systems to minimize human error.
  - Safety Management Systems (SMS):
    - Components and implementation of SMS.
    - Continuous improvement and auditing of safety systems.
  - Emergency Preparedness and Response:
    - Developing and executing emergency response plans.
    - Conducting drills and evaluating readiness.
  - Leadership and Communication:
    - Effective communication strategies for safety leaders.
    - Building and leading safety-focused teams.
  - Technological Innovations in Rail Safety:
    - Latest technologies and their application in rail safety.
    - Case studies of successful technology implementations.

3. Innovative learning methods.
- Interactive Workshops:
  - Hands-on sessions with real-life scenarios and case studies.
  - Group discussions and problem-solving activities.
- Simulations and Role-Playing:
  - Simulated incidents to practice response and decision-making.
  - Role-playing exercises to develop communication and leadership skills.
- E-Learning Modules:
  - Online courses for flexible learning schedules.
  - Multimedia content including videos, quizzes, and interactive materials.
- Field Visits and Practical Training:
  - Visits to operational rail facilities to observe best practices.
  - Practical training sessions on-site to apply learned concepts.
- Mentorship and Coaching:
  - Pairing trainees with experienced safety leaders for guidance and support.
  - Regular feedback and performance reviews.

4. Skill development.
- Technical Skills:
  - Proficiency in safety management tools and technologies.
  - Ability to conduct thorough risk assessments and safety audits.
- Analytical Skills:
  - Competence in analysing data to identify trends and areas for improvement.
  - Capability to develop and implement effective safety strategies.
- Leadership Skills:

- Strong leadership qualities to inspire and influence others.
- Skills to build a safety-first culture and manage safety teams.

- Communication Skills:
  - Clear and effective communication to convey safety policies and procedures.
  - Ability to engage with stakeholders at all levels.
- Decision-Making Skills:
  - Making informed decisions under pressure.
  - Balancing safety with operational efficiency.

5. Evaluation and continuous improvement

- Performance Assessments:
  - Regular assessments to evaluate trainees' knowledge and skills.
  - Feedback mechanisms to identify areas for improvement.
- Continuous Learning:
  - Opportunities for ongoing education and professional development.
  - Access to the latest research and developments in rail safety.
- Program Evaluation:
  - Regular review and update of the training program to ensure relevance and effectiveness.
  - Incorporation of trainee feedback to enhance the learning experience.

An education and training program for rail safety leaders should be comprehensive, covering all essential aspects of rail safety, and should employ innovative learning methods to ensure effective skill development. By focusing on both technical and leadership skills, and incorporating continuous improvement practices, the program can prepare safety leaders to effectively manage and enhance rail safety, fostering a culture of safety within the organization.

The main objective of the course is to raise the awareness of managers and professionals of the railway industry about the importance of safety leadership. The training emphasizes the need to put safety first in everyday actions, in every decision made. Upon completion of the course, each participant should have a clear understanding of what safety leadership is and how to improve it.

The Rail Safety Leadership training course has been designed to raise awareness among railway managers and professionals about the importance of safety leadership and to teach them how to improve safety through their daily actions and decision-making. The main objectives of the course include:

- awareness of the importance of safety;
- development of leadership skills;
- introduction of safety culture;
- learning through practicality;
- stimulation of changes.

Course participants will gain an understanding that safety is a critical component of successful rail operations and that leadership plays a key role in ensuring safety. The course enables participants to develop effective security leadership skills, including communication, decision-making and staff motivation skills. During training, participants should be encouraged to actively incorporate safety principles into their daily activities and management practices to create a safe and healthy work environment. It is important to provide hands-on experience and interactive exercises that allow participants to learn specific strategies and techniques for rail safety leadership. Participants should also be encouraged to be change agents in their organizations, which will contribute to the improvement of security practices and processes.

Rail safety leaders must have a variety of competencies and skills to effectively implement and maintain safety standards and practices. Here are some of them:

1. Expert knowledge in the field of railway transport safety. Leaders must have an in-depth knowledge of the safety requirements, standards and regulations that apply to the rail industry. This includes understanding operational processes, technical aspects of infrastructure and rolling stock, as well as security risks and threats.

2. Leadership skills. Leaders must have the skills to effectively manage and motivate staff. This includes the ability to create an open and supportive work environment, the ability to communicate effectively with employees at various levels, and the ability to lead and develop a team.

3. Analytical abilities. Leaders must be able to analyze complex situations and make informed decisions based on available data and security information.

4. The ability to make decisions in conditions of uncertainty. In the railway industry, situations may arise where you need to react quickly and make decisions in conditions of uncertainty. Leaders must have risk assessment skills and the ability to make informed decisions, even in difficult circumstances.

5. Ability to communicate and influence. Leaders must have excellent communication skills to effectively communicate with and influence various stakeholders to support rail safety.

6. Strategic thinking. Leaders must have the ability to plan long-term and develop strategies to improve rail safety.

7. Creativity and innovativeness. Leaders must be open to innovative approaches and innovations in security that can help achieve goals and improve results.

Conclusions. Safety leadership is essential to ensuring employee safety, reducing risk and incidents, increasing employee engagement, and enhancing organizational reputation. Safety leadership contributes to the formation and strengthening of the safety culture in the organization. Leaders who actively support and embody the principles of safety in their work create a positive example for subordinates and contribute to the establishment of norms and values related to safety. Leaders who prioritize safety help avoid and reduce the risk of incidents and accidents. Their management and decision-making is based on putting safety first, helping to ensure a safer work environment for all employees. Leaders who take an interest in safety and actively involve staff in decision-making and safety implementation processes create a more engaged and accountable work environment.

Organizations with strong security leadership typically have a better reputation with consumers, investors, and regulators. This can help increase brand trust and create positive relationships with stakeholders.

The research has explored innovative approaches to establishing a comprehensive national policy on railway safety and cultivating effective safety leaders within the railway industry. The study's objectives were successfully addressed through the following findings:

Firstly, the research examined various mechanisms and methods for introducing innovations into national railway safety policies. By focusing on best practices from other countries, the study highlighted how the integration of advanced technologies, standardized regulations, and collaborative initiatives can lead to significant improvements in railway safety. Positive outcomes from the implementation of these innovative approaches in national security strategies were analyzed, providing a framework for potential adaptation in other contexts.

Secondly, the evaluation of leadership competencies in railway safety revealed the critical skills and attributes required by safety leaders. The analysis underscored the importance of a leadership approach in addressing security challenges and developing robust national strategies. Effective safety leaders must possess a blend of technical expertise, strategic thinking, and the ability to foster a culture of safety across all organizational levels.

Lastly, the study developed a comprehensive framework for training programs aimed at security leaders in the railway sector. Key elements and directions for these programs were identified, emphasizing innovative training methods and skill development tailored to contemporary railway safety requirements. The proposed training initiatives aim to equip safety leaders with the necessary tools to effectively manage and mitigate safety risks in the ever-evolving railway environment.

In conclusion, the research provides valuable insights into the formation of a national railway safety policy and the development of competent safety leaders. By leveraging innovative approaches and focusing on best practices, the railway industry can enhance its safety standards and ensure a secure and efficient transportation system.

REFERENCES

1. Bal, O. (2023). Formation and management of safety culture in the railway industry: best practices and strategies. *Transport Systems and Technologies*, (42), 69–80. https://doi.org/10.32703/2617-9059-2023-42-6.
2. Schein, E. H. (2010). *Organizational culture and leadership* (Vol. 2). John Wiley & Sons.
3. Collaborative incident analysis and human performance Handbook (2014). In. Federal Railroad Administration (FRA), US Department of Transportation, Washington, DC, USA. FRA. https://railroads.dot.gov/sites/fra.dot.gov/files/fra_net/14293/FRA_ORS_HumanPeformanceManual.pdf.
4. Evaluation of Rail Innovation Programme (July 2021). Report v5.00. Department for Transport. https://assets.publishing.service.gov.uk/media/61659350d3bf7f56077ce641/evaluation-of-rail-innovation-programme.pdf.
5. Support to Europe's Rail Joint Undertaking | Framework Contract S2R.19.OP.02 LOT 1 - Strategy Advice Specific Contract n° 3 – European DAC Investment Plan Final Reportv6 – 16 (December 2022).
6. Directive (EU) 2016/798 of the European Parliament and of the Council of 11 May 2016 on railway safety (recast) (Text for EEA). (May 2016).
7. Shift2Rail Joint Undertaking, Multi-annual action plan, Publications Office, 2020, https://data.europa.eu/doi/10.2881/314331.
8. Regulation (EU) 2021/2085 of 19 November 2021 establishing the Joint Undertakings under Horizon Europe. (November 2021).
9. European Commission, Directorate-General for Research and Innovation, Horizon Europe, the EU research and innovation programme (2021-27) – For a green, healthy, digital and inclusive Europe, Publications Office of the European Union, 2021, https://data.europa.eu/doi/10.2777/052084.
10. Funke, U. (2017). Development of functional requirements for sustainable and attractive european rail freight. *European Union's Horizon Research and Innovation Programme, Luxembourg*.
11. Song, J., Li, S., & Ma, Q. (2012). Overview on earthquake monitoring and early warning system for high-speed railway (Shinkansen) in Japan. *World Earthq Eng*, *28*, 1-10.
12. ETCS Implementation Handbook. ISBN 2-7461-1499-2. https://uic.org/cdrom/2011/05_ERTMS_training2011/docs/ETCS_handbookf.pdf.
13. Stalder, C., Ducellier, G., & Lewkowicz, M. (2023). The implementation of a digital twin as an intelligent asset management system of a railway infrastructure: application to the work scheduling process at SNCF Réseau. *Transportation Research Procedia*, *72*, 2302-2308. https://doi.org/10.1016/j.trpro.2023.11.720.
14. Aoun, J., Goverde, R. M., Nardone, R., Quaglietta, E., & Vittorini, V. (2024). Analysis of safe and effective next-generation rail signalling systems. *Transportation Research Part C: Emerging Technologies*, *162*, 104573. https://doi.org/10.1016/j.trc.2024.104573.
15. Kosarchuk, V., Chausov, M., Pylypenko, A., Tverdomed, V., Maruschak, P., & Menou, A. (2022). Nanopowders of Different Chemical Composition Added to Industrial Lubricants and Their Impact on Wear Resistance of Steel Friction Pairs. *Lubricants*, *10*(10), 244. https://doi.org/10.3390/lubricants10100244.
16. Bolzhelarskyi, Y., Bal, O., Luchko, J., & Kovalchuk, V. (2023). Determining the energy of impact of a railroad rolling stock wheelset when derailing over reinforced concrete sleepers using impact trace parameters. *Eastern-European Journal of Enterprise Technologies*, *6*(7(126), 39–46. https://doi.org/10.15587/1729-4061.2023.293007 .

Олена Баль[1], Володимир Твердомед[2], Ореста Ковальчук[3]

[1]Кандидат технічних наук, доцент, завідувач кафедри залізничного транспорту НУ «Львівська політехніка», вул. Степана Бандери, 12, м. Львів, 79000; Судовий експерт, Львівський НДІ судових експертиз, вул. Липинського, 54, м. Львів, 79024. ORCID: https://orcid.org/0000-0003-2188-4098.

[2]Кандидат технічних наук, доцент, директор Київського інституту залізничного транспорту Державного університету інфраструктури та технологій, 04071, м. Київ, вул. Кирилівська, 9. ORCID: https://orcid.org/0000-0002-0695-1304.

[3]Завідувач сектору Львівський НДІ судових експертиз, вул. Липинського, 54, м. Львів, 79024; Аспірант, Київський інститут залізничного транспорту Державний університет інфраструктури та технологій, вул. Кирилівська, 9, м. Київ, 04071. ORCID: https://orcid.org/0000-0002-8570-313X.