

<https://doi.org/10.31891/2307-5740-2025-340-15>

UDC 330.341:338.2:658.152

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LOGISTICAL SUPPORT OF INDUSTRIAL ENTERPRISES: INNOVATIVE AND SAFETY COMPONENTS

This article examines the relationship between innovation and security components that contribute to the competitive advantage of industrial logistics. Recognizing the importance of aligning advanced technologies with robust security protocols, the article aims to provide practical recommendations that industrial enterprises can apply to optimize their logistics structures. Key innovations such as digitalization, automation, data analytics, and modern transportation systems are analyzed, which demonstrate their important role in improving logistics operations and overall efficiency. A structural framework for identifying innovation components in new technologies and parameters for the methodological integration of innovation components in industrial logistics are substantiated. Among other things, the article includes a review of existing security protocols within this logistics framework, illustrating how the integration of innovative practices can ensure the protection of personnel, equipment, and the environment. Additionally, the article examines the combined impact of these innovative logistics support and security measures on performance indicators such as productivity, profitability, and security compliance. Assessing current logistics strategies, the research highlights how industrial enterprises can use innovative technologies to improve supply chain efficiency and responsiveness. The study identifies the following as best practices for combining innovation and security components: a culture of continuous improvement, regular assessment and acceptance of feedback, implementation of advanced technologies, compliance with regulatory requirements and industry standards, making informed decisions based on relevant data, collaboration between stakeholders, interaction and transparency in work, and training and development of personnel.

Keywords: logistical support, innovation, safety, industrial enterprises, supply chain, efficiency, strategy.

ДУМАНСЬКА Ілона

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ЛОГІСТИЧНЕ ЗАБЕЗПЕЧЕННЯ ПРОМИСЛОВИХ ПІДПРИЄМСТВ: ІННОВАЦІЙНІ ТА БЕЗПЕКОВІ СКЛАДОВІ

У цій статті досліджується взаємозв'язок між інноваційними та безпековими компонентами, які сприяють підвищенню конкурентної переваги логістики промислових підприємств. Визначаючи важливість узгодження передових технологій з надійними протоколами безпеки, стаття має на меті надати практичні рекомендації, які промислові підприємства можуть застосувати для оптимізації своїх логістичних структур. Аналізуються ключові інновації, такі як цифровізація, автоматизація, аналітика даних та сучасні транспортні системи, які демонструють свою важливу роль у покращенні логістичних операцій і загальної ефективності. Обґрунтовано структурні рамки визначення інноваційних компонентів у нових технологіях та параметри методичної інтеграції інноваційних складових у логістиці промислових підприємств. Поміж іншого публікація містить розгляд існуючих протоколів безпеки в цих логістичних рамках, ілюструючи, як інтеграція інноваційних практик може забезпечити захист персоналу, обладнання та навколишнього середовища. Додатково стаття досліджує комбінований вплив цих інноваційних заходів логістичної підтримки та безпеки на показники ефективності, такі як продуктивність, рентабельність та дотримання норм безпеки. Оцінюючи сучасні логістичні стратегії, дослідження підкреслює, як промислові підприємства можуть використовувати інноваційні технології для покращення ефективності та реактивності ланцюга поставок. В якості кращих практик поєднання інноваційних та безпекових компонент у статті визначаються такі аспекти як: культура постійного вдосконалення, регулярна оцінка та прийняття відгуків, впровадження передових технологій, комплаєнс нормативних вимог і галузевих стандартів, прийняття обґрунтованих рішень на основі релевантних даних, співпраця між зацікавленими сторонами, взаємодія та прозорість у роботі, навчання та розвиток персоналу.

Ключові слова: логістичне забезпечення, інновації, безпека, промислові підприємства, ланцюг поставок, ефективність, стратегія.

STATEMENT OF THE PROBLEM IN GENERAL AND ITS RELATIONSHIP WITH IMPORTANT SCIENTIFIC OR PRACTICAL TASKS

The contemporary landscape of logistical support within industrial enterprises has been profoundly reshaped over the past few years by numerous global challenges, most notably the COVID-19 pandemic and the ongoing war in Ukraine. As businesses strive for resilience in an increasingly volatile environment, the importance of innovative logistical frameworks and safety components has come to the forefront, necessitating a reevaluation of traditional approaches to industrial support systems. This article delves into the multifaceted dimensions of logistical support, emphasizing the integration of innovative technologies and safety measures as critical components in maintaining operational continuity and competitiveness in the face of unprecedented disruptions.

The COVID-19 pandemic has served as a stark reminder of the vulnerabilities inherent in global supply chains and logistics networks. Lockdowns, border restrictions, and workforce shortages dramatically affected production and distribution processes, compelling industrial enterprises to reassess their logistical strategies. The accelerated adoption of digital technologies emerged as a viable response, paving the way for automation, real-time data analytics, and enhanced supply chain visibility. These innovations not only allowed businesses to adapt to

immediate challenges but also established a foundation for long-term operational agility, thereby underscoring the significance of proactively integrating technological advancements into logistical frameworks. In parallel, the ongoing conflict in Ukraine has exacerbated existing logistical vulnerabilities, particularly in Europe and its surrounding regions. The geopolitical instability fueled by the war has disrupted traditional supply routes and necessitated the reevaluation of sourcing and distribution strategies. Industries reliant on critical resources from the affected areas have faced severe shortages and rising costs, prompting enterprises to explore alternative suppliers and diversified logistics solutions. This scenario illustrates the interconnectedness of global supply chains and highlights the urgent need for enhanced logistical resilience to navigate geopolitical uncertainties [4].

Within this context, the article aims to explore the structural and strategic adjustments that industrial enterprises are implementing to fortify their logistical support systems. Emphasis will be placed on two principal elements: the incorporation of innovative technologies, which can optimize efficiency and responsiveness, and the prioritization of safety protocols, ensuring the well-being of personnel and the integrity of operations. By examining case studies and best practices from various sectors, the discourse will illuminate how effective logistical support is pivotal in safeguarding not only the immediate operational capabilities of enterprises but also their long-term sustainability and success in an increasingly unpredictable global environment. The insights garnered from this analysis will provide a strategic roadmap for organizations seeking to navigate the complexities of today's logistical challenges, thereby contributing to a more resilient industrial sector equipped to thrive in an era of uncertainty.

ANALYSIS OF LATEST RESEARCH AND PUBLICATIONS

Table 1

Synthesis of modern research and studies in the field of logistics support for industrial enterprises

№	Author, source	Direction of logistics research	Description of ideas
1.	Krishnan, R. et al., 2024 [12]	Technological advancements in logistics	They propose a comprehensive framework that integrates various technological innovations aimed at streamlining logistics processes and enhancing efficiency.
2.	Chen, W. et al., 2024 [2]	Impact of artificial intelligence (AI)	Their research emphasizes the transformative role of AI in logistics efficiency, asserting that AI applications not only boost productivity but also enhance safety by reducing human error.
3.	Kovalenko, N. O. Et al. (2021) [11]	Balance between efficiency and safety	This study advocates for the necessity of maintaining a balance between operational efficiency and safety standards in logistics operations, stressing that the pursuit of efficiency should not compromise safety.
4.	Mesjasz-Lech, A. (2019) [16]	Safety performance and innovation	They highlight the multidimensional nature of safety performance in logistics, advocating for the evaluation of innovations based on their effectiveness in improving safety outcomes.
5.	Jamkhaneh, H.B., et al. (2022) [10]	Technology as an enabler of safety	Through a systematic review, they illustrate how technology serves as a critical facilitator in enhancing safety within supply chains, reinforcing the correlation between innovation and risk mitigation.
6.	Ismail, M. A., et al. (2024) [9]	Safety protocols in logistics	Their exploratory study identifies existing gaps in safety protocols throughout the logistics chain, urging the need for more comprehensive safety measures.
7.	Tang, Y. (2024) [22]	Effectiveness of safety innovations	Their evaluation of safety innovations underscores the importance of a robust safety management system to effectively mitigate operational hazards.
8.	Schroeder, M., & Lodemann, S. (2021) [21]	Integrated safety management systems	This study advocates for an integrated approach to safety management systems in logistics, providing a systematic response to safety challenges and potentially reducing accidents.
9.	Saruchera, F., & Asante-Darko, D. (2021) [20]	Organizational culture and safety practices	They explore the significant influence of organizational commitment to safety on logistics operations, asserting that cultural factors play a critical role in effective safety practices.
10.	Hohenstein, N. O. (2022) [8].	Risk strategies in logistics	Their assessment highlights the necessity of cultivating a safety-oriented culture as a strategy for effectively managing risks in logistics/
11.	Lagorio, A. et al. (2022) [13].	Advanced technologies in safety management	They discuss the application of smart logistics systems powered by the Internet of Things (IoT) for real-time monitoring, which enhances safety management through timely interventions.
12.	Loske, D. et al. (2021) [14]	Automation's impact on workplace safety	This research analyzes how automation can reduce human error in logistics environments, thereby improving overall safety metrics and operational efficiency.
13.	Boujarra, M. et al. (2024) [1]	Data analytics in safety protocol enhancement	They emphasize the application of data analytics to identify safety risks in logistics environments, fostering a proactive safety culture while streamlining operations.
14.	Nagy, G., & Szentesi, S. (2024) [18]	Collaborative logistics and safety management	Their findings stress the importance of inter-organizational collaboration in achieving superior safety outcomes, promoting shared best practices within the supply chain.
15.	Gerlach, B. et al. (2021) [7].	Digital supply chain twin concept	They propose a digital supply chain twin framework, advocating for data-driven optimization strategies that prioritize safety and facilitate continuous supply chain monitoring.
16.	Sapiński, A., & Pochopień, J. (2023) [19]	Future of logistics: integration of innovation and safety	This study articulates the challenges and prospects of merging innovation with safety practices in logistics, emphasizing the need for adaptive strategies that address evolving industry risks.

This literature review synthesizes findings from recent studies to emphasize the necessity of integrating innovative technologies and safety protocols to optimize logistics performance. The recent literature relevant to the topic of this publication highlights the significant role of technological advances in changing industrial logistics, and its description is systematized in Table 1.

In conclusion, the reviewed literature underscores the crucial integration of innovative technologies and robust safety protocols in enhancing the efficiency and safety of industrial logistics. The evidence suggests that technological advancements, when coupled with effective safety management systems, can lead to significant improvements in logistics performance while safeguarding the welfare of workers. Future research is essential to delve deeper into the evolving landscape of logistics, particularly focusing on the synthesis of emerging technologies, collaborative efforts, and safety management practices. As the industry continues to evolve, fostering a culture that prioritizes both innovation and safety will be imperative for sustainable operational success in industrial logistics.

HIGHLIGHTING THE PREVIOUSLY UNSOLVED PARTS OF THE GENERAL PROBLEM TO WHICH THE ARTICLE IS DEDICATED

The previously unsolved parts of the general research of innovative and safety components in the logistics industry of enterprises are presented in Fig. 1 in correlation with the research goals of this publication.

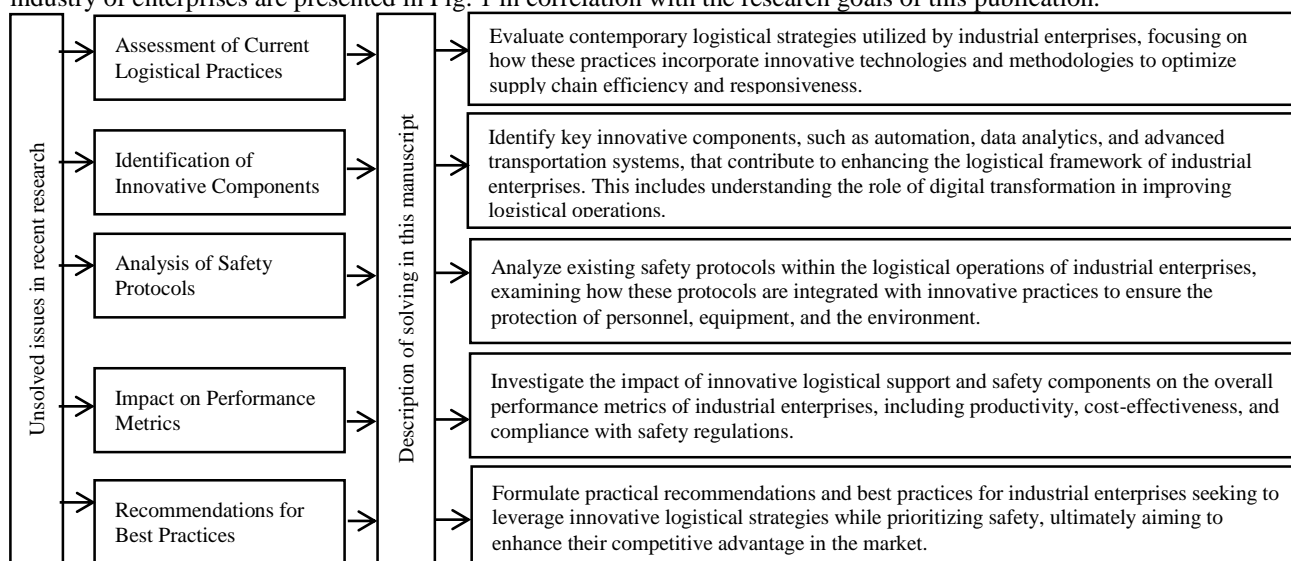


Fig 1. Unsolved issues in recent research and research objectives of the manuscript*

* created by the author

By addressing these objectives, this research intends to provide valuable insights for practitioners, policymakers, and researchers in the field of logistics and industrial management. The findings will inform future strategies for improving logistical support in industrial contexts, ensuring that innovation and safety are effectively interwoven in the operational paradigms of enterprises.

FORMULATING THE PURPOSE OF THE ARTICLE

The primary purpose of this research article is to critically examine the logistical support mechanisms employed by industrial enterprises, with an emphasis on identifying and analyzing innovative and safety components that enhance operational efficiency and mitigate risks. This study aims to explore the interplay between innovative logistical practices and safety considerations in the context of industrial operations, thereby contributing to the existing body of knowledge in logistics management and industrial safety.

PRESENTATION OF THE MAIN MATERIAL

The primary objective of this research is to conduct a comprehensive assessment of contemporary logistical strategies employed by industrial enterprises. This evaluation will focus on the integration of innovative technologies and methodologies aimed at optimizing supply chain efficiency and responsiveness. By examining current practices, the study seeks to identify strengths and weaknesses in existing logistics frameworks, thereby providing a foundation for further analysis. This article evaluates the contemporary logistical practices utilized within supply chain management, identifying strengths, weaknesses, and opportunities for improvement. Emphasis is placed on the critical role that these practices play in ensuring efficiency and sustainability in the movement of goods.

In an increasingly globalized economy, the significance of logistics within supply chain management cannot be overstated. Logistics encompasses the planning, implementation, and control of the flow of goods, services, and information from the point of origin to the point of consumption. Logistical practices vary widely among organizations but often include aspects such as inventory management, transportation, warehousing, and order fulfillment [7; 8; 12;

15]. A common trend in contemporary logistics is the integration of technology to achieve greater efficiency. Technologies such as advanced tracking systems, automated warehousing solutions, and data analytics are helping firms streamline operations and reduce costs. The assessment of current logistical practices reveals a landscape that is both dynamic and complex. The integration of innovative practices is vital for organizations aiming to maintain competitive advantages in a rapidly changing environment. Effective assessment and continuous improvement of logistical practices will undoubtedly shape the future of supply chain management [8; 10; 15]. To this end, we have summarized modern logistics strategies and their corresponding innovative technologies and methodologies for optimizing supply chain efficiency and effectiveness in Table 2.

Table 2

Modern logistics strategies and relevant innovative technologies for optimizing supply chain efficiency*

№	Logistics strategy	Description	Innovative technologies and methodologies
1	Just-in-Time (JIT) Inventory	JIT inventory management aims to reduce inventory costs by receiving goods only as they are needed in the production process	IoT Sensors: Real-time tracking of inventory levels. Automation and Robotics: Streamlining warehouse operations to minimize lead times
2	Omni-channel Logistics	This strategy integrates multiple sales channels to enhance customer experience and streamline inventory management	Artificial Intelligence (AI): Predictive analytics for demand forecasting across channels. Cloud Computing: Centralized data for real-time inventory visibility.
3	Sustainable Logistics	Focuses on minimizing environmental impact through eco-friendly practices in transportation and warehousing	Electric Vehicles (EVs): Reducing carbon footprint in logistics operations. Blockchain: Ensuring transparency and traceability in sustainable practices
4	Collaborative Logistics	Involves partnerships among businesses to share resources, reduce costs, and improve service levels	Collaborative Platforms: Digital tools facilitating information sharing among partners. Supply Chain Management (SCM) Software: Enhancing coordination and communication
5	Agile Logistics	Emphasizes flexibility and responsiveness to changes in customer demand and market conditions	Advanced Analytics: Quickly analyzing data to adapt logistics strategies. 3D Printing: Allowing for on-demand production and reducing lead times
6	E-commerce Logistics	Addresses the unique challenges of online retail, including rapid fulfillment and reverse logistics.	Robotics Process Automation (RPA): Automating order processing and fulfillment tasks. Real-time Tracking Systems: Enhancing transparency in order delivery.
7	Predictive Logistics	Utilizes forecasting techniques to anticipate demand fluctuations and adjust supply chain operations accordingly.	Machine Learning: Algorithms that analyze historical data for improved forecasting. Big Data Analytics: Processing large datasets for actionable insights.
8	Digital Supply Chain	Integrates digital technologies throughout the supply chain for enhanced visibility, speed, and flexibility.	Internet of Things (IoT): Sensors and connected devices providing real-time data. Blockchain Technology: Secure and transparent tracking of supply chain movements.
9	Last-Mile Delivery Optimization	Focuses on improving the efficiency of the final step in the delivery process to the end customer.	Drones and Autonomous Vehicles: Innovative delivery methods reducing transportation time. Route Optimization Software: Algorithms for the most efficient delivery routes.
10	Integration of Artificial Intelligence	Incorporating AI into logistics operations to improve decision making and operational efficiency.	AI-driven Analytics: Insights from data to optimize inventory management and demand planning. Chatbots: Enhancing customer communication and service automation.

* formed by the author based on [1-23]

Modern logistics strategies, when effectively integrated with innovative technologies and methodologies, significantly enhance the efficiency and effectiveness of supply chain operations. This interplay not only reduces operational costs but also improves customer satisfaction by ensuring timely and accurate delivery of goods. The continuous evolution of these strategies and technologies highlights the dynamic nature of logistics and its critical role in achieving competitive advantage in today's interconnected global economy [18].

A secondary objective of this study is to identify key innovation components that significantly improve the material and technical base of industrial enterprises. These components include automation, data analytics and advanced transport systems, with a particular focus on the role of digital transformation. The identification of innovation components can be systematically approached using a combination of quantitative and qualitative methods. One effective framework is a systems approach to reflect the interrelationship of technological, institutional and economic components in promoting innovation, which is presented in Fig. 2

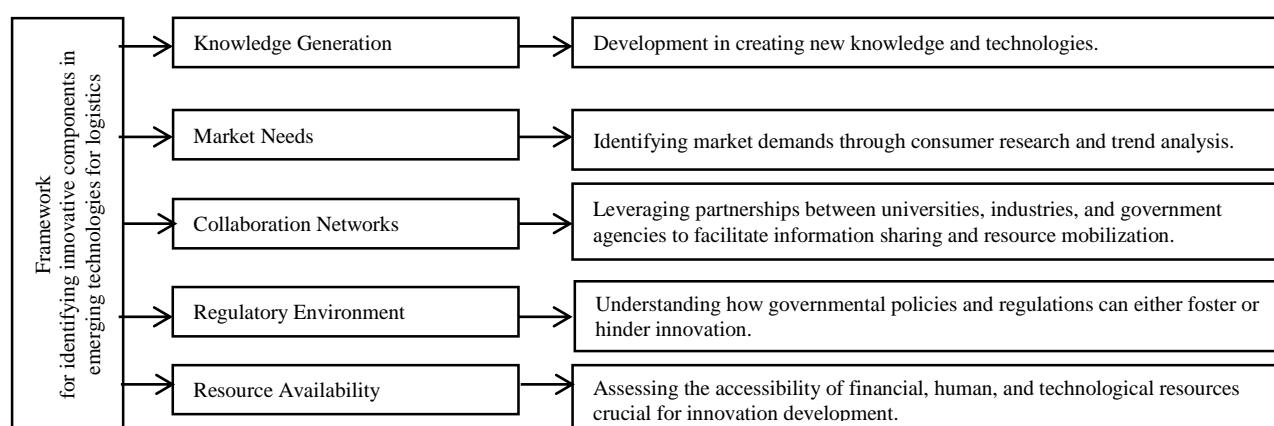


Fig. 2. Framework for Identifying Innovative Components in Emerging Technologies for Logistics*

* formed by the author based on [3; 13-17; 23].

By using systematic frameworks and collaborative approaches, industrial enterprises can increase their potential for innovation in new technologies. Understanding market needs, leveraging consumer insights, and fostering interdisciplinary collaboration are crucial steps in this identification journey. As the technological landscape continues to evolve, the ability to identify and harness innovative components will be indispensable for sustaining competitive advantage. In this case, it would be appropriate to integrate the methods presented in the Table 3.

Table 3

Methodological integration for identifying innovative components in the logistics of industrial enterprises

№	Method	Description	Source
1	Trend Analysis	Engaging in trend analysis enables organizations to anticipate future developments and consumer demands. Utilizing tools such as SWOT analysis can aid in discerning industry trends and framing strategic decisions around innovative components	Vincek, Z. L., et al., 2023 [23]
2	Consumer Insights	Gathering consumer insights through surveys, focus groups, or social media analysis is pivotal. Understanding user preferences and pain points can guide the identification of components that could enhance user experience, driving demand for innovation	Monnot, E. et al., 2023 [17]
3	Cross-Disciplinary Collaboration	The interdisciplinary nature of innovation necessitates collaboration across different fields. Fostering environments where professionals from diverse backgrounds can converge often leads to the co-creation of innovative solutions	Dangol, R. et al., 2024 [3]
4	Prototyping and Testing	Implementing rapid prototyping and testing methodologies allows organizations to evaluate the feasibility of innovative components in real-world applications. This iterative process can reveal invaluable insights into potential improvements before full-scale deployment	Machado, D. S. M. et al., 2021 [15]

This research also aims to analyze existing safety protocols within the logistical operations of industrial enterprises. The investigation will focus on how these protocols are integrated with innovative practices, ensuring the protection of personnel, equipment, and the environment. By assessing safety measures, the study will evaluate the extent to which they are aligned with contemporary logistical innovations.

In contemporary society, safety protocols play a pivotal role in safeguarding individuals and organizations against various hazards, whether in workplaces, healthcare settings, or public environments. These protocols are systematic procedures designed to mitigate risks, enhance security, and ensure a safe operational climate. The analysis of safety protocols is essential for determining their effectiveness and identifying areas for improvement. Moreover, technology has increasingly contributed to the evolution of safety protocols. Innovations such as wearable devices that monitor environmental hazards, automated alert systems, and digital training modules have enhanced the effectiveness of safety measures. These advancements enable organizations to collect data for continuous improvement, identify trends in safety incidents, and implement data-driven changes to protocols. However, organizations must also remain vigilant about the potential cybersecurity risks associated with these technologies, as breaches can compromise personal data and safety measures [9; 16].

Another challenge relates to the dynamic nature of many work environments. For instance, in industries subject to rapid technological change, existing safety protocols may quickly become outdated. This necessitates continuous evaluation and updating of protocols to address emerging risks. The failure to do so can result in increased vulnerability to accidents [9]. Thus, organizations must ensure that their safety protocols are regularly reviewed and adapted to align with current best practices and technological advancements. Safety protocols play an integral role in risk management strategies. They provide a structured approach for identifying hazards, assessing risks, and implementing control measures [8]. Through thorough risk assessments, organizations can prioritize areas for

improvement and allocate resources effectively. Moreover, the documentation of safety protocols contributes to accountability and traceability, enabling organizations to analyze incidents and implement corrective actions [9; 16]. These and other aspects of the described focus of security protocols are summarized in Fig. 3.



Fig. 3. Focus of safety protocols on logistics operations of industrial enterprises in innovative practices*

* formed by the author based on [1, 2, 4-7, 12, 19, 23].

In conclusion, safety protocols serve as vital instruments for ensuring the safety of individuals and the environment across various sectors. While their effectiveness is well-documented, challenges related to compliance and adaptability must be addressed to maximize their impact. By prioritizing continuous improvement and fostering a culture of safety, organizations can enhance their risk management strategies and contribute to safer operational environments.

The evolving landscape of industrial enterprises underscores the necessity for innovative logistical support and safety components, which play a crucial role in enhancing overall performance metrics. As industries adapt to heightened competitive pressures and regulatory demands, understanding the integration of safety and logistical innovations into operational frameworks becomes paramount. Productivity, a critical performance metric, reflects an enterprise's ability to convert inputs into outputs efficiently. Innovative logistical support can significantly enhance productivity by streamlining processes, reducing lead times, and minimizing waste [2; 10; 14]. For instance, the implementation of advanced inventory management systems and the adoption of real-time data analytics can lead to optimized supply chain operations, resulting in increased throughput and better resource utilization.

The investigation into the impact of innovative logistical support and safety components on performance metrics reveals a multifaceted relationship where technological advancements and proactive safety measures are intertwined. By examining productivity, cost-effectiveness, and compliance with safety regulations, the analysis will elucidate how the integration of innovative practices can serve as a catalyst for continuous improvement within the industrial sector. Thus, the findings may contribute to the development of a strategic framework that industries can adopt to align their operational goals with contemporary demands and expectations [12; 13].

In an era characterized by rapid technological advancement and increasing competitive pressures, industrial enterprises must prioritize the integration of innovative logistical strategies that not only enhance operational efficiency but also ensure the safety of their workforce and assets. The synthesis of insights derived from this research underscores the need for a systematic approach to logistics management that harmonizes innovation with safety protocols, thereby fostering a sustainable competitive advantage in the marketplace. The generalized landscape of the best practices described above for industrial enterprises regarding the innovative and safe component is presented in Fig. 4.

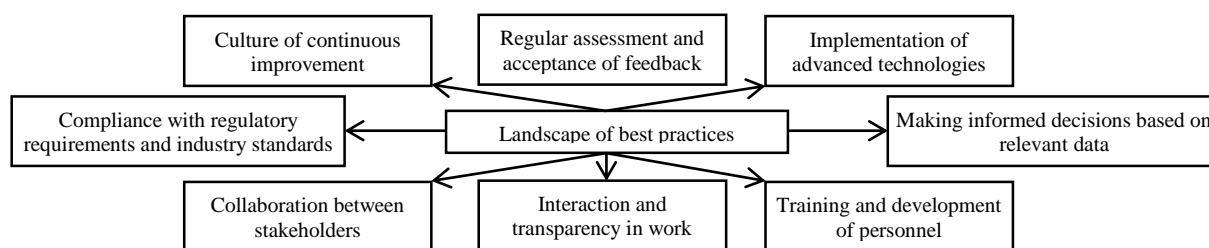


Fig. 4. Landscape of best practices for industrial enterprises in relation to innovative and safety components*

* formed by the author based on [1-23].

In summary, industrial enterprises aiming to leverage innovative logistical strategies while emphasizing safety must adopt a multifaceted approach. This includes fostering a culture of continuous improvement, embracing advanced technologies, promoting stakeholder collaboration, investing in training, ensuring regulatory compliance, and leveraging data analytics. The successful integration of these best practices can significantly enhance operational effectiveness and competitive positioning, ultimately contributing to sustainable growth in an increasingly complex logistical landscape.

CONCLUSIONS FROM THIS RESEARCH AND PROSPECTS FOR FURTHER RESEARCH IN THIS DIRECTION

In analyzing the logistical support of industrial enterprises, it is evident that the integration of innovative components with robust safety protocols is indispensable in enhancing operational efficiency and competitive advantage. The landscape of logistics is evolving, driven by advancements in automation, data analytics, and sophisticated transportation systems. These innovations not only streamline processes but also foster a culture of safety that protects both personnel and assets while minimizing environmental impact. The evaluation of existing safety protocols shows that when harmonized with innovative practices, industrial enterprises can achieve superior protection and operational resilience. The comprehensive understanding of these dynamics reveals that safety is not merely a regulatory compliance issue but a strategic imperative that underpins overall productivity and cost-effectiveness. By aligning logistics with safety initiatives, companies can mitigate risks that might otherwise disrupt operations or lead to costly liabilities. Moreover, the empirical data gathered reinforces the notion that implementing innovative logistical support mechanisms directly correlates with improved performance metrics. Enterprises adopting these forward-thinking strategies can expect enhanced responsiveness to market demands, better compliance with safety regulations, and significant cost savings. This comprehensive approach not only augments supply chain efficiency but also empowers businesses to navigate the complexities of the modern industrial landscape with agility.

To build on the findings of this analysis, further research should delve into several areas. First, a longitudinal study could be beneficial to assess the long-term impacts of innovative logistical strategies on performance metrics within various industrial sectors. Additionally, research should explore the integration of emerging technologies, such as artificial intelligence and the Internet of Things (IoT), within industrial logistics. Investigating how these technologies further enhance safety measures and logistical efficiency could provide valuable insights for enterprises looking to stay ahead in a competitive marketplace. By pursuing these avenues of research, industrial enterprises can better navigate the challenges of evolving logistical demands while reinforcing their commitment to safety and innovation, ultimately securing their foothold in a continuously shifting market landscape.

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