

## STUDY OF ACCIDENT RATES AND EVALUATION OF ACCIDENT EVENT CORRELATION IN THE PERIOD 2022-2023 FOR SELECTED LOGISTICS COMPANIES

Magdalena MARECIK

Amazon Fulfillment Poland Sp. z o.o., Gliwice; magdalena.marecik89@gmail.com;  
ORCID 0000-0003-4008-5136

**Purpose:** The main purpose of the article is to analyze accident rates and the ocean of correlation of accident events in the period 2022-2023, as well as to identify relationships affecting changes in the number of accident events.

**Design/methodology/approach:** The research methods used in the article were quantitative methods, which included empirical surveys and qualitative methods including conducting interviews/questionnaires with representatives of the surveyed companies. An additional approach to the research referred to the statistical data.

**Findings:** The considerations presented in the publication made it possible to analyze the accident rates for the surveyed 25 companies in the logistics industry, statistical data in correlation with both the level of employment and the measures taken that are aimed at the complete elimination of accidents at work. The article seeks to analyze in detail the correlations that occur in the surveyed enterprises in relation to the decreases in accident rates, which were evident in the whole set at 52.98%, with a slight decrease in employment determined for the total at 2.443%. Thus, new courses of action were verified and established, through which companies will eliminate accidental events, affecting the provision of very safe working conditions.

**Originality/value:** The carried out assessment of accident rates in the surveyed companies as well as on the basis of statistical research indicates minimization and strives for complete elimination of accident events in the logistics sector. The main influence on this is the raising of awareness by employees as well as the continuous spreading of safety culture through the implementation of new technical, organizational, analytical or management solutions. The focus on the development, implementation and maintenance of safety management at the highest level, as well as its continuous improvement, significantly affects the decrease in accident rates, which should continue to be maintained and introduced in the logistics industry, but also in other branches of the economy.

**Keywords:** safety management, accidents at work, accident rate, safety management system, occupational safety and health, reduction of accidents.

**Category of the paper:** research paper.

## 1. Introduction

The continuous development of enterprises and the pursuit of the highest position in the market both domestically and expansion into international markets, forces entrepreneurs to continuously improve, in every aspect of the functioning of the organization. A variety of factors, including modern economic conditions, which now include the volatility of the business environment, the focus on meeting customer requirements, time compression prompts organizations to the so-called integration of the above elements, which directed entrepreneurs to seek areas of improvement in productivity, efficiency. These activities have influenced the desire of organizations to expand modern and unconventional business models. Important issues in the construction and creation of new directions for the logistics industry sector is, first of all, the mutual correlation between service providers and service recipients, who together take care of many aspects that are an indispensable element that is a link of symbiotic fulfillment of common expectations occurring in the process.

These correlations and actions taken include, first and foremost, the building of common ties between stakeholders (internal/external customers) in the integration of supply chains to ensure the proper exchange of goods, from production through the marketing of the product to the direct transfer of the order to the customer. Companies go to great lengths to streamline the supply system to improve customer satisfaction. It is by taking such measures, that the competitiveness of a given enterprise in the markets increases (Staniewska, 2021). An important aspect that is placed as a priority in many industries, including logistics, is the approach to health and safety management. It is the guarantee of a certain, currently high level of safety that makes it possible to establish mutual business correlations between organizations. It has been found that the trend of striving for the highest safety standards is increasingly evident. Ensuring safety at an appropriate level for the processes carried out provides the opportunity to feel that a certain kind of mission has been fulfilled, which is a guarantee of the real creation of supply chain relationships, which is also pointed out by M. Hugos, who argues the following, that it is the companies that mutually learn to build and maintain sustainable supply chains, including effectively as well as productively operate within them, that will achieve a significant competitive advantage in the markets (Hugos, 2011). There is a lot of information in the literature, indicating that the theoretical basis for a kind of integrated supply chain concept, is the value chain of M.P. Porter (Porter, 2001), who states that in conditions of significant market competition it is necessary to seek growth and increase the value for stakeholders, as well as to adapt to their needs. Stakeholders according to the understanding of customers, local government units, the social side, or employees, without whom organizations would not function. In all this juxtaposition and chain of successive important issues, values, the term safety, in relation to working conditions, the environment in which it is carried out, productivity and process efficiency, increasingly appears, ending with the most important - employee awareness. It is the employees' awareness of an appropriate

safety culture that is the backbone of companies' operations and, consequently, their high position in the market. Conscious management gives confidence in the direction of safe processing by employees, ending with external customers in the area of safety (Woźny, Pacana, Dobosz, Saja, 2015). It is the full responsibility of business that influences the constantly improved and enhanced safety management systems. Through proper safety management, companies regularly influence the reduction of accidental incidents, which are reduced through the implementation of a series of measures ranging from technological, organizational to behavioral that are the essence of spreading safety culture.

### 2. Health and safety management system in the logistics sector

The modern logistics system is an important function in the management of the enterprise, as well as the entire market for the exchange of goods and products. It is the logistics enterprises that are necessary for the proper flow of materials. It all starts with production processes, which in turn, after the production of a given item, trigger the product flow system. After the production processes, the given product goes through the technological system (more, or less complicated) to warehouses, where the processes of delivering it to the customer are underway. It is the logistics processes that consist of various handling activities, which include moving, storing, receiving or issuing materials, products or finished shipments. Everything along the supply chain in terms of warehousing consists of a series of activities that are carried out during the flow of the aforementioned elements through the warehouse. A detailed diagram of the flow of products, products and goods is shown in Figure 1 (Rut, Wolczanski, 2015).

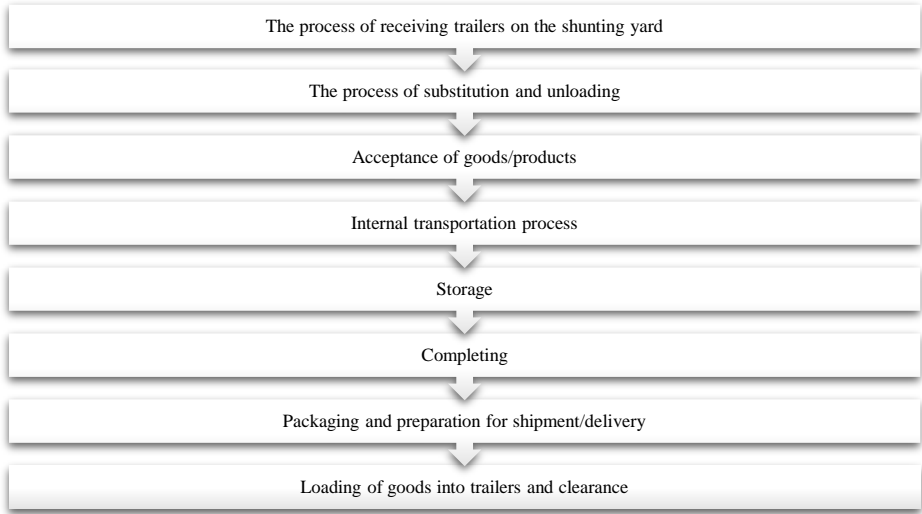


Figure 1. Flow diagram of products in the supply chain.

Source: own work based on (Rut, Kulinska, 2006).

In order to ensure the continuity of the logistics (warehouse) process, appropriate technical and organizational conditions should be met. Space along with technical place should be provided in a way that allows the execution of warehouse activities, equipment, machinery and devices should meet appropriate conditions, and employees carrying out the work should have the knowledge and experience to perform the work, which will give a high probability of processing in a safe manner (Dudzinski, Kizym, 2000). Analyzing the modern market, at each stage of the activities of enterprises we are in contact with logistics. Therefore, the effective implementation of processes from production to distribution is closely related to ensuring their continuity and consistency. Many components and factors have a significant impact on the continuity of processing, and one of the most important elements is occupational health and safety (Wojciechowski, 2009).

When analyzing the way logistics processes are approached, one notices a trend indicating continuous improvement and an attempt to raise employee awareness toward promoting a culture of safety. An important element is to influence the way processes are carried out by taking measures to minimize accident events and then eliminate them altogether. In connection with the processes carried out in the supply chain, one notices many risks in warehouse operations that can negatively affect employees, which can ultimately result in occupational accidents, including severe ones. With the continuous improvement, implementation, certification and maintenance of safety management systems, including on the basis of standards such as ISO 45001, SCC, SCP etc. in the area of safety, it can be concluded, that companies are focused on meeting the highest safety standards (Zywiólek, Staniszevska, Jarosz, 2012). The most important and main factor shaping the safety culture, whether the organization has a safety system in place or not, is first and foremost the awareness, knowledge, experience and willingness of managers to pass on the rules for the safe execution of work. In line with the statement that the example should always "come from the top", in this situation good practice, acting in accordance with the guidelines by managers provides the opportunity for analogous processing by all employees. The combination in employees of their knowledge, experience, aptitude for the job combined with commitment and adherence to the safety standards of the facility, can influence the maintenance of safety ranges at the highest possible level. Thus, combining additionally the above with proper maintenance of infrastructure, machinery, equipment or installations, together can affect the on the elimination of accident events, which can potentially be completely eliminated (Dworecki, Berny, 2005).

### 3. Evaluate accident rates in 2022-2023 for selected logistics industry enterprises and statistical data

The evaluation of accident rates was made on the basis of an analysis of data obtained from 25 enterprises providing services in the area of broadly understood logistics, supply chain and selected scopes of production. By subjecting the received data to analysis, a compilation was made, and a comparison was made of the results obtained from the surveyed enterprises in relation to indicators made available by the Central Statistical Office for the period 2022-2023. While conducting an evaluation of the number of accidents, comparing them for the period 2022-2023, consultations were held with representatives of the management of companies in the logistics industry, and the possibilities and causes affecting the difference between the number of accidents in the period 2022 compared to 2023 were discussed.

#### Analyzing the rate of fatal accidents in relation to the total number of deaths in Poland in the period 2020-2023

By analyzing the sources of literature data, which indicate that the third classification of causes of death includes accidents at work, the actual state of affairs in Poland was verified on the basis of statistical data. In order to verify the above, the number of deaths over 4 years in the period 2020-2023 was evaluated and determined the proportion of deaths resulting from accidents at work, to the total number of deaths, as shown in table 1.

**Table 1.**

*Number of deaths with occupational fatality rate for the period 2020-2023*

Year	Number of deaths in Poland	Number of fatal accidents in Poland	Information on percentage data covering deaths due to occupational accidents in relation to the total number of deaths [%]
2020	477355	99	0,021
2021	519517	180	0,035
2022	448448	219	0,049
2023	397968	99	0,025

Source: own work based on data from the Central Statistical Office (access: 25.01.2024).

Based on Table 1, it is concluded that fatal occupational accidents account for no more than 0.05% of the total number of deaths recorded in Poland. This trend does not confirm global trends, which indicate that accidents at work affect a significant reduction in the human population.

#### Analyze accident rates on the example of the surveyed logistics industry companies for the period 2022-2023

In order to verify the level of the number of accidents and the indicators that have been achieved by individual companies, the level and degree of the number of accidents were analyzed and evaluated with reference to the period 2022-2023. Companies from selected areas of the Poland were selected for the study, which was a total for:

- a) Silesia Province – 32% of the surveyed companies;
- b) Lodzkie Province – 16% of the surveyed enterprises;
- c) Greater Poland – 12 % of the surveyed companies;
- d) West Pomeranian province – 12% of the surveyed companies;
- e) Lower Silesia province – 12% of the surveyed companies;
- f) Masovia province – 4% of the surveyed enterprises.

**Table 2.**

*Characteristics of companies in the logistics industry included in the assessment of accident rates*

Company		Year of establishment	The economic area in which the surveyed enterprise is classified	Number of employment 2022	Number of employment 2023
1	2	3	4	5	6
1	Company 1	2014	Transportation/storage	3100	2905
2	Company 2	2020	Transportation/storage	1908	1988
3	Company 3	2014	Transportation/storage/production	350	433
4	Company 4	2021	Transportation/storage	11	24
5	Company 5	2018	Transportation/storage	3225	3124
6	Company 6	2015	Transportation/storage	1280	1210
7	Company 7	2020	Transportation/storage	2135	2566
8	Company 8	2021	Transportation/storage	1255	1032
9	Company 9	2019	Transportation/storage	550	451
10	Company 10	2017	Transportation/storage	135	260
11	Company 11	2018	Transportation/storage/production	768	774
12	Company 12	2020	Transportation/storage	1856	1862
13	Company 13	2014	Transportation/storage	3220	3022
14	Company 14	2017	Transportation/storage	2330	2411
15	Company 15	2021	Transportation/storage	2390	1992
16	Company 16	2019	Transportation/storage	2480	2352
17	Company 17	2015	Transportation/storage	1244	1218
18	Company 18	2019	Transportation/storage	455	470
19	Company 19	2014	Transportation/storage	1658	1722
20	Company 20	2014	Transportation/storage	2599	2254
21	Company 21	2016	Transportation/storage/production	233	260
22	Company 22	2018	Transportation/storage/production	1789	1644
23	Company 23	2019	Transportation/storage	542	551
24	Company 24	2015	Transportation/storage	1754	1840
25	Company 25	2020	Transportation/storage	2122	2062

Source: own work based on consultations with representatives of enterprises.

On the basis of the data obtained from companies in the logistics sector, which are presented in Table 2, an analysis of employment for selected companies was carried out, verifying what percentage constitutes employment for the surveyed companies from each province, to the total level of employment in all analyzed companies in 2022-2023, as indicated in Table 3.

**Table 3.**

*Summary of the number of employees in each province of the surveyed enterprises in the period 2022-2023*

Province	Number of employment 2022	Number of employment 2022	Number of employment 2023	Number of employment 2023	Dependency of employment in relation YoY [%]
<b>Silesia</b>	13264	33,67	13282	34,56	0,14 ↑
<b>Lodzkie</b>	3309	8,40	3347	8,71	1,14↑
<b>Great Poland</b>	7940	20,16	7425	19,32	6,49 ↓
<b>West Pomerania</b>	4179	10,61	4040	10,51	3,33 ↓
<b>Lower Silesia</b>	8575	21,77	8271	21,52	3,55 ↓
<b>Masovia</b>	2122	5,39	2062	5,37	2,83 ↓
<b>Sum</b>	<b>39389</b>		<b>38427</b>		<b>2,44 ↓</b>

Source: own work based on collected data from the analyzed enterprises.

Based on Table 3, it is concluded that the most employment for the analyzed enterprises in the logistics industry is for organizations located in Silesia Province, which indicates a 33.67% level in 2022 and 34.56% for the 2023r period in terms of total employment. Next in the top three provinces is the predominance of the Lower Silesia province indicating 21.77% of employment in the 2022 period and 21.52% for 2023 in relation to the total sum of the surveyed enterprises. The third voivodeship with the most employment in the surveyed organizations is Greater Poland, whose rate for the 2022 period is 20.16% and for 2023 it is 19.32%. In order to verify the number of accidents for the periods 2022-2023 for the surveyed enterprises, taking into account the indicators of the organizations in terms of occurrence in the particular province in which the enterprises are located, the summary and comparison shown in Table 4 was obtained.

**Table 4.**

*Summary of the rate of occupational accidents in each province of the surveyed enterprises for the period 2022-2023*

Province	Number of accidents 2022	Number of accidents 2022	Number of accidents 2023	Number of accidents 2023	Dependency of employment in relation YoY[%]
<b>Silesia</b>	153	33,77	59	27,70	61,44 ↓
<b>Lodzkie</b>	26	5,74	20	9,39	23,08 ↓
<b>Great Poland</b>	102	22,52	33	15,49	67,65 ↓
<b>West Pomerania</b>	37	8,17	16	7,51	56,76 ↓
<b>Lower Silesia</b>	93	20,53	73	34,27	21,51 ↓
<b>Masovia</b>	42	9,27	12	5,63	71,43 ↓
<b>Sum</b>	<b>453</b>		<b>213</b>		<b>52,98↓</b>

Source: own work on the basis of collected data from the analyzed enterprises.

On the basis of Table 4 it is noted that in the case of the averaged values of accident rates for the surveyed companies in the logistics industry, decreases in accidents at work are indicated in sum for all provinces. The largest decrease was recorded in the Masovia province, which is a decrease at 71.43% in 2023 compared to 2022, followed by Greater Poland province with a decrease of 67.65%, and Silesia with a decrease of 61.44%.

The next step is to verify and evaluate the number of accidents in the surveyed logistics companies with an indication of accident rates for the period 2022-2023, and to verify how the number of accidents is shaping up, in order to determine whether it is characterized by a decrease or increase in the area of accidents, and then to determine the directions to achieve the intended goals by the surveyed companies, which is to be presented in Table 5.

**Table 5.**

*Summary of the number of accidents for the period 2022-2023 at the surveyed companies in the logistics industry*

Company	Number of employment		Difference in Employment Decrease ↓ Increase ↑ [%]	Number of accidents		Difference in accidents rates Decrease ↓ Increase ↑ [%]	
	2022	2023	YoY	2022	2023	YoY	
1	Company 1	3100	2905	6,29 0 ↓	30	14	53,33 ↓
2	Company 2	1908	1988	4,020 ↑	13	3	76,92 ↓
3	Company 3	350	433	19,17 ↑	4	6	33,33 ↑
4	Company 4	11	24	54,17 ↑	0	0	0,000 -
5	Company 5	3225	3124	3,130 ↓	8	2	75,00 ↓
6	Company 6	1280	1210	5,470 ↓	22	8	63,64 ↓
7	Company 7	2135	2566	16,80 ↓	38	15	60,53 ↓
8	Company 8	1255	1032	17,77 ↑	38	11	71,05 ↓
9	Company 9	550	451	18,00 ↑	4	2	50,00 ↓
10	Company 10	135	260	48,08 ↓	2	2	0,000 -
11	Company 11	768	774	0,780 ↓	6	11	45,45 ↑
12	Company 12	1856	1862	0,320 ↓	14	5	64,29 ↓
13	Company 13	3220	3022	6,150 ↑	45	11	75,56 ↓
14	Company 14	2330	2411	3,360 ↓	15	10	33,33 ↓
15	Company 15	2390	1992	16,65 ↑	42	12	71,43 ↓
16	Company 16	2480	2352	5,160 ↑	5	4	20,00 ↓
17	Company 17	1244	1218	2,090 ↑	21	8	61,90 ↓
18	Company 18	455	470	3,190 ↓	11	4	63,64 ↓
19	Company 19	1658	1722	3,720 ↓	14	14	0,000 ↓
20	Company 20	2599	2254	13,27 ↑	27	12	55,56 ↓
21	Company 21	233	260	10,38 ↓	5	5	0,000 -
22	Company 22	1789	1644	8,110 ↑	24	26	7,690 ↑
23	Company 23	542	551	1,630 ↓	12	7	41,67 ↓
24	Company 24	1754	1840	4,670 ↓	11	9	18,18 ↓
25	Company 25	2122	2062	2,830 ↑	42	12	71,43 ↓
<b>Sum</b>		<b>39 389</b>	<b>38427</b>	<b>2,443 ↓</b>	<b>453</b>	<b>213</b>	<b>52,98 ↓</b>

Source: own work based on collected data from companies in the logistics industry.

Based on Table 5, the relationship between employment rates and accident rates for the period 2022-2023 in the surveyed companies, as shown in Table 6.



**Table 6.**

*Relationship of the employment rate to the number of occupational accidents in the surveyed companies*

Lp.	Relationship indicated in evaluation of indicators	Number of companies
1	Decrease in employment rate vs decrease in accidents	10
2	Decrease in employment rate vs increase in number of accidents	2
3	Decrease in employment rate vs number of accidents unchanged	2
4	Increase in employment rate vs number of accidents unchanged	1
5	Increase in employment rate vs decrease in number of accidents	9
6	Increase in employment rate vs increase in number of accidents	1

Source: own work based on collected data from companies in the logistics industry.

Analyzing the rates of all surveyed companies, it was indicated that the number of employment fell from 39,389 (2022) to 38427 (2023), which is 2.443%. Analyzing the accident rate, an analogous trend was presented, showing a decrease from 453 (2022) accidents to 213 (2023), a total of 52.98%.

#### **4. Discussion of the results obtained and conclusions from the analysis of accident rates in the surveyed logistics industry companies and on the basis of statistical data**

The analysis of accident rates for companies in the logistics industry was aimed at verifying how the number of accidents develops, whether it presents an upward or downward trend, and what factors affect the change in the above-mentioned rates. The first part of the data analysis consisted of verifying the statistical data that the Central Statistical Office presents in its reports in terms of accident rates and the indicator relating to the total number of deaths in the periods 2020-2023. When analyzing the data in terms of fatal accidents that occurred in the period 2020-2023, they represent between 0.02% and 0.049% of all deaths in Poland, which does not confirm global trends in the area of mortality due to occupational accidents. Thus, it is also concluded that the percentage of fatal accidents is small compared to the figures presented by the Central Statistical Office.

The next steps included analyzing the data collected from the 25 selected logistics industry enterprises, mainly focusing attention on the number of employment and accident rates that were determined for 2022-2023, and then verifying, based on the information collected from company representatives, what measures were taken to affect the rates and their potential decreases/increases.

The companies that were selected for the assessment of accident rates for the period 2022-2023 in the logistics industry are located in 6 provinces, including the most employment, were as follows for the provinces:

- a) Silesia - employment in 2022 amounted to 13264, while in 2023 it was shaped at the level of 13282, which represents 0.14% annual growth;
- b) Lower Silesia - employment in 2022 amounted to 8575, while in 2023 it was at the level of 8271, which represents a decrease of 3.55% per year;
- c) Greater Poland - employment in 2022 amounted to 7940, while in 2023 it was at the level of 7425, a decrease of 6.49% per year.

Analogous to the above, analyzing the accident rate for the surveyed enterprises in the period 2022-2023 by 6 provinces indicated that all metrics experienced decreases in the area of the number of accidents at work. The largest reductions in accidents occurred in enterprises located in the following provinces:

- a) Masovia - in 2022 the number of accidents was 42, while in 2023 it was at the level of 12 incidents, a decrease of 71.43%;
- b) Greater Poland - in 2022 the number of accidents was 102, while in 2023 it was at the level of 33 incidents, a decrease of 67.65%;
- c) Silesia - in 2022 the number of accidents was 153, while in 2023 it was at the level of 59 incidents, a decrease of 61.44%.

Moving smoothly to the discussion of detailed data on the surveyed companies, analyzing the information in Table 5 and Table 6, it was found that for the 10 organizations, the number of occupational accidents decreased with the decrease in employment, accounting for a total of 10 companies. No less, however, 9 companies indicated a significant increase in employment, with a decrease in occupational accidents. Overall, looking at the total number of employment in 2022 was 39 389 which represents a decrease of 2.443% to 2023. The number of accident is on a similar downward trend. In 2022, the number of accidents amounted to 453 which represents a decrease of 52.98% to 2023 in which a total of 213 accidents occurred.

When comparing the year-over-year (YoY) decrease in employment of 2.443%, it is significantly lower than the accident incident rate, which is 52.98%, clearly indicating the unobserved correlation between the decrease in employment in the decrease in accidents. After verification the above data and additional consultation with representatives of the companies included in the study for the period 2022-2023, it was determined what caused such large differences in the minimization of accident events. Namely:

1. After the occurrence of accident events, measures were taken to determine all possible causes of accidents on the basis of extensive analysis, including brainstorming, 5Why analysis and other tools used to obtain the necessary information on causes;
2. A number of corrective actions have been implemented to eliminate similar accidents to those that occurred in 2022;
3. A number of training sessions were conducted with employees, from management to entry level employees. The increase in training was around 25-55% at the surveyed companies;

4. Special internal trainings have been implemented to successively remind employees of rules as well as safety standards. They are held at enterprises on a monthly/quarterly basis. The trainings are conducted by internal instructors, trainers or mentors;
5. There have been a number of campaigns in the area of safety, to which employees have been involved at a level of 15-45% for the surveyed companies;
6. During post-accident processing, companies use external technical experts, as well as support themselves with additional opinions from experts, representatives of medical units to analyze the circumstances very thoroughly and causes of occupational accidents;
7. enterprises place greater emphasis on reporting hazardous and potentially accidental events, which affect the ability to take prompt action and determine the cause of the event. Such actions affect the ability to take action to eliminate the occurrence of an accident at work. The increase in reported hazardous or near miss incidents was between 36-52% among the surveyed enterprises.

## 5. Summary

Analyzing in detail the data that are collected, processed and then made available by the Central Statistical Office, as well as on the basis of the collected data obtained directly from the surveyed companies in the logistics sector for the specified time frame, the accident rates and the dependencies affecting their occurrence were verified. It is found, based on the data obtained, that the number of accidents at work each year shows a downward trend, which is a good trend if confirmed, that entrepreneurs are striving to achieve their complete elimination. Such measures are aimed at providing a sense of safety, thus giving convenient conditions for the execution of work.

Based on the results, it is noted that there is a minimal trend of decline in employment in the logistics industry of the surveyed enterprises, which decreased by more than 2.4% compared to 2023. On the other hand, the number of accidents decreased significantly, i.e. by 52.98%, and this is not a clear correlation with the decrease in employment. The decrease in the number of accidents is evident in 19 companies out of a total of 25 surveyed, which is influenced by a number of factors that are an indispensable part of the goal of achieving zero accidents at work. The correlation occurs primarily with the increase in reporting and reporting of near-misses (an increase between 36 and 52%), which in turn indicates that it is the actions taken after reporting potential hazards that influence the elimination of the actual occurrence of an accident at work. Thus, it is confirmed that companies in the logistics industry are taking a number of measures and initiatives to influence the pursuit of to achieve the best results, i.e. 0 accidents at work. Thus, there is an opportunity to create the most optimal and safe

conditions for employees for the provision of work, and the spread of a safety culture will influence the continuous improvement of their awareness.

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