IOSUD – Politehnica University of Timișoara
Doctoral School of Engineering Studies

A comprehensive analysis of the relationship between the occupational health and safety management system and the incidence of work incidents in production processes

Doctoral Thesis – Abstract
for obtaining the scientific title of Doctor at
Politehnica University of Timișoara
in the doctoral field of Industrial Engineering
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Importance, relevance, and timeliness of the doctoral thesis

Currently, the rapid development of technologies, the continuous transformation of workplaces, as well as of work schedules, represent challenges for occupational health and safety management systems (OHSMS) both at the national and global levels. At the same time, the persistence and, in some cases, even the increase of industrial development inequalities between geographical areas imply the need to enhance the performance of OHSMS. One of the main directions of OHSMS is the reduction and elimination of work incidents. It is well known that work incidents represent a significant issue because they interrupt or hinder the work process and affect, physically, psychologically, socially, and economically, at least one of the components of the work system: the worker, the work task, the means used in work, and the work environment [1]. It must be emphasized that merely mentioning the occupational health and safety strategy will not lead to the prevention of work

incidents unless it is followed by concrete measures implemented at each workplace. Work incidents are a major societal problem, and effective measures must be taken to prevent them [2].

The most recent statistics from the Statistical Office of the European Communities, Eurostat, show that Romania records one of the highest rates of work incidents resulting in death, far exceeding the European average (figure 1), (figure 2) [3].

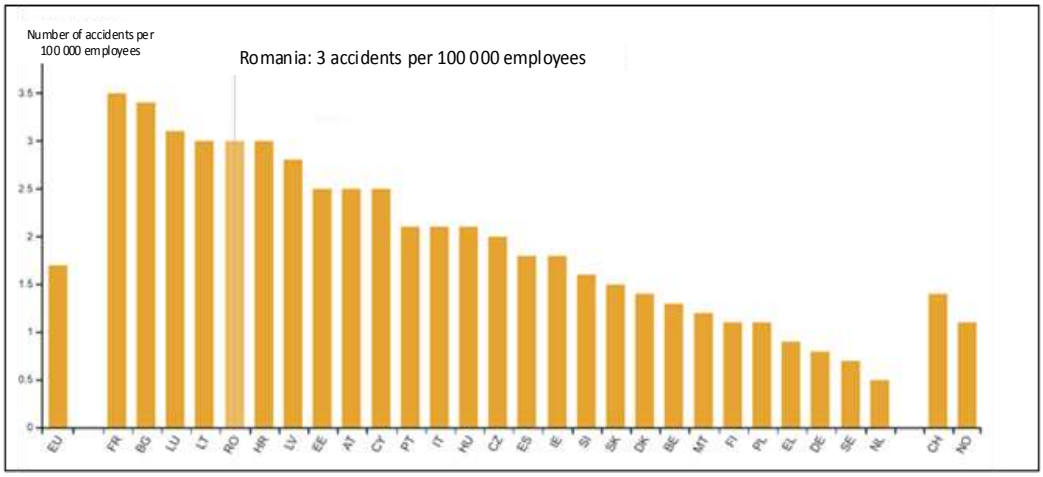

Figure 1 Incidence of fatal work incidents in the EU in 2019 per 100,000 workers

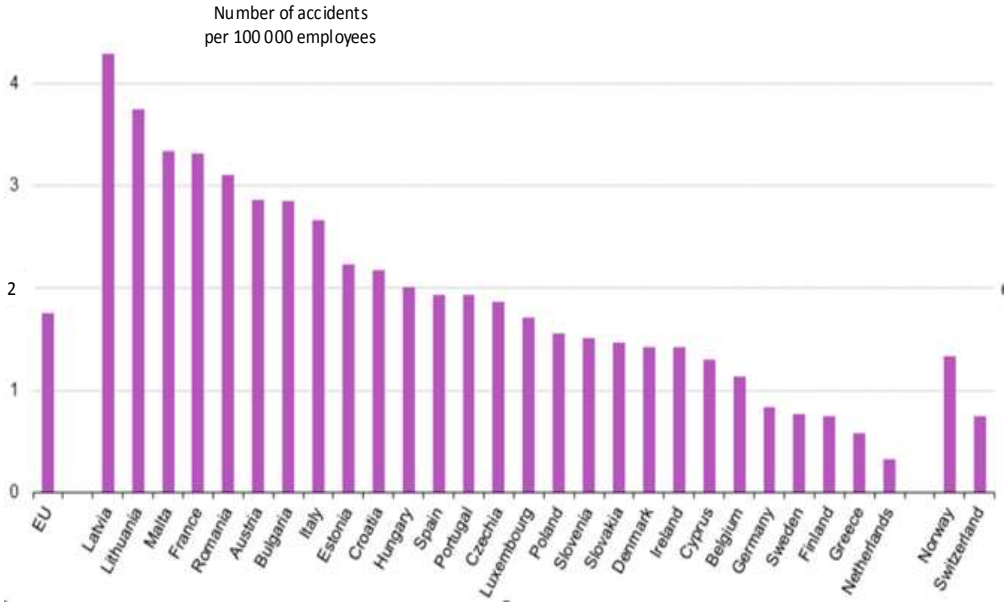

Figure 2 Incidence of fatal work incidents in the EU in 2021 per 100,000 workers

The thesis aims to establish objectives and strategies for OHSMS focused on analyzing the causes of work incidents and proposing measures to eliminate or reduce them, so that a decrease in work incidents can be recorded.

This objective can only be achieved through complex measures resulting from a systemic approach to work processes, by building an integrated management of occupational risk that considers all factors, as well as the elements for ranking their influence, in order to achieve prioritization that proportionally sizes the intervention. This is intended to optimize both the effects and the efforts, while also increasing effectiveness.

The thesis proposes a study based on the principle that work incidents can be prevented if the verification of compliance with occupational health and safety regulations by all employees is organized effectively and efficiently.

Objectives and content of the research

The main objective of the present research topic is **to increase workplace safety through effective solutions that involve all stakeholders (employer, employee, regulatory bodies), under conditions of an integrated approach to OHSMS.**

In connection with the main objective, the research aimed to achieve a set of **secondary objectives**, corresponding to the available resources and the scope of the approach, as follows:

1. Critical analysis of the current state of occupational risk management, from the perspective of findings regarding the causes of accidents;
2. Evaluation of the level and main characteristics of the components of the work system (the worker, the work task, the means used, the work environment), considered as independent variables;
3. Evaluation of the fundamental components of the work system (the worker, the work task, the means used, the work environment), starting from the components included in the previous objective and addressing their behavior in interaction with others (external environment, scientific and technological factors, etc.), based on output analysis (number of work-related events);
4. Evaluation of the level and main characteristics of the fundamental components of the work system (the worker, the work task, the means used, the work environment), considering it as an industrial technological system, based on the hypothesis of the work system as an industrial technological process, attempting to transpose specific methods of such processes;
5. Development of an integrated model for the work system (the worker, the work task, the means used, the work environment), which respects the general principles of systemic construction, identifying the main variables and the relationships among them, in the form of a cybernetic system;
6. Identification of the main causes of work incidents in Timiș County through an analysis of multiannual dynamics, in order to identify optimal solutions for reducing

their number and consequences, while simultaneously reducing the resources consumed;

7. Ranking of causes using statistical-mathematical methods and establishing functional cause-effect relationships based on statistical processing of results and analysis of significance, correlation, and dependency.

To achieve and cover these objectives, the thesis comprises 194 pages, structured into 3 chapters, containing 108 tables, 81 figures, and a bibliography of 151 titles and online references. Additionally, a list of the author's works is attached.

Chapter 1 analyzes the Integrated Industrial Management System (IIMS), presenting the concept and the normative acts regulating the application of integrated management systems. The advantages and disadvantages of an IIMS are also presented. The chapter continues with the role of OHSMS within IIMS and the structure and components of OHSMS. At the end of the chapter, key performance indicators for OHSMS are defined and classified.

Chapter 2 comprises three parts. The first part defines, classifies, and analyzes work-related events. It also examines the causes and consequences of such events and presents conclusions and solutions. The second part of the chapter presents the experimental research regarding workers' perception of OHSMS using the Key Performance Indicators (KPI) method. This includes the methodology of the experimental research, followed by the presentation and analysis of results. The chapter concludes with the original contributions of the thesis.

Chapter 3 presents the general conclusions and defines the perspectives for further development of the research.

1. Analysis of the current state of information in the specialized literature regarding the relationship between the occupational health and safety management system and the incidence of work-related events

An Integrated Management System (IMS) is a holistic approach that considers all systems and processes as a unified whole within a complete framework, enabling an organization to operate as a single entity with compact, specific objectives. The integrated system provides a clear view of all aspects of the organization, how they influence each other, and the associated risks. In any organization, the need to develop an integrated system generally arises internally (microenvironment), rather than externally (macroenvironment).Typically, an IMS mainly includes elements specific to occupational health and safety management (ISO 45001), information security management (ISO/IEC 27001), quality management (ISO 9001), energy management (ISO 50001), and environmental management (ISO 14001).

Structure and components of OHSMS

The International Labor Organization defines OHSMS as "a set of elements that are interrelated and interact to establish and fulfill policies and objectives regarding occupational health and safety" [26].

The most well-known occupational health and safety management systems include the concept of "Lost Control," which was developed within the "International Safety Rating System" (ISRS) [28]. According to this concept, a primary task of managers is to manage risk effectively. Risk management begins with hazard identification and the analysis and evaluation of risks to which the organization and its personnel are exposed.

Key Performance Indicators (KPI) of OHSMS

KPIs are based on objective and validated measurements or, where this is not possible (such as safety climate or worker satisfaction), on surveys or questionnaires.

KPIs must provide objective data regarding the OHS situation, following the principle that "what can be measured can be managed." To be useful as a management tool for OHS, KPIs must provide quantitative or semi-quantitative data reflecting safety and health aspects and activities within the organization. They should include condensed information on existing and emerging risks, exposures, and preventive activities to reduce residual risks [52].

The relevance of KPIs increases when they are based on real-time measurements or at the highest possible frequency. For example, a KPI monitored weekly can impose immediate measures, whereas a KPI measured annually will lead to delayed actions and cannot influence the management of acute risks.

KPIs can be classified as "lagging" or "leading."

Lagging KPIs measure the "results" of past occupational health and safety management processes. Lagging KPIs indicate when the desired OHS outcome has failed or when OHSMS objectives have not been achieved. Essentially, they allow learning from mistakes.

Commonly used lagging KPIs include:

- Occupational injuries and illnesses;
- Lost workdays due to occupational injuries and illnesses;
- Incidents and near misses;
- Complaints regarding unsafe or unhealthy working conditions;
- Number of early retirements [52][53].

Leading KPIs have predictive value and can therefore be used to improve OHS management in general or to intervene in risky situations before safety or health is compromised. They often measure factors generally considered essential elements of good OHS management.

Commonly used leading KPIs include:

- Percentage of managers with adequate OHS training;
- Percentage of workers with adequate OHS training;
- Percentage of management meetings addressing OHS issues;
- Percentage of manager-worker meetings addressing OHS issues;
- Number of workplace visits by management related to occupational health and safety;
- Percentage of business partners (suppliers, contractors, etc.) evaluated and selected based on their OHS performance or a widely accepted OHS certification;

- Number of OHS-related inspections or their results;
- Frequency of observing (un)safe behaviors;
- Number of OHS audits conducted;
- Percentage of OHS projects/activities completed on time;
- Percentage of suggestions or complaints regarding OHS where feedback is provided to reporters within established deadlines;
- Safety climate (survey) [54].

Several international bodies have developed and disseminated globally or regionally various guidelines and normative documents containing recommendations for the design, implementation, and improvement (not legally mandatory) of OHSMS [55]. Some relevant examples include: *"Guidelines on Occupational Safety and Health Management Systems"* (ILO-OSH:2001), (ILO, 2009), *"Good Practices in Labour Inspection: Rural Sector with Special Attention to Agriculture"* (ILO, 2012), *"Practical Guide for Implementing ISO 45001:2018"* (ASRO, 2023), etc.

Work incidents – an important factor for the evaluation and improvement of OHSMS

The General Conference of the International Labour Organization, at its 90th session on June 3, 2002 [80], established procedures for compiling statistics on work incidents and diseases and defined the following terms:

- work incidents (hereinafter referred to as N) – an event occurring in the course of or arising from the performance of work duties, resulting in bodily injury;
- Occupational disease – any disease contracted as a result of exposure to risk factors at the workplace;
- Hazardous event – an event, as defined by national legislation, with the potential to cause bodily injury or illness to workers or the public;
- Commuting accident – an accident resulting in bodily injury, occurring on the direct route between the workplace and the worker's residence, the place of meal service, or the location where the worker receives wages.

In 2006, the Romanian Parliament adopted Law No. 319 on Occupational Health and Safety [81] with the purpose of promoting improvements in OHS and defining terms in accordance with the ILO protocol.

Possible causes of work incidents

The most frequent causes of work incidents are classified according to the components of the work system, as follows:

1.Work task, if it contains errors/omissions, is not correlated with the worker's technological/OHS training, tolerates technological/OHS deviations, or allows work with inadequate equipment;

2.Work environment, reflected by high/low temperature or humidity, excessive noise, increased/decreased air pressure, air currents, high noise levels, work in isolation, unethical relationships between supervisors and subordinates or among workers;

3.Work equipment, represented by machines, moving machine parts, equipment with sharp, pointed, or abrasive edges, areas with high or low temperatures, risk of direct or indirect electrocution, excessive vibrations, contact with toxic, caustic, or flammable surfaces, equipment requiring forced or harmful working positions, excessive speed, attention, or force, or monotonous work;

4.Worker, who may cause accidents through failure to use protective equipment, improper execution of commands, maneuvers, positioning, assembly, adjustments, falls on the same level due to imbalance, slipping, tripping, falls from height due to stepping into voids, imbalance, slipping, presence at work under the influence of alcohol, psychotropic substances, excessive fatigue, or erroneous communication.

Consequences of work incidents (N)

Consequences represent the outcomes of an N, classified according to the effects produced on the worker(s) and/or on other components of the work system, including other societal components [146].

The consequences of N are multiple and affect all components of the work system (work task, work environment, work equipment, worker) and are classified according to different criteria [146] [149]. For example, regarding the "worker" component, the consequences of N are classified based on the nature and severity of bodily injuries.

Solutions for reducing work-related events through evaluation and improvement of OHSMS

Not only, but especially in cases where N occur, organizations, through OHSMS, conduct analyses to identify all causes, propose, and then implement measures to eliminate the causes of such events, with the aim of preventing similar occurrences [150]. In Romania, taking measures after N is mandatory and imposed by legal provisions [84].

Researchers have used quantitative analyses based on lagging KPIs to study the effect of implementing safety policies and qualitative analyses focusing on the process and implementation of policies, both proposing measures and suggestions for improvement [85] [121].Regarding the implementation of OHS policies, it has been observed that organizations tend to undertake multiple OHS-related actions without emphasizing factors fully critical to worker safety and health. As a result, despite efforts, the number of N has not been significantly reduced [86] [87].

Excessive bureaucracy within OHSMS leads to disadvantages in achieving objectives, including complicating communication between institutions, departments, and individuals, thereby reducing OHSMS performance [89].

2. Original contributions regarding the complex analysis of the relationship between the Occupational Health and Safety Management System and the incidence of work incidents in production processes

2.1 Research on the integrated comparative analysis of the incidence of work incidents in Timiș County (2012–2021)

Research objectives

This chapter aims to optimize and improve the management of OHSMS by identifying dependency relationships between causes and factors and by constructing statistical models of internal relationships within OHSMS. This is based on the experimental plan adopted for the selection of all work incidents (N) that occurred during the period 2012–2021 in Timiș County, in activities coded according to CAEN (Classification of Activities in the National Economy) [119], Division 10 – Food Industry, and Classes 4321 – Electrical Installation Works and 4322 – Plumbing, Heating, and Air Conditioning Installation Works, to analyze (including in terms of statistical relevance) the following elements:

1 – Causes dependent on the employer (violation of any employer obligation regarding work equipment, work task, and work environment);

2 – Causes dependent on the employee (violation by the employee of OHS regulations);

3 – Causes due to road traffic (responsibilities established by the competent authorities).

Description of the research methodology

The research methodology applied for analyzing the incidence of N in the food industry is schematically presented in Figure 2.5.

The research for analyzing the incidence of N was carried out by applying the methodology described above in two stages: one stage was dedicated to the specific relationship for N in production activities within the food industry, and the second stage focused on specific production activities within the construction industry.

Obtained Results

Results obtained in the specific field of production within the food industry

According to the methodology, 819 organizations operating in the food industry sector (CAEN Division 10) were selected, with a total of 64 work incidents (N). The economic activities in which N were recorded have the following CAEN codes:

- 1011 – Processing and preservation of meat;
- 1013 – Manufacture of meat products (including poultry meat);

- 1051 – Manufacture of dairy products and cheeses;
- 1052 – Manufacture of ice cream;
- 1061 – Manufacture of milling products;
- 1071 – Manufacture of bread; manufacture of fresh cakes and pastry products;
- 1072 – Manufacture of biscuits and rusks; manufacture of preserved cakes and pastry products.

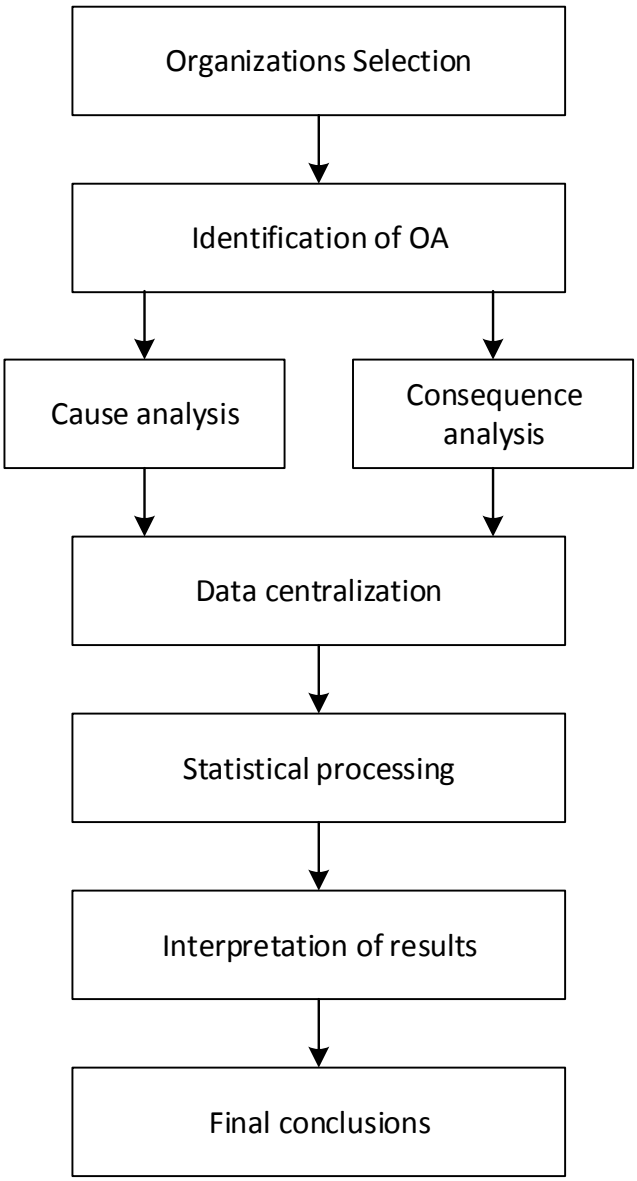

Figure 2.5 Stages of the Research Methodology

For the economic activities with the highest average number of N (CAEN codes 1011 and 1071), the relationships between the number of employees and the number of N and days of temporary incapacity for work (ITM) were analyzed. The results were calculated per 1,000 employees, depending on the actual solutions used [110].

From the study of the possible relationship between the number of employees in the company (independent variable) and the number of N in the economic activity with CAEN code 1011, following the practical application, an exponential function model was considered optimal (also considering other simple regression models, both linear and nonlinear):

Y = exp(a + b/X) where:

Y – total annual number of accidents;
X – total number of employees (NE under the same conditions);
a, b – regression coefficients to be determined for each case individually.

The results processed using the STATGRAPHICS Centurion V19 software indicated the following optimal relationship for the chosen mathematical model, in the case of the total number of work incidents (N):

N = exp(2.60759 - 1328.52/NE)

Table 2.2 presents the results for the coefficients and the analysis of variance for the relationship N = f(NE) for CAEN class 1011, while Figure 2.6 shows the graph of the adapted model for the relationship N = f(NE), CAEN class 1011.

Table 2.2 Results of the Statistical Analysis for the Relationship N = f(NE), CAEN Class 1011

Coefficients

Parameters	Least squares estimates	Standard error	Test T	P
Residual	2.60759	0.533549	4.88726	0.0012
Slope	-1328.52	754.044	-1.76186	0.1161

Analysis of variance

Source	Square Sum	Df	Square Average	Test F	P
Model	0.857658	1	0.857658	3.1	0.1161
Residuals	2.21035	8	0.276294		
Total	3.06801	9			

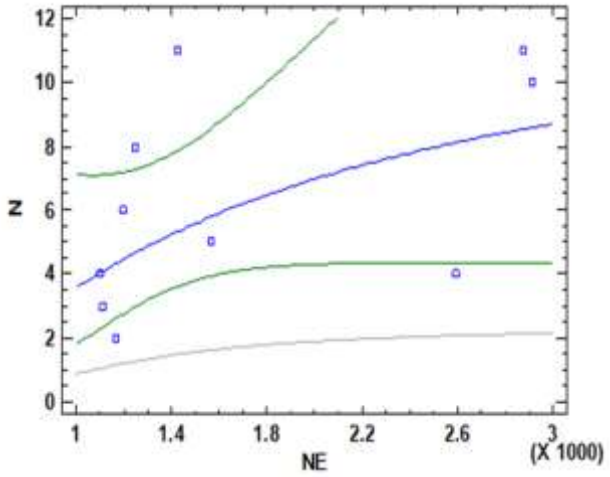

Figure 2.6 STATGRAPHICS Chart of the Adapted Model for the Relationship N = f(NE), CAEN Class 1011

The statistical parameters (Correlation Coefficient = -0.528724; R-squared = 27.9549%; R-squared [adjusted for degrees of freedom] = 18.9492%; Standard Error of Estimate = 0.525637; Mean Absolute Error = 0.39141; P = 0.1379), as well as the residual autocorrelation (Lag1 = 0.189778), indicate a moderately strong relationship between the variables.

Since the P-value in Table 2.2 is greater than or equal to 0.05, there is no statistically significant relationship between the number of accidents and the number of employees at a confidence level of 95.0% or higher. A possible explanation is the difference between the level of risk perception regarding occupational health and safety and the differences among organizations' OHSMS in terms of work processes and KPIs.

Results obtained in the field of specialized construction works

In the second stage of the N analysis, according to CAEN codes 4321 – Electrical Installation Works and 4322 – Plumbing, Heating, and Air Conditioning Installation Works, a total of 1,397 enterprises were selected for the study.

The first analysis examined the nature of the relationship between the annual number of work incidents (N) and the number of employees (NA), starting with a simple regression that considered a relevant S-curve model (Y = exp(a + b/X)). This model was deemed appropriate after testing linear and/or nonlinear models. In this context, Y represents the total annual number of N, while X represents the total number of employees (NE, under the same conditions). The results obtained using the STATGRAPHICS software indicated the optimal equation of the adjusted model:

N = exp(1.37568 – 7.10394/NE)

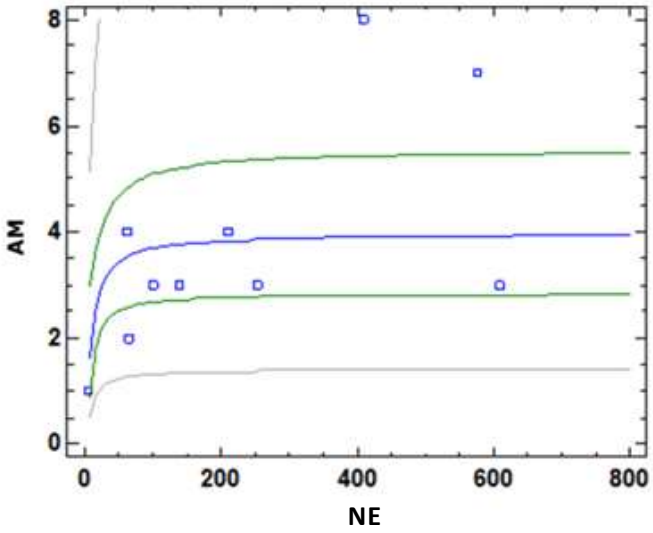

Figure 2.31 Graph of the Adjusted Model for the Function N = f(NE) during the Period 2012–2021

Figure 2.31 presents the graphical representation, while Table 2.50 shows the results of the coefficients and the analysis of variance. The R^2 statistic indicates that the adjusted model explains 54.3402% of the variability of NE values. The correlation coefficient has a value of -0.737158, which indicates a moderately strong relationship between the variables. The standard error of estimation shows that the standard deviation of the residuals is 0.423062. The mean absolute error (MAE) has a value of 0.30368. Since the P-value is greater than 0.05, there is no evidence of serial autocorrelation of the residuals at a confidence level of 95.0%.

Table 2.50 Results of the Statistical Analysis for the Function N = f(NE), CAEN Division 43

Coefficients

Parameters	Least squares estimates	Standard error	Test T	P
Residual	1.37568	0.146888	9.3655	0
Slope	-7.10394	2.30229	-3.0856	0.02

Analysis of variance

Source	Square Sum	Df	Square Average	Test F	P
Model	1.70407	1	1.70407	9.5	0.02
Residuals	1.43185	8	0.178982		
Total	3.13592	9			

Conclusions

This research on the incidence of work incidents (N) in the food industry and specialized construction works in Timiș County represents a first step and a foundation for extending the study at the national level in the future. N resulting in severe injuries

occurred in economic activities corresponding to CAEN groups 1011, 1071, 4321, and 4322.

A moderately strong relationship was observed between the number of employees and the number of accidents, but not a statistically significant relationship at a confidence level of 95.0% or higher for the S-curve model. For the same model, a relatively weak relationship was noted between the number of employees and the number of days of temporary incapacity for work. For the CAEN 1071 activity group, the most appropriate model was linear regression, showing a moderately strong relationship between the number of employees and the number of accidents, without evidence of serial autocorrelation at a confidence level of 95.0% or higher, and similarly for the relationship between the number of employees and the number of days of temporary incapacity for work.

The results obtained once again justify the need to expand OHS measures and continuously improve OHSMS. Despite existing measures and a steady decline in accident rates, activities in these sectors remain generally intensive in terms of physical effort, and the frequency of N continues to be higher compared to other industries. Recent statistics indicate an average of approximately one day of temporary incapacity for work per employee per year.

A special mention is required for enterprises with fewer than 50 employees (micro and small enterprises), where the number of work incidents is proportionally influenced by the number of employees. Conversely, in organizations with more than 100 employees, the number of work incidents remains relatively constant regardless of subsequent staff increases.

All results indicated significant differences between OHSMS and the potential to reduce N rates through effective measures, limiting worker access to hazardous areas, and addressing low motivation for OHSMS. The final results of the method could be used to evaluate such management systems through the application of specific key performance indicators [108].

Following the analysis of the nature of accident causes cumulatively for both industries, it was found that the majority—71%—of causes were due to employees' non-compliance with OHS regulations.

Future research should analyze comparative evolution at the organizational and national levels, along with investigating workers' perceptions of OHSMS.

2.2 Experimental research on the analysis of workers' perception of the Occupational Health and Safety Management System (OHSMS) using the Key Performance Indicator (KPI) method

Relevance and timeliness. research objectives

Starting from the idea that OHSMS performance can be measured by evaluating the performance of supervisors and employees, the main objective of this research was to assess workers' perception of the occupational risk management system across several enterprises of different sizes and from various fields of activity, using the KPI method, with the aim of optimizing OHSMS.

Research methodology

The experimental research methodology involved a series of steps in accordance with the proposed objective (Figure 2.44).

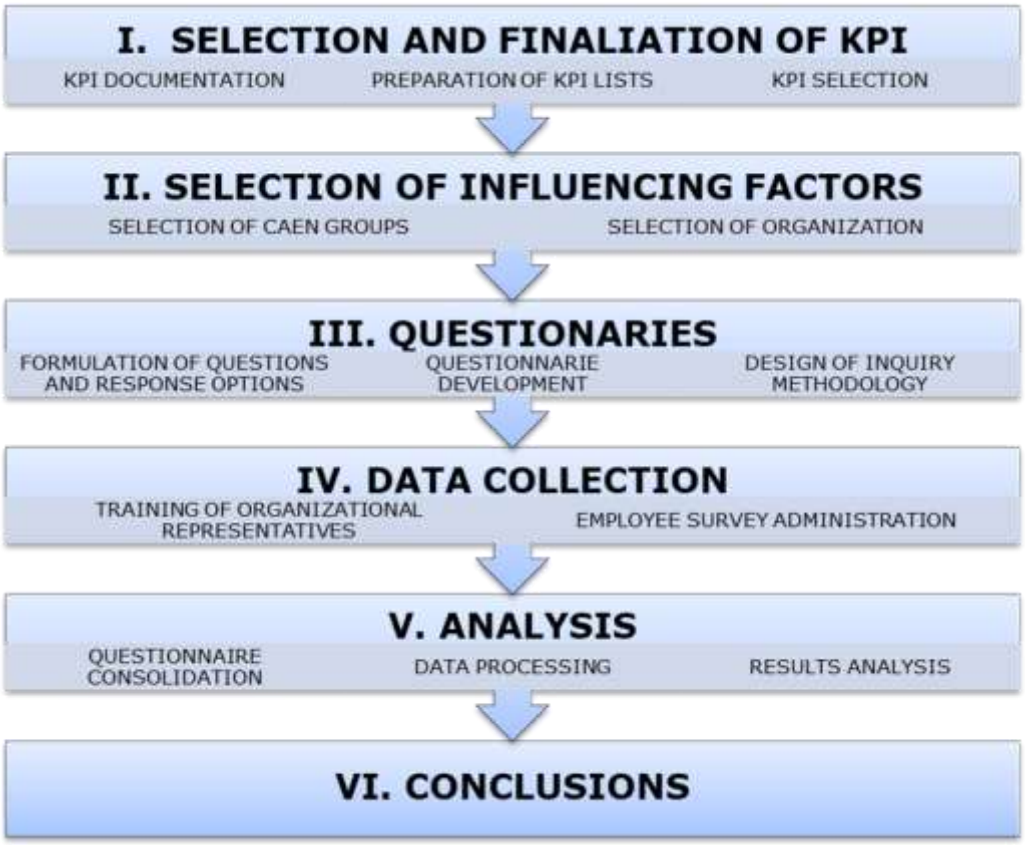

Figure 2.44 Research Methodology (Stages and Sections)

Documentation regarding the KPI method was carried out either by consulting the recommendations of international bodies (ILO, OSHA, ISSA) or by reviewing scientific works published in the Clarivate Analytics (Web of Science) database, as presented in previous chapters.

The selected KPIs had to meet the research objective of analyzing workers' perception of OHSMS, address various elements related to OHSMS performance, and target different groups involved in prevention and protection actions.

Analysis

The consolidated data were statistically analyzed and interpreted using ANOVA, Microsoft Excel, and STATGRAPHICS Centurion X, following the steps presented in Figure 2.45.

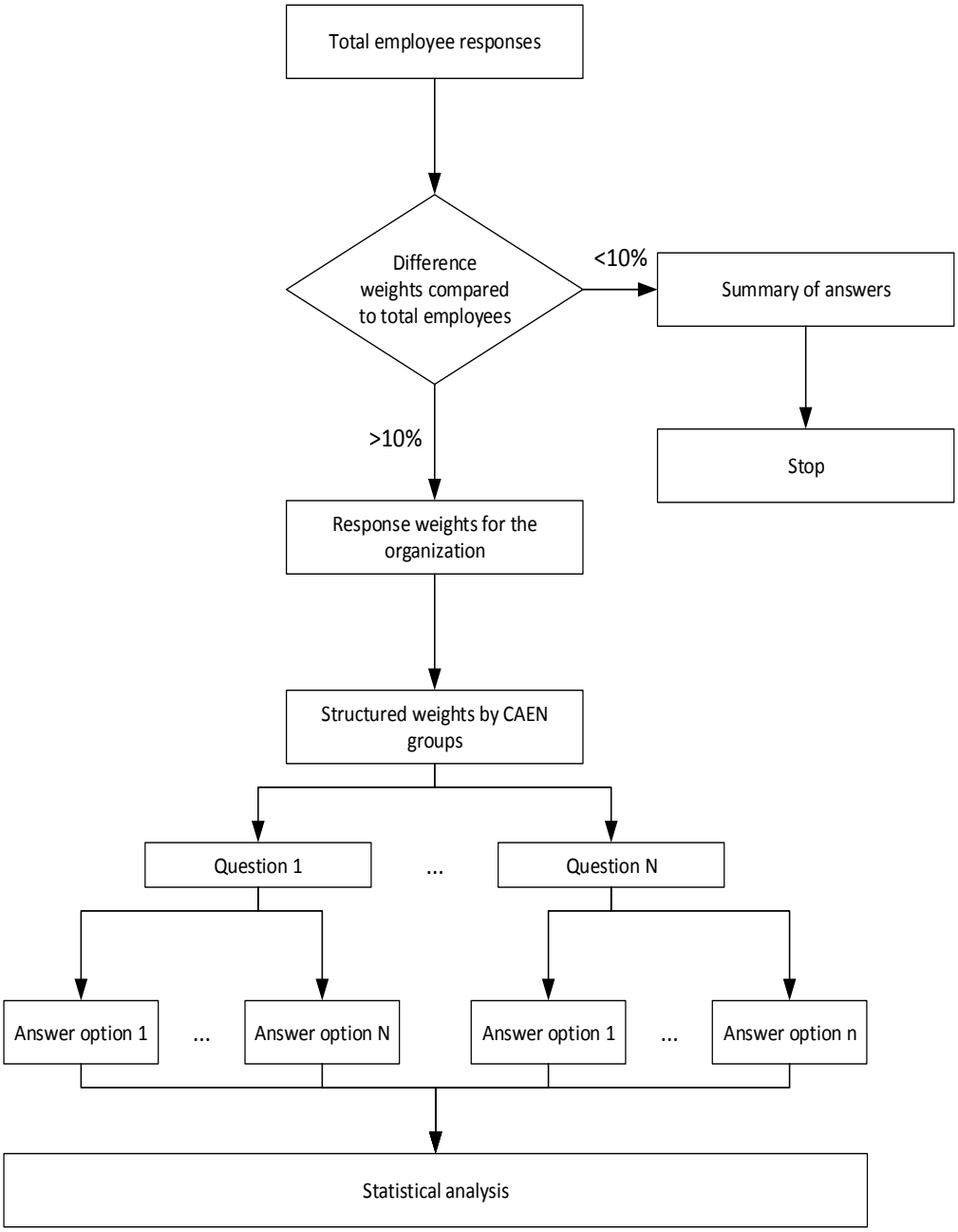

Figure 2.45 Diagram of the Results Analysis

Next, the responses to the questionnaires were analyzed, grouped according to questions I1 ("How many times in the past year (2022) did you feel that you were checked regarding your knowledge and/or practical compliance with occupational health and safety rules?") and I4 ("How many proposals and/or notifications regarding

occupational health and safety activities did you make in the past year?"), based on the selected influencing factors (workplace location, gender of workers, age category, length of service, professional training). For questions I2, I3, and I5, the responses were 92%, 87%, and 97%, respectively, for a single answer option, which is why they were not further analyzed in relation to influencing factors.

The analysis of the proportions of total responses to question I1, by influencing factor "type of activity," shows that most respondents perceive that they were checked frequently or sometimes (0.84). Regarding the analysis within CAEN divisions, the highest proportion of "frequent" responses was recorded among respondents from CAEN divisions 16 and 62 (wood processing industry and information technology), with nearly equal proportions of 0.46 and 0.45, respectively. The lowest proportion of "frequent" responses was recorded in CAEN division 10 (food industry), with a proportion of 0.31. The highest proportion of "sometimes" responses was recorded in CAEN division 10 (0.53), followed by CAEN divisions 62 (0.45) and 22 (manufacture of rubber and plastic products) with 0.43. The lowest proportion of "sometimes" responses was recorded in CAEN division 16 (0.31). The analysis of "never" responses shows that all CAEN divisions are approximately equal, around the value of 0.1. The percentage of respondents who did not answer question I1 is below 1% and was not analyzed.

Figures 2.56 and 2.61 present the graphical representation of responses to questions I1 and I4, and the influencing factor "age."

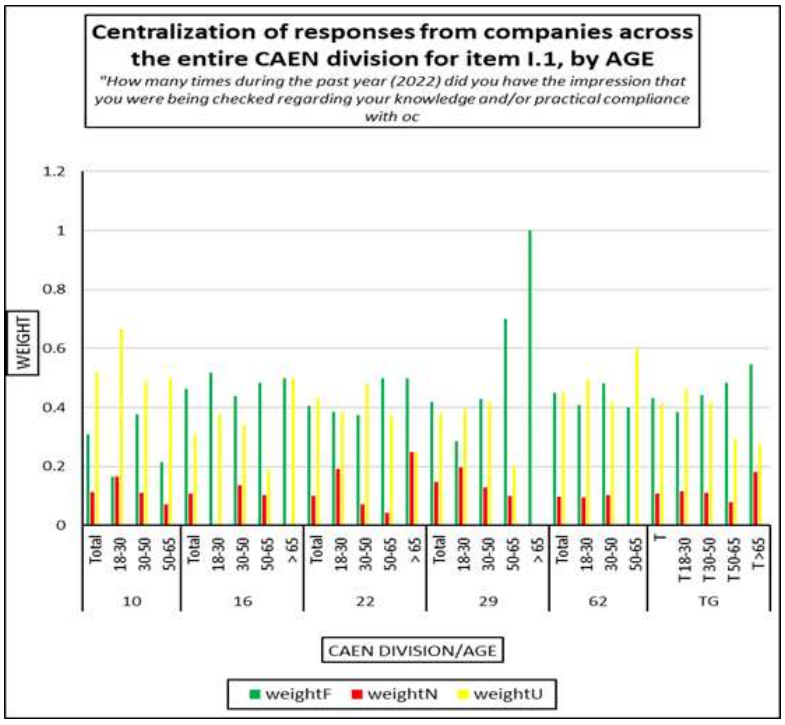

Figure 2.56 Consolidation of Response Weights for Question I1 by Age

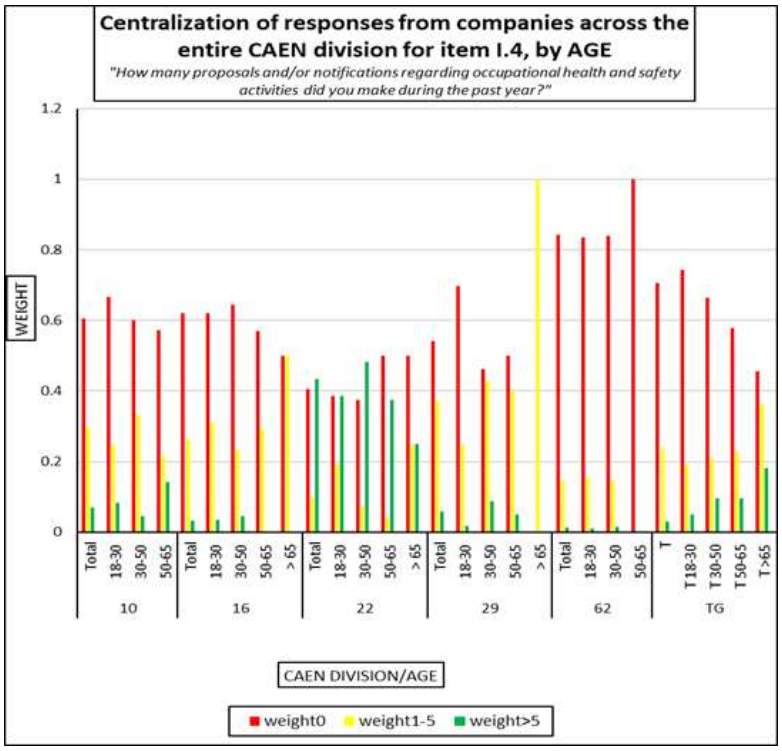

Figure 2.61 Consolidation of Response Weights for Question I4 by Age

The analysis within the classifications of the influencing factor "age" shows that the highest proportion of "**frequent**" responses was recorded among respondents aged 18–30 working in the wood processing industry (CAEN 16) with a proportion of 0.52, while at the opposite end were respondents aged 18–30 working in the food industry (CAEN 10) with a proportion of 0.17.

The highest proportion of "**sometimes**" responses was recorded among respondents aged 18–30 in CAEN division 10 (0.67), and the lowest proportion was observed among respondents aged 50–65 working in the wood processing industry (CAEN 16) with a proportion of 0.19. The proportions of "**never**" responses vary between a minimum of 0.04 for respondents aged 50–65 in CAEN 22 and 0.20 for respondents aged 18–30 in CAEN 29 ("Manufacture of motor vehicles for road transport, trailers, and semi-trailers").

Figures 2.57 and 2.62 present the graphical representation of responses to questions I1 and I4 and the influencing factor "education."

The overall proportion of responses shows that two-thirds (0.71) of respondents did not make any proposal related to OHS activities, and a very small percentage (0.03) made more than five proposals during the year 2022.

Analyzing responses by age category, we note CAEN division 62, where for all age groups the proportion of "never" responses is higher than the overall total (TG), as follows: for the 18–30 and 30–50 age categories, the proportion is 0.84, and for the 50–65 age category, the proportion is 1.

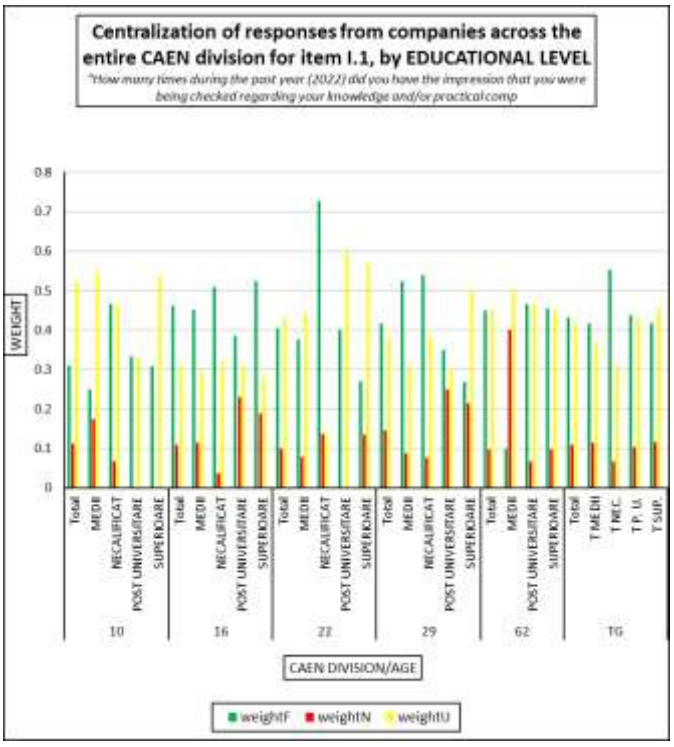

Figure 2.57 Consolidation of Response Weights for Question I1 by Education

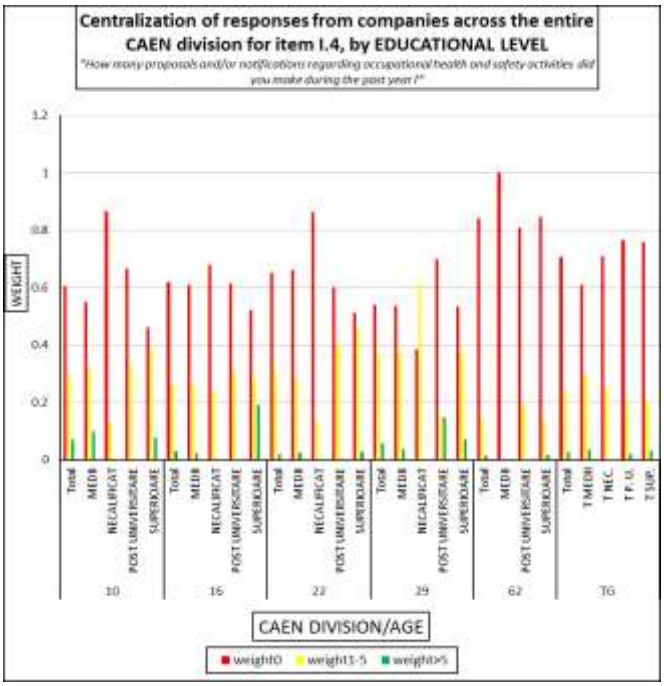

Figure 2.62 Consolidation of Response Weights for Question I4 by Education

Also within CAEN division 62, for all age groups, the proportion of responses "**>5**" is the lowest (ages 18–30: 0.01; ages 30–50: 0.01; ages 50–65: 0). The maximum proportion of "**>5**" responses was recorded in CAEN division 22 with 0.43. The highest proportion of "**1–5**" responses was observed among respondents aged 30–50 working in CAEN division 29 (0.43), while the lowest proportion was recorded among respondents aged 30–50 in CAEN division 22 (0.07).

The analysis of responses to question I1 and the proportions classified by the influencing factor "education" shows that the highest proportion of "**frequent**" responses was recorded among unskilled respondents in CAEN divisions 29 (0.54) and 16 (0.51), as well as among respondents with higher education in CAEN division 16 (0.52). The lowest proportion of "**frequent**" responses was recorded in CAEN division 62 (0.10). We also note a maximum proportion of "**sometimes**" responses among respondents in CAEN division 22 with postgraduate education (0.60), CAEN division 22 with higher education (0.57), and CAEN division 10 with secondary education (0.55). The lowest proportion of "**sometimes**" responses was recorded among unskilled respondents in CAEN division 22 (0.14). Regarding the proportion of "**never**" responses, the greatest difference was observed in CAEN division 16, with 0.04 for unskilled respondents and 0.23 for those with postgraduate education.

We note that the lowest proportions of respondents who reported **never** making any proposal or notification regarding OHS activities in 2022 were among unskilled respondents in CAEN division 29 (0.38) and respondents with higher education in CAEN division 10 (0.46). For respondents who made between **1–5** proposals/notifications, the maximum proportion was 0.62 in CAEN division 29 for unskilled respondents, and the minimum was 0.38 in CAEN division 29 for respondents with higher education. For respondents who made more than **>5** proposals/notifications, the maximum proportion was 0.19 in CAEN division 16 for respondents with higher education, significantly above the overall average for all education groups (TG = 0.018).

Figures 2.59 and 2.64 present histograms showing the graphical representation of responses to questions I1 and I4 and the influencing factor "length of service" It is observed that the proportion of "**frequent**" responses among respondents with less than one year of service is much lower than the proportion for the division where they work in the case of CAEN 16 (T = 0.46, [0–1] = 0.20), CAEN 22 (T = 0.40, [0–1] = 0.15), and CAEN 29 (T = 0.47, [0–1] = 0.20), and much higher in the case of CAEN division 10 (T = 0.31, [0–1] = 0.62). For "**sometimes**" responses, the maximum proportion (0.62 for respondents in CAEN division 10 with more than 10 years of service) is approximately three times higher than the minimum recorded value (0.23 for respondents in CAEN division 16 with 1–3 years of service). The analysis of "**never**" responses shows that the lowest values were recorded among respondents with more than 10 years of service (CAEN 10 = 0; CAEN 22 = 0.03) and the highest values among respondents with less than one year of service (CAEN 22 = 0.30; CAEN 62 = 0.22; CAEN 29 = 0.27).

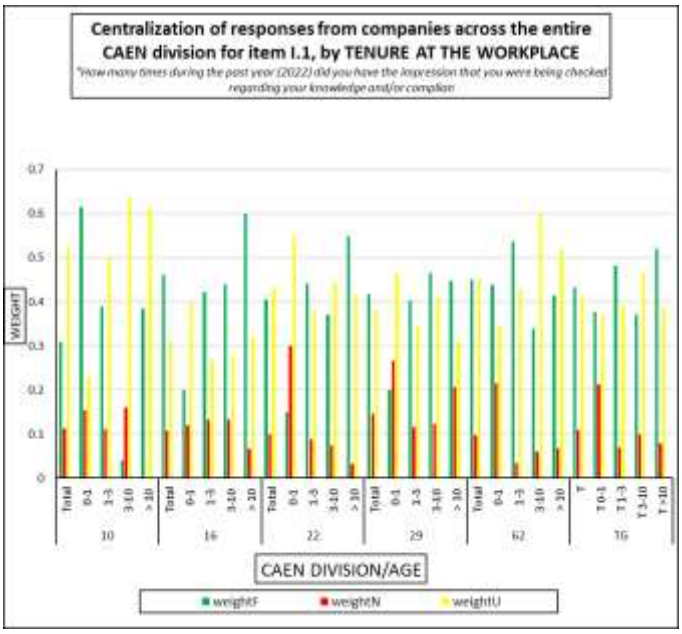

Figure 2.59 Consolidation of Response Weights for Question I1 by Length of Service

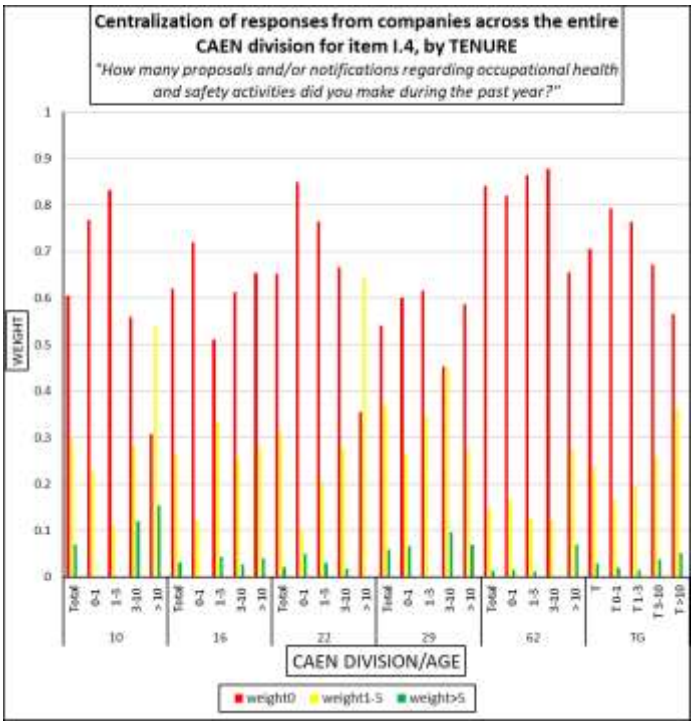

Figure 2.64 Consolidation of Response Weights for Question I4 by Length of Service

The highest proportion of respondents who did not make any proposals/notifications was recorded among respondents in CAEN division 62 with 3–10 years of service (0.88), while the lowest proportion was recorded among respondents in CAEN division 10 with more than 10 years of service (0.31). The proportions of respondents who made between 1–5 proposals/notifications were highest in CAEN division 22 with more than 10 years of service (0.65), CAEN division 10 with more than 10 years of service (0.54), and CAEN division 29 with 3–10 years of service (0.45). For respondents who made more than 5 proposals/notifications, the maximum values were recorded in CAEN division 29 with 3–10 years of service (0.10) and CAEN division 62 with more than 10 years of service (0.07).

3 Conclusions and research perspectives

From the analysis carried out in this thesis, it results that merely mentioning the occupational health and safety strategy will not automatically lead to the prevention of work incidents, but only if it is followed by concrete measures implemented at each workplace. These measures must be decided after a careful analysis of the complex reality of work systems, involving a substantial reconsideration of specific and concrete elements at the level of each working entity, including a reassessment of the position and magnitude of the time factor (particularly evident in the dynamics of work processes in the industrial environment, as well as in work systems).

As a result of the research conducted in this doctoral thesis, several directions for future activities have been identified, as follows:

- Development of a package of legislative/regulatory proposals regarding the reconsideration of psychosocial factors as risk factors for occupational health and safety, and the generation of methodological norms/guidelines corresponding to an appropriate level of implementation in OHS practice;
- Extension of experimental research to other fields of activity (CAEN codes) and categories of workers, in line with current developments in work environments specific to entities with a higher degree of integration in ICT and Hi-Tech areas;
- Opening new research directions within an integrated system, specifically addressing motivational factors for compliance with preventive industrial conduct, OHS regulations, and knowledge of work equipment under current working conditions;
- Development of a package of proposals for modifications to KPIs, as well as to the evaluation system using such indicators (including the development of specific OHS standards or the completion of existing standards);
- Deepening research on the analysis of workers' perception of indicators and influencing factors of OHS, with the aim of improving OHSMS and its degree of integration into the overall business management system.

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