Costs calculation of an work accident in a production hall for metallic confections

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Abstract. Work accidents and occupational illnesses are subjected to a strict and distinct part of the legislation regarding health and safety at work. Each year, in the all world, a significant number of workers get ill, are injured or lose their lives at work. From this situation results, first of all, the generation of human costs, and second, a number of financial costs. Therefore, the total cost of work accidents and occupational illnesses includes both financial costs and an assessment of the human costs which will be borne by economic organizations and businesses. Work accidents, generated and quantified in Romania, lead to economic losses that are not negligible. Therefore an expert procedure needs to be adopted to determine their cost and consequently to determine the impact they have on the enterprise or organization. This paper presents a cost calculation model, using the method PREVENT-MATRIX, in the case of a work accident in a production hall for metallic confections.

1. Introduction

Work accidents and occupational illnesses are subject to a strict and distinct part of the legislation in the field of health and safety at work. Consequently, metalworking enterprises need to implement prevention and protection policies and actions to limit and even cope with the economic and social impacts involved in eliminating the risk of injury, which will implicitly lead to reduce the number of industrial accidents in this sector of the industrial construction industry.

Most experts in the field have spoken of the cost of occupational accidents and illnesses, splitting them into two large groups: direct costs and indirect costs [6, 7]. From the analysis of the two cost categories and the existing relationships between them, the specialists defined the direct costs as those costs that can be directly attributed to the expenses resulting from the consequences of an accident and recorded in the company's accounting system. At the same time, indirect costs are those resulting from the accident, but are not allocated and accounted for by the employer [1, 2, and 3].

A starting point for this research is the need to use an analytical tool to know the impact of the work accident costs on the budget of the metalworking organization. To achieve this, the PREVENT-MATRIX method has been chosen as it is a practical way to analyze the actual cost of an accident at work based on a model that can be adapted to a cost calculation that applies to the metalworking section welded [5].

For applying the method PREVENT–MATRIX the testing of some real situations was made, using the experience gained so far, which has proven the utility and effectiveness of such an instrument. Rather, it is a representation highlighting the results that correspond to the company's accounting practices and which can be immediately specified as arguments for applying and supporting a quality
management that is applicable to the prevention of accidents at work. By performing such an analysis for the different categories of work accidents, one can conclude their financial impact. In the same way, it is possible to establish and manage, in concrete conditions, what are the accidents that cause the largest expenses [8].

2. Initial data

In determining the cost of a work accident, it is necessary to analyze the cost-generating factors, which are distributed based on a model known in the professional risk prevention environment as the HEEPO model (human - equipment - environment - product - organization). A matrix is obtained (see Table 1), where each cost is attributed to a cost carrier and a task by their nature. The assignment of "tasks by their nature" is done through the typology of the accounting plan which is the basic structure of the organization's accounting. The accounting plan is divided into several classes - groups - subgroups - costs. The total cost of an accident at work is given by the sum of costs for each task, by its nature and reported to each cost carrier, according to the equation 1:

$$\sum_{i=1}^{n} \sum_{j=1}^{m} X_{ij}$$

Using equation 1, it is possible to calculate the costs for each cost-factor, in part, “human - equipment - environment - product - organization “, built up by the categories of tasks defined as ”purchases-services-personal - damping” and it will result the matrix presented in Table 1.

Table 1. The matrix model for calculating the cost of work accidents

| Costs factors | Tasks defined by their nature | Resulted sum |
|---------------|-------------------------------|--------------|
| A) People     | 1) acquisitions 2) services 3) personal 4) reducing the value | $\sum_{i=A,j=E} X_{ij}$ |
| B) Equipament |                              | $\sum_{i=B,j=E} X_{ij}$ |
| C) Job management |                          | $\sum_{i=C,j=E} X_{ij}$ |
| D) Product    |                              | $\sum_{i=D,j=E} X_{ij}$ |
| E) Enviroment |                              | $\sum_{i=E,j=E} X_{ij}$ |
| Total costs   | $\sum_{i=A,j=E} X_{ij}$ $\sum_{i=A,j=E} X_{ij}$ $\sum_{i=A,j=E} X_{ij}$ $\sum_{i=A,j=E} X_{ij}$ $\sum_{i=A,j=E} X_{ij}$ |

Using this model, a proper analysis of a specific work accident can be quantified and, to the same extent, it can be determined which costs are wholly accounted for by the enterprise.

For the purpose of calculating the cost of a work accident, was exemplified a situation in an organization, equipped with a welding metal production hall.

Presentation of the Situation: During the production process, a profiled steel girder of 2.4t was transported by means of the rolling bridge through the production hall from one workstation to another. At some point, inadvertently, the steel girder is colliding with a metal-clad metal structure, which is being assembled and intended to be installed on an industrial construction site. The structure of the casing deformed and the part of the metal parts gives up and falls, deteriorating without being usable in
the planned structure and requiring replacement. Due to the impact, there is also the overturning of the mobile scaffolding used by a welder that falls off from the work equipment platform. It is injured by the 2.5m fall and requires medical care; the mobile scaffolding is damaged and requires major repairs and the irreparable deformation of the deformed parts. Also, the metal subassemblies of the casing, in their fall, have damaged the floor of the hall, which must also be repaired, because it represents the main circulation path in the hall for both machinery and workers.

By the specific analysis of the consequences of the work accident described, it follows that the main expenses evaluated following this event are presented in Figure 1.

From the point of view of the legislation on safety and health at work, applied to Romanian companies, more investigations and activities are needed to solve the effects of the event in the production room, which means expenses and time.

Others costs generated by work accidents are the following: investigation of the accident at the time of its occurrence (specialized personnel, materials and equipment used); recovery of the employee (treatment, medication); training the operator of the rolling bridge; additional costs for the purchase of new semi-finished products; costs associated with damage to the work equipment of the injured person; transport from the supplier and installation of the new metallic structure; expenditure on undamaged value of the damaged scaffolding; expenditure on the salaries of staff charged with analyzing the causes of the accident; expenses related to the temporary discontinuation of the activity due to the accident (estimated consumption of electricity, utilities) estimated; costs with price differences on newly acquired parts; shipping costs; expenses for additional repairs and additional facilities for observing the legal norms of work safety; expenditure on waste collection services (damaged materials, garbage, etc.) and salary costs for bringing the space to the initial form.

3. Method application

All the expenses described in the above are contained in the annual accounting plan, approved by the accounting law, where the distribution and recording of the expenses due and made after the work accident are made, according to the enterprise plan of the enterprise metal fabrications.

The chart of accounts in Romania is divided into several classes, groups and subgroups. Each of these divisions is indicated in the code number, thus the first number indicates the class, the second number of the group and the third subgroup number. For the range between Class 1 and Class 5, these...
are costs for the balance sheet, and for classes 6 to 7 they are assigned to the resulting costs from different activities.

Thus, in the case of Class 6, which includes all expenditure accounts for work, the following costs accounts can be identified:

- 60 – Materials costs – develops on subgroups and records expense on raw materials, consumables, machinery fuel, auxiliary materials, spare parts, inventory items, semi-finished products, packaging;
- 61 and 62 – Third parties Services costs - develops on subgroups and allows the recording of maintenance and repairs of the means of work, insurance premiums, expenses with collaborators, expenses for the transport of goods and persons, etc.;
- 64 – Staff Expenses - Develops on subgroups to record personnel wage costs and social security and social protection costs;
- 65 – Other operating costs - develops on subgroups for the recording of environmental protection expenditures, specific losses, damages, unpaid fixed assets.

To exemplify the calculation method for the consequences of the work accident, using the proposed matrix method and referring to the four types of expenditure accounts, the resulting cost amounts, depending on the cost elements, can be determined as follows (see Table 2).

**Table 2. Application on the accounting and value structure for the PREVENT-MATRIX method within the Metal Structures Production Section**

| Costs elements          | Costs types                                                                 | Costs types                                                                 | Costs types                                                                 | Resulted sum (lei) |
|-------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|--------------------|
|                         | Services performed by third parties (61 and 62)                              | Services performed by third parties (61 and 62)                              | Services performed by third parties (61 and 62)                              |                    |
| People                  | Costs related to the deterioration of the work equipment of the injured      | Expenses for investigating the employee’s state of health                    | Wage and social security costs for the ITM period                            |                    |
|                         | $X_{A_1}=87,00$                                                              | $X_{A_2}=376,00$                                                            | $X_{A_3}=6731,00$                                                           | $X_{A_4}=998,00$   |
| Equipment               | Costs with new equipment                                                    | Costs with transportation and installation of the new equipment             | Costs with the staff instruction                                             |                    |
|                         | $X_{B_1}=7991,00$                                                           | $X_{B_2}=1498,00$                                                          | $X_{B_3}=289,00$                                                           | $X_{B_4}=4370,00$  |
| Job management          | Additional costs regarding the acquisition of new products and equipment    | Repair costs                                                                | Investigation costs related to the accident                                  |                    |
|                         | $X_{C_1}=150,00$                                                            |                                                                              |                                                                              | $X_{C_4}=9.952,00$ |
| Product                 | Costs with the price difference of new products                             | Costs with the transport of the new products                                | Replacement wage costs                                                      |                    |
|                         | $X_{D_1}=749,00$                                                            | $X_{D_2}=250,00$                                                            | $X_{D_3}=44912,00$                                                        | $X_{D_4}=8989,00$ |
| Environment             | Materials costs needed for the repair the workspace                          | Waste collection services costs                                             | Salary costs for work area repair                                            |                    |
|                         | $X_{E_1}=1248,00$                                                           |                                                                              |                                                                              | $X_{E_4}=6.175,00$  |
| Total costs             | $\sum_{i=1}^{4}X_{A_i}=10.225$                                              | $\sum_{i=1}^{4}X_{B_i}=6.644$                                              | $\sum_{i=1}^{4}X_{A_i}=56.046$                                            | $\sum_{i=1}^{4}X_{A_i}=20.425$ |

**Notes:**
- Additional costs regarding the acquisition of new products and equipment.
- Repair costs.
- Investigation costs related to the accident.
- Work discontinuation costs to do the remedial.
- Additional costs on environmental protection.
- Other operating expenses (65).
- Recovery costs of the employee following the accident.
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From the sum of the costs calculated for the specific expenses described in Table 2, it follows that the total cost of the labor accident in the production hall is 93,340.00 lei.

In Table 3 it is presented the incomes-costa balance obtained for the month May 2018 and resulted from the work accidents costs, through utilization of the class, groups and sub-groups specific to the activities of accounting, within the production section for metal welded structures.

| Table 3. Value application on the accounting structure of the Metal Structures Production Section |
|--------------------------------------------------|------------------|
| Month: MAY 2018                                  | Costs (RON)      |
| 6028.0.0 Consumables costs                       | 1,248,00         |
| 603.0.0 Inventory items costs                   | 8,228,00         |
| 607.0.0 Product cost                            | 750,00           |
| 611.0.0 Maintenance and repair costs             | 4,495,00         |
| 624.0.0 Expenses for transporting goods and people | 250,00     |
| 628.0.0 Third party services costs               | 1,898,00         |
| 647.0.0 Expenditure on staff remuneration        | 44,596,00        |
| 6451.0.0 CAS costs                              | 8,087,00         |
| 6452.0.0 Expenditure on unit contribution to unemployment costs | 223,00 |
| 6453.0.0 Unity's contributions to the health     | 2,648,00         |
| 6454.0.0 FNUASS                                 | 380,00           |
| 6456.0.0 Wage Guarantee Fund                     | 112,00           |
| 658.0.0 Others exploitations costs              | 20,425,00        |
| TOTAL MONTH MAY 2018                            | 93,340,00        |

The results of the calculations lead to the same total value of the costs for the work accident in the production section for welded metal structures, respectively 93,340.00 lei. These costs were not anticipated by the employer through the health and safety in work management, which led to the generation of null values for income in accounting.

4. Conclusions
Designing and carrying out an analysis of indirect costs in the event of work-related accidents requires the employer not to ignore this reality and to take into account these costs, which become a key element in determining the return on investment of the enterprise and providing funds for prevention management and reducing the risk of injury and occupational illnesses.

The assessment model presented aims to help specialized staff in the analysis of work-related accidents through an overview of identified expenditures leading to increasing the economic efficiency of the enterprise by applying an integrated management, focused on a policy of prevention against accidents at work, effectively emphasized by the direct benefits realized.

The benefits of the organization, through its prevention and protection policy against occupational accidents and illness, may include:
- reduced costs for the company economic dynamics;
- reduced risks regarding working conditions that can cause accidents, especially by decreasing their severity;
• reducing the employee absenteeism rate and implicitly increasing the turnover of the organization;
• reducing the number of work accidents, which reduces both the specific costs and the suffering of the employees;
• reducing threats to non-conforming labor conditions, which attract legal sanctions;
• the continues improvement the relationship between vendors and business partners by stabilizing a secure and trustworthy environment;
• getting a better reputation for corporate responsibility among investors, customers, suppliers and communities;
• increase productivity, because the employees are healthier, happier and better motivated, etc.

Education, through permanent training of worker staff generates the consolidation of a real culture in the management of health and safety at work. Which improves the correct perceptions regarding the strengthening this field of activity and the conviction that the safety in work it is not seen like a regulated and impose by law burden, but as natural step for the security of employees at work.

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