

Methodological considerations on the evaluation of cost of work accidents and occupational disease

Author:
Cătălin RUSU-ZAGAR¹

Abstract: The accident at work is a phenomenon which unpredictably interrupt the work processes, causing unscheduled effects on economic activity. The events of this nature produced within the organizations will affect every element of it, and the system as a whole. No company and no national economy cannot afford to eliminate or lessen, at once, all risks of injury and occupational diseases, because they would not have sufficient resources to resume the production cycle, the one that makes the organization survive. Diminishing human capital, time loss, damage or destruction of fixed capital is negatively reflected in quantifiable decreasing of economic-financial performance which have important implications for the economy.

Keywords: accident, cost, work, computing, economics

JEL Classification: I15

1. Introduction

Work hazard is a phenomenon which interrupts the work processes unpredictably, thus causing unscheduled effects on the economic activity.

The research work carried out to improve safety at work has gradually evolved into a trend of economic origin. The idea from which we started is that the prevention of hazards and occupational diseases, like any resource-consuming activity, should be dealt with in terms of effectiveness.

Two were the reasons that made this trend not only to be maintained, but also to impose itself.

¹ The "Alexandru Darabont" National Research and Development Institute of Occupational Safety, e-mail: catalinrusuzagar@gmail.com.

The first is the fact that society as a whole has become increasingly aware of the fact that man represents an essential resource, whose protection and continuity is vital for the development of the human civilization.

This phenomenon has materialized in the inclusion in the national legislation of some regulations aimed at protecting under all aspects, including against the scourges that social work can generate.

There is a second motivation that led to raising the problem of cost of hazards and professional disease costs.

It is an objective phenomenon which manifests itself now: the classic ways of increasing economic efficiency, based on its ability to boost profitability at the expense of raw materials and technologies are no longer sufficient. Thus, the attention was directed to the possibilities offered by improving the leadership and management activities of production and labor, as well as to the ways of increasing the performance of human resources.

Hence the question, on the one hand, if a way to improve performers' effectiveness would be eliminating hazards and occupational diseases and, on the other hand, if the actions undertaken to this end are somewhat more expensive than the effect achieved.

2. The need to use economic calculation in the field of safety and health at work

The research work carried out to improve safety at work has gradually produced two guidelines.

The first is a *psychological* one: the workers must be sensitive to the idea that the hazard is avoidable, that it is not a fatality. In this direction, hazards prevention consists mainly in worker protection and avoidance of potentially dangerous behaviors.

The second one is of economic origin, its pioneers being the American researchers. We start from the idea that prevention of hazards and occupational diseases, like any resource-consuming activity, should be dealt with in terms of effectiveness.

Moreover, the risks causing hazards and the most serious diseases and the ones acknowledged as such, generally, by population are totally different. A direct consequence of this fact is the waste of some money, in a more or less useless way. Another consequence, even more serious, is that many human lives are lost, either by death or by disability.

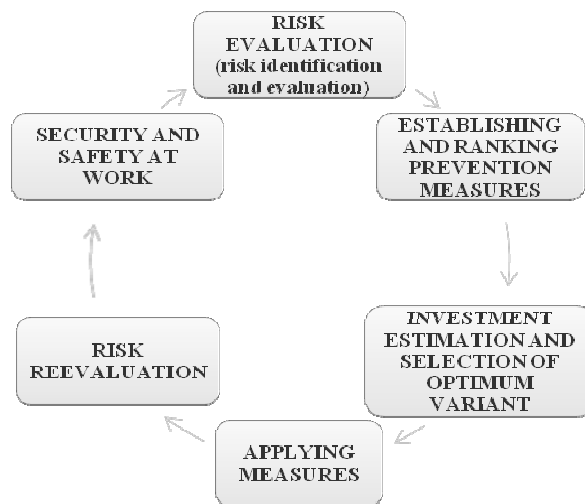
Both lives and resources can be saved by dealing in a more rigorous and rational way with security and health at work.

One of the ways of obtaining a right approach of eliminating or reducing the risks is evaluating them, which leads to their correct hierarchy in order to adopt appropriate measures.

But no company has sufficient economic power to deal simultaneously with all risks equally and, anyway, everyone wants security at the lowest cost.

A rational circuit, which suggests the usefulness and importance of the economic criteria concerning the preventive activity, is shown in Figure 1.

Figure 1. The rank of economic calculation in the decision concerning building up security and health at work



Things do not happen differently at the society level either. Resources are limited and their full allocation for life saving is not possible, irrespective of the value it would be assigned. Therefore, it is desirable that the limited funds allocated for safety at work be used as efficiently as possible, which means with maximum positive economic and social effects.

This requires the necessity of introducing the economic calculation in making decision on labour protection, at micro and macro social level.

The economic criterion is the one which enables the decision maker, on the one hand, to establish the importance of employment protection among other social activities and, on the other hand, within it, to what major directions more funds must be allocated.

There are also other arguments for using economic calculation in relation to safety and health at work.

The activity of safety at work is in fact, an integral part of the production activity. Under these circumstances, the question is what impact the way it is enforced has on financial and economic terms.

As a result, the activity of achieving safety and health at work cannot be separated from the general activity of the company and its purpose - obtaining financial benefits.

Indeed, a solution of increasing the use of working time (thus of profit) is to reduce the interruptions due to work hazards, as well as absenteeism due to occupational hazards and diseases. But for this positive effect to occur, the consumption of human, material, financial and time resources for labor protection must be sized so that the benefits should outweigh the efforts. And this is not possible unless the economic dimension of the phenomenon of hazards and occupational disease can be appreciated.

3. The economic dimension of hazards and occupational diseases

Work hazards and occupational diseases are closely linked to work. They disrupt or make the working process more difficult affecting at least one component of the working system. But the working process and system are fundamentals of any micro economy.

Therefore, hazards or diseases actually disrupt its functioning, having effects on its components and on the relationships between them, purely economic effects: waste of working time, diminishing of fixed assets, etc.

Due to the nature of the subsystem-system relationship between micro and macro-economy, the consequences of work hazards and occupational diseases on the company reach the national economy level.

Therefore, we can assert that one of the sides of the economic dimensions of the phenomenon taken into account is represented by the economic effects of work hazards and occupational diseases, that is consequences on micro and macro-economy's elements and functioning.

A quantitative assessment of all the consequences of work hazards and occupational diseases, or at least of those quantifiable (whatever their nature, economic or otherwise), means determining a cost for this type of event that can be used as an economic indicator.

The economic dimension of the phenomenon of work hazards and occupational disease has two components: the economic effects of these events, the cost of hazards and diseases, as an economic indicator that reflects all the quantifiable effects of such events.

Non-safety cost is actually the cost of hazards and occupational diseases, namely the amount of all losses caused by hazards/ diseases. In other words, achieving job security - in the sense of absolute state - produces as benefit the equivalence of costs that would have been generated by hazards and occupational diseases that have been eliminated, reduced by the cost of preventive measures.

The cost of hazards and diseases cannot be established unless their consequences are known and, implicitly, unless these consequences can be measured by means of quantitative indicators, namely financial or economic ones.

Highlighting the assembly of all the implications of hazards and diseases is particularly difficult, due to their varied nature and to the myriads of levels at which they occur, but this is the only way to identify the quantifiable ones.

The cost of work hazards and occupational diseases can also be used for other applications, not only to improve the efficiency of labor protection: determining the amount of the insurance premium for the risk of work hazards and occupational diseases, substantiation of preventive policy at national level etc.

In conclusion, we may say that identifying the consequences and establishing the cost of occupational work hazards and occupational diseases can be a tool for improving the quality of life of the entire population (not only the active one, if we consider that by reducing losses from hazards/ diseases a redistribution of resources towards other sectors of society can be achieved - health, other areas of social protection, education etc.).

The objective of all efforts for human security should be directed towards making people live longer and enjoy good health - towards extending hopes for a healthy life, as long as possible in relation to the funds available for this purpose. Of course, the allocation of resources will favor, within a certain period of time, certain groups or individuals; that is why the selection of security programs requires as much impartiality as possible.

The opinions of specialists converge towards the idea that by using economic calculation in occupational health and safety management and establishing the cost of work hazards respectively, can answer several purposes:

- at the victim level:
 - as part of the consequences to society, to social legislation substantiation;
 - as a means of making the performers aware of the importance of respecting labor protection measures;
- at the level of the enterprise where the accident occurred (or where it may occur):
 - persuasion tool for decision makers as to the opportunity of adopting prevention or protection measures;
 - support for sizing the budget prevention programs budget;
 - means of evaluating programs and prevention and protection measures
- at the level of insurance companies:
 - sizing tool for the insurance premium level;
 - means of evaluating the prevention programs backed up by the insured companies, as well as the profitability and prevention activity at their level;
- at society level:
 - substantiation of social legislation, such as the one concerning the protection and help of the victims of work hazards and occupational diseases;
 - a tool for obtaining the consensus of employers, professional associations, etc. for adopting the normative regulations in the field of labor safety.

Depending on one or another of the purposes mentioned, there is a variation in the elements to be considered in determining the cost of hazards, the strictness of calculation, etc.

4. Consequences of work hazards and occupational diseases

Due to the construction and operation of the work systems, any event occurring inside them will affect both each element, and the system as a whole.

A first benchmark for the delimitation of the consequences of work hazards and occupational diseases is represented by the work system elements. This means that will be distinguished.

4.1. Consequences on the worker

In the case of the worker, the main consequence is the reduction in his/her work capacity: the temporary or permanent loss of this capacity, often accompanied by a decrease in his/her individual productivity when resuming the work, diminishing of professional skills, of the quality of the work performed.

If we think only of hazards and take into account the performer as a collective worker (the workplaces where one task is carried out by several workers), we can notice that the other participants in the process interrupted by the event are also affected, as they waste work time in the period following the event (first aid given to the victim, commenting on the situation, preparation of the workplace to resume the activity, participation as witnesses in the hazard investigation, etc.), as well as by the reduction in productivity as a result of the mistrust in safety at the workplace.

4.2. Consequences for the work task

The direct consequence is the failure of accomplishing the work task, either failing to accomplish it in due time or accomplishing it improperly (at the resumption of work by a victim of a hazard/disease or due to his/her replacement with a less experienced employee).

4.3. Consequences for the means of production

Following the work hazards, damage or destruction of assets, raw materials, materials, etc. can occur... (explosions, fires, blown off things, etc.). The deterioration of the technical equipment has a negative impact on the efficiency of using the fixed assets, modifies the degree of technical endowment, etc.

4.4. Consequences for the working environment

Both environmental categories –physical one and social one - can be affected by the work hazards and occupational diseases, but especially by the social one.

The physical working environment is affected only indirectly and only by the generation of hazards as a result of the deterioration of technical equipment, containers in which raw materials and used materials are stored, etc., if such harmful or dangerous substances are released into the atmosphere and/if, if the control of microclimate parameters is not performed, etc. (Table 1).

The consequences on the social environment are materialized into the stress incurred by those working in the neighborhood of the hazard or disease victim, also leading to distrust in the policy of safety and health at work promoted within the company, etc.

The second benchmark for identifying the consequences of work hazards and occupational diseases is the company with its interrelated subsystems - the individual and the enterprise. The three levels of expression cover the full range of possible effects of hazards (Table 1).

Reporting on these items, however, is still very vague. In order to be expressive, it is necessary to introduce the main levels at which human life, in general, manifests itself (including the social ones): physical, mental, spiritual, economic, financial, demographic, political. This provides an overview of the possible consequences, no matter how remote in space and time, of a work hazard or occupational disease.

Also, the reality does not allow for a static and so rigorous separation of the levels showing the various effects. It is important that from this classification can emphasized the fact that hazards and occupational diseases cause quantifiable losses, economic and financial ones. They represent the main reason for using the cost - benefit analysis in relation to occupational safety.

Table 1. The consequences of work hazards and occupational diseases

No.	Level of manifestation	Reference plan	Consequences of work hazards and occupational diseases
1.	INDIVIDUAL	Biological, Physical	Impairing the anatomic and functional integrity Decrease / loss of vital and work capacity Pain, suffering
		Mental	<ul style="list-style-type: none"> • Victim: State of stress due to: - Decreasing confidence in their own capabilities of fulfilling the work task - Fear of producing another similar accident - Feeling of social uselessness in the case of permanent incapacity to work - The humility of the deteriorated physical condition and the dependence on other persons • Other close persons - Pain, compassion, etc. felt by those close to the victim - Fear of a possible similar accident to be supported for those working in identical working places in the respective unit - Hazard Image
		Spiritual	Decrease, partial or total, in the creative and emotional potential (especially in the case of permanent incapacity to work)
		Financial	Decrease in the personal income of the victim and his dependents due to: <ul style="list-style-type: none"> - temporary or permanent loss of working capacity

No.	Level of manifestation	Reference plan	Consequences of work hazards and occupational diseases
			<ul style="list-style-type: none"> - the costs of different services as well as of care and rehabilitation, to the extent they are not fully covered by the insurance company - changing social and professional status
2a.	COMPANY	Economic	Decrease in the labor productivity
			Damage/destruction of tangible and intangible assets
			Loss of physical production
		Financial	Decrease in gross profit
2b.	INSURANCE COMPANY	Financial	Consumption of resources in the form of benefits provided and the funding of prevention programs
3.	SOCIETY	Human	Reducing the human potential (creativity, affectivity, etc.)
		Political	Diminishing the confidence in the adequacy of the national social protection policy Damaging the prestige on the home and international labor market
		Demographical	Decreasing the number and the quality of the population (in terms of anatomic and functional integrity)
		Economic	Decrease in the gross national product
		Financial	GDP decrease due to: <ul style="list-style-type: none"> - reduction in the gross profit of economic agents and individual incomes; - change in the volume of funds obtained from taxes on wages and other taxes; - increased social spending as a result of recovery efforts of hazard effects; - loss of investment and the need for additional investment for: <ul style="list-style-type: none"> - the work force growth, training and qualification; - materialization of technical creativity in the form of fixed assets; - non observance of contractual international market terms; - loss of prestige in front of the potential work force

5. The economic effects of work hazards

In the modern economy, characterized by highly dynamic market relations and especially by globalization, the ability to improve the economic performance of a company is a vital element for its survival.

If the performance is limited by the financial possibilities of the company regarding the technical component, in the organization of production and labor changes can be made with much less effort and considerable positive effects on

the efficiency of the activity. Among the working organization measures there are also those covering security and health.

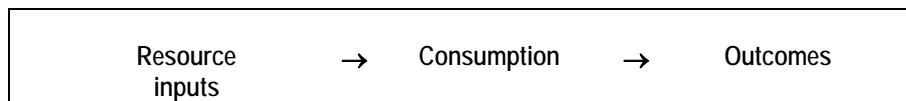
Setting the size and direction (positive or negative) of the economic effects of hazards or occupational disease provides an important prerequisite for finding new resources to increase the economic performance of the company.

In the classification presented above, among the consequences of work hazards and occupational diseases we have mentioned the professional and economic ones. Since they are clearly quantifiable and represent the basis for determining the cost of these events, they require a deeper study in the future. We will, however, restrict the area of the topic to work hazards, because they are mainly responsible for such consequences.

The economic effects occur at micro and macroeconomic level, namely in companies where the hazard occurs and in the national economy.

5.1. Economic effects at company level

The economy of a company can be regarded as a cybernetic system of the type:



Its performance will be determined by the quantity, quality and the way of making use of the resources, namely of production factors.

The first category of economic effects of work hazards occurs in relation with the inputs and the consumption of the factors of production, namely the labor and capital, by of destroying, altering the structure, quality, the use for other purposes than the scheduled ones, etc.

The distortion of the production process by work hazards has two types of consequences for the "labor" factor of the company:

- the impossibility of performing the transforming action, that is the failure to use the workforce or its use for other purposes than those scheduled, both for the victim and other employees, which means a waste of working time;
 - modification in the "human capital" - people's ability to produce goods and services efficiently.
- The working time is the common element of all social activities carried out in society. Regardless of the organization of production, materials, services, public and private sector, the results of the work performed can be expressed as a time consuming job.

- The human capital of the victim is clearly diminished by the work hazard:
 - health is damaged temporarily (during the period of temporary disability) or permanently (disability);
 - professional skills and abilities are diminished or lost due to the physical problems (disability), accident-induced fear, or the lack of experience in the case of changing jobs, profession;
 - in the case of fatal accidents, the human capital is lost entirely by the death of the victim.
- The fixed capital is affected in the case of work hazards accompanied by damage and/or destruction of machinery. The effect is both quantitative - the technical potential decreases (when the destroyed equipment is not replaced at all or replaced later) and qualitative (changes in the structure and quality of the technical potential).
- The working capital is the part of the real capital consisting of the goods participating in a single production cycle, being entirely consumed and needing to be replaced with each new cycle: raw materials, basic and auxiliary materials, energy, fuels, semi-finished products, work in progress, other consumables.

Due to the relationship between the elements of the economic circuit, work hazards also have effects on the outcome of resource allocation and consumption. Affecting the volume, the structure and the use of the factors of production, it will also have effects on the economic performance of the company.

Therefore, the second category of economic effects of the hazard consists in the negative alteration of the outcome indicators such as: turnover, value added, physical output and production costs.

All these consequences - input, expenditure and outcomes level - can be expressed synthetically by changing the company's profitability.

As the change direction is negative, given the relationship of feedback, the *decrease in profitability will affect the conditions for resuming the economic circuit* - it will diminish the possibility of attracting resources similar to the original one (the next cycle will have generally fewer resources or resources of poorer quality than the cycle in which the hazard occurred).

5.2. Economic effects at the macroeconomic level

The real economy is the whole of economic activities of supporting aggregate supply of goods and services, designed to satisfy the aggregate demand for such goods.

Analyzing them, it appears that work hazards also have economic effects at this level in the following forms:

- *changing the structure of employed population* by industry and by level of training – hazards leading to permanent work incapacity and those followed by professional retraining and employment for another job;
- *decrease in the employed population* – hazards causing second and first degree of invalidity and death;
- *decrease in the industrial and agricultural production*, on the one hand when the injured worker's work is not recovered through other forms and, on the other, by decreasing the companies' capacity to resume the production cycle at the same level;
- changing the volume and structure of foreign trade components (import - export): the export opportunities may decrease; additional technical equipment is imported, raw materials, etc. are damaged during the accident.

Conclusions

Work hazards cause significant effects affecting a company's profit, complicating and endangering its functioning. Eliminating or even reducing the risk of hazards in a society can be achieved gradually without affecting the production cycle resources, which are vital for carrying out the activity.

Reducing the human capital is obvious in the case of work hazards. This has many negative consequences reflected in property damage.

The waste of time caused by work hazards is also reflected in the performed activity which is expressed as a time-consuming job.

No organization and no national economy can afford to eliminate or lessen, suddenly, all the risks of hazard and professional disease because it would not have sufficient resources to resume the production cycle, which determines the survival of that organization.

The damage/destruction of fixed capital causes a change in volume, structure and technical potential quality, as well as it render the fixed assets useless. The effects can be also quantitative and qualitative, being reflected in losses at company level with implications for the industrial branch. This loss at the macroeconomic level is reflected in the gross national product.

In conclusion, all these consequences are reflected negatively by the measurable decrease in economic and financial performances which have important implications for the economy.

Acknowledgement

This paper has been supported financially within the project “Horizon 2020 - Doctoral and Postdoctoral Studies: Promoting the National Interest through Excellence, Competitiveness and Responsibility in the Field of Romanian Fundamental and Applied Scientific Research”, contract number POSDRU/159/1.5/S/140106. This project is co-financed by the European Social Fund through the Sectoral Operational Programme for Human Resources Development 2007-2013. Investing in people!

References

- Anderson L. (1977), *Benefit-Cost Analysis: A practical Guide*, Levington, UK;
- Andreoni D. (1986), The Cost of Occupational Accidents and Disease Occupational, *Safety and Health Series 54*, ILO, Geneva, Switzerland;
- Brody B., Letourneau Y., Poirier A., An indirect cost theory of work accident prevention, *Journal of Occupational Accidents*, UK, 1990, 13, p. 255-270;
- Chadelat J.F., La sécurité sociale – des aspects économiques et financière, *Revue Française des affaires sociales*, France, nr. 4, 1980, p. 15-20;
- Darabont A., Pece Șt., Dăscălescu A., *Managementul securității și sănătății în muncă*, Ed. Agir, București, 2001;
- Darabont Al., Pece Șt. and team., *Protecția muncii (manual pentru învățământul universitar)*, Ed. Didactică și Pedagogică, București, 1996;
- Dăscălescu A., *Efecte economice ale accidentelor de muncă*, INID, București, 1991;
- Dăscălescu A., *Metodologie de evaluare a costului accidentelor de muncă*, ICSPM, București, 1992;
- Dăscălescu A., Olteanu C., Consecințele economice ale accidentelor de muncă. Metodă de evaluare, *La Santé Publique, Revue internationale trimestrielle*, 1989, XXXII, 1;
- Gold D., Waffa N. - Le coût des accidents du travail, *BIS*, Geneva, Switzerland, nr. 1, 1987, p. 165-167;
- Pece Șt., Dăscălescu A. and team., *Securitate și sănătate în muncă – dicționar explicativ*, Ed. Genicod, București, 2001;
- Lancianse D., Nivelul ascendent al costului accidentelor de muncă, *Occupational Hazards*, Cleveland, SUA, August 1983
- Soderqvist A., Rundmo T., Aaltonen M., Cost of occupational accidents in the Nordic furniture industry, *Newsletter*, Suedia, nr. 1, 1990;
- Sorine A., The Calculation of the Security spending, *Occupational Hazards*, SUA, September 1994, p. 53-56;
- Rusu-Zagar Cătălin, "Evaluarea costurilor datorate accidentelor de muncă, Conferința Impactul transformărilor socio-economice și tehnologice la nivel național european și mondial", 22 mai 2015
- Rusu-Zagar Cătălin, Rusu-Zagar Gilda, Mihaela Mocanu, "Eficiența și utilitatea calculului economic în domeniul securității și sănătății în muncă în condițiile unui echilibru macroeconomic la nivelul societății românești" – Conferința națională „Politica fiscală a României și influența acesteia asupra dezvoltării societății românești”. Universitatea Creștină "Dimitrie Cantemir" București, 28-30 mai 2014, <http://www.ucdc.ro/io/28-30mai2014.pdf>.
- Rusu-Zagar Cătălin, Rusu-Zagar Gilda, Mocanu Mihaela, "Creșterea utilizării echipamentelor electrice în contextul dezvoltării economice. Influența asupra calității vieții și a stării sistemelor de izolație electrică" – Conferința națională „Politica fiscală a României și influența acesteia asupra dezvoltării societății românești”. Universitatea Creștină "Dimitrie Cantemir" București, 28-30 mai 2014, <http://www.ucdc.ro/io/28-30mai2014.pdf>.