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Improvement of safety by analysis of costs and benefits of the system

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ABSTRACT

Purpose: of the paper has been the assessment of the dependence between improvement of the implemented occupational health and safety management system and both minimization of costs connected with occupational health and safety assurance and optimization of real work conditions.
Design/methodology/approach: used for the analysis has included definition of the occupational health and safety system with regard to the rules and tool allowing for occupational safety assurance in the organisational and technical way, analyses of costs and benefits of the system maintenance as well as study on the tools for potential improvement of processes.
Findings: of analysis are as follows: continuously improving occupational safety management system guarantees the advancement of work conditions, the decrease of the rate of occupational illnesses as well as the lowering of the amount of occupational accidents.
Research limitations/implications: can apply in case of any organisation, which uses both organizational and technical rules, methods and tools to assure the optimal level of occupational health and safety conditions.
Originality/value: of the presented paper has been constituted by the specification of the continuous improvement tools and methods in the system implemented on the basis on quality criterion.
Keywords: Improvement of system; Occupational health and safety; Costs and benefits

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1. Introduction

Nowadays the inherent element of activity of any organization is assurance of occupational safety, which can be defined as lack of threats or protection against them. The only one way of safety assurance is safety management aiming at minimization of risk of health or life lost to the acceptable level and its maintenance on the fixed or the lover level.

The fundamental condition of occupational safety management is the approach based on the rules that safety conditions are not created by themselves, but they have to be realized according to the earlier accepted program. That is why it is so important to make decisions orientated on maintenance and improvement of work conditions based both on human resources and infrastructure.

As a rule the first step in occupational health and safety management is implementation of occupational health and safety system based on the formal standard including requirements for system functioning; as a standard OHSAS 18001 or PN-N 18001 can be treated. Implementation of the occupational system is accompanied by both usage of accident preventive methods and costs management. This kind of double-track analysis allows for finding the golden mean between costs of usage of occupational risk minimization methods and possible founds.

2. Occupational heath and safety standard

PN-N 18001 standard includes all the requirements characterizing occupational health and safety management system, which allows for specification and realization of occupational policy and aims. Independently on the profile of the organization, occupational health and safety management makes a part of the whole management system in the organization and includes planning, organizational structure, procedures, rules, resources as well as processes, which are necessary for implementation and maintenance of occupational health and safety policy [1].

The most important elements of the system are [2-5]:

- occupational health and safety policy and general and detailed aims,
- internal audits,
- management review to characterize the current state of the system,
- occupational risk assessment which allows for determination of the risk acceptance,
- corrective and preventive actions leading to the occupational health and safety improvement,
- awareness creation by explanation of the benefits of the system implementation for every participant of process,
- internal communication increasing workers' commitment and exchange of information connected with occupational health and safety,
- competences and liabilities,
- occupational health and safety monitoring.

Occupational heath and safety system, created this way, makes possible [2-5]:

- prevention of accidents and breakdowns on workplaces,
- definition of sources of potential threats as well as methods of prevention and elimination of threats,
- assessment of work environment influences and elimination of occupational threats.

The structure of PN-N 18001 standard is characterized by mutually connected requirements (Fig. 1) closed in the Deming cycle of continuous improvement [1,6].

One of the most important requirements included in the standard is improvement of the processes concerning the occupational health and safety conditions. The examples of the activities undertaken to improve occupational safety are [2-5]:

- assurance of personal protective equipment,
- regular controls of safety conditions,
- identification of threats,
- definition of risk level on work positions,
- increase of workers' awareness by using trainings,
- determination of work places being especially dangerous.

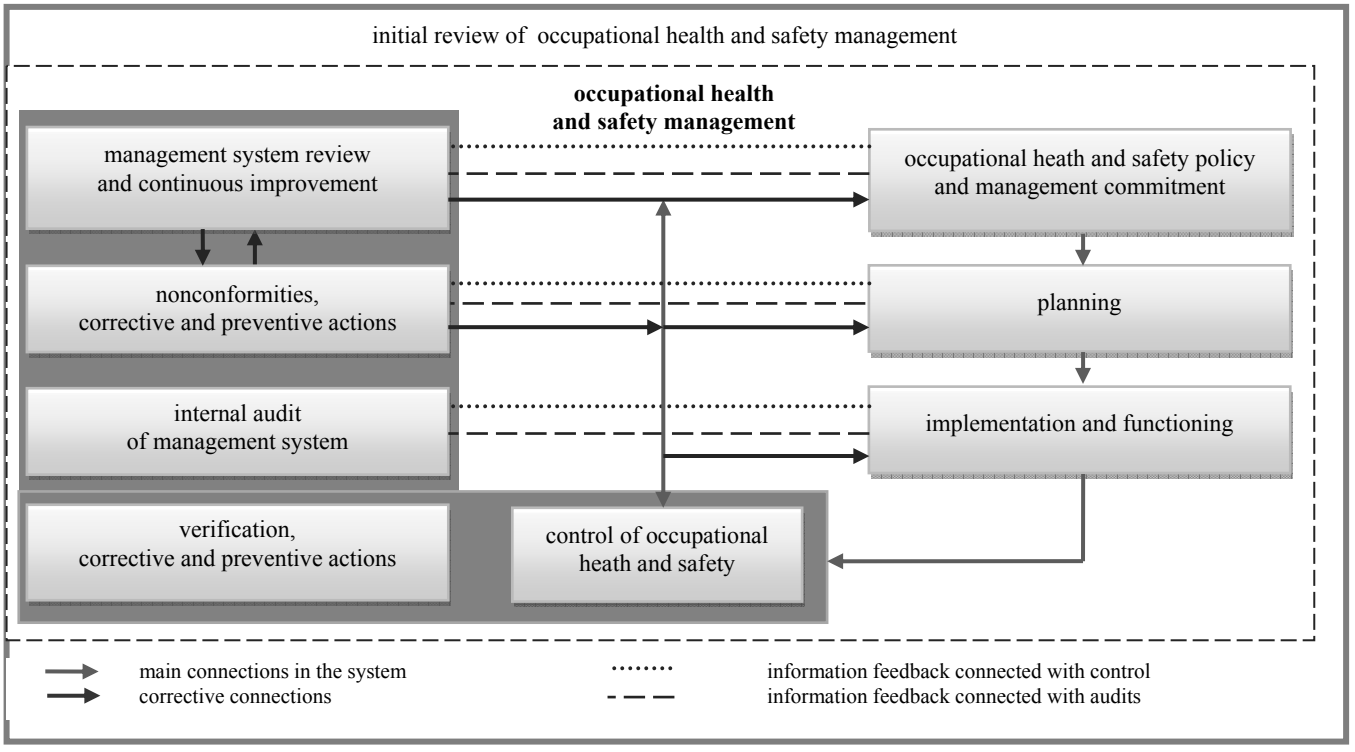


Fig. 1. Chart of occupational heath and safety system describing main and corrective connections as well as information feedback connected with control and audits [6]

3. Occupational health and safety costs and benefits

Occupational health and safety costs incurred by the organization are connected both with bed work conditions and preventive actions (Fig. 2). Among the occupational costs one can differentiate costs of [7,8]:

- occupational diseases and accidents at work,
- accidents insurances,
- work in bothersome and harmful conditions resulting in decrease of work efficiency, diseases absences and preventive actions.

Preventive costs, according to PN-N 18001 standard, are connected with implementation and maintenance of occupational health and safety management system and realization of legal requirements, in particular these are [1-5]:

- monitoring of occupational health and safety conditions,
- employment,
- audits,
- occupational health and safety trainings,
- purchase of individual security measures,
- occupational conditions verification,
- examinations.

The optimal level of occupational health and safety means the level, when the total amount of expenses related to the occupational accidents, potential occupational accidents and preventive actions is minimal (M point on Fig. 3). The increase of prevention costs usually causes the decrease of costs connected with bad working conditions. K_1 and K_2 points symbolize the same value of expenses but different safety risk (P_1, P_2) [7].

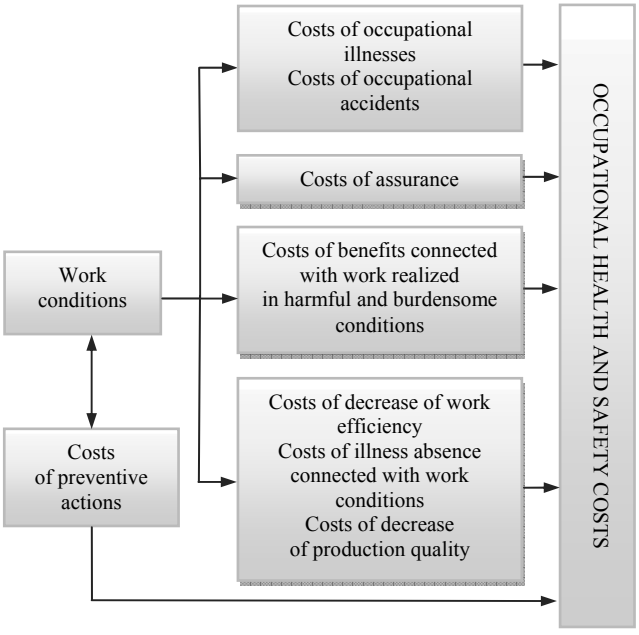


Fig. 2. Draft of detailed classification of occupational health and safety costs [7]

Occupational health and safety costs are usually accompanied by benefits, to which one can classify [2,4,8]:

- easier management particularly by fulfilling legal requirements,
- continuous improvement in the range of occupational health and safety,
- workers' commitment in the creation of the occupational health and safety management, identification of workers with the organization,
- growing importance of clients' and other interested parties' confidence,
- decrease of the amount and costs of accidents,
- increase of work efficiency,
- positive organization's image, increase of competitiveness,

limitation of nonconformities, quality decrease.

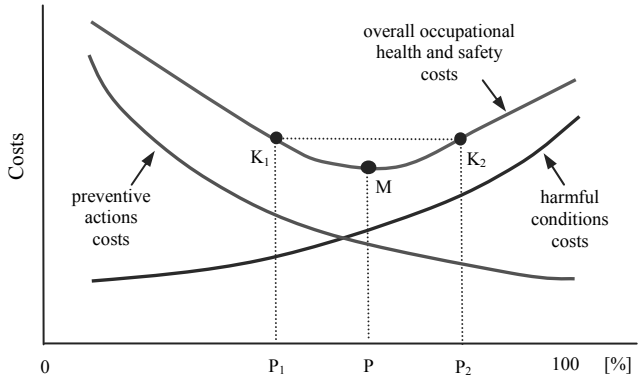


Fig. 3. Draft of the rule of defining the optimal level of occupational health and safety [7]

4. Improvement activities

One of the most important elements of occupational health and safety management system, aiming at minimization of costs connected with occupational health and safety assurance, are improvement activities. Those corrective and preventive actions are based on occupational health and safety monitoring; monitoring is defined as analyzes of occupational conditions, workers behavior as well as results of actions improving occupational safety. One can differentiate two manners of monitoring [1,4,9,10]:

- active - activities undertaking to verify if the used occupational safety means connected with occupational risk are adequate and if the organizational solutions in the range of management system are satisfactory,
- reactive - activities focused on nonconformities in occupational health management system; those activities are among others: analyzes of breakdowns, accidents and occupational illnesses.

For measurement of occupational health and safety conditions it is necessary to work out procedures, which should assure [1,4,5]:

- feedback information about occupational conditions,
- base of information connected with identification of threats and risk assessment,
- base of information which applies to activities minimizing occupational risk,
- assignation of responsibilities.

The most important tool for verification of occupational health and safety conditions in the meaning of efficiency of occupational health and safety management system is audit. Every audit's aim is complex assessment of system functioning and maintenance, and the same - identification of points of its potential improvement [1,4,11].

The corrective and preventive actions, undertaking as results of internal and external audits, to eliminate current and potential nonconformities should be adequate to the scale of the problem and used in the following sequence [4,12]:

- technical means eliminating or minimizing threats "at source",
- bulk preventive means,
- production and organizational means, mostly procedures and instructions,
- individual preventive means.

Corrective and preventive actions should be realized on the basis of documented procedures [4,10].

5. Own research

The research have been conducted in order to characterise the functioning in the organisation occupational health and safety system, analyse costs and benefits connected with the system implementation and maintenance as well as to show the possible tools for its improvement.

The methodology, shown below, has been used in the organisation being one of the biggest steel producers in the world, supplier of steel products for automotive and building industry. The organisation disposes the perfect distribution system being present on European, Asian American and African trades. Products, offered by the organisation, are mostly: long products (rods, wire rods, wires, bars), flat products (cold-rolled and hot-rolled sheets and belts, zinc-plated sheets and belts), special products (bridge rails and other accessories).

5.1. Methodology

Methodology used for the analysis has included:

- definition of the occupational health and safety system with regard to rules and tool allowing for occupational safety assurance in the organisational and technical way,
- analyses of costs and benefits of the system implementation and maintenance,
- study on the tools for potential improvement of processes.

5.2. Practical analysis

Continuous improvement

Continuous improvement in the organization is realized with usage of both organizational and technical rules and tools (Fig. 4).

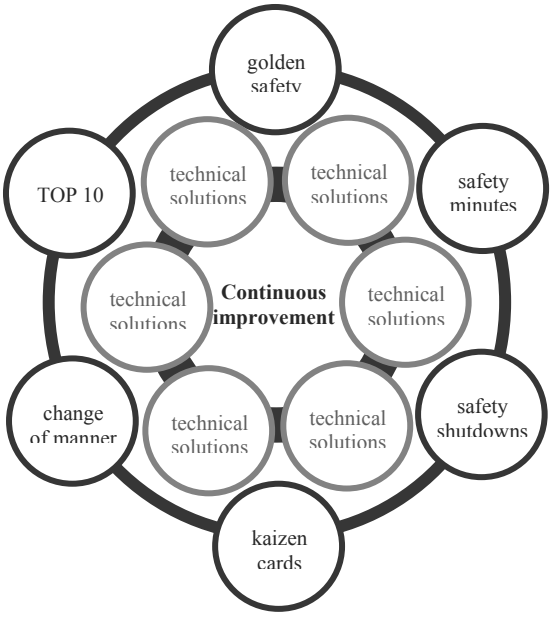


Fig. 4. Specification of the system continuous improvement tools

In the first group one can define:

- safety minutes - meetings in the small groups concerning threats in the workplaces and possibilities of their elimination by using the easiest technical and organizational solutions,
- top 10 - meetings of foremen discussing the most important threats on the chosen part of production line,
- golden safety rules - rules necessary for assurance of safety work conditions; for example: "I'm going to come to work being relaxed", "I'm not going to turn of protective devices", "I'm going to fulfill occupational health and safety rules, signs, standards",
- safety shutdowns - meetings organized according to the management instructions to discuss already implemented, planned to implementation and verified occupational safety meeting,
- kaizen cards - conception using workers commitment in "their" processes' improvement by searching and proposing on the special cards ideas of "making processes better",
- change of activity manner - concept of radical change of methods of common work referring to workplaces, organizational structure, responsibilities, competences and interactions, and basing on changes in the range of culture, rights and subsidiarity.

In the group of technical improvement methods used in the organization one can classify:

- informational boards including the most important telephone numbers and obligatory safety equipment (Fig. 5),

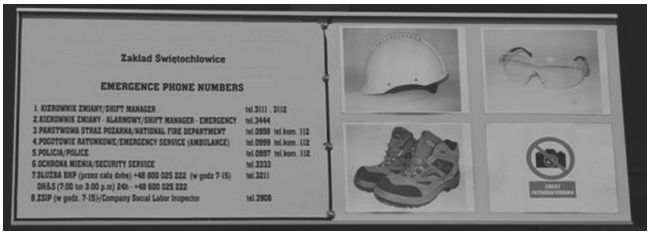


Fig. 5. Photography of informational board in front of the entrance to the production plant of the organization

- black points indicating places of multiple work accidents (Fig. 6),

Fig. 6. Photography of informational board indicating black point in the organization

- threats maps reflecting places of multiple work accidents (Fig. 7),

Fig. 7. Photography of threats map in the organization

- security barriers protecting workers against entries in the dangerous areas (Fig. 8),

Fig. 8. Photography of security barriers in front of the entrances to the production buildings of the organization

Accidents rate assessment, benefits and costs of implementation

The reflection of places and amount of body injures resulting from occupational accidents is map of body injuries. The map of body injuries in the organization in years 2000-2010 has been shown on Fig. 9.

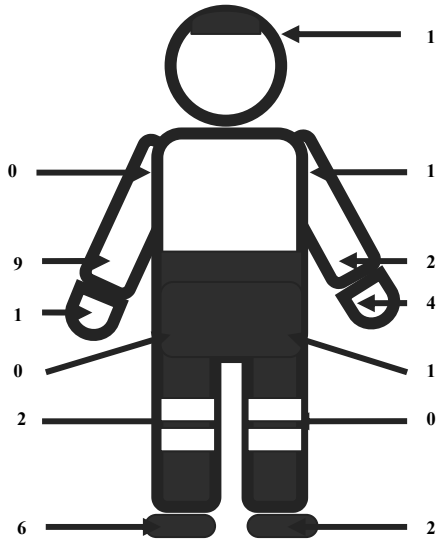


Fig. 9. Map of body injuries in the organization in years 2000-2010

According to the organization profile, the most frequent injuries are the ones connected with hands, head, feet and right forearm, as it can be seen on the map.

The most important and measurable benefit resulting from occupational health and safety management system is decrease of occupational accidents amount. Data connected with occupational accidents and including breaks at work, the amount of lost workdays, rate of accidents frequency and rate of their significance during last five years have been shown in the Table 1.

Table 1.
Specification of data connected with occupational accidents during last five years in the organization

	Year					
	2005	2006	2007	2008	2009	2010
amount of accidents with breaks at work	8	3	2	2	1	0
amount of accidents without breaks at work	0	0	0	3	0	0
amount of lost workdays	526	53	93	221	122	44
time worked [hours]	1 245 887	1 173 469	1 047 437	876 363	729 756	686 672
amount of workers	727	685	625	539	447	400
rate of accidents frequency per million work hours	6.42	2.56	1.91	2.28	1.37	0.00
rate of accidents significance	0.42	0.05	0.09	0.25	0.17	0.06

The specification (Table 1) confirms the reduction of :

- amount of occupational accidents (Fig. 10),
- rate of accidents frequency (Fig. 11),
- rate of accidents significance (Fig. 12).

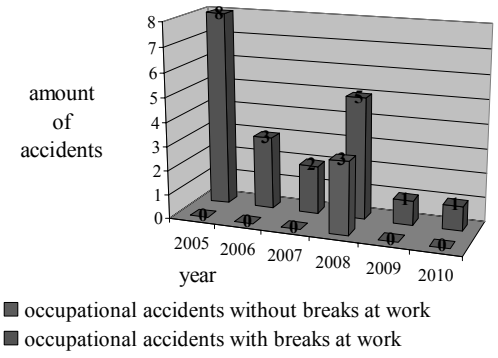


Fig. 10. Diagram of amount of occupational accidents in years 2005-2010

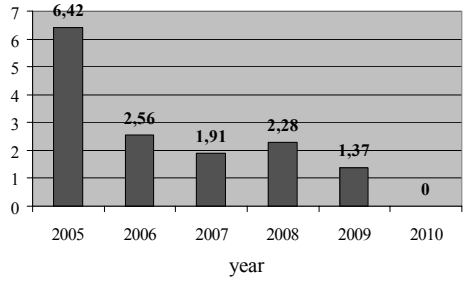


Fig. 11. Diagram of rate of accidents frequency in years 2005-2010

As the effect of both occupational health and safety management system and new technological solutions implementation the organization eliminated occupational illnesses (Table 2).

All of the costs connected with activities improving occupational health and safety management system and resulting in the lowering of the amount of: occupational accidents with and without breaks at work, the amount of lost workdays and the same - rate of accidents frequency and rate of their significance and in the elimination of occupational illnesses have been shown on the Fig. 13.

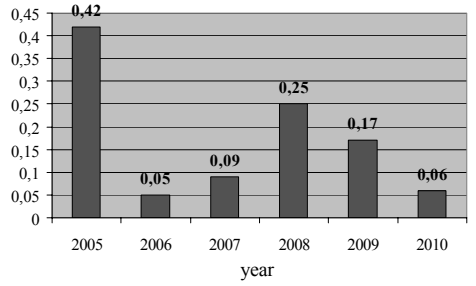


Fig. 12. Diagram of rate of accidents significance in years 2005-2010

Table 2.
Specification of the rate of occupational illnesses in years 2007-2010

Name of illness	2007	2008	2009	2010
hearing impairment	0	0	0	0
skin illnesses	0	0	0	0
dust disease	0	0	0	0
vibrating syndrome	0	0	0	0
total	0	0	0	0

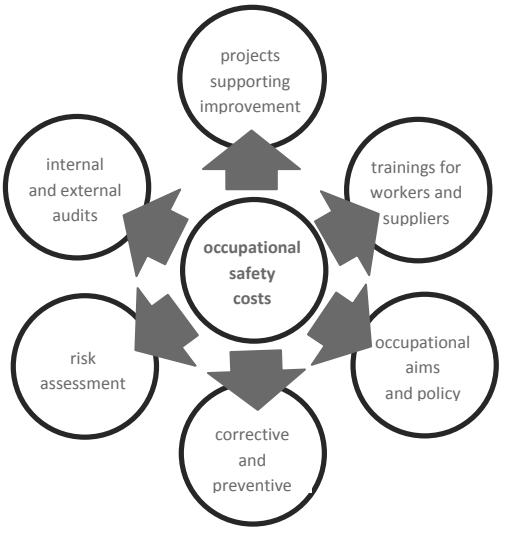


Fig. 13. Presentation of costs undertaken by the organization for improvement of occupational heath and safety conditions

System improvement by report of potential accident event

Independently on the perfection level of any occupational health and safety system in every organization both accidents without-injury and potential accident events take place. Every of the workers, who met that kind of accident can create valuable information about the process basing not only on the technological but also on the occupational safety criterion and indicating ways of threats elimination. Therefore not only the accident report but also potential accident report can be treated as improvement tool.

Preparation of potential accident event should include:

- analysis of occupational health and safety standards being in force in the organization,
- identification of threats and occupational risk assessment,
- avoidance of experiments based on potential accident event.

Report of potential accident event can have a form of report of accident supplemented by observations and ideas aiming on elimination of threats; exemplary report of potential accident event has been shown on Table 3.

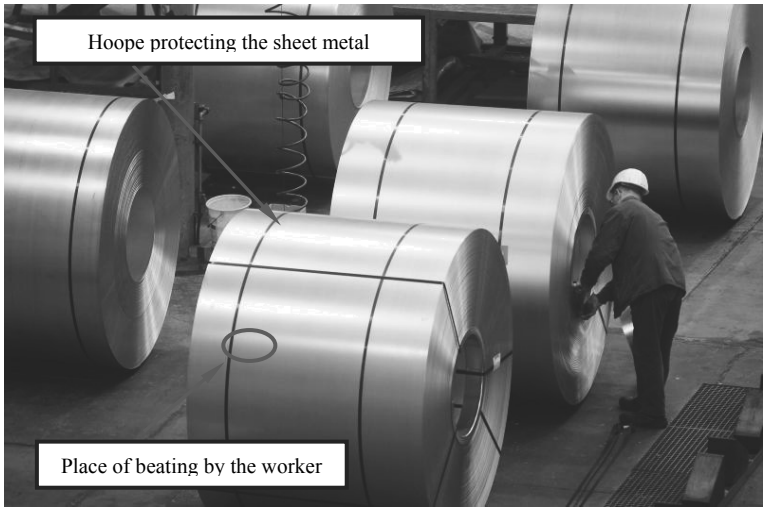
6. Conclusions

In any organisation implementation of occupational health and safety management system is connected both with costs and benefits. Carrying out the financial analysis of occupational system allows for undertaking activities, which are the most profitable for the organization and the most advantageous in the non-economic aspect. Occupational health and safety management system, which is properly prepared and controlled, guarantees the improvement of work conditions, the decrease of the rate of occupational illnesses as well as the lowering of the amount of occupational accidents.

In the analyzed organization set the amount and the realization of the processes in order in the range of occupational health and safety system brings about the decrease of work accidents and the elimination of occupational illnesses resulting in limitation of breaks at work and the same - costs on one hand, and - on the other - improvement of safety conditions.

Table 3.
Report of potential accident event

Report of potential accident event			
Name: M. Andraczke	Tel:	E-mail:	
Day: 23	Month: April	Year: 2011	Hour: 10:40
Workplace: production worker		Place of accident: production line	
Kind of threat: sharp edges of sheets and their bands		Possible effects of threats: perforations, abrasions; injury of head, eyes, limbs	
Relay: first		Last risk assessment: 15.02. 2011	
Time at work: 4 hours		Time on relay: 4th hour	
Potential accident event characterization: On 23.04.2011 at 10.40 a.m. during the slitting of the hoops protecting the sheet metal ring against the unrolling, the problem connected with removal of one of them occurred. Worker didn't obey occupational health and safety rules beating his hand against sharp edge of the sheet metal. Worker didn't experience any injures, but the protective glove was cut open.			



The conception of continuous improvement takes into account the usage of both organizational and technical rules and tools, among others: safety minutes, top 10, golden safety rules, safety shutdowns, kaizen cards, change of activity manner and informational boards including the most important telephone numbers and obligatory safety equipment, black points indicating places of multiple work accidents, threats maps reflecting places of multiple work accidents, security barriers protecting workers against entries in the dangerous areas. The improvement conception should be constantly improved by planning and implementation of the new tools, methods and rules.

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