Program Supporting the Assessment of Occupational Risk - Harmful Factors

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Abstract. In Poland as well as in most European countries one of the most important problem, is still high rate of occupational diseases among workers of different branches of national economy. It is caused by many factors such as: high percentage of workers exposed to one or a few harmful factors in technological process, exceeding acceptable limits of a factor in a workplace, inappropriate identification of harmful factors and long-term effects of exposition to them. This chapter presents basic assumptions of computer system supporting health risk evaluation in mining. The computer system uses assumptions of rating method of health risk evaluation worked out in Institute of Ergonomics and Safety Management in Technical University of Silesia. The advantages of presented computer system supporting health risk evaluation are: the easiness of registration and documentation of all activities in the range of health protection of workers in the work process, the possibility of determining aims and priorities of activities in the field improving work conditions, enabling controlling hazards by showing the necessity of undertaking activities essential for their reducing, obtaining a up-to-date information which leads to taking fast preventive actions.

1. Introduction
The contents of the article is in the area of the Management of Occupational Health and Safety, with evaluation of health risk in a workstation as one of its basic issues. A few thousands of new cases of work-related diseases are recorded in Poland every year, and although the number has been considerably decreasing recently, they are still one of the most serious problems of our society.

In Poland most cases of occupational diseases are registered in such branches of national economy as industrial processing (516) and agriculture, forestry, fishing (522). Mining occupies a third place in this classification with 488 cases. The number of cases in mining related to a hundred thousand workers is much bigger. Mining with a rate of 329.7 proceeds, agriculture, forestry, fishing (21.9) and education (17.9).

The most serious cases of occupational diseases occur more often in mining then in other branches national economy. For example: related to every 100 000 workers: [1]

- in mining there are 17.6 cases of silicoses and only 6 in other branches,
- in mining there are 75 cases of hearing damage and 8 in other branches,
- in mining there are 17 cases of vibration syndrome and 2 in other branches,
- in mining there are 11 cases of chronic inflammation and 1 in other branches,
- in mining there are 7 cases of diseases of locomotor system and 1 in other branches,
The research concentrates not only on occurrence of occupational disease but also on such facts as:

- **267,961** workers exposed to minimum one harmful factor in **Poland** (Wzat on 1000 workers is **49.8**),
- **21,318** workers exposed by one harmful factor only in **Mining** (Wzat on 1000 workers is **172.8**),
- **19,455** workers exposed by a few harmful factors simultaneously in **Mining** (Wzat on 1000 workers is **128.2**),
- **40 million** of lost working days, as a result of occupational diseases, which is **74%** of lost days in general in **Poland** (other **25 %** are accidents, and **1 %** are strikes),
- more than **PLN 3 million** (EUR 0.7 million) of one-off compensations paid by due to occupational diseases,
- over **PLN 2.52 billion** (EUR 0.6 billion) of pension benefits paid by government due to occupational diseases, which is almost **PLN 1 billion** more than pension benefits paid because of accidents at work [2].

Presented data show that both control over occupational health care and structures of Occupational Safety and Health in the area of occupational diseases is insufficient.

This is caused by many factors, such as: a high percentage of workers exposed to one or several harmful factors in the technological process, exceeding the acceptable limits in the workplace, inappropriate identification of harmful factors and long-lasting effects of their exposure. All these factors make it impossible to carry out a proper health risk assessment at a specific workplace [3]. In order to reduce these adverse factors, the author has developed a special method that allows for a detailed health risk assessment in the workplace or plant, including parameters such as: probability of appearing of exposure effects (P), a value of exposition (E), a number of people exposed (L), and a value of probable losses caused by exposure (S) [4]. The developed method of health risk assessment in the work environment requires the collection and processing of various data, such as: physical and chemical parameters, employment, measurements of the work environment and frequency. Its results depend on the quality of collected information as well as precise determination of partial risk indicators. For the purposes of this method, the author also established a COMPUTER SYSTEM SUPPORTING HEALTH RISK ASSESSMENT, which he presents in the following article [5].

2. **GROSZ – Computer System Supporting Health Risk Evaluation.**

2.1. **Theoretical assumptions and functions of the system.**

Theoretical assumptions of computer system take into consideration such parameters as:

On the side of probability:
- value of concentration or intensity of a given harmful factor at a workplace,
- character of work and functions of individual departments in work plant,
- kind of harmful factors at the workplace,
- dynamics of changes of technological processes in the department

On the side of losses:
- the number of days or hours of work in exposure during a year,
- the number of people exposed to harmful factors,
- the number of recorded cases of occupational diseases in the smallest organizational unit (which is department in case of a mine),
- the shortest period of time for which statistics of incidence rate is comparable (5-years period is accepted),
- the value of expected losses resulting from new incidence.

System meet the requirements of the European Union directives, the Polish Working Environment Act, geological and mining law and executive regulations in concerning of risk evaluation [6].
Basic functions of the presented system are:
1. Creation and modification of a permanent net of measuring points in the workplace.
2. Introduction or modification of the highest acceptable concentrations and intensities of harmful factors at work and possibility of independent evaluation of risk in accordance with valid Polish and EU norms.
3. Obtaining hygienic evaluations of positions, places of work and departments on the basis of introduced and processed data coming from environmental measurements.
4. Determining high-risk zones and classifying workplaces within a department into separate categories of risk.
5. Determining the order of activities connected with technical, medical, methodological and organizational prevention aiming at limiting the risks and the number of cases of occupational diseases.
6. Review and printing of a full or shortened hygienic evaluation of a workplace, for individual and grouped work environment factors [7].

2.2. Description of the system.
Computer programme called "Mining system of evaluating health risk" is based on Microsoft Access programme of Microsoft Office 2010 and working in Microsoft Windows.

This programme is a tool helping to register the exposition and to evaluate the health risk for each work place in a mine. Its usefulness results from the fact that it is placed in the reality of Polish mining and it meet the requirements of Polish and EU legislation.

System GROSZ enables to define a workstation in connection with both: a worker and a place of work, where a productive process takes place. Regular workstations in mining are often of a changing character and they are not attributed to a specific place for example: a shotfirer and also transport miner can work in a few different places within one shift. Organizational structure of every mine is a dynamic object. It is subject to changes in time, which must be properly registered. The most important changes which influence health and safety of workers as well as risk assessment concern: the workstations, structure of employment and a set of harmful factors in mining work environment. Moreover, the system includes occupational diseases statistic and the length of work experience of workers, for whom the evaluation of risk is done [8].

All calculations used in the programme are based on assumptions of "Indicatory method of health risk evaluation", which enables to determine the risks rate, risks level and risk zones for workplace, excavations, departments and individual people.

2.3. Basic modules of "GROSZ" programme
A window of System module (shown below), opens upon starting a programme. It is divided into three parts: organizational data, detailed data and risk evaluation with occupational diseases statistics. Pressing one of the functional keys in first or second column of data enables creating an appropriate data base. Pressing the Risk evaluation key (Ocena ryzyka) opens a base with results of risk evaluation and analyses. Pressing occupational diseases - statistic key (Statystyka chorób) enables to create and to view the data concerning the cases of occupational diseases occurring in the mine (figure 1).
Module “Factories”

Pressing a functional key Factories (Zakłady) starts operating the module. This module enables to list and review data related to individual mines, where a risk analysis is carried out. Pressing the records rewinding key enables to review or create data of the next plant. System GROSZ enables to create data bases essential for a risk evaluation in a few plants simultaneously (figure 2).

Figure 1. The view of “System” module.

Figure 2. The view of “Factories” module.
Module “Departments”

Pressing a functional key Departments and places (oddziały i miejsca) starts operating the module. This module enables to define a function of a department and to attribute new workplaces in a department. Pressing a down-rewinding key enables to review or create data about a new department. Pressing a up-rewinding key enables to review or attribute new workplaces to a department (figure 3).

Module “Department employees”

Pressing a functional key Employees (Pracownicy) starts operating the module. This module enables to relate a worker with a department in which he is permanently or temporarily employed. Pressing a down-rewinding key enables to review data about another department. Pressing a up-rewinding key enables to review or attribute a new workers to a department (figure 4).
Module “Factors”

Pressing a functional key Harmful factors (Czynniki szkodliwe) starts operating the module. This module enables to write in and review data related to individual work factors in the mine and to attribute valid values according to the Polish and EU standards. Pressing a up-rewinding key enables to review or create data for new factor for example: vibration or noise (figure 5).

![Figure 5. The view of “Harmful factors” module.](image)

Module “workplaces”

Pressing a functional key Workplaces (Stanowiska) starts operating the module. Presented module enables attributing workplaces and workers to each object in the department area. First records rewind key enables reviewing and creating workplaces for a given object. Second rewind key enables reviewing and adding workplaces in a new object, and the third one enables to add workplaces in the next department (figure 6).

![Figure 6. The view of “workplaces” module.](image)
Module “Assigning the workplaces”

Pressing a functional key Assigning the workplaces (Przydział stanowisk) starts operating the module. In the first stage pressing a down-rewind key enables to choose a department, where the workers are employed (figure 7).

Figure 7. The view of “Assigning the workplaces” module.

In the second stage after pressing a functional key Employee (Pracownicy) starts operating the module of assigning the workplace to an employee in a department. A worker is assigned such data as work period and the number of working hours. The upper record enables to assign the next workplace to another worker and the lower one key enables to choose another person from a department (Fig. 8.)

Figure 8. The view of “Assigning the workplaces in a department” module.
Module “Hazards”

Pressing a functional key Factors at the workplace (Czynniki na stanowiskach) starts operating the module. This module enables to assign the results of factor measurement to each workplace. The upper record is used for introducing new measured values. The lower record enables to choose a new workplace (figure 9).

Figure 9. The view of “Hazards” module.

Module “Occupational diseases”

Pressing a functional key Occupational diseases (Choroby zawodowe) starts operating the module. In the first stage pressing a down-rewind key enables to choose a department for viewing the recorded cases of occupational diseases among its workers or adding new ones (figure 10).

Figure 10. The view of “Occupational diseases” module.

In the second stage after pressing a functional key Employee (Pracownicy) starts operating a module “cases of diseases”, in which we can ascribe an acquired disease, its cause, granted benefits, range of health detriment and effects on the worker. The upper record in extreme cases enables ascribing another disease to the same worker, and lower record enables to choose another worker from the department (figure 11).
Module “Risk evaluation”

Pressing a functional key Risk evaluation (Ocena ryzyka) starts operating the module. In the first stage pressing a down-rewinding key enables choosing a department for risk analyses (figure 12).

In the second stage pressing a functional key Risk (Ryzyko) opens a “risk in a department” module where information about a number of workers in department and a number of diseases cases can be found. This module enables also to choose an appropriate object for evaluation: department, excavation or a workplace (figure 13).
Figure 13. The view of “Risk in a department” module.

Pressing an appropriate functional key enables to receive a full information about the risk evaluation in a department or in a workplace.

Health risk evaluation can be done for a single harmful factor (figure 14) or for a group of factors (figure 15) by their aggregation. Pressing one of the rewind keys placed in the bottom part of the form enables to choose the factors for analyses. Marking a suitable option in the upper part of the form enables to choose a proper norm for the analyses. Values of individual risk rates are calculated automatically. Also a risk category and influence zones are determined automatically.

Figure 14. Health risk evaluation for a single harmful factor.
3. Summary
The elaboration presents current problems related to ensuring safe and healthy working conditions, meeting the requirements of Polish and EU legislation, economical analysis of the state of occupational safety and health and increasing awareness of the society in this area. In Poland as well as in European countries one of the most important problems is still high occupational accident and disease rate, for example in branch of national economy “mining”. It is caused by many factors such as: high percentage of workers exposed to one or a few harmful factors in technological process, exceeding acceptable limits of a factor in a workplace, inappropriate identification of harmful factors and long-term effects of exposition to them.

This paper presents a computer tool supporting assessment of hygienic working conditions in an enterprise, which is based on guidelines developed by the author of the Indicative Health Risk Assessment Method, which is a part of a doctoral dissertation at the Faculty of Mining and Geology of the Silesian University of Technology in Gliwice. In order to achieve of reliable and thorough evaluation of occupational health state in big factories such as mines, it is necessary to use a computer system supporting health risk evaluation in a mine, for example the proposed “GROSZ” system. The main idea of the system is using three different sources of information characterizing occupational risk for assessment of working conditions: research and measurements of harmful work environment factors, register of occupational diseases, and state of employment for individual workplaces. Using these enables health risk evaluation on various levels of management: the whole factory, organizational units, individual workplaces and workers.

4. Conclusions
The advantages of presented computer system supporting health risk evaluation:
1. Easiness of registration and documentation of all activities in the range of health protection of workers in the work process.
2. Possibility of determining aims and priorities of activities in the field improving work conditions.
3. Enabling controlling hazards by showing the necessity of undertaking activities essential for their reducing.
4. Obtaining a up-to-date information which leads to taking fast preventive actions.
5. Enabling the use of collected risk evaluation data to all four groups: workers, employers, work conditions supervisors and insurance companies.

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