

APPLICATION OF MERIT SURVEY IN THE ASSESSMENT PROCESS OF THE MANAGEMENT QUALITY OF THE OCCUPATIONAL HEALTH SAFETY – CASE STUDY

2.1 INTRODUCTION

The approach to the problems of occupational health and safety is closely related to the socioeconomic development of human society, and it has been evolving considerably over years. While as far back as in the early 1970s the concept of occupational health and safety was primarily associated with ensuring 'safe technical means', i.e. technical equipment appropriate for specific work tasks and conditions in which those tasks were realized, the next decades gave rise to a new approach where more attention was paid to the social-organizational aspect [3, 6]. The notion of human factor error (man's error) was defined as an action which deviates from the required standards and requirements of a specific situation [2, 8, 10]. Nowadays, the approach to OHS is based on the assumption that occupational safety is combining three elements: psychophysical disposition, qualifications and experience of the employees and finally their behaviour as well as the behaviour of the surrounding environment (social or material), in which the execution of work tasks is taking place. We are witnessing the development of the idea of occupational health and safety management and together with it the idea of workers' participation, i.e. co-responsibility of the working staff for the level of OHS [7].

According to the standard PN-N-18001:2004 „Systemy zarządzania bezpieczeństwem i higiena pracy. Wytyczne”, the following major elements should be included in each management system of the occupational health and safety: prevention of accidents at work, minimizing the probability of occupational diseases, constant efforts to improve the shape of OHS in the organization, incessant perfection of actions undertaken with respect to OHS. The above provision is in congruence with the principle observed in all member countries of the European Union, where the issues of occupational health and safety are supposed to be based on the prevention policy against accidents at the possibly earliest stages of their

generation. To implement the management system alone acc. PN-N-18001:2004, we need to work out appropriate system procedures and to define the way of their efficient monitoring (supervision).

In the realm of Polish coal mines, the MERIT survey (Management Evaluation Regarding Itemized Tendencies) was a diagnostic instrument used for the first time in the assessment process of decision making quality in the field of health and safety management, elaborated by the National Institute for Occupational Safety and Health (NIOSH). The survey, which was an element of the Total Safety Management (TSM) [1, 9], was adapted in the mid 1990s to Polish conditions within the framework of the program Partners in Economic Reforms (PIER). The survey contains questions grouped into nine problem areas: A – Planning actions in the field of occupational safety management, B–Investigation of accidents, C–OHS control and inspection, D – Observation and analysis of the way of work task realization, E – Personal protection, F – The knowledge of binding OHS regulations in the company, G – Information provided on the condition of OHS, H – Promotion of OHS, I – Personal evaluation of OHS conditions.

Basing on the completed survey sheets, assessment indexes WOP_i are determined separately for each problem area, and they allow us to determine the final assessment index WZBP (the mathematical model applied within the framework of MERIT survey was in greater detail discussed in [1, 5, 9]) and to work out comparative rankings of the problem areas (in this way we can define strong and weak points involving the occupational health and safety management system).

2.2 AUDIT RESULTS OF THE MANAGEMENT SYSTEM OF OCCUPATIONAL HEALTH AND SAFETY

The survey research studies were carried out twice (in the years 2014-2015) on a group of supervising staff and manual workers from three coal mine departments. While in the first edition of the research studies, in the acquisition process of a representative group, a simple dependant draw (without returning)¹ was applied, in the second edition the selection was intentional - the research studies included exactly the same people as in the first edition. By the application of such an acquisition method of respondents, independently of the carried out quality assessment of actions undertaken in particular problem areas, we could work out the assessment prediction based on the linear discriminant function. The audit results are presented in Fig. 2.1.

With respect to six problem areas: A – Planning actions in the field of occupational safety management, B – Investigation of accidents, C – OHS control and inspection, D – Observation and analysis of the way of work task realization, E – Personal protection and G – Information provided on the condition of OHS the rise of WOP_i index was recorded, and the drop involved three areas: F – Knowledge of the

¹ - for the population of 158 people, for $\alpha = 0,95$ and for the maximum error at the level of 10%, the group of respondents consisted of 60 people.

binding OHS regulations in the company, H – Promotion of OHS and I – Personal evaluation of OHS conditions.

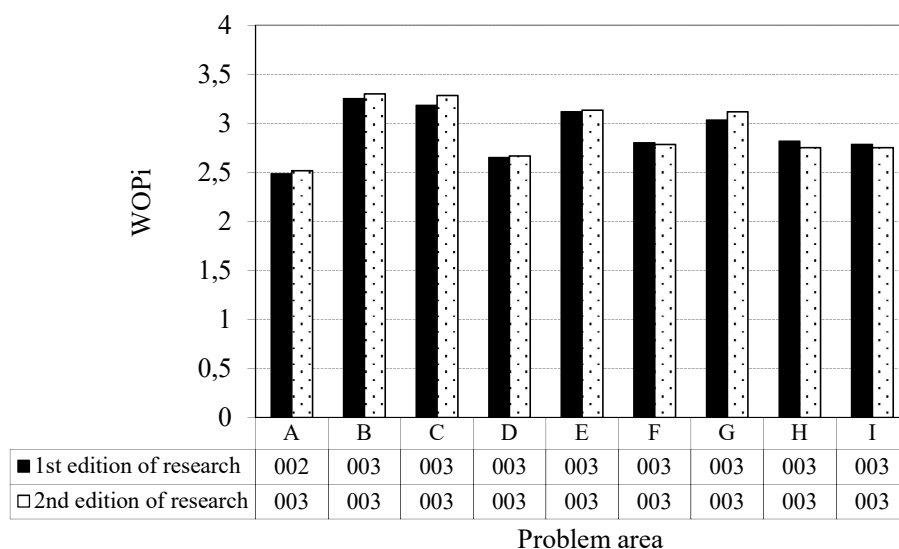


Fig. 2.1 Audit results of the occupational health and safety management system involving the first and second edition of research carried out in three departments of a coal mine company

Source: own study

Both in the case of the first and the second edition of research, the highest score was given to the area B – Investigation of accidents (the values of WOP_B were 3.25 and 3.30 respectively). The respondents agreed that the accidents were given a lot of careful analysis followed by the preparation and implementation of appropriate preventive actions.

The second position was occupied by the area C – OHS control and inspection ($WOP_C = 3.18$ in the first edition and $WOP_C = 3.28$ in the second edition of research). The actions perceived by the respondents as positive involved the controls and inspections done by external bodies or managerial staff of the company. In the comments included in the obtained answers, the problem of a large number of work stations frequently located considerably far from one another was raised (specific character of the departments), which often slows down or even hinders the control process to be carried out thoroughly.

The third place in the ranking was occupied by the area E – Personal protection (the WOP_E values were 3.12 and 3.13 respectively). The respondents acknowledged the efforts of the managerial staff to provide the workers with maximum protection through the application of a wide range of personal protection means, adapted optimally to given work conditions, ensuring at the same time appropriate work comfort for the workers.

The last place in both rankings was occupied by the area A – Planning actions in the field of occupational safety management (WOP_A was only 2.48 in the first edition and 2.52 in the second edition of research). The results of the survey showed

that the proclaimed by the management executives safety policy was weakly perceived by the workers.

Good knowledge of the system and full confidence of the working staff that its implementation is fully grounded is one of the basic conditions to reach the planned objective, and therefore decisive actions should be taken right away to improve the existing situation. It is crucial to carry out a campaign promoting the need to implement the management system of occupational health and safety, to present basic organizational and structural assumptions and to convince the working staff about the advisability of such measures. It seems that one of the key arguments for such a solution may be provided by simulations illustrating the possibility to obtain substantial financial returns both for the company and also for the workers (lower insurance premium, lower compensation costs, positive marketing image, etc.).

2.3 PREDICTION OF THE ASSESSMENT OF THE OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT QUALITY

The second edition of audit studies in the realm of occupational health and safety management was repeated on the group of the same respondents (panel research), which allowed us to work out a prediction involving the assessment of OHS management quality. For that purpose, one of the determination methods of discriminant function was applied – a so called linear discriminant function. The prediction process can be in this case narrowed down to the creation of a function expressed by the following equation [4]:

$$f = \sum_{i=1}^k b_i X_i \quad (2.1)$$

The assessment vector of parameters b of the function f is obtained by solving the system of linear equations :

$$Cb = (C_1 + C_2)b = g \quad (2.2)$$

where:

C_1 – variance and covariance matrix in the defined subspace No 1 ,

C_2 – variance and covariance matrix in the defined subspace No 2,

$$g = g_1 - g_2 \quad (2.3)$$

where:

g_1 – k -dimensional vectors of arithmetic means in the subspace 1,

g_2 – k -dimensional vectors of arithmetic means in the subspace 2.

In order to define both subspaces, the results of the second edition of research were grouped into two subsets: the first one involved the results of surveys whereof the final assessment index of OHS management quality (WZBP) surpassed the final assessment index of OHS management quality obtained in the first edition of research. In the case of subspace 2 we have a reverse situation: the assessment index of OHS management quality (WZBP) obtained in the second edition of research did not surpass the value of the final assessment index of OHS management

quality obtained in the first edition of research.

Basing on the data and information from surveys, we created the following covariance matrixes separately for each subspace:

$$C_1 = \begin{bmatrix} 0.202 & 1.740 & 1.436 \\ 1.740 & 43.152 & 38.137 \\ 1.436 & 38.137 & 37.934 \end{bmatrix}, \quad C_2 = \begin{bmatrix} 0.188 & 1.321 & 1.063 \\ 1.321 & 39.673 & 32.888 \\ 1.063 & 32.888 & 32.861 \end{bmatrix}$$

and the vectors of arithmetic means:

$$g_1 = [0.719 \quad 32.188 \quad 10.438], \quad g_2 = [0.250 \quad 32.571 \quad 10.321].$$

Basing on the above matrixes, we determined the matrix $b = gC^{-1}$, which enabled us to define the function f :

$$f = 1.778X_1 - 0.129X_2 + 0.068X_3$$

For the subspace 1 the arithmetic mean f_1 from the theoretical values of the discriminant function was -2.153 , and for the subspace 2 - $f_2 = -3.043$, which ultimately yielded $f_0 = -2.598$. We can, therefore, state that when the value of the discriminant function of the respondent described by three parameters (work station occupied by them, their age and seniority in the company) is higher than -2.598 , we can predict that the successive respondent's final assessment (or that of people reflecting the respondent's characteristic) involving the OHS management quality, i.e. the WZBP index for the next edition will be higher than the final assessment of OHS management quality offered by the respondent for the previous edition of research. Hence, we can predict that in the opinion of that respondent (or people having a similar characteristic) the improvement in the quality of actions undertaken by the coal mine company in the area of OHS management will take place.

Additionally, within the scope of the discussed example, basing on covariance matrixes C_1 and C_2 , we determined the correlation matrixes R_1 and R_2 :

$$R_1 = \begin{bmatrix} 1 & 0.589 & 0.518 \\ 0.589 & 1 & 0.943 \\ 0.518 & 0.943 & 1 \end{bmatrix}, \quad R_2 = \begin{bmatrix} 1 & 0.484 & 0.428 \\ 0.484 & 1 & 0.911 \\ 0.428 & 0.911 & 1 \end{bmatrix}$$

Basing on the obtained values of matrix R_1 and R_2 , we can state that within the prediction process of OHS management quality, the correlative relationships between the employment character of the respondent (production supervisor, manual worker) and the age of the worker as well as between the employment character of the respondent (production supervisor, manual worker) and their seniority in the company are moderate $r_{ij} \in \langle 0.4; 0.7 \rangle$, whereas the correlative relationships between the worker's age and their seniority in the coal mine company are very strong ($r_{ij} \geq 0.9$).

2.4 CONCLUSIONS

The technological and civilizational development brings about situations where hazards may lead to breakdowns or accidents having serious consequences. Efficient counteraction on the company level depends also on the effectiveness of management, which means that the employer is obliged to look for solutions which can ensure proper protection of human health and life. During the realization of such objectives, more and more frequently audit research studies are applied. Their implementation and effective realization can have impact not only on the production efficiency but also on the image of the company, which is even more essential with respect to mining sector companies.

The paper is discussing the results of survey research studies carried out in a coal mine company with the application of MERIT survey. Using that survey, we can define strong and weak sides in the realm of occupational health and safety management, but we can also observe the directions of changes which are taking place in the area of OHS management. Using the research results and one of the prediction methods (linear discriminant function), the author proposed to carry out the prediction of the assessment results of the occupational health and safety management quality. Basing on the opinion survey complemented with other additional information (characteristics) describing the respondent, as the employment profile of the respondent (supervision staff, manual worker), age of the employee and their seniority in the company, we determined the value of the function which can be used to single out a so called subspace 1 and subspace 2, where subspace 1 is understood as the one for which the final assessment index of OHS management quality obtained in the process of the successive edition of research studies exceeded the value of the final assessment index of OHS management quality obtained in the course of the previous edition of research studies (in the case of subspace 2, a reverse process is applicable). In the author's opinion, by such an application of the linear discriminant function (or other determination methods of the discriminant function) we may complement audit procedures and we can use it as a planning tool of remedial measures (novel undertakings, corrections) undertaken by companies in the realm of OHS management.

REFERENCES

- [1] L. A. Arrington-Webb and E. Loyd, "ISO 9002 Certification Helps Thiele Kaolin", *Mining Engineering*, vol. 49, no. 2, pp. 23-25, Feb.1997.
- [2] K. Bukowski et. al., „*Psychologia i bezpieczeństwo pracy*”. Warszawa: Wydawnictwo Książkowe Instytutu Psychologii PAN, 1992.
- [3] D. I. Gertman et. al., "INTENT: A method for estimating human error probabilities for decision based errors", *Reliability Engineering&System Safety*, vol. 35, pp. 127-136, 1992.
- [4] T. Grabiński et. al., „*Metody prognozowania rozwoju społeczno-gospodarczego*”. Warszawa: Polskie Wydawnictwo Ekonomiczne, 1983.

- [5] Z. Korban, "Analysis of Structural Diversification of Work Safety Management Quality Illustrated with an Example of a Coalmine", PhD dissertation. Politechnika Śląska, Gliwice, Poland, 2001.
- [6] U. Kumar, "*Human Reliability and Its Impact on Mechanized and Automated Mining Operations*". Luleå: Luleå University of Technology, 1992.
- [7] D. Paterson, "*Techniques of Safety Management*". New York: Mc Grow Hill Book, 1971.
- [8] J. T. Reason, "*Human error*". New York: Cambridge University Press, 1990.
- [9] M. J. Smith et. al., "Characteristics of Successful Safety Program", *Journal of Safety Research*, vol. 10, no. 1, pp. 87-88, Spr. 1978.
- [10] D. A. Wiegmann and S. A. Shappell, "Human Error Perspectives in Aviation", *International Journal of Aviation Psychology*, vol.4, pp. 341-357, 2001.

Date of submission of the article to the Editor: 04.2017

Date of acceptance of the article by the Editor: 05.2017

dr inż. Zygmunt Korban

Silesian University of Technology

Faculty of Mining and Geology

Akademicka 2, 44-100 Gliwice, Poland

tel.: +4832 237 17 65, e-mail: zygmunt.korban@polsl.pl

APPLICATION OF MERIT SURVEY IN THE ASSESSMENT PROCESS OF THE MANAGEMENT QUALITY OF THE OCCUPATIONAL HEALTH SAFETY – CASE STUDY

Abstract: *The experience of economically developed countries proves that the quality of actions undertaken in the realm involving the management of the occupational health and safety may substantially contribute the attainment of higher OHS standards. A significant role in the improvement of OHS management quality is played among others by audit surveys of the management system of OHS which is viewed as a form of controlling tool. One of the first solutions of that type was applied in the mining industry in Poland, and they were based on the MERIT survey (Management Evaluation Regarding Itemized Tendencies). The mathematical model applied within the scope of that survey makes it possible to determine assessment indexes (final index WZBP and partial indexes WOP_i). The results obtained from the survey carried out on a group of respondents – employees of departments of mining coal – were then used for the prediction of the assessment of the quality of actions undertaken in the area of OHS management (the linear discriminant function was applied as the prediction method).*

Key words: *management of occupational health and safety, MERIT.*

WYKORZYSTANIE ANKIETY MERIT W PROCESIE OCENY JAKOŚCI ZARZĄDZANIA BEZPIECZEŃSTWEM I HIGIENĄ PRACY – STUDIUM PRZYPADKU

Streszczenie: *Doświadczenia krajów rozwiniętych gospodarczo są dowodem na to, iż jakość działań podejmowanych w obszarze zarządzania bezpieczeństwem i higieną pracy może stanowić ważny element w procesie podnoszenia standardów bhp. Istotną rolę w tym zakresie spełniają m. in. badania audytowe systemu zarządzania bezpieczeństwem i higieną pracy będące formą i narzędziem kontroingu. Jednym z pierwszych rozwiązań tego typu zastosowanym w przemyśle wydobywczym w Polsce były badania oparte na ankiecie MERIT (Management Evaluation Regarding Itemized Tendencies). Zastosowany w ramach ankiety model matematyczny pozwala na wyznaczenie wskaźników ocenowych (wskaźnika końcowego WZBP i wskaźników cząstkowych WOP_i). Przedstawione w artykule wyniki badań ankietowych przeprowadzonych na grupie respondentów – pracowników oddziałów górniczych kopalni – zostały następnie wykorzystane w procesie prognozowania oceny jakości działań podejmowanych w obszarze zarządzania bezpieczeństwem i higieną pracy (jako metodę prognozowania wykorzystano liniową funkcję dyskryminacyjną).*

Słowa kluczowe: *zarządzanie bezpieczeństwem i higieną pracy, MERIT.*