

QUALITY ASSESSMENT OF ACTIVITIES UNDERTAKEN IN THE AREA OF HEALTH AND SAFETY MANAGEMENT USING THE MERIT METHOD - CASE STUDY

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Research article

Abstract: This article discusses the results of audit examinations of the health and safety management system performed in the years 2007 - 2012 on a group of the MSz - I shaft department supervisory employees at the "Jan" Coal Mine. The linear trend function was used for description of changes in rating indices - the evaluation of goodness of fit between the theoretical data of the trend function and the set of empirical data was made and the seasonal fluctuations were distinguished.

Keywords: Health, Safety, Management, Model, Trend.

Introduction

On the rising tide of the structural and system changes that took place in the late 1990s in Poland, the interest in new management trends appeared among other things. Quality management, environmental management as well as health and safety management are new fields of science, which have been developing dynamically over of the last two decades.

The substantive premises that lay at the root of implementing the health and safety management idea (HSMS) also in Poland include not only the limited effectiveness of the work safety analysis methods that have been used so far (retrospective assessment of causes and circumstances of accidents), but also the reasons of a legal (need for adjusting the legal solutions applicable in Poland to those in the member states of the European Union), organisational (need for making use and processing of possessed information resources related to the state of hazards), economical (relationship between work safety and profitability of coal mines) and social nature (no public opinion's acceptance of working under conditions which are dangerous to life and health).

The technical means used at present to improve the occupational health and safety status have reached the level satisfactory enough that causes of accidents/dangerous incidents should be more and more often sought in the way how people conduct and behave when working. This statement is supported, among other things, by accident statistics - as early as in the beginning of the 1990s, the State Mining Authority drew attention to the fact

that approx. 90 % of mining accidents occur due to reasons attributable to human nature (Departament Ochrony Zdrowia i Warunków Pracy Wyższego Urzędu Górniczego, 1994). Therefore, in addition to the investigation of causes and circumstances of accidents, preventive measures are taken and the example is the so-called employee participation in the area of management. The co-responsibility of the personnel for the occupational health and safety level in their parent plant with possibility of influencing directly the directions of activities undertaken to improve the occupational health and safety level are reflected in the conception of development and implementation of health and safety management systems. According to PN-N 18001, the implementation of any health and safety management system is a complex and long-term process, one of the basic elements of which is to define the effective way of monitoring the activities undertaken and supervision of their performance at every management level (PN - N 18004, 2001). These objectives are realised, among other things, by the use of audit examinations of the health and safety management system. These examinations are to define whether the activities undertaken as a part of the health and safety management system and the obtained results correspond to the expected findings and whether these findings have been implemented and are suitable for conducting the occupational health and safety policy as well as for accomplishment of the organisation's objectives in this field. In other words, the occupational safety management system audit is a tool for and forms of work safety controlling.

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Materials and methods

Regardless of the concerned organisation level, the work safety management system audit should include the following formalised execution procedures:

1. Identification of the purpose and subject of examinations.
2. Identification of problem areas in work safety management and preparation of the questionnaire form.
3. Determination of the group of personnel subject to examinations (the whole population or a representative group).
4. Execution of questionnaires.
5. Development of rating matrices and calculation of rating indices.
6. Updating the ratings in the adopted time horizon.

The example of method used in audit examinations of HSMS is the MERIT (Management Evaluation Regarding Itemized Tendentious) questionnaire. This questionnaire consists of 29 questions in nine problem area groups (area A, B, C, \dots, I):

- A. Scheduling of activities in the area of health and safety management (4 questions).
- B. Investigation of accidents (6 questions).
- C. OHS control and inspection (3 questions).
- D. Observation and analysis of how the work is performed (4 questions).
- E. Personal protection (1 question).
- F. OHS regulations at the plant (2 questions).
- G. Informing on OHS status (3 questions).
- H. Promotion of OHS (3 questions).
- I. Personal assessment of OHS conditions at the plant (3 questions).

The respondents are to circle one answer to each of the questions, scored from 0 to 4 (0 - fail, 4 - ideal), i.e. the answer which, in the respondent's opinion, provides the best description of the performance status of activities undertaken in specific health and safety management area. The following is determined based on the questionnaires:

- partial rating indices for individual problem areas ($WOP_A, WOP_B, WOP_C, \dots, WOP_I$), where:

$$WOP_{A(B, C, \dots, I)} = \frac{\sum_{j=0}^4 jc_j}{pn}$$

where

- j prescribed rating;
- c_j number of responses to the evaluation j ;
- p number of questions within the problem area;
- n the number of experts rating;

- final health and safety management quality rating index (WZBP), which is the arithmetic mean of the partial indicators of rating WOP_A, \dots, WOP_I .

The mathematical model of the method is discussed in (Korban, 2001; Krzemień, 1996).

Results

Discussion of the results of questionnaire surveys conducted at the MSz - I department of the "Jan" Coal Mine

The scope of the said surveys conducted in the years 2007 - 2012 included the whole supervision personnel (at lower, middle and higher level) of the MSz - I, it's mean 12 people (this number did not change in subsequent surveys which were repeated every quarter). The surveys were repeated once every three months, which allowed the construction of time series consisting of 24 elements. Due to its method, the survey can be referred to as the "survey in the field". As composition of the general community remained practically constant in time (which should be associated with the ban on taking new employees in the coalmine and specificity of work in the department), these surveys can also be considered as the panel ones (Steczkowski, 1995).

The survey results in the form of WOP_i partial ratings and final WZBP index are presented in Tab. 1.

The summary of evaluation measures of goodness of fit between the theoretical data of the trend function and the set of empirical data is presented in Tab. 2.

The seasonal fluctuations are presented in Tab. 3.

Tab. 1 Summary of WOP_i partial ratings and final WZBP index

Problem area	2007				2008				2009			
	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter
	WOP_i											
A	2.95	2.91	2.92	2.95	3.02	2.98	3.01	2.98	3.01	3.1	3.02	3.03
B	2.85	3.01	3.09	3.12	3.02	3.15	3.01	3.06	3.14	3.09	3.19	3.2
C	3.01	2.97	2.86	2.78	2.79	2.91	2.76	2.87	2.99	2.93	3.04	3.08
D	2.47	2.65	2.5	2.79	2.92	2.65	2.97	3.1	2.86	2.9	3.26	3.73
E	3.01	3.25	2.86	3.05	2.97	2.79	2.82	2.76	3.05	2.97	3.05	2.7
F	2.45	2.34	2.43	2.45	2.83	2.32	2.39	2.41	2.19	2.56	2.78	3.05
G	2.79	2.69	2.81	2.84	2.84	2.73	2.73	2.61	2.51	2.64	2.73	2.63
H	2.35	2.53	2.34	2.51	2.51	2.49	2.48	2.34	2.51	2.51	2.62	2.54
I	2.74	3.01	2.78	2.89	3.01	2.96	3.13	3.01	2.97	2.31	2.97	2.97
	WZBP											
	2.74	2.82	2.73	2.82	2.88	2.78	2.81	2.79	2.80	2.78	2.96	2.99
Problem area	2010				2011				2012			
	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter
A	2.99	3.14	3.06	3.06	3.05	3.04	3.09	3.02	3.14	3.15	3.11	3.12
B	3.23	3.17	3.01	3.23	3.15	3.21	3.26	3.18	3.26	3.19	3.33	3.12
C	3.27	3.02	3.27	3.3	3.15	3.1	2.97	3.21	3.18	3.21	3.15	3.26
D	3.05	3.73	3.25	3.43	3.25	3.25	2.5	3.35	3.5	3.25	3.45	3.47
E	3.05	3.2	2.71	3.1	3.25	3.44	3.1	3.14	3.25	3.47	3.34	3.1
F	3.38	2.96	2.99	3.01	3.07	3.06	2.89	3.21	3.12	3.14	3.16	3.11
G	2.63	2.49	2.49	2.56	2.47	2.56	2.61	2.59	2.56	2.49	2.51	2.47
H	2.48	2.45	2.51	2.48	2.38	2.51	2.62	2.51	2.51	2.45	2.67	2.67
I	2.97	3.05	3.54	3.29	3.24	3.24	3.28	3.28	3.31	3.03	3.31	3.29
	WZBP											
	3.01	3.02	2.98	3.05	3.00	3.05	2.92	3.05	3.09	3.04	3.11	3.07

Tab. 2 Evaluation measures of goodness of fit between the theoretical data of the trend function and the set of empirical data

Problem area	Linear trend function $\hat{y}_t = at + b$	Standard deviation of residual component (average error of estimate) $S(e_t)$	Coefficient of determination R^2	Standard errors of structural parameters of linear trend function	
				S(a)	S(b)
A	$\hat{y}_t = 0,008t + 2,934$	0.040	0.680	0.001	0.017
B	$\hat{y}_t = 0,011t + 3,004$	0.077	0.495	0.002	0.032
C	$\hat{y}_t = 0,018t + 2,826$	0.114	0.552	0.003	0.048
D	$\hat{y}_t = 0,035t + 2,652$	0.288	0.442	0.008	0.121
E	$\hat{y}_t = 0,016t + 2,861$	0.187	0.274	0.006	0.079
F	$\hat{y}_t = 0,040t + 2,302$	0.211	0.654	0.006	0.089
G	$\hat{y}_t = -0,014t + 2,796$	0.073	0.646	0.002	0.031
H	$\hat{y}_t = 0,006t + 2,423$	0.080	0.231	0.002	0.034
I	$\hat{y}_t = 0,022t + 2,789$	0.201	0.389	0.006	0.085

In case of the analysed problem areas, the linear trend function was used for description of changes in rating indices - for the final WZBP rating index the function takes the form of $\hat{y}_t = 0,016t + 2,732$ (coefficient of determination $R^2 = 0.793$).

In case of three problem areas: A - "Scheduling of activities in the area of health and safety management", F - "OHS regulations at the plant" and G - "Informing on OHS status", the fitting of trend function was highest and amounted to: 68.0 %, 65.4 % and 64.6 %, respectively (standard errors of parameters "a" and "b" are provided in Tab. 1).

The coefficient of determination reached its lowest value for areas H - "Promotion of OHS" ($R^2 = 0.231$) and E - "Personal protection" ($R^2 = 0.274$).

The downward trend of WOPi rating indices was reported in case of area G - "Informing on OHS status" only. For other problem areas, there was the upward trend - most distinctly in areas F - "OHS regulations at the plant" ($a = 0.044$) and A - "Scheduling of activities in the area of health and safety management" ($a = 0.032$).

Tab. 3 Raw and adjusted frequency indices for individual quarters (by individual problem areas)

Problem area	Raw seasonal indices				Adjustment factor	Adjusted seasonal indices			
	1 st quarter	2 nd quarter	3 rd quarter	4 th quarter		1 st quarter	2 nd quarter	3 rd quarter	4 th quarter
A	0.0047	0.0233	-0.0030	-0.0193	0.0014	0.0033	0.0219	-0.0044	-0.0207
B	-0.0167	0.0007	0.0013	-0.0063	-0.0053	-0.0114	0.0059	0.0066	-0.0011
C	0.0410	-0.0187	-0.0517	0.0053	-0.0060	0.0470	-0.0127	-0.0457	0.0113
D	0.1503	0.2327	0.1683	0.5107	0.2655	-0.1152	-0.0328	-0.0972	0.2452
E	0.4157	0.5237	0.3350	0.3480	0.4056	0.0101	0.1181	-0.0706	-0.0576
F	0.0980	-0.0520	-0.0487	0.0113	0.0022	0.0958	-0.0542	-0.0508	0.0092
G	-0.0087	-0.0280	0.0327	0.0167	0.0032	-0.0118	-0.0312	0.0295	0.0135
H	0.0147	0.0750	0.1520	0.1473	0.0973	-0.0826	-0.0223	0.0548	0.0501
I	0.0090	-0.1197	0.0933	0.0247	0.0018	0.0072	-0.1215	0.0915	0.0228

Due to the impact of seasonal fluctuations, the differences between the determined rating index and trend were highest for area D - "Observation and analysis of how the work is performed" (in the 4th quarters, WOP_D value was higher as compared to the trend by 0.2452), area I - "Personal assessment of OHS conditions at the plant" (in the 2nd quarters, WOP_I value was lower as compared to the trend by 0.1215) and E - "Personal protection" (in the 2nd quarters, WOP_E value was higher as compared to the trend by 0.1181). The empirical areas of variability are presented in Fig. 1 and Fig. 2.

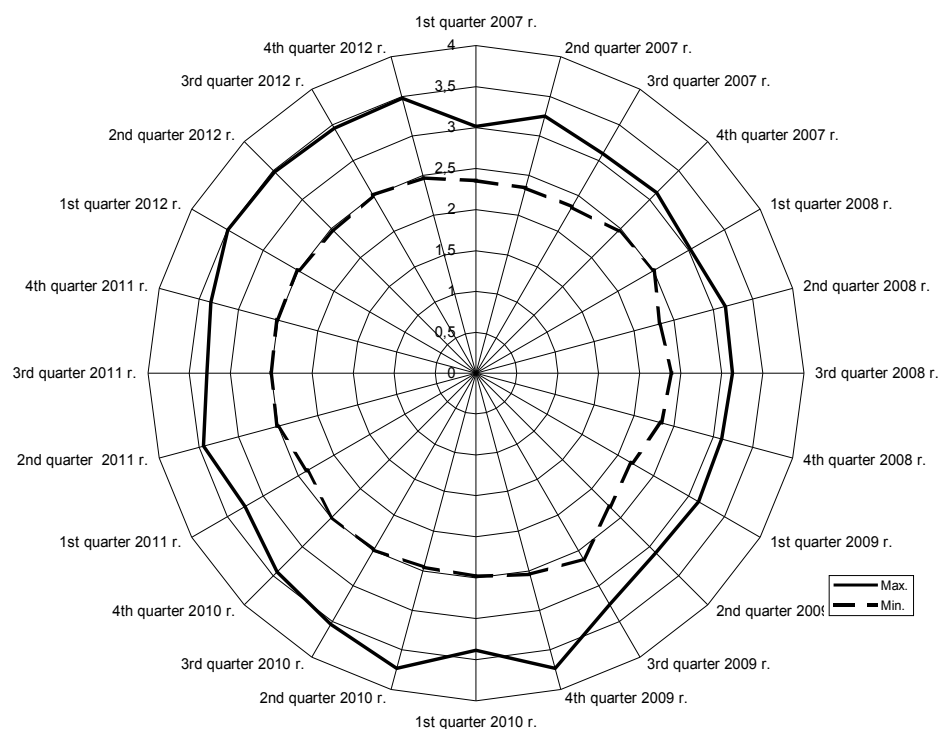


Fig. 1 Empirical areas of variability in successive survey editions in the years 2007 - 2012

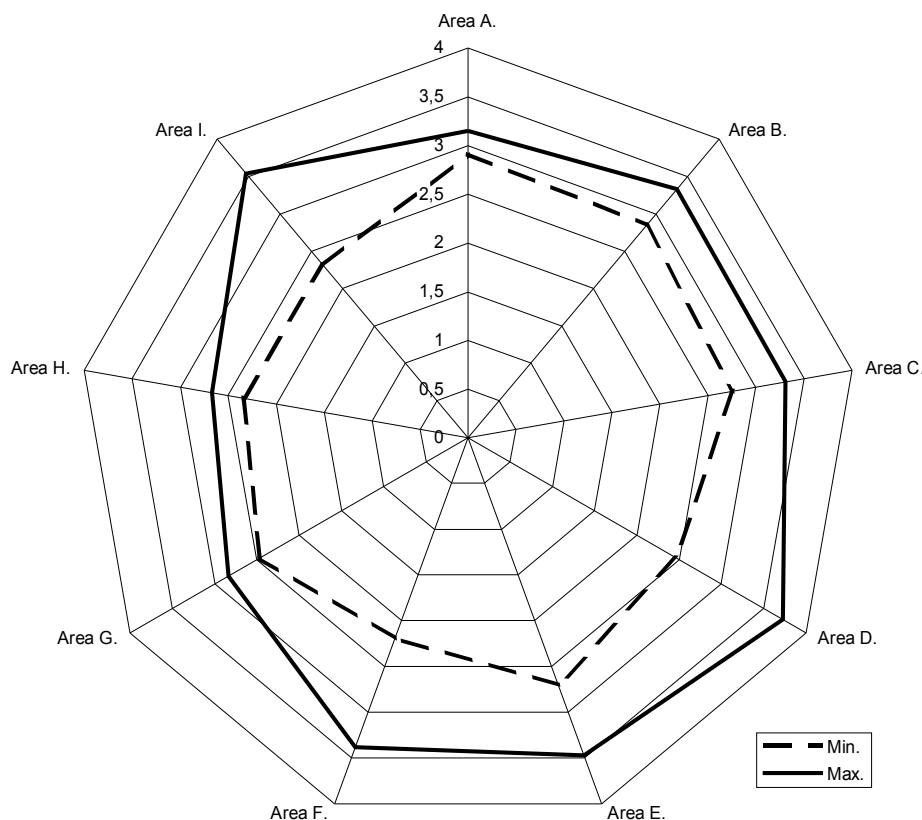


Fig. 2 Empirical areas of variability for areas A-I in the years 2007 - 2012

The highest diversity in obtained values of WOP_i indices were reported in the 2nd quarter of 2010 (1.28), 4th quarter of 2009 (1.19) and 3rd quarter of 2010 (1.05), while the least diverse values - in the 1st quarter of 2008 (0.51).

Over the analysed period, the highest range was reported in areas D - "Observation and analysis of how the work is performed" (1.26), I - "Personal assessment of OHS conditions at the plant" (1.23) and F - "OHS regulations at the plant" (1.19), while the least for areas:

A - "Scheduling of activities in the area of health and safety management" (0.24),

H - "Promotion of OHS" (0.33) and G - "Informing on OHS status" (0.37).

Taking into consideration the average values of WOP_i rating indices, it can be stated that the highest rating was given to areas B and D (for areas I, E, C and A the ratings are slightly lower, but on a very similar level). For areas F, G and H the final ratings are definitely worse.

The first place in the ranking was taken by area B - "Investigation of accidents" ($WOP_B = 3.14$). This area was placed first 5 times in the successive editions of the survey. The quality of activities taken

by the occupational health and safety services in the field of investigations of work accidents was assessed highly. In the respondents' opinion, these investigations are characterised by a careful analysis of every accident case, each time ended with a preparation and implementation of relevant preventive measures. The respondents drew attention to the need of including near-miss incidents in these investigations too (pre-accident prevention), which should not be a surprise taking into consideration the fact that the survey concerned the supervision personnel

(employees with secondary and higher technical education).

The second place in the ranking of problem areas was taken by area D - "Observation and analysis of how the work is performed" ($WOP_D = 3.10$). This area was placed first as many as 10 times in the successive editions of the survey repeated in subsequent quarters. In the respondents' opinion, the work supervision is correct, work instructions and technologies are developed on an ongoing basis, at higher and higher co-participation of physical workers with highest seniority and experience.

The third place in the ranking was taken by area I "Personal assessment of OHS conditions at the plant" ($WOP_I = 3.07$). The employees appreciate the involvement of the coal mine management personnel in activities undertaken to create proper (i.e. safe) working conditions. This rating corresponds to those obtained by areas E - "Personal protection" ($WOP_E = 3.06$), C - "OHS control and inspection" ($WOP_C = 3.05$) and A - "Scheduling of activities in the area of health and safety management" ($WOP_A = 3.04$). The respondents declared free access to the personal protection equipment, which should be associated with specificity of the works carried out by the "shaft department" (works at height, shaft revisions, replacements of lifting slings or ropes

etc). The inspections are carried out in a reliable and prompt manner.

The respondents declared the knowledge of work safety policy assumptions adopted by the plant, which is undoubtedly the result of activities undertaken in connection with applying for the certificate confirming the implementation of health and safety management system by the coal mine.

Definitely, the lowest values of the WOP_i index were reported in areas F - "OHS regulations at the plant" ($WOP_F = 2.80$), G - "Informing on OHS status" ($WOP_G = 2.62$) and H - "Promotion of OHS" ($WOP_H = 2.50$) - the last one was placed on the last (tenth) place as many as 14 times in the successive editions of the survey. The main reason for this state of affairs is, in the respondents' opinion, the timing issues when dividing the personnel for assigned tasks. According to the surveyed supervision personnel, the disproportion between the amount of available time during the divisions and the range of information to be provided to the employees indicates the urgent need to make changes. In the respondents' opinion, there is no even the possibility to exhaustively provide the employees with information on OHS status discussed during the supervision briefings. The problem can be solved neither by traditional (charts, radio broadcasting system) nor modern (multimedia presentations) forms of promoting safe behaviours. According to the respondents, in case of the first one the information is updated very seldom and provided in an uninteresting form, while in case of the latter - it is impossible to watch the broadcast for a longer time due to the location of information display screens (in the pithead building). The

attempts to familiarise the employees with OHS regulations on a wider scale are taken, among other things, by organisation of competitions of OHS knowledge, however they do not enjoy higher interest of the personnel. In the respondents' opinion, different solutions should be looked for, such as, for example, the simulations to illustrate the possibility of obtaining measurable financial benefits by the plant and employees themselves (lower insurance premium, lower costs of compensation, positive marketing effects etc).

Conclusion

The labour market situation, strong competition and care of the company image cause that the need to pay higher and higher attention not only to the issues related to production itself, but also to the issues related to work safety, quality and ecology is discerned. The quality assessment of activities undertaken in the area of work safety management is undoubtedly the tool, which may contribute to the improvement in both the economic result and the way of perceiving the company. The issues presented in this article are the example of how audit examinations can be used for both promoting the idea of personnel participation and determination of the necessary directions of corrective actions (identification of the so-called "strong" and "weak" points in the area of OHS management), while the discussed procedures create conditions for application of organisational improvements that may contribute to the enhancement of OHS level without the need of increasing the costs of production itself.

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