SAFETY ENVIRONMENTAL ASSESSMENT IN THE BLAST FURNACE SECTION

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ABSTRACT

Assessing the safety climate used as a practical means to a relevant determinant problem regarding the safety and health in the work in the organization. The instruments applied are collected through questionnaires, group discussions or interviews and observations. The aim of the study is to determine a working climate at a steel section of elaboration (furnace) and a climatic definition of administration (management, health communication and safety).

KEYWORDS: blast furnace section, safety climate, occupational management

1. Introduction

The steel industry is one of the industrial activities, quite complex, with production costs, and high professional risks. This is how global trends of implementation in production technologies, raw materials, characterized by efficiency and performance have occurred and are currently manifesting, with the ultimate goal of reducing specific fuel consumption and energy losses, which will affect as little as possible the environment and which does not lead to occupational accidents and diseases. As the number of people in charge increased, the number and importance of managerial functions increased, and the structure organized to make the managerial act more efficient, bears the name of managerial organization.

The term "safety climate" has been used as a multi-domain factor, having an important role in the safety of the work environment, and represents the interaction between the safety climate and the security behaviour [3].

The climate of safety measures and describes the common perception of the employees on how to manage safety in a working environment in a certain period. Depending on priorities such as production and quality, perceptions provide an index to prioritize safety within an organization. The study of the safety climate has been presented as an important index in the health and safety problems of the working environments and the corrective actions thereof have a considerable effect on the efficiency of the work of the workers and the successful control over the accidents in the working environment [3].

Security behaviour is considered as another important index in the health and safety problems of the working environment, and it has an instrument for implementing and reforming the results of the effects of creating efficiency in the functioning of the employees and the successful control of accidents that could have environments for work [3].

2. Objectives

The aim of the study is to determine the climate and safety profile in a steel section for the development of the first fusion furnace and to define the safety climate (management, communication for health and safety at work, safety priority). Ten aspects of safety aspects are evaluated, including the relationship of the organization and the manager's commitment, the role of the process leader, the role of the staff, the effect of the colleague, the competence of the worker, the risky behaviour, the obstacles in the safety behaviour, the work permit and the incident and pseudo incidents report in the section. ovens. The result indicated that there is a significant difference in the safety climate between the different working groups.

3. Theoretical considerations

A Quality Management System (SMC) is a system through which an organization intends to eliminate or at least reduce non-conformities to the technical specifications, the respective industrial standards, in the most efficient and effective way possible. In other words, a SMC represents a set of

policies, processes and procedures necessary for planning and execution in the area of basic activities. The Likert scale is an ordinal scale, which is used to evaluate multiple rating statements between a "total agreement" and a "total disagree". The number of

steps of the ladder is one and the same for all statements about the phenomenon (five steps). For the processing and interpretation of the data of the 5 levels (Table 1) of the scale will be assigned scores [2].

Table 1. *Assessing the importance of values*

Question evaluation	Disagree Total	Disagree	No Agreement / Disagree	Agreement	Agreement Total
Scores	-2	-1	0	+1	+2

After completing the questionnaire, each article can be analysed separately or, in some cases, responses to an article can be summed to create a score for a group of articles. Therefore, the Likert scale is often called summative scale. The score obtained by the subject is calculated by making the algebraic sum [4].

Data processing is performed in the same way as in the case of Semantic Differential. The average scores for each statement are calculated on a scale from (-2) total disagreement to (2) total agreement.

The total score represents the arithmetic mean of the calculated scores:

$$S_i = \frac{1}{n}\sum x_i \qquad (1)$$

where:
$x_1, x_2..., x_m$ is the possible values of characteristic X (scale of values of characteristic X);

The relative frequencies, expressed as a percentage, are also called percentage frequencies. They are calculated according to the formula [4]:

$$f_i = \frac{n_i}{n}\cdot 100 \ [\%] \qquad (2)$$

where:
f_i is the relative frequency of a value [%];
n - number of subjects investigated;
$n_1, n_2...n_i$ - number of subjects, corresponding to the investigated feature.

The cumulative frequency is the percentage of individuals that do find up to or below a step (value) of the scale. She is calculated according to the formula [4]:

$$F_i = \frac{n_1 + n_2 + n_3 + \cdots + n_i}{n}\cdot 100 \ [\%]$$

$$F_i = f_1 + f_2 + f_3 + \cdots + f_i \qquad (3)$$

where:
F_i is the cumulative frequency [%];

The score obtained by the subject is calculated by making the algebraic sum. Frequency distributions can also be represented graphically, in form of bar charts, circular charts, radar, etc.

The values of the studied characteristics, collected from the analysed subjects, represent some statistical data (concrete sizes, determined by counting, measuring, etc.), which are grouped in the so-called databases.

4. Material and methods

The security climate can be measured in several ways, depending on the needs and capacity of an organization. The tool can be used to examine the climate or safety situation in an organization.

For this reason, the data are obtained through three separate and independent sources (questionnaire, face-to-face interviews and group discussions, observation) and are used in the evaluation [5, 6].

Qualitative methods can be classified as follows:
- questionnaire is defined as a list of questions addressed to employees, made up in order to obtain, based on the answers given, information on a problem.
- observation - online collection of information on events, phenomena, objects, persons, etc.;
- interview - discussion that involves the use of an interview guide, unstructured or semi-structured, applied to individuals, with manoeuvring possibilities.

The issues of safety aspects are evaluated, including the relationship of the organization and the manager's commitment, the role of the trial leader, the role of the staff, the effect of the colleague, the competence of the worker, the obstacles in the safety behaviour, the work permit and the incident report and the pseudo incidents in the furnace section.

The questionnaire was established based on documentation, to measure the credibility or validity of the content (Table 2).

After completing the questionnaire, each element (question) is analysed separately. Although

there is an ordered relationship by category sets, there is no indication of real differences between categories.

Table 2

The question ??
What is the safety climate in the manager's commitment?
What is the safety climate for the benefit of the worker?
Which is the priority of the safety climate?
What is the safety climate in the operating instructions?
What is the safety climate in a supportive environment?
What is the safety climate in worker participation?
What is the safety climate as an individual priority?
What is the safe climate in the work environment?
What is the safety climate in the communication of health?
What is the safety climate in managing change?
What is the safety climate in the training of employees?
What is the safe climate in safe behavior?
What is the safety climate in common values?
What is the adaptation of the safety climate to the system?
What is the safety climate in accidents and accidents?
What is the safe climate in the perception of risk?
What is the safety climate in the management style?

5. Working method

The research is on one of the steel industries in ArcelorMittal Galati blast furnace 5 (Vu= 2700 m³) to determine the safety climate and provide a profile, [1].

In total, 57 subjects were asked to complete the questionnaire (all worked in the blast furnace section).

Their age ranged from 27-48 years and their working age, from 10-24 years. Of these, 88% are married, a total of 25 subunits, 20 subjects have general and secondary education, and 12 have higher education. The results are presented below (Table 3).

The processing is necessary for the creation of databases of personal data interviewed (Table 2) and average scores (weighted average) and frequencies relative to the relationship (1) are calculated.

1. Management

Table 3. *Calculation for question no. 1*

What is the safety climate in the manager's commitment?				
Scores	-2	-1	0	+1	+2
Respondents	2	4	2	15	34

Formula of calculation, score 1(57 subjects):

$$S_1 = \frac{-2 \cdot 2 - 1 \cdot 4 + 0 \cdot 2 + 1 \cdot 15 + 2 \cdot 34}{57} \approx 1,315$$

2. Marketing

Table 4. *Calculation for question no. 2*

Which is the priority of the safety climate?				
Scores	-2	-1	0	+1	+2
Respondents	2	1	7	15	32

Formula of calculation score 2 (57 subjects):

$$S_2 = \frac{-2 \cdot 2 - 1 \cdot 1 + 0 \cdot 7 + 1 \cdot 15 + 2 \cdot 32}{57} \approx 1,263$$

3. Education

Table 5. *Calculation for question no. 3*

What is the priority of the safety climate in education??				
Scores	-2	-1	0	+1	+2
Respondents	4	1	6	3	43

Formula of calculation, score 1(57 subjects):

$$S_3 = \frac{-2 \cdot 4 - 1 \cdot 1 + 0 \cdot 6 + 1 \cdot 3 + 2 \cdot 43}{57} \approx 1,403$$

4. Safety instructions

Table 6. *Calculation for question no. 4*

What is the safety climate in the operating instructions?				
Scores	-2	-1	0	+1	+2
Respondents	1	3	5	15	33

Formula of calculation, score 1(57 subjects):

$$S_4 = \frac{-2 \cdot 1 - 1 \cdot 3 + 0 \cdot 5 + 1 \cdot 15 + 2 \cdot 33}{57} \approx 1,333$$

5. Costs

Table 7. *Calculation for question no. 5*

What is the safety climate in a supportive environment?				
Scores	-2	-1	0	+1	+2
Respondents	2	2	1	10	42

Formula of calculation, score 1(57 subjects):

$$S_5 = \frac{-2 \cdot 2 - 1 \cdot 2 + 0 \cdot 1 + 1 \cdot 10 + 2 \cdot 42}{57} \approx 1,543$$

6. Participation

Table 8. Calculation for question no. 6

What is the safety climate in worker participation?				
Scores	-2	-1	0	+1	+2
Respondents	2	4	1	19	31

Formula of calculation, score 1(57 subjects):

$$S_6 = \frac{-2 \cdot 2 - 1 \cdot 4 + 0 \cdot 1 + 1 \cdot 19 + 2 \cdot 31}{57} \approx 1,280$$

7. Individual priority and insecurity

Table 9. Calculation for question no. 7

What is the safety climate as an individual priority?				
Scores	-2	-1	0	+1	+2
Respondents	0	1	2	3	51

Formula of calculation, score 1(57 subjects):

$$S_7 = \frac{-2 \cdot 0 - 1 \cdot 1 + 0 \cdot 2 + 1 \cdot 3 + 2 \cdot 51}{57} \approx 1,824$$

8. Individual perception of risk

Table 10. Calculation for question no. 8

What is the safety climate in perception of risk?				
Scores	-2	-1	0	+1	+2
Respondents	1	6	6	19	25

Formula of calculation, score 1(57 subjects):

$$S_8 = \frac{-2 \cdot 1 - 1 \cdot 6 + 0 \cdot 6 + 1 \cdot 19 + 2 \cdot 25}{57} \approx 1,070$$

9. Working environment

Table 11. Calculation for question no. 9

What is the safety climate in a supportive environment?				
Scores	-2	-1	0	+1	+2
Respondents	4	3	1	16	33

Formula of calculation, score 1(57 subjects):

$$S_9 = \frac{-2 \cdot 4 - 1 \cdot 3 + 0 \cdot 1 + 1 \cdot 16 + 2 \cdot 33}{57} \approx 1,245$$

10. Common values

Table 12. Calculation for question no. 10

What is the safety climate in common values?				
Scores	-2	-1	0	+1	+2
Respondents	4	8	3	20	18

Formula of calculation, score 1(57 subjects):

$$S_{10} = \frac{-2 \cdot 4 - 1 \cdot 8 + 0 \cdot 3 + 1 \cdot 20 + 2 \cdot 18}{57} \approx 0,701$$

11. Management of change

Table 13. Calculation for question no. 11

What is the safety climate in management of change?				
Scores	-2	-1	0	+1	+2
Respondents	2	4	2	15	34

Formula of calculation, score 1(57 subjects):

$$S_{11} = \frac{-2 \cdot 2 - 1 \cdot 4 + 0 \cdot 2 + 1 \cdot 15 + 2 \cdot 34}{57} = 0,719$$

12. Public perception

Table 14. Calculation for question no. 12

What is the safety climate in the Public perception?				
Scores	-2	-1	0	+1	+2
Respondents	6	6	2	24	19

Formula of calculation, score 1(57 subjects):

$$S_{12} = \frac{-2 \cdot 6 - 1 \cdot 6 + 0 \cdot 2 + 1 \cdot 24 + 2 \cdot 19}{57} \approx 0,771$$

13. Competence and certification

Table 15. Calculation for question no. 13

What is the climate in the competence and certification?				
Scores	-2	-1	0	+1	+2
Respondents	5	2	2	28	20

Formula of calculation, score 1(57 subjects):

$$S_{13} = \frac{-2 \cdot 5 - 1 \cdot 2 + 0 \cdot 2 + 1 \cdot 28 + 2 \cdot 20}{57} \approx 0,982$$

14. Cooperation

Table 16. Calculation for question no. 14

What is the safety climate in the communication of health?					
Scores	-2	-1	0	+1	+2
Respondents	9	12	6	15	16

Formula of calculation, score 1(57 subjects):

$$S_{14} = \frac{-2 \cdot 9 - 1 \cdot 12 + 0 \cdot 6 + 1 \cdot 15 + 2 \cdot 16}{57} \approx 0,298$$

15. Safe behavior

Table 17. Calculation for question no. 15

What is the adaptation of the safety climate to the system?					
Scores	-2	-1	0	+1	+2
Respondents	2	6	6	22	21

Formula of calculation, score 1(57 subjects):

$$S_{15} = \frac{-2 \cdot 2 - 1 \cdot 6 + 0 \cdot 6 + 1 \cdot 22 + 2 \cdot 21}{57} \approx 0,947$$

16. Incidents and accidents

Table 18. Calculation for question no. 16

What is the safety climate in accidents and accidents?					
Scores	-2	-1	0	+1	+2
Respondents	8	11	6	22	10

Formula of calculation, score 1(57 subjects):

$$S_{16} = \frac{-2 \cdot 8 - 1 \cdot 11 + 0 \cdot 6 + 1 \cdot 22 + 2 \cdot 10}{57} \approx 0,263$$

17. Implementation of the safety system

Table 19. Calculation for question no. 17

What is the safety climate in the management style??					
Scores	-2	-1	0	+1	+2
Respondents	3	3	1	18	32

Formula of calculation, score 1(57 subjects):

$$S_{17} = \frac{-2 \cdot 3 - 1 \cdot 3 + 0 \cdot 1 + 1 \cdot 18 + 2 \cdot 32}{57} \approx 1,280$$

The average score values for each statement are presented in the table below: - average scores calculated on a scale of -2 (Total disagreement) to 2 (Total agreement). The results are presented in the Table 20:

Table 20

No.	The field of evaluation	Method of evaluation	Average value
1	Management	Checklist	1.315
2	Marketing	Checklist	1.263
3	Education	Checklist	1.403
4	Safety instructions	Checklist	1.333
5	Costs	Checklist	1.543
6	Participation	Checklist	1.280
7	Individual priority and insecurity	Checklist	1.842
8	Individual perception of risk	Checklist	1.070
9	Working environment	Checklist	1.245
10	Common values	Checklist	0.701
11	Management of change	Checklist	0.719
12	Public perception	Checklist	0.771
13	Competence and certification	Checklist	0.982
14	Cooperation	Checklist	0.298
15	Safe behavior	Checklist	0.947
16	Incidents and accidents	Checklist	0.263
17	Implementation the safety system	Checklist	1.280

The average score values for each statement are presented in the table below: - average scores calculated on a scale of -2 (Total disagreement) to 2 (Total agreement).

The data that is arranged in columns or rows in a worksheet can be graphically represented in a radar chart. Radar diagrams compare the aggregate values of several data series.

The total score: Based on the calculated scores, determining the total score middle, as the arithmetic mean of the scores of the n (n = 17) characteristics:

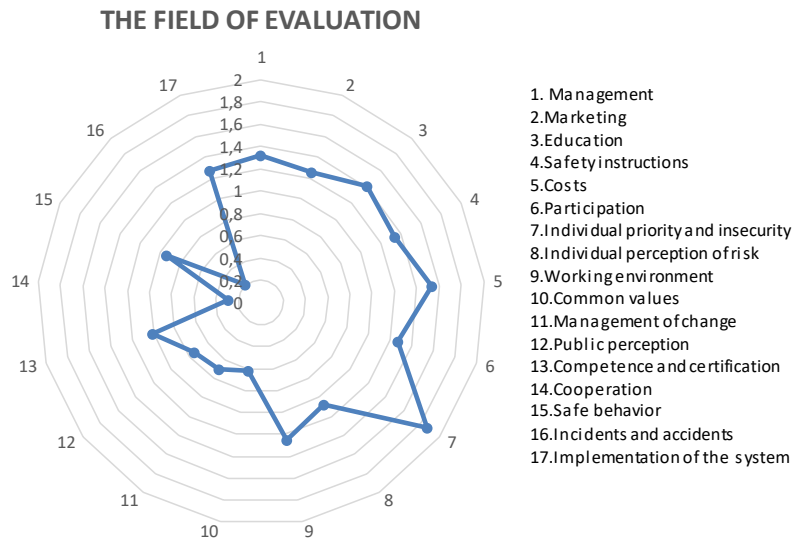$$S_T = \frac{1}{n}\sum_{1=1}^{n} S_i = \frac{17,536}{17} \coloneqq \mathbf{1,03153}$$

Fig. 1. *Graphic diagram of the safety climate profile*

6. Conclusions

Management's decision regarding safety issues, conducting proactive activities regarding incidents, immediate reform of safety issues, lead to the creation of a safe and healthy work climate (overall average score ST = 1.03153). Research has shown that the safety climate is on average in the industry.

1. The employees criticized the concerns regarding the non-observance of the safety instructions from some employees;

2. On the other hand, in 7 areas, they are below the average of evaluation, namely, areas of incidents and accidents ($\approx$ 0.263), cooperation ($\approx$ 0.298) common values ($\approx$ 0.701) change management ($\approx$ 0.719) and leadership style (0.771) which need to be further analysed and urgent measures taken to address the shortcomings;

3. On the opposite side, based on the analysis, it turns out that there are very well-developed areas, such as, individual priority (1.824), costs (1.543), education and training (1.403) and management (1.315);

4. The rest of the analysed areas (7) are above average;

5. As measures the interest of the services responsible for the safety on behalf of the employees and of the management is proposed;

6. Research has shown that the safety climate is on average in the industry. In some areas of the security climate, such as the commitment of management, communication, security priority, security regulations, support environment, participation, individual priority, individual perception of risk, working environment, achievement of the safety climate are approximately in average. In other areas, including common values, change management, leadership style, competence and training, cooperation, safe behaviour, incidents and accidents, the score is poor.

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