SAFETY CULTURE IN THE MANUFACTURING ENTERPRISES – SELECTED ASPECTS OF EXAMINATION

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Abstract. The safety culture is an important element in risk prevention systems in the manufacturing enterprises. There are many methods for shaping a safety culture, and the many tools and approaches to the study of this culture. In the article, the analysis and assessment of the safety culture in the manufacturing enterprise, using an approach based on the study of the causes of accidents at work, was performed. The research has identified departments of industrial manufacturing with low and high level of the safety culture, measured through the prism, leading to the accidents of employees' improper and arbitrary behavior. Moreover, a fixed relationship between the level of the safety culture and the size of the enterprises in the specified industry, has been found.

Keywords: safety culture, prevention systems, safety at work, manufacturing systems

1. Introduction

Since when the human factor plays a key role in shaping safe working conditions in companies, the safety culture is an important element in risk prevention systems, and not only in high-risk companies, but also in companies operating in traditional sectors.

The International Atomic Energy Agency defined safety culture as: "*that assembly of characteristics and attitudes in organizations and individuals which establishes that, as an overriding priority, nuclear plant safety issues receives the attention warranted by their significance*" [1]. The definition of the British Advisory Committee on the Safety of Nuclear Installations is also one of the most popular: "*the product of individual and group values, attitudes, perceptions, competences, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organization's health and safety management"* [2].

The safety culture/climate distinction is further linked to Schein's [3] three-level framework on organisational culture (artefacts, espoused values and basic assumptions), where the climate is at the level of espoused values and culture is at the level of basic assumptions [4].

2. Approaches to the safety culture study

Relevant studies have identified the following 13 major dimensions of safety culture: safety leadership [5], safety environment [6,7], safety commitment [8,9,10], safety communication [9,11], safety rules [4,12], safety training [13,14], risk management [9,15], safety systems [15,16,17,18], safety encouragement and punishment [9], safety knowledge [19], safety awareness and attitude [19,20], worker participation [21,22], and safety behavior [20,23,24,25].

There are many methods for shaping a safety culture and the many tools and approaches, used to study of this culture. A questionnaire is still the most important tool.

Basic four questionnaires are: the Corporate Culture Survey (CCS) by Glaser [26]; the Organizational Beliefs Questionnaire (OBQ), developed by Sashkin [27]; the Culture Gap Survey (CGS) by Kilmann and Saxton [28] and the Organizational Culture Inventory (OCI), developed by Cooke and Lafferty [29]. In recent years some researchers have used ethnographic measures to examine safety culture [30] as well as techniques include ''in-depth interviews, simulations and role playing'' [31].

And, at the same time, a safety culture modeling is greatly expanding. According to the literature review, the models safety cultures were included: IAEA Safety Culture Model [1], Total Safety Culture Model [20], Reciprocal Model of Safety Culture [32], System Model of Safety Culture [33], Safety Culture Maturity Model [34], the Safety Culture Model [35], and Safety Culture Model based on EFQM Model [36, 37].

According to García Herrero et al. [38] organizations typically go through three phases in developing and strengthening safety culture: control of safety, guarantee of safety and total safety. However, Parker et al. [39] describe five distinct levels ranging from Pathological to Generative:

- Pathological (who cares about safety as long as we are not caught?),
- Reactive (safety is important: we do a lot every time we have an injury),
- Calculative (we have systems in place to manage all hazards),
- Proactive (we try to anticipate safety problems before they arise),
- Generative (health and safety is how we do business around here).

Examination of these models and phases or levels revealed that culture is a multi-dimensional concept that should be approached from different perspectives.

3. Research methodology

The main objective was to examine the safety culture in manufacturing companies, by analyzing the frequency of accidents (IND1), caused by improper, arbitrary behavior of the employee and determine, whether there is a relationship between the frequency of accidents caused by improper, arbitrary conduct of the worker and the size of the company (IND2). Based on a literature review on safety culture survey, carried out in the first part of the article, it was assumed, that improper, arbitrary behavior of the employee is an important manifestation of the poor safety culture.

Therefore, it has been calculated:

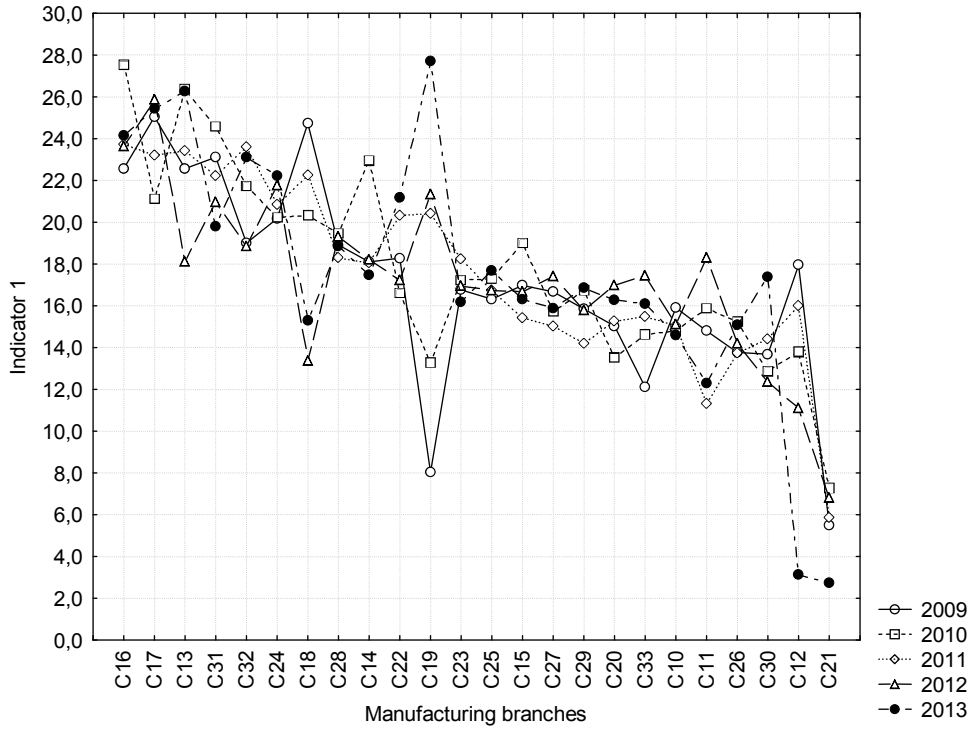
1) The indicator of incidence rates of accidents caused by improper, arbitrary behavior of the employee - IND1 (Indicator 1),
2) indicators of entity structure - IND2 (Indicator 2),
3) The Pearson correlation coefficient for the average values of AIND1 and AIND2 of the surveyed years, and
4) average values of IND1 indicators for four groups of companies with different structures of entities.

The study used statistical data from the years 2009-2013, collected annually by the Central Statistical Office [40, 41].

4. The results

4.1. The examination of the frequency of accidents caused by improper, arbitrary behavior of the worker

Indicators of accidents frequency caused by improper, arbitrary behavior of the employee - IND1 - were calculated for each manufacturing divisions, as the ratio of the number of reasons for the number of accidents per 100 accidents, for the surveyed years 2009-2013. According to the explanatory notes to the statistical reports of accidents, improper, arbitrary behavior of the employee is involved in activities such as: perform work outside the scope of the employee's duties; passage, passing or being in prohibited places; entrance, sliding up surveillance zone without making sure there is no danger; perform tasks without removing threats (eg. exemption of machinery, exemption of voltage, etc.), too fast movement; improper handling of limbs in the danger zone as well as jokes or fights. The figure 1 shows the development of the indicators of incidence rates of accidents caused by improper, arbitrary behavior of the worker, in various sectors of manufacturing.



Legend: Notation C according to Polish Classification of Activities (PKD) for Section: Manufacturing

Fig 1. Shaping the index of the frequency of accidents caused by improper, arbitrary behavior of the employee (Source: Own work based upon statistical information)

The IND1 highest index value was recorded for the manufacture of products of wood, cork, straw and wicker (C16 - 24.31), while the lowest - for the production department of

pharmaceutical products (C21 - 5.63). A significant dispersion of IND1 value, were found in the division manufacture of coke and refined petroleum products (C19 from 8.03 in 2009. to 27.71 in 2013.) and in the case of the production of tobacco products (C12 - from 17.95 in 2009. to 3.12 in 2013).

4.2. The study of the structure of entities in the various sectors of manufacturing

The entity structure Indicators - IND2, for various manufacturing divisions, were calculated as the standard deviation of the size of the shares of companies of a certain size of employment (U1 to 9, U2 from 10 to 49, the U3 from 50 to 249, U4 250 to 999 and U5 above 1,000 employees), in the studied years. The higher IND2 value, the less diversity of structures, which practically means to increase the share in the structure of micro and small enterprises. Figure 2 shows the development of these indicators in the various sectors of manufacturing.

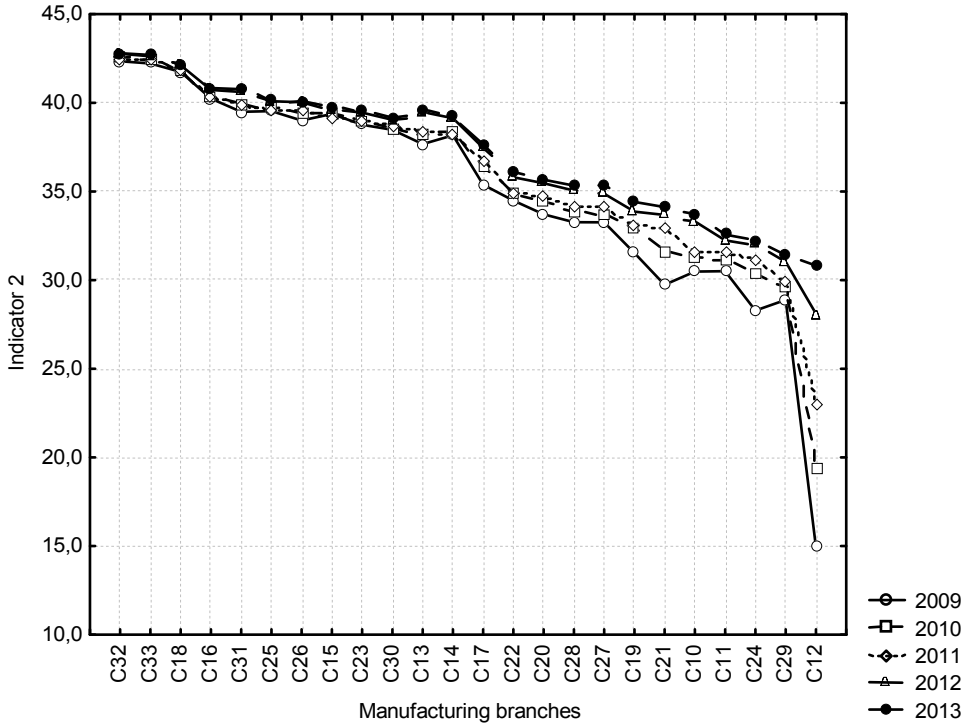


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Fig 2. The shaping of the entity structure in the various sectors of manufacturing (Source: Own work based upon statistical information).

The highest value of IND2 indicator was recorded for the rest of the production department (C32 - 42.58), while the lowest - for the production of tobacco products (C12 - 23.22). A significant dispersion in IND2 value was found in the production of tobacco products (C12 - from 14.94 in 2009. to 30.82 in 2013.).

4.3. Investigating the relationship between the IND1 indicator and the indicator rate structure IND2

To verify the existence of correlation between the frequency of accidents caused by improper, arbitrary behavior of the employee - IND1 and the structure of individual entities - IND2, the Pearson's correlation coefficient was used.

While the average values of the ND1 indicators for four groups of companies with different structures of entities, have been determined based on the results of the descriptive statistics. The calculations are presented in Table 1.

Table 1. Summary of test results

(1) Pearson correlation analysis of variables AIND1&AIND2 ($p<0.05$)							
	A	DEV	R(X,Y)	R^2	t	p	N
AIND2	36.2747	4.7358	0.4158	0.1729	2.1449	0.0342	24
AIND1	17.4956	4.1679					
(2) Pearson correlation analysis of variables AU&AIND1 ($p<0.05$)							
AU1	84.3899	8.7999	0.4112	0.1691	2.1160	0.0358	24
AIND1	17.4956	4.1679					
AU2	10.0680	4.4838	-0.2018	0.0407	-0.9665	0.3442	24
AIND1	17.4956	4.1679					
AU3	3.6751	2.6612	-0.4647	0.2160	-2.4621	0.0221	24
AIND1	17.4956	4.1679					
AU4	1.4520	2.8250	-0.4038	0.1631	-2.0707	0.0503	24
AIND1	17.4956	4.1679					
AU5	0.4144	0,9425	-0.3463	0.1269	-1.7887	0.0874	24
AIND1	17.4956	4.1679					

(3) The Two-Table descriptive statistics for the variable AIND1					
Category AIND2	Code AIND2	Value AIND2	Average IND1	Deviation IND1	N
<=25%	1	23.22 – 32.07	15.7868	3.2096	5
>25% and <=50%	2	32.37 – 36.72	15.5043	5.0430	6
>50% and <=75%	3	38.65 – 39.45	19.0873	3.9267	6
> 75% and <=100%	4	39.64 – 42.58	19.0588	3.7277	7

A - the arithmetic mean of the variable; DEV - standard deviation; R (X, Y) - Pearson's correlation coefficient; R2 - a precision factor regression fit to the empirical data; t - statistics investigating the significance of the correlation coefficient, p - level of significance; N - sample size; AIND1 - the average value of the frequency of accidents caused by improper, arbitrary behavior of the employee; AIND2 - the average value of entity structure; AU1 - the average value of the firm employing up to 9 workers AU2 - employing 10 to 49 employees; AU3 - employing 50 to 249 workers; AU4 - employing from 250 to 999 employees and AU5 - employing more than 500 workers.

Source: Own work based upon statistical information.

The study Pearson correlation (1) revealed a positive correlation between the frequency of accidents caused by improper, arbitrary behavior of the employee and the size of the enterprise: the correlation coefficient R = 0.4158; the significance of the correlation coefficient p = 2.1449 and the level of significance p = 0.0342 for the assumed $p < 0.05$. This means that the growth rate of the entity structure, increase in the share in the structure of micro and small enterprises, companions increase in the frequency of accidents caused by improper, arbitrary behavior of the employee.

This is also confirmed by detailed scrutiny (2), taking into account the interests of individual groups of companies U1-U5 in the structure. For UA1: R = 0.4112; t = 2.1160

and a significance level of p = 0.0358 for the assumed p <0.05, while for AU3: R = (-) 0.4647; t = (-) 2.4621 and the level of significance p = 0.0221 for the assumed p <0.05. Moreover, from the two-table of descriptive statistics (3), suggest that the average accident frequency rate in the group with more micro and small enterprises amounts to: 19.0588; while in the group with a greater share of large and very large: 15.7868.

5. Summary and conclusions

Safety culture has been identified as a critical element of healthy and safe workplaces. Building and improving the safety culture, as a part of organizational culture [42] is a complex and long-term process, which is influenced by many internal and external factors, relative to the enterprise.

Building a strong safety culture conducive mainly:

- commitment and leadership of top management in the area of occupational health and safety,
- to establish and implement a clear health and safety policy statement and standards and procedures relevant to her,
- belief that safety is a value associated with each objective of the organization,
- stimulating the involvement of employees, strengthening their self-esteem,
- identify workers with the objectives of safety, the conviction of its importance and the need to achieve these goals,
- underline the importance of teamwork,
- education and employees' training,
- develop concern for their own safety and colleagues,
- expressing appreciation for the achievements of groups and individuals,
- communication based on mutual trust,
- rapid response to emerging issues in the area of security.

The short characteristics, to describe a strong safety culture, are the established by the International Atomic Energy Agency [43]. These characteristics are:

- Safety is a clearly recognized value,
- Accountability for safety is clear,
- Safety is integrated into all the activities in the organization,
- Leadership for safety is clear,
- Safety is learning driven.

A strong safety culture is characterized by organizations with a high level of work safety. Injuries and the associated costs decrease over time when an organization views safety as an investment rather than an expense [44].

Safety culture, like organizational culture, is measured by surveying employee attitudes and perceptions of the organization, its management, and their own actions regarding safety. Commitment, development and improvement of workers are not only the key success factors for companies in the market [45], but also play a particularly important role in building a culture of safety.

Improper, arbitrary behavior of the employee is an important manifestation of the poor safety culture. Research carried out in the article, made it possible to identify the manufacturing divisions with the highest and lowest level of the safety culture, analyzed through the prism of the frequency of accidents caused by improper, arbitrary behavior of the employee. At the same time, the study also showed that sense of poor safety culture

occurs more frequently in enterprises with fewer employees. It seems advisable to identify the causes of this condition.

The actions that were taken in the article are significant part in the area of research into the factors shaping the safety culture in manufacturing enterprises, and they can be the basis for building appropriate prevention strategies in the field of health and safety in organizations of this group.

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