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SAFETY CULTURE MODEL AND ITS DIMENSIONS ON THE OF EXAMPLE OF THE COAL MINES IN POLAND

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Abstract:
In the article an original model of safety culture and connected with it research results on the example of enterprises from the coal industry will be presented. Survey included 1170 miners.

Thesis concerning that the key role in forming "high" safety culture is played by managers was verified.

Keywords: organisational culture, safety culture, leadership.

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1. INTRODUCTION

Safety culture is not a completely new concept, and on a larger scale occurred in enterprises in the late 80's. However, today due to the fact that on one hand organizations want to be well perceived on the market and search for methods to reduce costs and improve their quality of functioning, on the other hand external customers of enterprises put more emphasis on monitoring the activities of an organization as a result of which the issues connected with safety culture appear more frequently in many scientific studies and practical studies. More and more companies discern the benefits from "high" safety culture (Zou, 2011, pp.11-12). The approach towards safety culture has significantly changed in organizations. The aim of this article is to present an original model of safety culture and it's verification in empirical studies which were carried out in coal mines in Poland on a sample of 1170 miners. Coal industry was chosen on purpose due to high risk potentially connected with performed work.

2. THE ESSENCE OF SAFETY CULTURE AND SCIENTIFIC APPROACH

There are many definitions of safety culture in the literature. A thorough review of the safety culture concept is presented by Guldenmund in his book (2010a, pp. 11-15). The same author in his article (Guldenmund, 2010, pp. 1466-1478) pays attention to differences and similarities between the terms which are „safety culture" and „safety climate". It is assumed that safety culture derives from research current of the 80s concentrated around organization's culture (E. Schein 1985, Ch. Handy 1976). Whereas to classics form the area of safety culture we can count such authors as Zohar (1980), Pidgedon (1991), or Geler (1994). Safety culture in an enterprise reflects employees attitudes in scope of Health and Safety. An interest in safety culture and it's first definitions were formulated on the base of analysis of accidents, failures such as Chernobyl and Piper Alpha. Reports after these occurrences led to the conclusions, that low level of safety culture was the key element leading to the disaster.

The safety culture concept plays critical role in used by people throughout the world, and explains everything which is connected with safety, defeats and failures in this area. In the subject literature there is no one commonly accepted definition of safety culture. The definition of safety culture was formulated for the first time by International Nuclear Safety Group (INSAG) (the year) to emphasise the far from optimal conditions in the nuclear power plant in Chernobyl, this term has gradually embedded in the standards explaining safety. A conclusion results from the literature overview that safety culture is non-united concept according to research assumptions. Some of the models emphasise the development of observable indicators of safety culture, whilst others concentrate more on identification of basic assumptions of safety culture which are created on the base of group and by this group accepted, and lead to safe and efficient action.

We can distinguish three approaches concerning it's understanding (Guldenmund 2010, pp. 1466 – 1470). The first one is that safety culture is identified with behavioural manifestations connected with safety. It is typical behavioural approach. Deal, Kennedy (1982) determines safety culture as „A way in which we act here". Ostrom, Wilhemsen, Kaplan (1993) present the concept according to which organizational beliefs and attitudes, shown actions, policy and procedures have influence over the level of safety. Geller (1994) evaluates that in total safety culture (Total Safety Culture) everyone feels responsible for safety and shows that in everyday work. This is typical behavioural approach. For Westrum (2004) safety culture is an organizational model of reacting to problems and chances which organization comes across.

The second approach is connected only with the research of foundations, values typical for classical approach of study of organizational culture. Safety culture according to that approach presents Cox, Cox (1991) for whom safety culture illustrates as approaches beliefs perception and values which are shared by employees in relation to safety. For Berends (1996) culture is a collective programming of mind aimed at safety of group of members of an organization. For Guldenmund (2000) these are the aspects of organizational culture which influence over attitudes and behaviours connected with minimizing the risk. Hale (2000) defines it as values, attitudes, ways of perceiving shared by a group influencing on defining by it the norms and values, which determine the way of reacting according to actions and risk reaction and risk control systems. For Richter, Koch (2004) these are commonly learned and shared meanings, experiences, interpretations connected with work and safety – partially expressed symbolically – which orient peoples activities connected with risk, accidents and prevention. INSAG (1991) The International Nuclear Safety Group presents the notion of safety culture

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which is a set of characteristics, attitudes underlying in organization as well as individuals, which decide how important priority is and how big attention is paid to nuclear safety at the power plant INSAG (Guledman 2010, p. 1467).

Third approach is complex i.e. consists of both deeper areas such as values or attitudes but is also connected with evaluation of effectiveness of connected with them activities. An example of a complex attitude in forming the definition of organizational culture is Pidgeon (Pidgeon 1994: Pidgeon, N. & O'Leary, M.,2000, pp13-15) for whom it is a set of beliefs, values, norms, attitudes, roles, social and technical practices which are connected with minimizing the exposure of employees, customers and other members of society to danger and threat. To ACSNI (1993) Advisory Committee on Safety of Nuclear Installations safety culture in organization is a creation composed of individual and group values, attitudes, competences and patterns of behaviours which determine engagement, style and organization's efficiency in the area of health and safety management. Organizations which have a positive safety culture of work are characterised by communication based on mutual trust, perception of the importance of security, belief in the efficiency of used safety measurements (Guledman 2010, p. 1467).

On the other hand, having regard to scientific approaches we can distinguish academic perspective (anthropological), analytical and pragmatic. The first one examines the culture according to ethnographic approach and these are research of quality nature. Its aim is describing and understanding the culture rather than evaluating. In analytical approach safety culture is usually examined by questionnaires of a survey, which are the main instrument of social and organizational psychologists' studies. Two first approaches together include the whole range of scientific research of safety culture. Academic one focuses on cultural "crux" and on understanding of its meaning by watching the past. Whereas analytical one allows to describe the current signs of culture and how different types of behaviours are perceived by existing groups of employees. A description of academic approach provides the context for the answers gathered from analytical approach.

The third approach that is pragmatic focuses on characteristics of organization which influence on high level of safety. It refers to interaction of structure, culture and management processes. Pragmatic studies specify in detail what organization should do in order to reach more developed level of safety culture, i.e. what processes should be realised and supported by accompanying structure.

The effectiveness of forming the desired level of safety culture in enterprise is largely determined by reliable diagnosis on the base of which the changes are introduced and systematically monitored. Referring to previously stated definition of safety culture according to Health and Safety Executive (Horbury, Bottomley, 1997), the safety culture can be considered according to two planes of visible and hidden its signs.

Based on the literature synthesis we can see that the most frequent method of safety culture studies are questionnaires methods and additionally organizational documents analysis (numerical data among others: accidents, costs of damages, absences). Currently, on the advisory market as well as in studies we can find different questionnaire forms for work safety culture. In used models of safety culture some common areas can be seen. Of course, the branch and risk connected with it can contribute to the fact that some factors seem to be more important at safety culture studies than others. The most popular dimensions of safety culture are presented below. The pioneer among them is D. Zohar D. (1980), who printed in his questionnaire eight areas. These are: importance of occupational safety and health trainings, attitudes of management towards safety, promoting good results connected with safety, risk level in workplace, influence of required work on safety, status of employees of occupational safety and health services, influence of actions connected with safety on social status, importance of security committee in an organization).

On the other hand Cooper i Philips (2000) focused on the following elements of safety culture: management attitudes towards safety, perceived level of risk, influence of work pace, activities of management connected with safety, status of employees of occupational safety and health service (particular employees and committee on quality), importance of occupational safety and health trainings, value assigned to safety and its promotion.

Niskanen (1994) promotes a somewhat different set of questions for employees and management. Questions for workers (miners) concerned:

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1. Attitudes towards safety in organization.
2. The value attributed to work (evaluation)
3. Changes in workload.
4. Safety as element of production process.

For supervisory staff four areas were used:
1. Changes in workload.
2. Attitudes towards safety in organization
3. The value attributed to work (evaluation).
4. Safety as element of production process.

Lee (1998) proposed a very complex survey. These are 172 questions which apply mainly to safety studies in nuclear power plants. There are six areas in a survey.
1. Procedures connected with safety: belief (faith) in existing safety procedures.
2. Rules connected with safety: individual understanding of safety rules, perception of clarity in safety rules, work control, conviction of trainings needs so called PTW (Personal Training Weapon), support for PTWs.
3. Risks: personal care connected with risk, perceived level of risk at work, perceived level of risk control in enterprise, personal interest in work.
4. Job satisfaction: job satisfaction, satisfaction with relations at work, satisfaction with rewards for good work.
5. Participation: participation in development of safety procedures, perception areas of change and change suggestions, perception of activities connected with safety, perception of personal control in the scope of safety.
6. Designing: satisfaction with project of enterprise structure, trainings (satisfaction with trainings), selection (satisfaction with selection of employees), emphasis on safety in an organization, communication channels for safety, perceived work safety at the post, feedback concerning safety (communication and activities), specific strategies connected with accidents prevention.

One of the newer is a concept of safety culture according to psychologist G. Kirscheina and E. Werner-Keppera (2011). It is popularised currently in Poland by consultants. We can distinguish seven areas here: vision and aims, organization and regulations, management and participation, accidents analysis, discussion on safety and trainings; safety control.

Summing up presented concepts of safety culture models we can notice that they have common areas such as: the role of occupational safety and work trainings, communication in occupational safety and work, the rank of health and safety services, co-operation with health and safety services, factors which affect safety, attitudes of employees, attitudes of managers, motivation system and control system in health and safety, workload, engagement and satisfaction with work, possibilities of introducing changes leading to safety, management actions in safety improvement.

3. SAFETY CULTURE MODEL AND HYPOTHESIS

In the study presented here by the authors as part of the research project "Shaping the competences of the managerial staff managing the safety culture in the bituminous coal mines" financed by Minister of Science and Higher Education in Poland Grant 4659/B/TO2/2010/39 a complex attitude was adopted – an original questionnaire was prepared concerning the diagnosis of safety culture. The basis of its preparation was a research model in which the following dimensions were proposed:
1. competences of the management,
2. attitudes of the management towards safety (all levels and the Board),
3. occupational safety and health trainings and their efficiency,
4. communication processes connected with improvement of safety management systems,
5. the role of safety management system and its efficiency,
6. practices in occupational safety and health and evaluation of their effectiveness by respondents,
7. job organization and its connections with safety
8. factors which are risks at work and their perception,
9. motivating system and engagement of employees in safety issues,
10. behaviours and co-operation in an emergency

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The main method were questionnaire research, interviews, organization's documents analysis (expenditures on occupational safety and health, data on human resource management (e.g.: accident, incidence of occupational diseases, rotation), organization of trainings processes (e.g.: effectiveness of trainings), a description of operation of quality management system. Analysis of the data used statistical methods among others chi-squared tests by Pearson, likelihood ratio, linear relationship test, Fisher test.

It was also assumed in the model that:
Safety culture is a reflection of organizational culture and hence is a reflection of its key features.
– increase of knowledge and skills and expanding prevention towards work safety improvement influences the higher level of safety;
– an enterprise with a high level of safety culture is characterised by communication based on mutual trust, common perception of the importance of safety and confidence in effectiveness of preventive measures
– the key role in creating the proper safety culture has leadership (management)
Three categories of questionnaires were prepared to carry out the research:
– for management (identical for three levels of supervision),
– for workers (miners),
– for chief engineers for occupational safety and health and proxies for quality management.

Apart from safety culture, organizational culture also underwent the diagnosis according to model and questionnaire by Cameron i Quinn (2006, pp. 36-59). Surveys consisted of two fundamental parts i.e.: the first part concerning safety culture and the part concerning the diagnosis of organizational culture. The first mentioned is an original questionnaire prepared by executors of the project. Additionally in case of management there were some questions concerning self-evaluation of competence and self-evaluation of level of involvement in work. A special emphasis was put on attitude survey, awareness, the degree of involvement, conducts and skills of people taking part in management of occupational and health safety culture. Mining industry was chosen because of the role of safety culture in coal mines (74-78%[1], State Mining Authority year 2011). Research sample consisted of 1170 mines (including management) from three coal mines of one capital group. Taken studies allowed to supplement existing state of studies and used practices in mining.
Theoretical investigations as well as analysis of Polish and especially foreign literature on the subject allowed to formulate three hypotheses:

H 1: Existing formal safety management system is not highly effective because the human factor is the most frequent reason causing accidents in examined enterprises.

Management has key influence on safety culture in enterprise. In particular it concerns competences and attitudes toward the problems with health and safety in a company. This leads to other hypothesis:

H 2: Poor organisational and leadership skills of managers influence the low safety level.

H 3: The lack of involvement of managerial staff in safety management issues has a negative influence on employees' attitudes and contributes to lower safety level.

4. RESEARCH DATA

There is a very strong organizational culture in examined enterprises which is based on long-standing mining traditions. Over 3/4 examined – concerning both managers and workers – feel strongly integrated with their working group. A similar proportion declares willingness to further integration and to continue cultural traditions.

Self-evaluation of competences and evaluation done by workers indicate the same poor competence areas. Managers competences are very good but only in the area of specialist skills, while management skills i.e. connected with organization and leading a team and, as further results show, in practice weaknesses of managers are: motivating, organizing the work and control subordinates' work. It should be noted that large group does not deal very well with the pace of the work and stress.

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[1] In Coal Mining Company about accidents, http://www.ekonomia24.pl/artykul/761525.html, http://www.rp.pl/artykul/761525.html, 28.11.2011

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To most stressful factors in work the managers counted: responsibility for people (68,6%), work in difficult conditions (55,6%), work under pressure (48,5%), technical risks and lack of protection means (42%).

Managers declare that they are generally satisfied with their work (75%), however, these results are poor when we ask about motivation. Only, every other thinks he is appreciated at work which can be translated to lower involvement in work.

Health and safety trainings are evaluated by managers and workers as useful but requiring improvements such as more practices , better quality of trainings.

Processes of communication connected with occupational safety and health are on an average level, less than half of workers thinks that superiors listen to suggestions concerning improvement of working conditions but about 1/3 think that there are no talks on this matter or are very rare "in case an accident happens". So called general communication is better, 75% of workers think that often and with no worries can turn to their superiors with any problem.

Safety management system on a sufficient level to ensure the average safety level. However, there is lack of active participation of employees responsible for this system i.e. health and safety services and proxy for quality management, to improve this system. There is a poor co-operation between those workers and managers. The effectiveness of measures to improve health and safety is seen only by 29% of workers.

In the scope of practice and procedures it must me stated that they not fulfil their role well which means they are not very effective. According to half of managers regulations of work safety are appropriate, the other half has less positive opinion on this subject claiming that they are not adapted to the conditions of work, wherein these opinions are differential. What is striking, managers admit that they happen to observe dangerous behaviours of employees of a cola mine. Workers, on the other hand, claim that they are witnesses to such behaviours (50,5% - I see such a behaviour occasionally, once a month, 18,5% - I often see such a behaviour, once a week, 6,4% - it is very often behaviour in my workplace, more than once a week). According to managers the most frequent reasons for undertaking risky behaviour by their subordinates is an attitude towards safety, staff shortages, improper way of adaptation of new employees. This amazes up to 67,4% of managers and 32,1% of workers – think that a conduct against applicable regulations can pay because of benefits connected with it e.g.: better production.
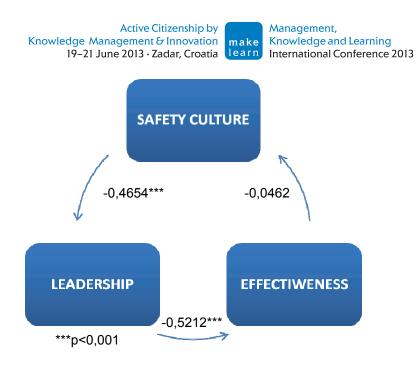
Improper organisation of work in examined enterprises is an essential factor threatening the safety of employees (say 61,9% of workers). Also managers complain very much about high pace of work and at the same time have low skills of organisation of work and leading the team. It is confirmed very clearly by results of organizational culture. The highest values were gained by: culture of market (32%) and culture of hierarchy (30,64%). This means that great importance is attached to the position of enterprise on the market i.e. production results (culture of market) and then keeping the order through procedures and control (culture of hierarchy). Managers very clearly feel the pressure from above for better results and they manage with this task – partially ignoring the rules.

Factors which constitute threats at work and their perception are different for particular groups of respondents – i.e. managers and workers have different task than people responsible formally for occupational safety and health system (health and safety engineers, proxies for quality management) Incentive system and involvement of employees in safety issues are a weak area in which there is a lot to do and it translates into behaviours in situations.

A further stage of studies was drawing up a model using path analysis (Structural Equation Modelling; SEM), and methods of statistical analysis (Tabachnick, Fidell 2007, pp. 676-680) (A. Rakowska, M. Cichorzewska, 2011). A multiple linear regression paths with one or more independent variables interacting with one dependent variable was used here. Three paths were analysed in the model:
1. Leadership   → Effectiveness in the safety management
2. Leadership   → Safety Culture
3. Safety Culture   → Effectiveness in the safety management (safety level and costs)

Picture 1: Safety Culture Model

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Source: Rakowska, A., Cichorzewska, M.2012, p 183-200.

Leadership involved: managerial skills and knowledge, knowledge and skills in the safety management, leadership and team building skills, communication with subordinates, attitudes toward safety problems and risky behaviours, attitudes towards goals and pressure on results.
Main futures of safety culture were determined on the basis of results of organisational culture by Quinn, Cameron (2006) but it the area of safety (especially the value of: procedures, risks, results, freedom of new ideas).

Safety effectives: general level of perceived safety, number of accidents, and fatal crashes, safety training costs and effectiveness.

Within this model it was stated that there is a indirect influence of Leadership through Culture over Effectiveness. Presented figure concerns the results derived from managers. Analysis has shown that Leadership influences Safety Culture and Effectiveness in the safety management area (A. Rakowska, M. Cichorzewska, 2011). Whereas, the path of Culture influencing the Effectiveness found out to be unimportant. The impact of Leadership on Effectiveness is somewhat higher than impact of Leadership on Culture.

5.   SUMMARY

Existing safety culture is far from safety culture models described as „high", or „total" culture. In safety management the role of formal management systems and procedures is dominant. This type is close to "calculation" culture according to P. Hudson (2001), in which the main role plays the formal system of management which allows to achieve the goal of compliance with provisions and to avoid punishment . In order for that culture to gain the next level i.e. become a "pro-active" culture in which certain level of involvement and staff initiative are required, significant changes in work organizational system as well as human resources management system are necessary. In this culture only managers are interested in safety but first of all because of the fact that certain regulations must be fulfilled. Whereas the employees themselves do not engage in this system. It is proved by results in organizational culture i.e. culture in which the most important are results and later procedures and regulations. The model enabled to verify thesis on the role of staff in creating proper safety culture of management. In this case, unfortunately, not always demonstrating willingness to change the culture and accepting some negative behaviours. The most surprising conclusions are those from which it appears that acting against the safety rules according to considerable group of respondents (over 30% of workers notice benefits), simply pays. And if management neglect partially this area – as miners think - it is difficult to expect positive behaviours from the miners. Results have also proved very strong organizational culture in examined coal mines, which is after all, is the basis for safety culture, which means that change of attitudes will not be easy.

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