Analysing and Assessing the State of Safety Culture at the Mining Industry Facilities in the Irkutsk Region

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Abstract. Safety at work is an important factor in the successful operation of an enterprise. In practice, it is quite difficult to achieve safety at work, but there exist all necessary conditions for this. The article considers the role of the systematic management of an enterprise, which helps to ensure safety at all stages of the production life cycle. In the paper, we discuss the system of organizational culture that supports the management system, the concept of safety culture and how it can be implemented. Also in this study, we discuss the history of systematic safety management drawing on the experience of mining enterprises in the Irkutsk Region. The article contains practical research and calculated data on the evaluation of safety culture at such enterprises as Angasolsky Crushed Stone Plant, Pereval Quarry, and the stone-cutting production of Baikalquartzsamotsvety OJSC. The article concludes with a discussion of how to achieve high safety culture at these enterprises taking into account the regulatory environment that can encourage the development of the systematic safety culture management without this being a burden for organizations.

1. Introduction
The world is changing. In the new context, particularly in the workplace, there often occur complex safety-related challenges. As managers grow in awareness of the importance of good safety practices to support initiatives, professionals in the field of labor protection (LP) and industrial safety (IS) are continuously developing more and more advanced tools and solutions. Nevertheless, it remains clear that there is a gap of misunderstanding between these two groups. This is often expressed in the areas of compliance, management and reporting, but in reality it relates to engagement, communication, and understanding.

This section considers the basic concepts of “safety culture”, what it is for and what it can lead to, and also assesses safety culture of personnel at the mining quarries in the Irkutsk Region, namely Angasolsky Crushed Stone Plant, Pereval Quarry, and Baikalquartzsamotsvety OJSC. The aim of this research is to determine the optimal method for studying safety culture at the above listed enterprises.

The term “safety culture” first appeared in the IAEA Summary Report on the Post-accident Review Meeting on the Chernobyl Accident. As defined by the IAEA, “the root cause (of the accident) is the main cause of the initial event, the elimination of which prevents its recurrence.” From the content of the Summary Report on the Post-accident Review Meeting on the Chernobyl Accident it followed that the true causes of the accident at the nuclear power plant were not of man-made, but rather of professional and psychological nature:
- insufficient training of operating personnel (lack of knowledge about the operation features...
typical for reactors of this type);
- negligence and recklessness (toleration of deviations from the technical safety regulations), etc. [1].

These factors, according to the authors of the report, revealed the level of safety culture at which the operating personnel violated a number of procedures for the operation of the reactor and turned off the unit protection systems.

Safety culture is a life philosophy expressed in an attitude to safety as an enduring value shared by each employee of the organization at each level. In other words, safety culture is the qualification and psychological competence of employees (personnel), where safety is a priority goal and an internal need leading to an awareness of personal responsibility and self-control in the process of performing all work affecting safety [2].

2. Materials and methods of research

High “safety culture”, and, accordingly, the conditions in order to achieve it, imply introduction of such tools as the labor protection management system (LPMS) and the assessment and prevention of occupational risks. Employees should automatically, out of habit, fulfill safety requirements in their work activities.

Accordingly, in order to achieve such results, it is necessary to systematically approach the issue of introducing “safety culture” and to fulfill all safety requirements and, in general, requirements for the organization of work, without exception and not just formally.

If we are talking about the development and implementation of LPMS, a formal approach and ineffective regulations and documents should be excluded. Excellent documentation on LPMS, but poor control over its implementation will result in nothing good. Having operating regulations available, but not fulfilling them, again, makes zero sense. The same applies to equipment and organization of labor - all aspects of work need to be controlled [3-4].

Based on this, it is necessary to understand that “safety culture” cannot be detached from “technological culture” and in general from “corporate culture”. The systemic approach also includes the selection, training, adaptation, development of competencies, as well as the development of internal motivation of employees to meet safety requirements. In its turn, a safe workplace implies technologies, collective protection equipment, organization of safe work, preventive medical measures (examinations, vaccinations, screenings), encouraging employees to work safely, and only a full set of protection against risks will allow creating safety culture at an enterprise.

So, “safety culture” is the highest level of labor protection, when the whole organization is permeated with the idea of safety, ranging from owners and top management to blue-collar and white-collar workers. All 100% of employees are committed to this idea and are involved in fulfilling the requirements at the level of habitual behavior and automatism. International research proves that in the long run, “safety culture” leads to increased productivity, profitability, efficiency, quality, corporate image and innovation potential [5].

Before introducing the tools for developing safety culture at an enterprise, it is necessary to understand and estimate at what level safety culture of the personnel is at the present moment. For this purpose, we assessed safety culture of the personnel at the selected facilities (Angasolsky Crushed Stone Plant, Pereval Quarry, and Baikalquartzsamotsvety OJSC). The main criteria for this study are:
- finding out your own level of cultural maturity and the level of cultural maturity of the enterprise in terms of safety;
- determination of your personal role in the formation of a stronger safety culture at the enterprise;
- planning of personal actions and committing to your obligations [6-7].

The most popular models of safety culture maturity recognized internationally are the Bradley curve, Fleming's safety culture maturity model and Hudson’s model. Each of the steps of the presented model demonstrates the next stage in the evolution of the internal corporate management system aimed at improving the effectiveness of efforts to protect the life and health of employees, as well as the assets of an enterprise. Such models use the experience of many world leading companies and help
other organizations understand the relationship between management systems, employees and equipment, allowing them to go through the described path and significantly improve the level of labor protection and industrial safety.

In the study of safety culture at the enterprises under consideration, we used the safety culture maturity model by Patrick Hudson, the program “Hearts and Minds” [8] (Figure 1).

![Safety culture maturity model by Patrick Hudson](image)

Figure 1. Safety culture maturity model by Patrick Hudson.

Each level in this model has its own distinctive features (Table 1).

| Model levels | Characteristic |
|--------------|----------------|
| **Pathological** (nascent) | LP and IS are a procedural decision; not a business risk. The LP and IS department is primarily responsible for ensuring safety. Accidents are considered an inevitable part of the job. |
| **Level 2** Reactive (reactive, passive) | The accident rate of the organization corresponds to the industry average. Safety is a business risk, but is viewed in terms of rules and regulations. Management makes efforts to prevent accidents and is convinced that the cause of the majority of accidents is the unsafe behavior of line personnel. Managers of the organization are involved in the work on LP and IS reacting to incidents and fines. |
| **Level 3** Calculating (system) | The accident rate is low, but significant progress is not observed. Management is convinced that the involvement of line personnel in LP is crucial for future improvements, but not for ongoing operations. Most of the personnel assume responsibility for their own safety and are willing to work with management on the improvement of LP and IS. Management recognizes that many of the root causes of accidents... |
| Model levels | Characteristic |
|--------------|---------------|
| **Level 4**  |               |
| *Proactive*  | The majority of the personnel is convinced of the importance of LP and IS. All employees are aware that accidents are caused by many factors, and their root causes often stem from wrong management decisions. Line personnel take responsibility for their own safety and the safety of others. Considerable efforts are made to prevent accidents by means of preventive measures. LP and IS indicators are continuously monitored using all available data. Preventing damage to the health of employees is a core corporate value. Accidents have not occurred for a long time, but employees are aware that they can happen at any time. The organization is constantly striving for improvements and is looking for optimal ways to improve the mechanisms for controlling hazards. Efforts are made to ensure safety of workers outside the workplace. |
| *Level 5*    |               |
| *Generative* |               |
| (productive, continuously improving) | |

The study using this model is carried out by handing out questionnaires to employees and comments to the questionnaire (Figure 2, 3).

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**Table: Organization features (comments to the questionnaire)**

| Management interest in discussing labor protection and industrial safety issues with employees? |
|------------------------------------------------------------------------------------------|
| **Pathological**                                                                          |
| Discussion of labor protection and industrial safety issues is not held. Management and employees often stem from its decisions. Mechanical systems are used to control hazards. |
| **Reactive**                                                                              |
| After an accident, top management passes down messages on labor protection and industrial safety temporarily disrupting management at the moment. As soon as everything fails to work, interest in labor protection and industrial safety is maintained at some level. |
| **Proactive**                                                                             |
| Management gives employees a list of information and often understands initiatives in the field of labor protection and industrial safety. Management talks a lot, but listens very little. |
| **Generative**                                                                            |
| A two-way communication process is established in the field of labor protection and industrial safety. There are not only messages passed, but also questions asked. |

| Employees' commitment to safety goals and level of care for colleagues?                     |
| **Pathological**                                                                          |
| "Who cares as long as we are not caught." (Everyone matters only himself)                  |
| **Reactive**                                                                              |
| No rewards are provided and expected for success in the field of labor protection and industrial safety. |
| **Proactive**                                                                             |
| All employees are aware that accidents are caused by many factors, and their root causes often stem from wrong management decisions. |
| **Generative**                                                                            |
| **Level 4**  |               |
| *Proactive* (interacting) | |
| The majority of the personnel is convinced of the importance of LP and IS. All employees are aware that accidents are caused by many factors, and their root causes often stem from wrong management decisions. Line personnel take responsibility for their own safety and the safety of others. Considerable efforts are made to prevent accidents by means of preventive measures. LP and IS indicators are continuously monitored using all available data. Preventing damage to the health of employees is a core corporate value. Accidents have not occurred for a long time, but employees are aware that they can happen at any time. The organization is constantly striving for improvements and is looking for optimal ways to improve the mechanisms for controlling hazards. Efforts are made to ensure safety of workers outside the workplace. |

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**Figure 2.** Organization features (comments to the questionnaire).
3. Discussion and results

In other words, when we interpret the table presented in Figure 2, we will see that pathological organizations simply do not care about safety at the enterprise, reactive organizations believe that there is nothing better than their currently accepted system of labor protection and industrial safety management. They do what they feel right, as good as possible. Calculative (bureaucratic) organizations have difficulties in introducing innovations in the field of safety, because they are comfortable, even if they know that improvement is possible. Initiative or proactive cultures are more advanced [10-11]. It is probably easier to reach such a level for small organizations. Large companies in this case will inevitably be highly bureaucratic, unless active steps are taken to counter this trend.

![Measurement description table]

**Figure 3.** Sample questionnaire for conducting a survey and determining the level of safety culture of an employee.

Each employee, after reading the comments to the questionnaire, will be able to determine the level of safety culture in the organization and understand at what level, in his opinion, it currently is.

Employees of each enterprise under consideration took part in the testing. The number of personnel at Angasolsky Crushed Stone Plant, Pereval Quarry, and the stone-cutting enterprise Baikalquartszamotsvety OJSC varies from 80 to 120 people. The study involved personnel at all levels of management and work execution, from management representatives to blue-collar staff.
Each of the employees was given the questionnaire and comments to the questionnaire. The results were given a score (average safety culture score). Further, these data were interpreted and recorded in a pivot table. The final safety level scores for each of the enterprises are shown in Figure 4.

![Figure 4. Final safety level scores.](image)

Obviously, the presented model demonstrates the transformation from the formal management of the LP and IS system to the implementation of the management system in the practical activity of the business entity, based on the continuous development of the labor protection and industrial safety system throughout the operation system [12-13]. The organizations studied are at the “calculative” level of safety culture. This means that the majority of the interviewed employees have an opinion that the issues of labor protection and industrial safety at the enterprise are solved formally, in fact and in most cases, they are not investigated in more detail.

4. Conclusion
The argument for the development of safety culture in this case is that the next step is the development of a safety culture that revives the system. A high level of safety culture pays off not only in the reduction of accidents, but also increases the level of trust between management decisions and personnel. Using this tool, it is possible to identify failures in the system, which later have a clear orientation on improving communication and productivity at all levels.

Another way in which safety culture pays off is the reduction of time and documents devoted to verifying the implementation of basic safety measures. Another main reason why safety culture brings positive results is ensuring safety. When safety is ensured, you can allocate resources and take risks more efficiently. In general, management of the organization must realize that safety brings benefits and that costs incurred should be considered as investments with a positive yield. Thus, the way to a complete safety culture must be open.

High safety culture can be formed only with a person-oriented attitude, and this is hampered by an excessive focus on the system, i.e. regulations, rules, instructions and inspections. The situation at the workplace will change for the better only if people want to work safely and understand why this is important for them. Then safety leaders will appear at all levels of the organization.

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