Analysis of the Concept of Human Factor Management in Labor Protection Management Systems (on the Example of Construction Organizations)

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Abstract. The article analyzes the concept of “human factor”, considers the characteristics of the human factor and the mechanisms for implementing the chain of undesirable events generated by the influence of the human factor on the production and technological process, presents the mechanism for implementing the negative impact of the human factor in decision-making in the field of labor protection, also the development of a chain of negative phenomena. It is shown that the effective functioning of OSH management systems in construction organizations can be ensured by an effective risk management system, the main link of which, in turn, is the education system for workers, which considers the continuous training of a person on safety and labor protection at all stages of his professional growth, education and training.

1. Introduction

Increased attention to a person at work, the increasing role of the subjective factor in industry is a global trend. In industrialized countries, serious attention is paid to the human factor in production, and the most important area here is the issue of labor protection and industrial safety [1].

In Russia, safe labor is becoming an essential social value. In Western countries, labor protection even in conditions of stable development comes to the fore and is rated higher than ecology and human rights, and in modern Russia the problem of labor safety is actualized by the crisis development of the country in the 90s of the XX century [1].

The economic basis of the aggravation of the problem of safe labor is not always the responsible attitude of employers and/or senior officials of construction organizations, savings on social programs, reduction, and sometimes simply elimination of labor protection services [1].

As the studies of various groups of authors and research centers have shown, labor protection and industrial safety are underestimated by both employers and employees of enterprises, and also by executive authorities. Due to the underdevelopment of personnel management, Career guidance and professional selection of personnel are poorly set; at most enterprises there are no sociological and psychological services.

In technology, the characteristics of a person (or a group of people) and a machine (or technical systems) are manifested in the specific conditions of their interaction in the “human - machine”...
system, the functioning of which is determined by the achievement of the set goal. The human factor is related primarily to that aspect of this interaction, which is determined by human activity. The correct combination of human abilities and machine capabilities significantly increases the efficiency of the “human - machine” systems and determines the rational use by a person of technical means in accordance with their purpose. The consideration of the human factor is an integral part of the design, creation and operation of machines and technical systems, a prerequisite for improving labor productivity and product quality.

The most complete account of this is carried out in the design of human systems "man - machine". Designing a specific type of activity involves the study of the internal means of human activity (his experience, knowledge, skills, perception, thinking, memory, etc.) and their coordination with external means (documents, algorithms, tools, manual controls, etc.) in accordance with the main purpose of the functioning of the created system.

On the basis of the developed project, requirements are formed for the technical means of the system that are used by a person to carry out this type of activity.

The conceptual content of the terms that make up the concept of “human factor” is presented in table 1.

Table 1. The relationship of words in the concept of the human factor.

| Word                        | Content                                                                 |
|-----------------------------|-------------------------------------------------------------------------|
| **Words are components of a concept** |                                                                         |
| Person                      | A living creature, unlike an animal, possesses the gift of speech, thought, the ability to produce tools and use them. It has certain qualities, personality |
| Factor                      | The driving force, the cause of any process, the phenomena that determine its nature |
| **Basic concept**           |                                                                         |
| Human factors               | Psychological, physiological (in particular, informational), anthropometric, and other characteristics of a person, his capabilities and limitations, defined in specific conditions, the driving forces of his interaction (control) with the object |
| **Related concepts**        |                                                                         |
| Personal factor             | Includes individual characteristics of a person regardless of the characteristics of the technical means with which he interacts |
| **Associative concepts**    |                                                                         |
| Human factors               | The system of social, economic, industrial, scientific, technical, organizational and managerial and other relations; everything that relates to a person as a subject of activity in different areas of public life |
| Human capital               | Production force                                                        |
| Human potential             | The ability of a person to act at a level higher than the current one |

2. **Analysis of the concept of the human factor**

Distinguish between the concepts of "human factor" and "personal factor" [1]. Unlike the human factor, the concept of “personal factor” (introduced in connection with the study of human errors that entail accidents in production and transport) includes the individual characteristics of a person regardless of the characteristics of the technical means with which he interacts. The human factor is a
relatively new concept that has arisen in connection with the study and design of human-machine systems as a functional whole.

One of the first attempts to disclose the content of the concept of “human factor” was made in 1930 by the Soviet scientist N. M. Dobrotvorsky, although the term itself was formulated later in 1964 by the American psychologist E.J. McCormick as a result of the translation and reduction of the expression “human factors engineering” used by the USA for designations of both the branch of knowledge and the process of designing systems "man - machine" in order to ensure the efficiency, reliability and safety of human activities (groups of people).

Also, the corresponding theories compared it with the carrier of effective interaction with engineering systems, but this turned out to be insufficient to identify an adequate role for man in modern industries;

In a knowledge society, the human factor is correlated mainly with production technologies. In 1957, the Society of Human Factors was formed in the USA; in 1958, the publication of the journal "Human Factors" began. In European countries, including the USSR, the term ergonomics is adopted to designate a special field of knowledge and a sphere of professional activity similar to that in the United States called the human factor.

In a broad sense, the human factor is a concept used in socio-economic disciplines to characterize the impact on the production management processes of the business and personal qualities of workers, their value orientations, moral principles, standards of behavior in the field of labor, leisure, consumption, their life plans, level of knowledge and the awareness, nature of labor and social skills, attitudes and ideas of personally important elements of life (social justice, human rights and freedoms, about his civic, professional duty, etc.).

In the narrow sense, it is a concept that denotes the integral characteristics of a person’s connection with a technical device, manifested in the specific conditions of their interaction during the functioning of the erratic system.

In determining and highlighting the human factor, fundamental knowledge of special sciences about each of the components of the system is used. However, the characteristics and properties recorded in the concept of the human factor are not isolated signs of the components of an erratic system, but its combined systemic qualities. To the greatest extent, they are determined by the position and functions in the human system.

From the point of view of philosophy, the human factor is a specific designation of a person’s functioning in a system of social, economic, industrial, scientific, technical, organizational and managerial and other relations; everything that relates to a person as a subject of activity in different spheres of public life. Successful solution of the problems of the country's socio-economic development, a qualitative renewal of society is associated with an increase in the role of the human factor as an inexhaustible reserve for such development, a decisive factor in all changes. This means that a person’s spiritual growth, enrichment with new knowledge, a high level of professional skills become not only conditions for the harmonious development of the individual, but also necessary prerequisites for everyone to actively participate in improving all aspects of social life.

The human factor can also be interpreted as a further development of the concept of “human behavior” [3]. A person, as an element of management, can participate in any of the main stages of the formation of management (perception, recognition, prediction, decision-making and execution). Therefore, at each stage, the human factor can manifest itself, and it must be analyzed with respect to the function that a person must perform (or his place in the hierarchy of management of large systems, since it must determine the function entrusted to a person), and the goal that must be achieved.

The main area where the human factor is most pronounced is the manufacturing process. A positive manifestation of the human factor, from the point of view of achieving the goal (reducing the level of injuries in construction organizations), can be achieved by activating the human factor, and a systematic approach is required to implement this process.

To any extent, any production has the following reserve in activating the human factor [1, 3]:

- increasing professional knowledge;
- mastery of professional skill;
- transition to a new form of labor organization;
- reducing the cost of a person’s internal resource for public, personal and other non-productive affairs;
- saving of working time: discipline and self-discipline;
- strengthening physical and mental health;
- improvement of safety and comfort of working conditions;
- development of inventive and rationalization activities;
- improvement of the incentive system that promotes a compromise of a person in the direction of the goals of the system, the full achievement of the goals of the technological process of saving system resources, the transition to a new technology, the introduction of new technology;
- increasing the social comfort of life;
- Improving the psychological climate in labor collectives.

Thus, the use of the human factor in the interests of production requires a systematic approach, serious organizational work, widespread use of simulation models and computers.

The safety of a worker in a construction organization is one of the most pressing problems that directly depends on the impact of the human factor.

3. The mechanism for implementing the negative impact of the human factor in labor protection

Figure 1 shows a scheme of the negative impact of the human factor on the risks of a construction organization and, in fact, on solving the problem of deciding on the safe execution of work.

![Figure 1. Scheme of the negative impact of the human factor on the risks in a construction organization.](image-url)

The environment of interaction "human-machine" is influenced by many factors that determine the professional, industrial and socio-economic risks of the construction organization. Depending on the levels of risks and the factors that determine these levels of factors and conditions, the environment
may be in one of the states (normal or not normal). An abnormal condition is characterized by hazardous conditions or an accident.

The patterns of development of an accident or accident is characterized by the fact that the probability of an undesirable event exists constantly and manifests itself as a result of an uncontrolled release of energy accumulated in materials, assemblies, devices, technical systems as a whole, as well as directly in a person [2].

The mechanism of the negative impact of the human factor on the safety of construction activities is presented in Figure 2.

**Figure 2.** The mechanism for implementing the negative impact of the human factor in construction.

The mechanism of the negative impact of the human factor on the safety of construction activities is triggered by the sequential or simultaneous implementation of undesirable events leading to the occurrence of an accident:

- deficiencies in the system of identification, assessment and risk management;
- the negative impact of the factors of the work process (construction and security of the process, etc.);
- lack of control or lack of control;
- Inappropriate (dangerous) conditions for the performance of work and (or) dangerous actions of employees.

The implementation of the mechanism is based on the following systemic reasons:

- low level of production and technological discipline of the personnel of construction organizations;
- low level of knowledge of the requirements of normative and technical documentation in the field of safety and labor protection;
- low level of training of personnel of construction organizations.

The first and fundamental factor in the chain of events leading to the realization of the negative impact of the human factor is unidentified and not assessed risks. Hazard identification, assessment and risk management - a method that allows you to assess whether the actions performed (work, production operations) can lead to an accident. It allows you to highlight the chain of events (or their links) that have sufficient potential to trigger the occurrence of unwanted events and lead to the occurrence of an incident. Having identified the risks, the construction organization can develop management decisions and risk control measures to eliminate or reduce the likelihood of a chain of undesirable events.

The second link in the chain of implementation of the mechanism of the negative impact of the human factor is the lack of control, which is expressed in the absence of a standardized approach to managing safety and labor protection, inadequacy with existing applicable requirements (standards, legislation, management system of a construction organization) or the lack of a safety and labor management system in a construction organization. All of the above plays the role of a “trigger” in the mechanism of realization of the negative impact of the human factor.

Lack of control or inadequate control creates opportunities for the implementation of personal and working factors.

Personal factors relate to the physical abilities of a person; his physical and mental state, psychological stress (experienced or experienced), behavior and skill level.

Working factors characterize deficiencies in the field of training and transfer of knowledge, distribution and consolidation of responsibility, management of contracting organizations, procurement and supply, untimely and / or inadequate maintenance, deficiencies in technology and work planning.

Performance of work in unsafe conditions or the commission of dangerous actions are the result of the implementation of personal and working factors.

Hazardous conditions are the actual conditions of work that do not meet the minimum applicable requirements (they are below these requirements). The result of this is the performance of work in an unsafe manner in unsafe conditions. Dangerous conditions include:

- not fenced machinery and equipment;
- unsafe ways of moving personnel (for example, chipped, or slippery);
- poor-quality cleaning of work places;
- insufficient lighting;
- insufficient ventilation of rooms.

Dangerous actions - refers to the behavior of people, which puts themselves and, possibly, others at risk. This means that people do not behave in accordance with the accepted practice of safe work, which creates a dangerous situation and can lead to losses in any form.

Hazardous conditions include:

- implementation of work of increased danger without issuing a work permit for their implementation;
- not informing colleagues about problems with equipment, tools, etc.;
- the use of unsafe methods of organizing and conducting work;
- independent shutdown of technical safety systems (for example, interlocks on electrical networks);
- games and entertainment in the places of work (during their implementation).

The result of the implementation of the mechanism of the negative impact of the human factor is an undesirable event - an incident of varying severity (from an incident without consequences to fatal and group accidents) caused by several reasons. Usually a combination of hazardous activities and hazardous conditions. Very rarely, a single cause is at the heart of an incident.

The amount of damage from the implementation of the mechanism of the negative impact of the human factor is different and is determined by the influence of the following factors:
- a factor determining the type of incident: an incident without consequences or an incident with consequences (accident, accident, incident);
- a factor determining the type of incident: suspension or stoppage of work, material damage, injury or illness of employees;
- a factor determining the severity of an injury or illness.

Each of these factors acts at a certain stage of the mechanism for implementing the negative impact of the human factor, determining the magnitude of material losses and the severity of the consequences.

4. Conclusion
The article analyzes the concept of the “human factor” in labor protection systems, analyzes the words that make up this concept and related concepts (for example, the personal factor). It is shown that the concept of the human factor is characterized by excessive versatility and complexity. Theoretically, in this concept all phenomena and organizations of traffic safety and life activity, one way or another connected with a person, can be included.

It is noted that the practical application of the concept of the human factor is reduced, as a rule, to the search for its simplest, most obvious and coarsest manifestations. At the same time, the human factor is a multifaceted and complex phenomenon, rarely amenable to sufficiently in-depth analysis and quantification.

The main points that determine the level of reliability and the role of the human factor in the "human - machine - production environment" system: physiological and psychological state of a person, engineering psychological and vocational training, ergonomics of the place of work, personal and business qualities of the employee, health status of the employee, monitoring the functional state during work, medical and psychological support.

Separately, the characteristics of the human factor are examined and determined, it is shown that the human factor can be considered as a set of personal and professional qualities of a person that significantly affect his interaction with people and equipment in the production process under constantly changing technical and technological conditions.

5. References
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