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# ESTIMATION OF EFFICIENCY AND RELIABILITY IN THE SYSTEMS OF MANAGEMENT FOR INDUSTRIAL SAFETY AND HEALTH

***Abstract.***
*The article substantiates the conditions of formation the requirements of efficiency and reliability the management of staff in the complex dynamic systems. The study system of industrial health and safety (SISH) in complex dynamic structures of Ukraine includes in itself the two interrelated subsystems - technical and human-machine.*

Employees who work in healthy conditions is essential for the company, which operates continuously and efficiently. The economic objectives of the enterprise should not be in conflict with the problems of working conditions, on the contrary, they are complementary. Unfortunately, a recent study of working conditions in the European Union showed that workers' health is not recognized as a factor in productivity. Of course, now there are "classic" threats to health - heavy jobs, work under the influence of weather conditions, etc., but also encountered new problems - the intensification of work, lack of time, increase accountability and improve concentration, and on the other hand, monotony and social isolation. This pressure causes difficulties with health, stress and the syndrome of "burning" which reduces motivation and encourages indifference.

Improving working conditions, including safety and health at work, play a critical role in increasing productivity. European Association of National Centres of performance with its members seek, through information meetings and consultations, to prove the economic importance of both the macro- and micro - conditions for as many government agencies and enterprises. This is necessary not only to employees, but plays a role in an open competition between enterprises and economies.

In Western countries, since the 90s of the last century, dramatically changing approaches to safety. On the one hand organizational factors in security policy are becoming more and more important. On the other hand represent organizations with regard to security has changed dramatically. There tendencies, when evaluating the security emphasis is not on the design features of the hardware, which in itself is very important, and such less tangible and measurable factors such as organizational culture, change in behavior, increased responsibility or commitment of certain goals and objectives. Eventually this led to the development of the West national quality standards that have emerged in a series of international quality standards ISO 9000-1994 and recently - ISO 9000-2000. Due to the fact that in the fight for the reduction of losses and quality included all structural units of the companies, as a result of the quality management system elements have been used in the creation of environmental management (ISO 14000-1996) and further such a system is created and safety management and health. In this regard, the British Standards Institute has developed in collaboration with leading certification bodies in different countries specifications OHSAS 18001: 1999, according to the requirements which it became possible to assess and certification of safety management systems of any organization.Currently OHSAS is one of the regulations on management of industrial safety and health protection for companies around the world. Its advantage is that OHSAS designed to be compatible with ISO 14001 and ISO 9001 [1,2].

The study system of industrial safety and health (SISH) in complex dynamic structures of Ukraine incorporates two interrelated subsystems: the technical synthesized based on a two-tier information-measuring systems and human-machine that performs gathering information about factors forming conditions in the workplace; analysis of data on the level of security; and making decisions on changing conditions in work areas.In addition, the introduction of SISH encourages managers and all units to intensify actions to meet the requirements of hygiene and safety.

The effectiveness of management depends on many factors, their combined allowable or worst characteristic of the type of production, works or professions [3,4]. As for the upper level system should be made that the operation of the SISH reduced to four stages of implementation:

- Information on working conditions;
- Evaluation of information and selection of characteristic features;
- Formation of the control action;
- Making decisions and issuing commands for their implementation.

The criterion of the efficiency of a top-level objective is evaluated and output of information received on the basis of its decisions. The information coming in the system and made a decision must satisfy the requirements:

- Reflect working conditions in controlled facilities;
- To be timely and accurate;
- Form presentation will compare operational data with normative values underlying factors;
- Action taken only on the basis of existing guidance documents;
- The time between taking the initial data and decision-making should be minimal (rate and processing).

The first stage is carried out assessment of information that characterizes the employment rate in the working area. This information is taken from the output device information display systems (detectors, indicators, video terminals). The estimation of aggregate values for each of the defined parameters $(i = 1,2,\dots,n)$ by checking the feasibility of dependencies (1):

$$A\left(t_{нр}\right) = A_1\left(t_{нр}\right) \wedge A_2\left(t_{нр}\right) \wedge \dots \wedge A_n\left(t_{нр}\right);$$
$$A_i\left(t_{нр}\right) = \begin{cases} 1, W_i \le W_{i,доп} \\ 0, W_i > W_{i,доп} \end{cases}; \quad (1)$$

where, $A$ - technical device status information display systems; $W_i$ - human condition - operator at the time moment; $W_{i,доп}$ – acceptable human condition - operator.

The system is recognized as fulfilling its function at time checking if $t_{нр}$, $A_i\left(t_{нр}\right) = 1$ and fails - if $A_i\left(t_{нр}\right) = 0$.

The second stage is implemented with the appearance of the values of informational factors that go beyond the tolerances established regulatory framework, when $A_i(t_{np}) = 0$. In this situation, a link of analysis, additional analyzes a data that coming from the lower level, with the possibility of establishing the causes of an abnormal situation on controlled objects (or place bursts of hazardous and harmful factors of the production process or the environment that go beyond tolerance), or exercises check to determine the most probable causes of problems and places SISH. This stage is implemented optimally in the presence of part of the system of automated controls and diagnostic equipment. Depending on the importance of the cause and depth control is tested path of signals, and other functional blocks.

The task of the second stage is performed in sequence: the stage of the flow of information by its collection, presented analytically dependence (2):

$$Q_{q_1,\dots,q_{n-1}}{}^{(n)} = \frac{1}{t_n}\sum_{q_n} P_{q_1,\dots,q_{n-1}(q_n)}\left[\sum_{l}\{P_{q_1,\dots,q_n(l)}\}\log_2\{P_{q_1,\dots,q_n(l)}\} - \sum_{l}\{P_{q_1,\dots,q_{n-1}(l)}\}\log_2\{P_{q_1,\dots,q_{n-1}(l)}\}\right] \qquad (2)$$

information is collected and placed according to the expression (3):

$$\{P_{q_1,\dots,q_n(l)}\} = \frac{\{P_{q_1,\dots,q_{n-1}(l)}\}P_{l,q_1,\dots,q_{n-1}(q_n)}}{\sum_l\{P_{q_1,\dots,q_{n-1}(l)}\}P_{l,q_1,\dots,q_{n-1}(q_n)}} \qquad (3)$$

based on the information presented formed a conclusion about a place or causes problems (4):

$$\{P_{q_1,\dots,q_n}{}^{(l=l^*)}\} \geq 1 - \Delta; \qquad (4)$$

where, $l$ - symbol of space and cause of problems;

$n - n$-*th* channel - carrier of diagnostic information, such as an electrical signal;

$q_n$- index n -th channel information on a standard ($q_n = 0$ - coincidence with the standard, $q_n = 1$opposite result) ;

$t_n$- time of receiving information n-th channel (carrier);

$Q_{q_1,\dots,q_{n-1}}{}^{(n)}$ - the volume of incoming information and comes up with n-th channels (carriers);

$P_{q_1,\dots,q_n(l)}$- the probability of possible prognoses of n-th information;

$P_{l,q_1,\dots,q_{n-1}(q_n)}$- the probability of error-free information on the n-th carrier of the place and the reasons for their occurrence;

$\Delta$ - measure the risk of choosing the diagnosis efficiency (e*) with incomplete information.

In the third phase formed the task for the resumption of normal conditions in the facilities. Developed strategy restorative process. This problem is a lot of parametric optimization comes down to choosing j - prevention strategies transactions in which a run relation (5):

$$f_j = f(T_{np}, T_в, t_{npoф}, t_{pacн}, K_в, m_v) \rightarrow \underset{j}{extr}; \qquad (5)$$

where, $T_{нр}$ - time the start of maintenance work; $T_{в}$ - time the restoration of normal conditions; $t_{нроф}$ - the time of maintenance (predictive); $t_{расн}$ - an acceptable time of restoration work; $m_{v}$ - the total number of manufacturing procedures for the facility hygiene and safety, requiring better working conditions; $K_{в}$ - the number of transactions for the remedial work (required) $f_j \rightleftarrows A(t_{нр}) = 1$.

This confirms the fact that SISH progressive with efficiency when it tends to unity $(0 < e^* \leq 1)$ [4].As shown in the analytical calculations based on the assessment criteria laid efficiency SISH concept. From the above shows that efficiency index(e*) will receive a set of values within acceptable tolerances.

The effectiveness of the system on the basis of the criteria characterizing its reliability. Reliability SISH determined reliability components, the ability to perform parts and devices functionality in the diversity and multiplicity of production of different factors that affect the most complex and dynamic nature of the management, territorial divisions objects hygiene and safety, imperfection of individual devices control, transmission, conversion and display information and so on.

## Conclusions

The effectiveness of the system on the basis of the criteria characterizing its reliability. SISH reliability define the reliability components to perform parts and devices functionality in the diversity and multiplicity of factors of production, complicated structure and dynamic process the management, territorial divisions objects hygiene and safety, imperfection of individual control devices, transmission, transformation and information display and etc.

## References

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