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FUNDAMENTAL IMPERATIVES OF ELIMINATING UNCERTAINTY ON THE BASIS OF MONITORING THE ACTIVITY OF THE IRON ORE ENTERPRISE

Purpose. Determination of the optimal ratio of determinism and stochasticity on the basis of monitoring the activity of an iron ore enterprise in order to eliminate uncertainty when making management decisions.

Methodology. In the research process, the methodological principles of system analysis were applied, namely entropy-information relations characterizing the structure and state of subsystems. Methodical approaches of the theory of information regarding the determination of the measure of information for the elimination of uncertainty. Methodology for monitoring the activities of enterprises in accordance with the accumulation and storage of information to ensure effective management.

Findings. It has been proven that in the process of monitoring the functioning of an iron ore enterprise, the amount of information increases. Thus, the presence of stochastic relationships becomes an objective necessity. However, at the same time deterministic connections do not become less essential. The amount of information is increasing, which is the basis for the appearance of redundant information. It is substantiated that stochastic connections are a source of new, unpredictable information that is received through channels from the external environment.

Originality. For the first time, the ratio of deterministic and stochastic information links in the functioning of the enterprise has been investigated and numerically determined on the basis of monitoring, which forms the basis for eliminating uncertainty when making management decisions.

Practical value. The analysis of the monitoring process of iron ore enterprises shows that, having achieved determination at a given level of management, the corresponding system continues development at a more complex level. For iron ore enterprises, there is a transition from paper media to digital systems. As a result of innovation, a high degree of determination can be achieved. Nevertheless, the statement that the limit of any development is narrow specialization, which is due to the complete determination of the system, is correct with one significant caveat: the considered development process is carried out at an unchanged structural level.

Keywords: *iron ore enterprise, determinism, stochasticity, uncertainty, monitoring, information*

Introduction. Currently, the general methodology for the study of complex systems has significantly developed. Iron ore enterprises belong to a special class of such systems, which are called complex managers. According to the general definition, this class includes systems with relatively independent, autonomous behavior of subsystems with high internal activity and selectivity, purposeful functioning of the system in general. Such systems are open, in constant interaction with the environment and fundamentally capable of solving various tasks under various conditions.

The problem of managing economic information prompts the need to adjust the information provision of the enterprise, to learn how to use economic information as efficiently as possible.

Studies show that the fact of a powerful information and analytical base, a favorable internal environment of the enterprise regarding the integration of information distinguishes efficiently operating enterprises from inefficient ones.

Any information arising at the enterprise or coming from outside must be taken into account and processed. After all, if a significant amount of it arrives, there is no way to cover it completely. That is, part of the information remains unprocessed, and attention is paid to the most important information regarding operational management.

Thus, the company will not receive a certain benefit expressed in additional profit from the most rational strategic planning and forecasting.

Therefore, the internal infrastructure of the enterprise must be defined in such a way as to ensure the processing and use of the total amount of information. The practical implementation of such a requirement may not always meet the requirements of optimization measures in the implementation of information use.

In order to influence the production system of the enterprise and make effective management decisions, a dynamic, current exchange of information between the components of the enterprise structure and with the environment is ensured.

An analysis of information regarding the achievement (or non-achievement) of the strategic goal of the enterprise is carried out.

In general, the functioning of a complex control system is associated with three types of matter: matter, energy and information. This fully applies to iron ore enterprises, as iron ore is mined and further processed to obtain a suitable concentrate, which is associated with both energy costs and the use of necessary information. At the same time, the functioning of such enterprises, despite their rich practical experience, requires constant information tracking, that is, monitoring. Analysis of modern approaches to defining the concept of monitoring proves that there is no single approach among authors.

Monitoring of the enterprise's activities for the integration of the adopted decisions should provide the enterprise with adequate, timely information. The integration of solutions contains two aspects: integration in time, which determines the regularity of information provision, and integration in space, which provides for the relationship of various solutions both in directions – production, financial, marketing, and in terms of level – strategic, tactical, operational

Literature review. Analytical indicators obtained as a result of monitoring the company's activity should be not only theoretically justified, but also practically explained. The form of submission of initial information should be convenient for use in the decision-making process. The initial information should identify the existing and expected problems of the enterprise. Thus, this principle for the monitoring system of the enterprise can be defined as the principle of transparency, which includes understanding the meaning of information presentation and the convenience of using it and the possibility of full coverage of all information.

The analysis of scientific developments in the field of management information gives reason to conclude: the information support of the management system is a combination of all the information about the internal and external environment of the production system, the relevant means and methods of its processing, the activities of specialists regarding the rational use of the received data, knowledge in the organization of production management system

Certain authors, S. S. Biliaiev, L. P. Shvets', N. P. Zakharkevych and others, associate this concept with purely technical characteristics [1, 2], others – A. Yu. Tsaruk., T. A. Vasyl'ieva, V. M. Boronos, O. O. Zakharkin., Yu. G. Bilous [3, 4], V. K. Halitsyn, O. P. Suslov and N. K. Samchenko with an analysis of management functions [5, 6], still others – G. O. Chornous [7], M. V. Rybakov [8], P. G. Pererva, I. V. Hladenko [9], V. M. Nyzhnyk [10], O. H. Mel'nyk, and M. D. Petskovych [11], Timofeev V. O., Chumachenko I. V. relate it to the management object [12].

This is explained by the stochasticity of both external influences (the composition of iron ore, the conditions of the product sales market, etc.), and the state of the technological processes themselves at these enterprises. O. V. Raievnieva, I. V. Chankina, improved the theoretical and methodological provisions regarding the complex of economic and mathematical models for managing the development of an industrial enterprise. Scientists took into account the transformational effects of the modern stage of development of the economy of Ukraine. The conceptual model of managing the development of an industrial enterprise takes into account the influence of the transformational effects of the modern stage of the development of the national economy. The mathematical basis of the developed concept is the methods of econometric modeling and system dynamics [13].

Unsolved aspects of the problem. The application of system analysis of iron ore enterprises: quarries, mines, shops, etc. – allows one to highlight the general properties of these enterprises from the point of view of monitoring their functioning.

The objective basis of such generalizations, which is provided by the system analysis, is the commonality of entropy-information ratios characterizing the structure and state of these subsystems. According to the aforementioned triad: matter, energy and information, this relationship is present for every iron ore enterprise. Moreover, the so-called self-similarity is observed, which manifests itself as a likeness in the parts of this whole, and similar to this whole, which leads to the well-known concept of a fractal. This feature allows applying system analysis for enterprise research with further transfer and consideration of similarities.

Thus, it is relevant to present the monitoring of the activity of an iron ore enterprise as a measure of information to eliminate uncertainty when making management decisions.

Results. When studying an iron ore enterprise, it is advisable to highlight such a concept as its information security, which, next to the "substance" that is processed at this enterprise, and the "energy" that is used for such processing, is the most important component of its functioning.

These statements do not substantiate the information system of the enterprise as an independent system. For now, we are only talking about its functioning as the most important element in the enterprise management system. However, it can be argued that under certain conditions and the quality of the information component, with the appropriate breadth of coverage, it can become an independent system and really influence management decisions.

The growing importance of information resources requires increased attention to both information processing and methods for obtaining it. The significant need for information resources in relation to management goals and the development of information processes meant the need to form the components of its infrastructure.

A complex structure of economic information can contain various combinations of information components that have a certain meaning. The information component is understood as a certain amount of data that characterizes the object, the process.

Therefore, an informational approach is a necessary component of the system analysis of an iron ore enterprise during its monitoring. The measure of the amount of information, which is defined as a measure of the orderliness of the enterprise's functioning, can be a natural assessment of the quality of monitoring of the enterprise's activities. Obviously, after the enterprise has achieved a certain degree of orderliness, which is evaluated by the amount of information, the enterprise functions as a whole.

Thus, we can state that the purpose of enterprise monitoring is to use the enterprise's functional characteristics, which include the following ones: organization, structure, relationships, management. It should be emphasized that the measure of the amount of information, as well as the category of information, which is one of the functional characteristics, has a fundamental difference from all others, as it reflects not single-valued dependencies, but multi-valued relationships of system elements. Thanks to abstraction from substantial characteristics, which are matter and energy, with the help of this measure it is possible to trace the transformation of information in the processes of its accumulation, storage and transmission, that is, during the implementation of monitoring.

It is important to emphasize that the use of cybernetics ideas in system analysis has significantly expanded the idea of the possibility of ensuring the functioning of the enterprise as a system. A condition for the functioning of rigidly deterministic systems is the constancy (strength) of their components, properties, and connections. This is possible only with previously known properties of both the state of the system and the external environment, even if they are stochastic. If the internal state of the system and(or) the properties of the environment are not known in advance, then the functioning of a rigidly deterministic system cannot be guaranteed. In this case, the homeostasis of controlled systems with a complex structure can be ensured only by the lability of connections that exist both within the system and between the system and the environment.

Therefore, the purpose of monitoring the enterprise's activity is to use the functional characteristics of the enterprise, which include such characteristics as organization, structure, relationship, and management.

Organizational and economic flexibility of the enterprise is achieved thanks to the appropriately chosen information structure of the enterprise, depending on its scale of production.

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The conducted analysis allows us to conclude that in the process of monitoring an iron ore enterprise, the amount of information accumulated and stored at this enterprise is increasing for further improvement of its functioning.

At the same time, the condition of accumulating information for improving the functioning of the enterprise is necessary, but not sufficient. Taking into account the fact that iron ore enterprises are open systems for information, there should be a selection of information during its accumulation when making connections with the external environment.

Thus, during enterprise monitoring, it is not necessary to duplicate previously known information, but to create new information channels. This will make it possible to realize progressive accumulation of information during monitoring of the enterprise, which allows for emergency selection.

This approach makes it possible to create conditions for the emergence of elements of evolution at the enterprise, in particular innovations. It follows from the conducted analysis that the progressive accumulation of information during enterprise monitoring cannot be carried out only according to a deterministic program.

Such processes must be based on a stochastic mechanism. Thus, during the monitoring of the company's activity, the presence of stochastic relationships is an objective necessity. However, it does not follow that deterministic connections are given a secondary role.

Only in the dialectical interaction of random and deterministic relationships are their roles equivalent. Preference towards random connections leads to disruption of the functioning of the enterprise, preference towards deterministic connections reduces the ability of the enterprise to adapt to the conditions of the external environment, the ability to innovate.

We denote the amount of redundant information by the symbol I_1, which is also a measure of preservation for a deterministic enterprise. Then the measure of the existing order at the enterprise can be represented by equality

$$H_1 = H_{\max} - H_0 = I_1, \quad (1)$$

where $H_{\max}$ is enterprise entropy, in conditions of maximum uncertainty, that is, when all actions at the enterprise are equally probable; H_0 is entropy of the enterprise, in the real conditions of its operation.

The entered notation (1) allows you to enter the stochastic coefficient for further analysis of the ratio of random and deterministic relationships

$$g = \frac{H_0}{H_1}. \quad (2)$$

The entered notation (1) allows you to enter the stochastic coefficient for further analysis of the ratio of random and deterministic relationships

$$r = 1 - \frac{H_0}{H_0 + H_1}. \quad (3)$$

Considering (3), formula (2) takes the form

$$g = \frac{H_0}{H_1} = \frac{H_0 + H_1 - H_1}{H_1} = \frac{H_0 + H_1}{H_1} - 1 = \frac{1}{\frac{H_1}{H_0 + H_1}} - 1;$$

$$g = \frac{1}{r} - 1. \quad (4)$$

Or, according to (4),

$$r = \frac{1}{1+g}. \quad (5)$$

Fig. 1 shows a graph of the dependence of the redundancy coefficient on the stochasticity coefficient, according to formula (5).

According to the given dependence (5), as the stochasticity coefficient increases, the redundancy coefficient decreases. This leads to the conclusion that as stochasticity increases at the enterprise as a system, its determinism decreases.

In the limiting case, when the stochasticity coefficient goes to infinity, the redundancy coefficient goes to zero. In other words, the enterprise as a system becomes stochastic, its management depends entirely on chance. On the other hand, when the stochasticity coefficient decreases, the redundancy coefficient increases.

This means that in this case the determinism of the enterprise increases, which leads to rigid determination in the process of functioning of the enterprise. When the redundancy coefficient is one, the stochasticity coefficient is zero. In this case, there will be complete determination in the functioning of the enterprise, which is possible only with unchanged external conditions and constancy of the internal state of the enterprise.

The conducted analysis shows that with real external factors and the internal state of the enterprise, there is such redundant information that is optimal for the functioning of the enterprise in these conditions.

It is clear that it is generally impossible to specifically identify the nature of real disturbances caused by external factors and changes in the internal state of the enterprise. However, it can be done indirectly by assuming that the stochastic coefficient is a continuous random variable, due to the action of the perturbations mentioned above.

Let the distribution density of the stochastic coefficient $f(g)$ be known. It is necessary to find the distribution density $\varphi(r)$ of the random variable R, which is given by the function

$$R = \frac{1}{1+G}. \quad (6)$$

Function (5) is monotonically decreasing and differentiable on the interval $(0; \infty)$. Then the inverse function (4) exists and is also monotonically decreasing and differentiable.

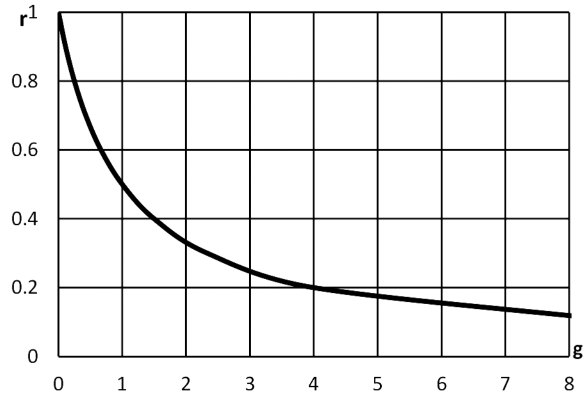

Fig. 1. Graph of the dependence of the redundancy coefficient on the stochasticity coefficient

Let us set the interval $(r, r+\Delta r)$ on the Or axis and display it using function (4) on the Og axis. As a result, we get the interval $(g, g+\Delta g)$.

The events $(r < R < r+\Delta r)$ and $(g < G < g+\Delta g)$ are identical. Therefore, there is an equality of probabilities

$$P(r < R < r+\Delta r) = P(g < G < g+\Delta g),$$

and, therefore, we have

$$\varphi(r) = \lim_{\Delta r\to 0}\frac{P(r<R<r+\Delta r)}{\Delta r} = \lim_{\Delta g\to 0}\frac{P(g<G<g+\Delta g)}{\Delta r} =$$
$$= \lim_{\substack{\Delta r\to 0\\ \Delta g\to 0}}\frac{P(g<G<g+\Delta g)}{|\Delta g|}\frac{|\Delta g|}{\Delta r} = f(g)\cdot\left|\frac{dg}{dr}\right|.$$

Thus, the formula holds

$$\varphi(r) = f(g(r))\cdot\left|\frac{dg(r)}{dr}\right|. \quad (7)$$

Given formula (4), according to (7), we find the probability density of the redundancy coefficient

$$\varphi(r) = f\left(\frac{1}{r}-1\right)\cdot\frac{1}{r^2}. \quad (8)$$

Thus, formula (8) allows you to determine the density of the distribution of the redundancy coefficient from the density of the distribution of the stochasticity coefficient with their known analytical dependence (4). According to formula (8), it is possible to calculate the average value of the redundancy coefficient

$$\overline{r} = \int_0^1 r\cdot\varphi(r)dr, \quad (9)$$

and mean square deviation

$$\sigma = \sqrt{\int_0^1\left(r-\overline{r}\right)^2\varphi(r)dr}. \quad (10)$$

Taking (8) into account, formulas (9) and (10) take the form

$$\overline{r} = \int_0^1 f\left(\frac{1}{r}-1\right)\frac{dr}{r};$$
$$\sigma = \sqrt{\int_0^1\left(r-\overline{r}\right)^2 f\left(\frac{1}{r}-1\right)\frac{dr}{r^2}}. \quad (11)$$

Knowing the density of the distribution of the redundancy coefficient, it is possible to determine the probability that this coefficient will be in a given interval according to the formul

$$P(r_1 < r < r_2) = \int_{r_1}^{r_2}\varphi(r)dr, \quad (12)$$

where (r_1, r_2) is the hit interval of the redundancy factor.

In general, the density of the stochastic coefficient distribution may depend on some parameter, i.e

$$f(g) = \psi(\alpha, g), \quad (13)$$

where α is the parameter.

Thus, according to (8, 13), the distribution density of the redundancy coefficient will also depend on the α parameter, i. e.

$$\varphi(r,\alpha) = \psi\left(\alpha, \frac{1}{r}-1\right)\cdot\frac{1}{r^2}. \quad (14)$$

As a result, it is possible to formulate the problem of optimal stabilization of the given value of the redundancy coefficient r_0 due to the parameter α

$$F(\alpha) = \int_0^1 (r-r_0)^2\psi\left(\alpha,\frac{1}{r}-1\right)\cdot\frac{dr}{r^2}\to\min_{\alpha}. \quad (15)$$

By minimizing the function (15) taking into account the restrictions on the size of the redundancy coefficient, the optimal value α_0 is found. This makes it possible to find the optimal density of the stochastic coefficient distribution

$$\psi(\alpha_0, g). \quad (16)$$

According to (16), the numerical characteristics of the stochasticity coefficient are found: the average value is

$$\overline{g}(\alpha_0) = \int_0^\infty g\cdot\psi(\alpha_0, g)dg,$$

mean square deviation is

$$\sigma_g(\alpha_0) = \sqrt{\int_0^\infty (g-\overline{g}(\alpha_0))^2\cdot\psi(\alpha_0,g)dg}.$$

As an example, we will consider specific data for monitoring. Let it be known that the density of the stochastic coefficient distribution is approximated by the normal distribution law

$$f(g, m_g, \sigma_g) = \frac{1}{\sigma_g\sqrt{2\pi}}e^{-\frac{(g-m_g)^2}{2\sigma_g^2}}, \quad (17)$$

where m_g, σ_g are numerical parameters: mathematical expectation and mean square deviation, respectively.

Fig. 2 shows the graph of the density of the normal distribution of the stochastic coefficient (17).

The corresponding parameters are equal

$$m_g = 0.5;\quad \sigma_g = 0.1;\quad m_{g,opt} = 0.26;\quad \sigma_g = 0.05.$$

According to formulas (14) and (17), the distribution density of the redundancy coefficient is written in the form

$$\varphi(r, m_g, \sigma_g) = \frac{1}{r^2\cdot\sigma_g\sqrt{2\pi}}e^{-\frac{\left(\frac{1}{r}-1-m_g\right)^2}{2\sigma_g^2}}. \quad (18)$$

Fig. 3 shows the density graph of the redundancy coefficient (18).

The numerical characteristics of the redundancy factor are presented below:

- average value

$$m_r = \int_0^1 r\cdot\frac{1}{r^2\cdot\sigma_g\sqrt{2\pi}}e^{-\frac{\left(\frac{1}{r}-1-m_g\right)^2}{2\sigma_g^2}}dr\times$$
$$\times\frac{1}{0.1\cdot\sqrt{2\pi}}\int_0^1\frac{1}{r}e^{-50\cdot\left(\frac{1}{r}-1.5\right)^2}dr = 0.67; \quad (19)$$

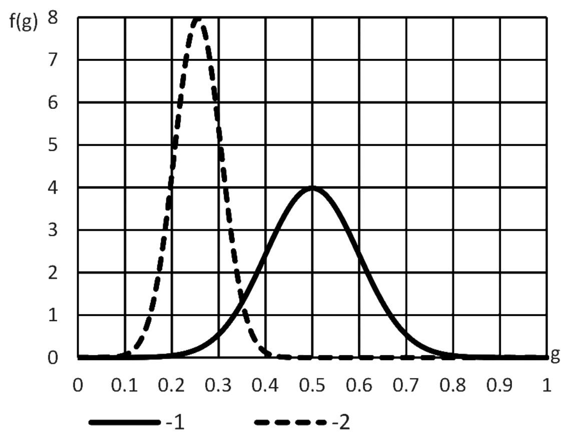

Fig. 2. Stochastic coefficient density plot:
1 – $m_g = 0.5$; $\sigma_g = 0.1$; 2 – $m_{g,opt} = 0.26$; $\sigma_g = 0.05$

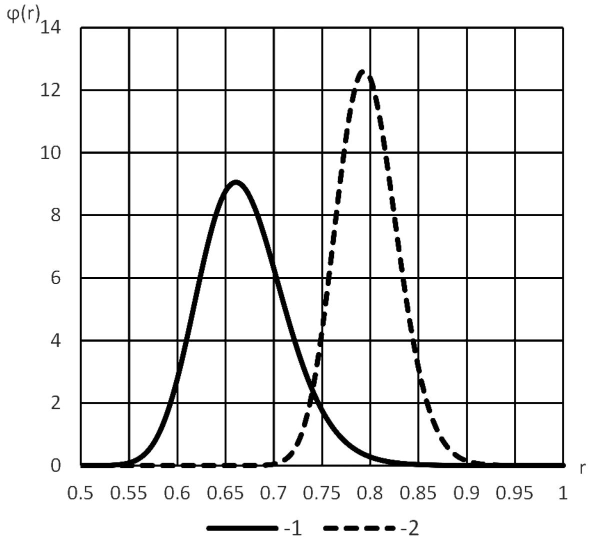

Fig. 3. Redundancy coefficient density plot:
1 – $m_g = 0.5$; $\sigma_g = 0.1$; *2* – $m_{g,opt} = 0.26$; $\sigma_g = 0.05$

- mean square deviation

$$\sigma_r = \sqrt{\int_0^1 \frac{(r-m_r)^2}{r^2\cdot\sigma_g\sqrt{2\pi}} e^{-\frac{\left(\frac{1}{r}-1-m_g\right)^2}{2\sigma_g^2}} dr} = \sqrt{\frac{1}{0.1\cdot\sqrt{2\pi}}\int_0^1 \frac{(r-m_r)^2}{r^2} e^{-50\cdot\left(\frac{1}{r}-1.5\right)^2} dr} = 0.045. \quad (20)$$

Consider the case when the stochasticity coefficient $r_0 = 0.8$ is set. Using formula (15), we will find the optimal value of the parameter m_g

$$F(m_g) = \int_0^1 (r-r_0)^2 \frac{1}{r^2\cdot\sigma_g\sqrt{2\pi}} e^{-\frac{\left(\frac{1}{r}-1-m_g\right)^2}{2\sigma_g^2}} \to \min_{m_g},$$

or

$$F(m_g) = \frac{1}{\sigma_g\sqrt{2\pi}}\int_0^1 \frac{(r-0.8)^2}{r^2} e^{-\frac{\left(\frac{1}{r}-1-m_g\right)^2}{2\sigma_g^2}} \to \min_{m_g}. \quad (21)$$

Carrying out the minimization according to (21) under the condition that $\sigma_g = 0.05$ gave the following result

$$m_{g,opt} = 0.26. \quad (22)$$

Then, according to (22),

$$m_{r,0} = \frac{20}{\sqrt{2\pi}}\int_0^1 \frac{1}{r} e^{-50\left(\frac{1}{r}-1.26\right)^2} dr = 0.797. \quad (23)$$

The found value (23) is quite close to the value given by $r_0 = 0.8$.

Figs. 2 and 3 present graphs of densities of stochasticity and redundancy coefficients as a result of optimization according to (21).

The analysis of the optimization results shows that the graph of the density of the stochasticity coefficient has shifted along the horizontal axis to the left, and, in turn, the graph of the density of the redundancy coefficient has shifted to the right. The obtained results indicate that at this enterprise the information is on average 79.4 % deterministic and 20.6 % stochastic with a mean square deviation of 5 %.

At the last step, we determine the probability of the redundancy coefficient falling into the specified interval using formula (12).

$$P(r_1 < r < r_2) = \int_{r_1}^{r_2} \frac{1}{r^2\cdot\sigma_g\sqrt{2\pi}} e^{-\frac{\left(\frac{1}{r}-1-m_{g,opt}\right)^2}{2\sigma_g^2}} dr. \quad (24)$$

Then, according to (24), the probability of the redundancy coefficient falling into the given interval (0.75; 0.85) will be

$$P(0.75 < r < 0.85) = \frac{1}{0.05\cdot\sqrt{2\pi}}\int_{0.75}^{0.85} \frac{1}{r^2} e^{-50\cdot\left(\frac{1}{r}-1.26\right)^2} dr = 0.881.$$

Thus, with a probability of 0.881, the redundancy coefficient as a random number will fall into the given interval (0.75; 0.85).

Conclusion. The conducted research made it possible to come to a conclusion regarding the existence of an optimal ratio of deterministic and stochastic information connections in the functioning of the enterprise.

Management decision-making processes at enterprises are currently implemented under the conditions of active development of the information society, the key concept of which is information, the basis is information and communication technologies, and the important goal is the realization of the value of time.

The enterprise activity monitoring system is the main component of information support for strategic management, which ensures the collection of information from various sources, its formalization in the form of structured data, and its further analysis.

In the conditions of the market economy, the interest of various participants in the economic process in timely, objective and adequate information about the business activity and financial condition of the enterprise has increased significantly. Users of information are different, their goals are competitive, and often opposite.

Despite the difference in their goals, all subjects at the enterprise have a common interest, they are interested in reliable analytical information about the enterprise's activities. The system of monitoring the company's activity should provide information useful for all interested parties, and in this sense it acts as a means of communication and coordination of interests. Therefore, the monitoring system of the enterprise should be intersubjective. This notion of monitoring is consistent with the general scientific principle of invariance.

Currently, there is, along with others, a general problem at enterprises of the mining and ore complex – the problem of information management. Management of enterprises must operate with a significant amount of information and make timely and rational decisions. The rationality of managerial decision-making depends on the level of awareness of managers, on the timeliness of receiving relevant information, on the level of access to "quality" information

It is proved that deterministic and stochastic relationships are not in equilibrium, but in a state of evolutionary dynamics. During monitoring, the amount of information about this enterprise increases. Reducing the uncertainty of knowledge about the enterprise leads to the appearance of redundant information. Such excessive information is deterministic information.

At the same time, stochastic connections are a source of new, unpredictable information received through channels from the external environment. It is noted that a high degree of determination can be achieved as a result of innovations. Nevertheless, the statement that the limit of any development is a narrow specialization caused by the complete determination of the system is correct with one significant caveat: the considered development process is carried out at an unchanged structural level.

Analysis of the monitoring process of enterprises shows that, having achieved determination at a given level of management, the management system continues development at a more complex level. The transition of Ukrainian mining enterprises to strategic tools of planning and control involves the improvement of information and analytical support of the management process.

The main purpose of monitoring the company's activity is to provide decision-makers with analytical information. At the same time, monitoring systems should not only provide generalization (aggregation and convolution) and provide data in a form convenient for perception. The principle of informativeness requires the use of such types of aggregation and convolution of indicators that minimize the loss of information during its transformation.

Regarding iron ore enterprises, this is the transition from paper media to digital systems.

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Засадничі імперативи усунення невизначеності на засадах моніторингу діяльності залізорудного підприємства

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Мета. Визначення оптимуму співвідношення детермінованості та стохастичності на засадах моніторингу діяльності залізорудного підприємства задля усунення невизначеності при прийняті управлінських рішень.

Методика. У процесі дослідження застосовані методологічні засади системного аналізу, а саме ентропійно-інформаційні співвідношення, що характеризують структуру та стан підсистем. Методичні підходи теорії інформації щодо визначення міри інформації задля усунення невизначеності. Методологія моніторингу діяльності підприємств відповідно до накопичення та зберігання інформації задля забезпечення ефективного управління.

Результати. Доведено, що у процесі здійснення моніторингу функціонування залізорудного підприємства відбувається збільшення кількості інформації. Таким чином, наявність стохастичних зв'язків стає об'єктивною необхідністю. Однак, при цьому детерміновані зв'язки не стають менш суттєвими. Збільшується кількість інформації, що є підґрунтям появи надлишкової інформації. Обґрунтовано, що стохастичні зв'язки є джерелом нової, непередбачуваної інформації, яка отримується по каналах із зовнішнього середовища.

Наукова новизна. Уперше досліджене й чисельно визначене співвідношення детермінованих і стохастичних інформаційних зв'язків на засадах моніторингу функціонування підприємства, що складає підґрунтя для усунення невизначеності при прийняті управлінських рішень.

Практична значимість. Аналіз процесу моніторингу залізорудних підприємств показує, що, досягнувши детермінації на заданому рівні управління, відповідна система продовжує розвиток на більш складному рівні. На залізорудних підприємствах спостерігається перехід від паперових носіїв інформації на цифрові системи. У результаті інновацій може бути досягнутий високий ступінь детермінації. І тим не менш, твердження, що межею будь-якого розвитку є вузька спеціалізація, яка обумовлена повною детермінацією системи, справедливе за одного суттєвого застереження: розглянутий процес розвитку здійснюється на незмінному структурному рівні.

Ключові слова: *залізорудне підприємство, детермінованість, стохастичність, невизначеність, моніторинг, інформація*

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