DETERMINATION OF PARAMETERS OF INFORMATION PROTECTION AT THE ENTERPRISE IN CONDITIONS OF DESTABILIZING INFORMATION INFLUENCE

The **subject** of the article is the models of protection of official, commercial, confidential and other information, which is used by the officials of enterprises when making managerial decisions in terms of destabilizing informative influences. The **aim** of the study is to obtain an integral index, which characterizes the protection of necessary information, which is used by the officials of the enterprise when making managerial decisions in the presence of destabilizing information influences from the social networks, open sources and insiders. The **task** of this work are determinations of basic parameters, that characterize the system of defense of information of enterprise at the acceptance of administrative decisions a public servant in the conditions of destabilizing informative influences. The **methods** of researches are a probability theory and quality theory of differential equalizations. Results: on the basis of the observation and research of the activity of officials in the enterprises of different forms of ownership it was established that making managerial decisions by an official of the enterprise under conditions of destabilizing information influence is a relaxation fluctuation in the non-autonomous model of psychological arousal. An analysis of the dynamics of the sequence of influencing impulses on an official from existing information sources was conducted. An integral index, that determines a thresholding at that the system of informative defense of enterprise answers politicians of informative defense of enterprise at the acceptance of administrative decisions, is got.

**Conclusions:** it was found that the threat of successful destabilizing information influence on management decision making by an official of the enterprise is determined by three parameters: the parameter, which determines the leakage of confidential information, the parameter, which determines the violation of the integrity of information and the parameter, which determines the blocking of access to information. It is noticed that the beginning of the emergence of a sequence of influencing destabilizing information influences on the enterprise determined by the content of the information at the initial moment of time (the effect of suggestion) and occurs over a period of time (lag effect).

**Keywords:** relaxation vibration; informative influences; time delay; influential impulses; managerial decisions.

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**Introduction**

Creating a system of information protection in making management decisions by an official of the enterprise in conditions of destabilizing information influences is currently one of the most important and at the same time the most difficult task. This is due to the fact that in the context of globalization, there are many different sources through which information is obtained for management decisions by an official of the enterprise and it is not always possible to conclude whether this information is useful or negative. To make management decisions in the work of the entity. In the performance of his duties, the official must first understand that incorrect management decisions can lead to accidents, catastrophes, financial losses, bankruptcy, etc. However, today, the decision-making of an enterprise official is significantly influenced by information flows, which are constantly distributed in the mass media (MM), social networks (SN), in the space of "rumors", and from other alternative sources. Identify and divide information into positive and negative components for making the right management decisions by an official of the company is one of the main tasks for the protection of confidential, commercial and other necessary information.

**Statement of the problem.** When studying the process of making management decisions by an official of the enterprise, the reaction of the official of the enterprise to external stimulating information coming from the media, social networks, and employees was observed. The most important task of these observations is to identify possible management decisions that will be made by an official of the enterprise depending on the content of the information received. It is interesting in these observations to study the consistent influential impulses on the official of the enterprise from stimulating information sources. It is assumed that the external stimulating informational influence on the official in making management decisions for a certain period of time is constant. Under this condition, the task of identifying influential impulses to the consciousness of the official to make management decisions is to determine the indicator that allows you to observe what management decisions will be made by an official of the company in the presence of informational influences on it.

**Analysis of recent research and publications.**

In [1, 6] a mathematical model of information threat propagation (destabilizing information influence) is proposed, which uses the theory of differential equations to describe the growth rate of the number of people (adherents) who were (were recruited) destabilizing information influence from external channels. Conducted by the media, social networks, etc.), and internal channels (between personal communication of members of the social group). This model only quantifies the rate of change in the number of adherents, but does not determine what exactly affects the spread of information threats. In [2] the main requirements to the system of protection of information and analytical support were formulated, but it is not presented how these requirements are taken into account in practice in the system of information protection. In [3], the analysis of existing models of information and psychological influence, which are based on the methods of mathematical logic, and on the basis of regression analysis. These approaches determine the fact of the implementation of negative destabilizing information influence (cyberattacks), but do not describe...
the mechanisms of information protection of persons belonging to a social group. In [4, 8] social networks are identified as a possible source of destabilizing information influence, which in turn is a threat to the official in making the right management decisions. In [5] a model of information security panic of the enterprise, which arises due to the social factor, was developed, but no mechanism was proposed for calculating the relevant parameters that characterize such processes as stress, cohesion, leadership pressure, etc. In [7] the relationships between the processes that manage events and the processes of information security management of the enterprise are considered. A scheme of the relationship between these processes is proposed, but it is not considered how this scheme relates to the protection of information for management decisions by officials. In [9] a meme model was developed, which is used to model the information influence system. This model applies to social groups, but does not address the issue related to the effect of the meme on management decisions by an official who must constantly make the right decisions. In [10] the essence of the influence of shadow information technologies on the information security of the business entity is revealed, which determines the main parameters of the information protection system for making managerial decisions by an official.

The purpose of the article is to obtain an integrated indicator that characterizes the protection of information for management decisions by officials of enterprises of various forms of ownership in the presence of destabilizing information influences from social networks, open sources and insiders.

Presentation of the main material

The system of information protection for making managerial decisions by an official of the enterprise is based on three basic principles that must be followed when creating appropriate measures that counteract destabilizing information influences.

The first principle is confidentiality of information. The essence of this principle is that stakeholders try to steal information owned by an official of the enterprise and which is not publicly available or secret.

The second principle is the integrity of information. Information can be damaged or substituted. Stakeholders can implement measures aimed at making managerial decisions according to their scenario. One of such measures is the substitution of actual information to another, using which the official of the enterprise can make a number of mistakes in making managerial decisions, which in turn will lead to negative consequences in the work of the enterprise.

The third principle is the availability of information. The essence of this principle lies in the inability of interested persons to block access to the necessary information that an official of the enterprise should possess when making managerial decisions.

Thus, to determine the integral indicator that characterizes the protection of information when making managerial decisions by the official of the enterprise, it is necessary to enter three parameters that define the above three principles: \( \kappa \) – characterizes the leakage of confidential information from the official of the enterprise due to information influence; \( \lambda \) – characterizes the violation of the integrity of the information that the official of the enterprise should possess for making the right management decisions; \( \mu \) – characterizes the blocking of access to relevant information by the official of the enterprise. Since these three parameters are random variables, they should be defined as the probability of confidential information leakage, the probability of information integrity violation and the probability of blocking access to information respectively.

When studying the properties of the information influence on the official of the enterprise, one of the key experiments is to study the response of the official to the internal and external stimulating information influence, which will lead to the maximum value of at least one of the parameters \( \kappa, \lambda, \mu \).

A number of studies have shown that the behavior of an official of the enterprise in making managerial decisions in conditions of destabilizing information influences can be studied as relaxation fluctuations in its management decisions. In addition, the main parameter of these fluctuations is trust \( \Xi \), which in turn is a function of \( \kappa, \lambda, \mu \). That is, \( \Xi = f(\kappa, \lambda, \mu) \). The parameter \( \kappa \) determines the probability of leakage of confidential information as a result of the actions of an official who has been exposed to destabilizing information. The parameter \( \lambda \) determines the probability of violation of the integrity of information, which led to erroneous management decisions of the official as a result of informational influence on him. The parameter \( \mu \) determines the probability of blocking access to the necessary information, which is necessary for the official of the enterprise to make the right management decisions. The parameter \( \Xi \) characterizes the correctness of management decisions by an official of the enterprise in conditions of destabilizing information influences. This parameter is defined as follows

\[
\Xi = (1-\kappa)(1-\lambda)(1-\mu).
\] (1)

When making appropriate management decisions, the official of the enterprise determined the threshold value \( p \) of parameters \( \kappa, \lambda, \mu \), at which the managerial decisions of the official will not lead to negative consequences for the enterprise in the conditions of destabilizing information influences. Summary table 1 shows the threshold values for these parameters on the basis of special studies conducted at three enterprises of different forms of ownership.

Based on table 1, determine the threshold value of the confidence parameter according to (1), which has the following estimate:

- for state-owned enterprises of critical infrastructure – \( \Xi \geq 0.93 \);
- for state-owned enterprises of non-critical infrastructure – \( \Xi \geq 0.84 \);
- for private and communal enterprises – \( \Xi \geq 0.75 \).
Based on research conducted at enterprises of different forms of ownership, a range of values of parameters $\kappa$, $\lambda$, $\mu$, depending on the sources from which the negative information influence on the official occurs and based on these data determined the dependence of these parameters on the time during which the influence occurs. Table 2 shows the values of the ranges of the relevant parameters, and their dependence on the time during which the destabilizing information influence.

### Table 1. Thresholds for the parameters of leakage of confidential information, violation of the integrity of information and blocking access to the necessary information for enterprises of different forms of ownership

<table>
<thead>
<tr>
<th>Form of ownership of the enterprise</th>
<th>Threshold value $p$ for the parameter under study</th>
<th>$\kappa$</th>
<th>$\lambda$</th>
<th>$\mu$</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Enterprise of Critical Infrastructure</td>
<td>$p \leq 0,02$</td>
<td>$p \leq 0,025$</td>
<td>$p \leq 0,03$</td>
<td></td>
</tr>
<tr>
<td>State-owned enterprise is not critical infrastructure</td>
<td>$p \leq 0,05$</td>
<td>$p \leq 0,055$</td>
<td>$p \leq 0,06$</td>
<td></td>
</tr>
<tr>
<td>Private enterprise</td>
<td>$p \leq 0,09$</td>
<td>$p \leq 0,09$</td>
<td>$p \leq 0,1$</td>
<td></td>
</tr>
</tbody>
</table>

### Table 2. Values of the ranges of parameters of leakage of confidential information, violation of the integrity of information and blocking access to the required information

<table>
<thead>
<tr>
<th>№</th>
<th>Sources of destabilizing information influence on the official</th>
<th>Parameters that characterize the information insecurity of the official</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Media</td>
<td>$0,1-0,8$, $0,3-0,5$, $0,25-0,45$</td>
</tr>
<tr>
<td>2</td>
<td>Social networks</td>
<td>$0,25-0,45$, $0,5-0,7$, $0,1-0,25$</td>
</tr>
<tr>
<td>3</td>
<td>Internal influence (insiders)</td>
<td>$0,4-0,8$, $0,55-0,7$, $0,45-0,6$</td>
</tr>
<tr>
<td>4</td>
<td>External influence (rumors)</td>
<td>$0,1-0,15$, $0,1-0,15$, $0,1-0,15$</td>
</tr>
</tbody>
</table>

According to table 2, graphs of the dependence of the parameters $\kappa$, $\lambda$, $\mu$ on the time during which the destabilizing information influence occurs. These graphs are presented in fig. 1, fig. 2, and fig. 3.

**Fig. 1.** The dependence of the parameter $\kappa(t)$ on the time during which the information influence

Fig. 1 shows a fragment of the relaxation oscillation of the parameter $k$ during the period $\tau=1$ day. The dependence of this parameter on time in analytical form can be represented as follows:

$$\kappa(t) = 1 - \frac{0.98}{\tau^2} t^2, \quad 0 \leq t \leq \tau.$$  

During the studies, it was assumed that at the initial time $t=0$ the parameter $\kappa(t)$ took the maximum possible value, i.e. $\kappa(0) = 1$. In other words, in the initial moment of time it was considered that there was a leak of confidential information due to the destabilizing information influence. However, further observation revealed that in the process of making management decisions by the official of the company under observation, the value of this parameter began to decrease and as a result, during the observation time its value approached almost 0. Analyzing fig. 1 we can conclude that when studying the process of leakage of confidential information, two areas can be distinguished – the area of danger and the area of security, the limit of which is the threshold value of the parameter $k(t)$. When making management decisions, it is necessary to observe the dynamics of the parameter $k(t)$ until its value reaches a value less than the threshold.

Similarly, studies were made to obtain analytical representations for the other two parameters. The results are presented in fig. 2 and fig. 3, as well as formulas (3) and (4).

**Fig. 2.** A fragment of the relaxation oscillation of the parameter $\lambda$ during the period $\tau=1$ day. In analytical form, the dependence of this parameter can be represented as follows:

$$\lambda(t) = 1 - \frac{0.98}{\tau} t, \quad 0 \leq t \leq \tau, \quad \lambda(0) = 1.$$  

**Fig. 3.** A fragment of the relaxation oscillation of the parameter $\mu$ during the period $\tau=1$ day. In analytical form, the dependence of this parameter can be represented as follows:

$$\mu(t) = 1 - \frac{0.98}{\tau} t, \quad 0 \leq t \leq \tau, \quad \mu(0) = 1.$$
Analyzing fig. 2, we can conclude that in the study of the process of violation of the integrity of information in the information destabilizing influence is also analyzed two areas – the danger area and the security area, the limit of which is the threshold value of the parameter \( \lambda(t) \).

When making management decisions, it is also necessary to monitor the dynamics of the parameter \( \lambda(t) \), until its value reaches a value less than the threshold.

Expressing from (3) the time \( t \) through \( \lambda(t) \) and substituting in (2), we obtain the dependence of the parameter \( \kappa(t) \) on \( \lambda(t) \): \[
\kappa(t) = 1 - \left( \frac{1 - \lambda(t)}{0.98} \right)^2 \quad 0 \leq t \leq \tau. \tag{4}
\]

Fig. 3 shows the dependence (4).

Expressing from (5) the dependence of time \( t \) on the parameter \( \mu(t) \), and then substituting in (2), we obtain the dependence of the parameter that characterizes the leakage of confidential information from the parameter that characterizes the blocking of information influence.

In analytical form, the dependence of this parameter can be represented as follows:

\[
\mu(t) = 0.98 \left( 1 - \frac{t}{\tau} \right), \quad 0 \leq t \leq \tau, \quad \mu(0) = 1. \tag{5}
\]

Fig. 4 highlights the dangerous and safe areas of the values of the parameter that characterizes the blocking of access to the required information. Expressing from (5) the dependence of time \( t \) on the parameter \( \mu(t) \), and then substituting in (2), we obtain the dependence of the parameter that characterizes the leakage of confidential information from the parameter that characterizes the blocking of access to the required information. Fig. 5 shows a graph of this relationship.
Fig. 4. Dependence of the parameter $\mu(t)$ on the time during which the informational influence occurs

Fig. 5 shows that this dependence is close to the dependence shown in fig. 3, which confirms that the direct way to obtain confidential information requires almost sufficient effort. However, by destabilizing the information influence to block access to the necessary information or to damage the information when making management decisions, you can get the conditions under which confidential information will leak.

The obtained analytical dependences (2), (3), (5) make it possible to obtain an analytical dependence (1), which will take the form

$$\Xi(t) = 0.98 \left( 1 - \frac{0.98}{\tau^2} t^2 \right) \left( 1 - \frac{0.98}{\tau} t \right) \left( 1 - \frac{t}{\tau} \right), \quad 0 \leq t \leq \tau. \quad (6)$$

Dependence (6) is an integrated indicator that determines the correctness of decision-making by an official in the face of destabilizing information influence that occurs during the period $\tau = 1$ day. If at some enterprise this indicator $\Xi$, which is called trust in management decisions by an official in conditions of destabilizing information influence for some period $\tau$ does not exceed its threshold value, it can be concluded that the system of information protection in management decisions by company officials in the conditions of destabilizing information influence provides this protection. Fig. 6 shows that the integral indicator $\Xi$, called trust, can be modeled by a differential equation that simulates relaxation oscillations and the definition of safe and dangerous areas, which are indicators in management decisions, is to analyze the stability of such differential equations.

Fig. 5. Dependence of the parameter that characterizes the leakage of confidential information from the parameter that characterizes the blocking of access to the required information

Fig. 7 shows the phase trajectory of changes in the speed of managerial decision-making by an official (vertical axis) and trust (horizontal axis) in managerial decision-making by an official in conditions of destabilizing information influences.
When constructing the phase trajectory, which is presented in fig. 7 for the observation period, it was noted that the beginning of the sequence of influential destabilizing information effects on the official, which have an oscillating nature, is determined by the content of information at the initial moment of influence (suggestion effect) (delay effect). Also from fig. 7 it is seen that the process of making managerial decisions is a process of inhibition over time, which corresponds to a negative value of the rate of change of trust over time. This is due to the fact that information from different sources is analyzed, compared and filtered. At a certain point in time, the parameters (2), (3), (5) and the integrated indicator (6) are determined. If the value of trust does not exceed the threshold, then the process of making managerial decisions by an official of the enterprise begins, which in turn begins to increase the speed of the decision-making process at the enterprise.

Conclusions

Thus, an attempt was made to determine the main parameters that characterize the information protection system in making management decisions at the enterprise in conditions of destabilizing information influence. Based on observations made at enterprises of various forms of ownership, it was concluded that management decisions by an official of the enterprise in a destabilizing information influence is characterized by trust in information, which in turn is a function of parameters characterizing the leakage of confidential information. Integrity of information, and blocking access to information. In turn, based on the numerical data of the above parameters, it was concluded that trust in management decisions to information aimed at destroying the information protection system in management decisions, is in a state of relaxation fluctuations arising from the content of information obtained at the initial moment destabilizing information influence (suggestion effect), and reasoning time (delay effect). The further development of the study of relaxation fluctuations of trust in making managerial decisions by an official of the enterprise in the conditions of destabilizing information influence, analysis of bifurcations that arise to determine zones of stability and bifurcation points for modeling destabilizing information effects. In addition, it was determined that in order to obtain confidential information that will further influence the official in making management decisions, it is first necessary to violate its integrity, and then block access to it.
References


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ВИЗНАЧЕННЯ ПАРАМЕТРІВ ЗАХИСТУ ІНФОРМАЦІЇ НА ПІДПРИЄМСТВІ В УМОВАХ ДЕСТАБІЛІЗУЮЧОГО ІНФОРМАЦІЙНОГО ВПЛИВУ

Предметом вивчення статті є процес захисту службової, комерційної, конфіденційної та іншої інформації, яку використовують посадові особи підприємства при прийнятті урядових рішень в умовах дестабілізуючих інформаційних впливів.

Метою дослідження є отримання інтегрального показника, який характеризує захист необхідної інформації, яку використовують посадові особи підприємства при прийнятті урядових рішень в умовах наявності дестабілізуючих інформаційних впливів з боку соціальних мереж, відкритих джерел та інсайдерів. Задачами даної роботи є визначення основних параметрів, які характеризують систему захисту інформації, які прийнятті урядових рішень посадовою особою в умовах дестабілізуючих інформаційних впливів. Методами дослідження є теорія ймовірності та жакіна теорія диференціальних рівнянь.

Результати: на основі проведених в роботі спостережень та досліджень, що виконані в роботі, встановлено, що прийняття урядових рішень посадовою особою в умовах дестабілізуючого інформаційного впливу відбувається на основі захисту інформації від атак, з метою захисту інформації від атак, з метою блокування доступу до інформації. Підключення, що використовується в посадових особах особи підприємства, визначається змістом інформації, яку використовують у процесі роботи на підприємстві.

ОПРЕДЕЛЕНИЕ ПАРАМЕТРОВ ЗАЩИТЫ ИНФОРМАЦИИ НА ПРЕДПРИЯТИИ В УСЛОВИЯХ ДЕСТАБИЛИЗУЮЩЕГО ИНФОРМАЦИОННОГО ВЛИЯНИЯ

Предметом изучения статьи являются модели защиты служебной, коммерческой, конфиденциальной и другой информации, которые используются должностными лицами предприятий при принятии управленческих решений в условиях дестабилизирующих информационных влияний. Целью исследования является определение основных параметров, которые характеризуют систему защиты информации, используемую в организациях, при принятии управленческих решений в условиях дестабилизирующих информационных влияний со стороны социальных сетей, открытых источников и инсайдеров. Задачами исследования являются теория вероятности и качественная теория дифференциальных уравнений. Результаты: на основе проведенных в работе наблюдений и исследований установлено, что принятие управленческих решений должно быть сосредоточено на обеспечении защиты информации, которая включает в себя функции блокирования доступа к информации, принятие управленческих решений, взаимодействие с пользователем.

Ключевые слова: дестабилизирующее информационное влияние; управление риском; настройка системы защиты информации; параметры безопасности; информационное взаимодействие; взаимодействие с пользователем.

Библиографические ссылки / Bibliographic descriptions
