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Determination Method of Some Operational Characteristics of Information Search System in Directive Document Database

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Abstract

The article provides a method for determining some of the operational characteristics of the information search engine in the Directive document database. During this time the life cycle of the system was studied, the schedule of time dependence of the system interruptions intensity was studied. The article states that although there are many interruptions and malfunctions at the start of operation, they are rapidly decreasing over time, and the interruption during the system's normal operation period is random. During the last wear and breakdown of system operation, the intensity of interruptions begins to increase. It also lists one of the possible structures of information search engine relationships. In practice, the basic structure of medium-sized information search engine relations in directive document databases can be represented in the article. Although the Database is located on a local network, the system may have different sources of information and can be located both on the local network and on the global Internet. Monitoring of information search engine operations is organized on the system server. According to the monitoring results, some operational characteristics of the system are calculated and refined over time.

During the monitoring process, various operating characteristics are calculated, starting with the commissioning of the system. This includes the total number of queries, the number of successful and failed surveys, the time intervals between different types of surveys and survey results. such as settings. These parameters calculate the experimental operation characteristics of the information search engine in the directive document database. The calculated characteristics become clearer with time and approach their theoretical estimates. Therefore, it will take some time before the practical results are obtained. However, the results obtained in the article can be used successfully from the start of system operation.

Index Terms: Directive Documents, Database, Technical State of System, System Operating Life, Operating Characteristics.

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1. Introduction

It is well known that the Directive Document Database Search Engine can also be in different situations, like other technical objects and systems:

- Technical condition of the system in accordance with all requirements established by normative and technical documentation;
- Technical condition determined by the system's failure to meet at least one of the requirements specified in normative and technical documentation;
- Technical condition characterized by the fact that the basic mode parameters are within the boundaries set by the normative and technical documentation when performing system functions. This indicates the availability of the system;
- The technical condition, characterized by the absence of at least one of the basic mode parameters during the implementation of the system's functions, within the boundaries defined by the normative and technical documents. This indicates a loss of system capacity;

Effectiveness of any system means that when using this system for its intended purpose, the results are useful. Fault - is an event related to the violation of the working condition of the facility. Due to its inherent nature, the runtime is associated with the breakdown of individual elements or a significant change in the parameters of the object.

The technical specifications of the information search system in the directive document can be largely determined by monitoring the long-term life of the system. By analyzing the operational cycle of the information search engine in the directive document database, we can see that any other technical system cable also has different life cycles. The life cycle of the system can be divided into three parts. The first part can be called the initial operational period, the second part normal life cycle, and the third part the term wear and breakdown as a result of the long operation [1]. Fig. 1 shows the system's interruption intensity $\lambda(t)$ depending on time (first graph). As can be seen from this graph, the interruption intensity is naturally high during the first period but decreases with time. By the end of the first period, interruptions occur in small numbers and are of a random nature. In the second normal operation period, interruptions are random and continue to be low. During the third wear period, the number of interruptions rapidly increased and began to become systematic. The breakdown period is illustrated in Figure 1 (graph. 2). This feature is a feature of many technical systems. The duration of the periods mentioned for different systems may vary. In addition, numerical estimates of the intensity of interruptions or malfunctions may vary with each system's operation. The value of these parameters in information search systems may also be related to the intensity of requests from executors to log in to the system.

It should be noted that the information search system consists of a complex of software tools. Therefore, the reliability of the system at all levels also depends on the faultless, reliable operation of the software and individual modules [2, 3]. The main reasons for software module defects are usually interface failures between individual modules, failure to transmit data, and no reliable means for detection and correction of distortions. Reliable access control of data from communication channels should be implemented.

The following factors can affect the reliability of the systems:

- The technical capabilities of the systems themselves;
- Availability of technological equipment for repair and maintenance works;
- Objective and subjective capabilities of the system specialists.

A mong the causes of interruptions and malfunctions that occur during system maintenance are:

- High operational intensity, non-compliance with operational requirements;
- Inadequate repairs;
- Non-compliance with technological requirements;
- Poor performance of executors, etc.

The article examines some of the characteristics of the normal search engine information system in the Directive.

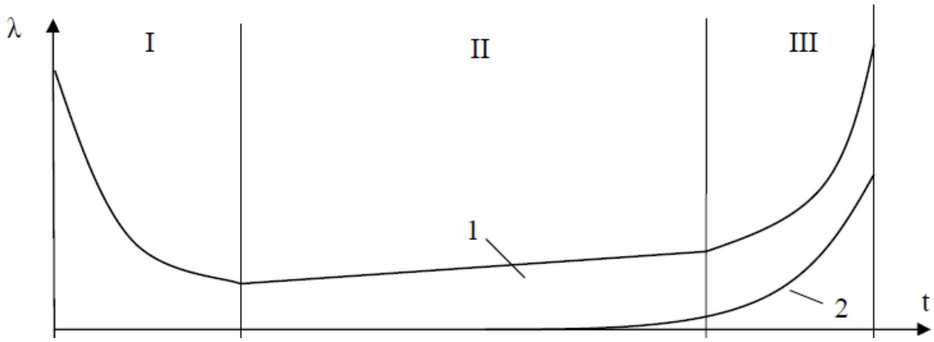

Fig. 1. Time intensity of interruptions: 1– graphic intensity schedule λ (t); 2 - abrasion curve; I - initial operation period; II - normal operating period; III - transportation period

2. Problem statement

It is possible to visualize the possible structure of information search engine system in the directive database as in Fig. 2.

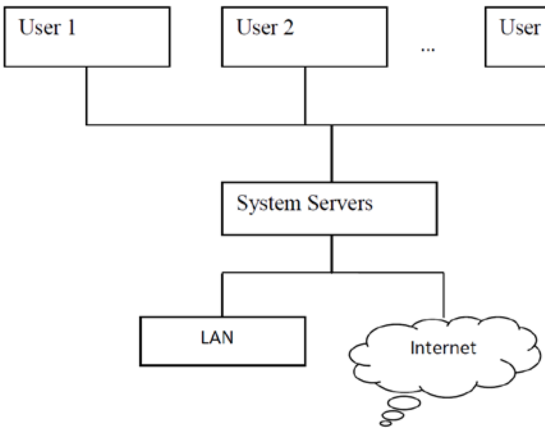

Fig. 2. Structure of communication of information search system in directive document database.

Fig. 2 shows the LAN-local computer network. The number of system users is K. In this system, users of the information search system are integrated with the system server. These compounds were implemented as if they were on a local computer network. Where users are located in a small area, the connections may be made by wireless communication [4]. A directive database within an enterprise can be stored on the Local Computer Network [5, 6]. The structure of this database and the information stored in the database are described in the literature. Information exchange within the system, exchange protocols, protection of transmitted and received data is carried out using modern methods and algorithms [7-10]. The sources of information in the directive database may be different. These may include directives created within the entity, documents created by the higher organizations to which the entity belongs, and documents created by international organizations [11 - 13].

The Directive Database Server can contain a single computer, virtual machine complex, or set of servers, depending on the amount of information stored in the system. One of the key issues to be addressed at this time is the dynamic distribution of computing resources between users and the choice of virtual machines for solving relevant issues. [14-16].

In order to determine the experimental characteristics of the information search system, it is necessary to organize the monitoring of the operations performed along with the main functions of the system server. The following parameters should be calculated separately for each user:

- Total number of requests;
- Number of successful requests;
- Number of failed requests;
- Interview intervals;
- Time intervals between surveys and responses to requests;
- Time intervals between surveys and positive responses to requests;
- Time intervals between surveys and negative responses to requests;
- And so on.

By placing the monitoring results in the Monitoring Database, it is possible to create algorithms for determining the experimental operation characteristics of the information search engine in the Directive document.

3.Monitoring of operations and investigating interruptions in search engines

As mentioned above, system monitoring is performed on the system server. The total number of requests from each system user and the number of successful and unsuccessful requests is calculated during the monitoring. Let i denote the number of requests from each i user, the number of requests from each ith user with N_i, the number of successful requests N_i^+ and the number of failed requests N_i^-. In the case of any inquiries from the ith user to the system

$$dist(D, D^*) = \frac{L(D, D^*)}{\lambda + \lambda^*}$$

$$N_i = N_i + 1 \tag{1}$$

The request results in success

$$N_i^+ = N_i^+ + 1 \tag{2}$$

on the contrary, if the request fails it can be calculated as

$$N_i^- = N_i^- + 1 \tag{3}$$

It is clear that

$$N_i^+ + N_i^- = N_i \tag{4}$$

The main numerical measure of the reliability of the system is the possibility of uninterrupted operation up to t time. The possibility of non-discontinuity means the possibility of failure of the system for a specified period of time under the given operating conditions. Since the system refuses to be a random event, its occurrence at t_0 should also be considered a coincidental event. Therefore, the probability of the system running uninterrupted can be

$$p(t) = p(t_0 > t) \tag{5}$$

In this equation t is given work time. Because interruption and non-interruption work are opposite events the probability of failure in the system for the given t period can be

$$q(t) = q(t_0 \le t) \tag{6}$$

The total of these two probabilities must be

$$q(t) + p(t) = 1 \tag{7}$$

It is possible to experimentally determine the probability of non-interruption before the given t time and the probability of failure search engine in directive database. We can denote these probabilities accordingly $p^*(t)$ and $q^*(t)$. This time

$$p^*(t) = \frac{\sum_{i=1}^{K} N_i^+}{\sum_{i=1}^{N} N_i} \tag{8}$$

$$q^*(t) = \frac{\sum_{i=1}^{K} N_i^-}{\sum_{i=1}^{N} N_i} \tag{9}$$

Can be calculated. By using formula (4)

$$p^*(t) + q^*(t) = \frac{\sum_{i=1}^{K} N_i^+}{\sum_{i=1}^{N} N_i} + \frac{\sum_{i=1}^{K} N_i^-}{\sum_{i=1}^{N} N_i} = \frac{\sum_{i=1}^{K} N_i}{\sum_{i=1}^{K} N_i} = 1 \tag{10}$$

it is clear. To further simplify our calculations lets accept

$$p^*(t) = p(t) \text{ and } q^*(t) = q(t) \tag{11}$$

The validity of these assumptions appears again,

$$p(t) = \lim_{N_i \to \infty} \frac{\sum_{i=1}^{K} N_i^+}{\sum_{i=1}^{K} N_i} \tag{12}$$

and

$$q(t) = \lim_{N_i \to \infty} \frac{\sum_{i=1}^{K} N_i^-}{\sum_{i=1}^{K} N_i} \tag{13}$$

Equality is true. It follows that equations (7) and (10) are the same. Of course, it is impossible to obtain

$N_i \to \infty$ in practice. However, over time, as a result of exploitation, the number of applications received from each user will get higher and higher. Over time, the number of interruptions in the system will begin to increase. Therefore, the value of p is greater than zero, and the value of q is less than 1. We can see this situation graphically in Fig. 3.

Any law that allows to find the probability of an event is called the distribution law of random variable , in other words, the relationship between the possible values of the random variable and their corresponding probabilities (one-sided compatibility). Distribution law can be provided in tables, graphs, and analytics. As mentioned above, during normal system operation, interruptions are random or system reliability is characterized by random interruption. Interruptions in this period are caused by various random factors and have a constant intensity. Therefore, the law of distribution of interruptions during this period may be represented by the exponential law. Exponential distribution is often referred to as the basic law of reliability [17-20]. The exponential distribution can be applied in the normal life of the system until permanent interruption occurs. This law can also be applied to complex systems when addressing service issues. In this case, the exponential probability distribution function of system interruptions is in theory

$$F(t) = \begin{cases} 1 - e^{-\lambda t}, t \geq 0 \\ 0, t \prec 0 \end{cases} \quad (14)$$

It can be provided with this formula. Probable distribution density of interruptions

$$f(t) = \frac{\partial F}{\partial t} = \begin{cases} \lambda e^{-\lambda t}, t \geq 0 \\ 0, t \prec 0 \end{cases} \quad (15)$$

Taking into consideration the exponential probability distribution function of the system continuous operation

$$P(t) = 1 - F(t) = \begin{cases} e^{-\lambda t}, t \geq 0 \\ 0, t \prec 0 \end{cases} \quad (16)$$

It can be provided with this formula.

A characteristic feature of the exponential distribution is that the average value of the interruptions and the average squared difference in the normal operation period of the system are equal.

$$\mu = \bar{t} = \frac{1}{\lambda}, \sigma = \frac{1}{\lambda} \quad (17)$$

and $\mu = \sigma$.

This equation is used as a sign of exponential distribution.

In the formulas (14) - (16), the parameter λ is the average intensity of the system's interruption during normal operating hours. It is seen from comparing (9) - (11) experimental formulas

$$P(t) = p(t) \quad (18)$$

and

$$F(t) = q(t) \quad (19)$$

As can be seen from the graphs in Fig. 3,

$$\lim_{t\to 0} P(t) = 1 \tag{20}$$

$$\lim_{t\to \infty} P(t) = 0 \tag{21}$$

$$\lim_{t\to \infty} F(t) = 1 \tag{22}$$

$$\lim_{t\to 0} F(t) = 0 \tag{23}$$

Using the exponential distribution function, you can calculate the probability of a interruption during the normal operation time of the search document database $[t_1, t_2]$:

$$t_0 = \frac{1}{\lambda(t)} \tag{24}$$

$$P(t_1 \prec t \prec t_2) = \int_{t_1}^{t_2} f(t)dt \tag{25}$$

Probability of interruptions until t time

$$F(t) = \int_{-\infty}^{t} f(t)dt \tag{26}$$

From a practical point of view, the system operates at $t \geq 0$:

$$F(0 \prec t) = \int_{0}^{t} f(t)dt \tag{27}$$

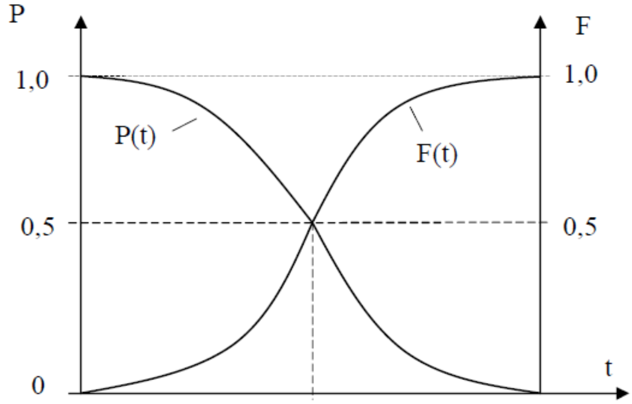

Fig. 3. $P(t) = p(t)$ and $F(t) = q(t)$ functions change according to time.

It is clear from what was said, reliability of the Search Engine in Directive Database is a function of the uninterrupted probability distribution of the system. The reliable operating probability of the system operating until given t time is denoted by $R(t)$ and

$$R(t) = P(t) \tag{28}$$

can be accepted. Taking into consideration, it can be written:

$$R(t) = 1 - F(t) \tag{29}$$

$$f(t) = \frac{\partial F}{\partial t} = 1 - \frac{dR}{dt} \tag{30}$$

One of the key parameters of reliability is the average intensity of interruptions during normal system operation. This parameter is calculated as follows:

$$\lambda(t) = \frac{f(t)}{1 - F(t)} \tag{31}$$

Taking into consideration of (28), (29) formulas

$$\lambda(t) = -\frac{dR(t)}{R(t)dt} \tag{32}$$

can be. Taking into consideration of experimental results from monitoring of the system

$$\lambda(t) = -\frac{N^{-}(t+\Delta t) - N^{-}(t)}{N(t)\Delta t} \tag{33}$$

$N * \Delta t = t_0$ can be written if $N * \Delta t$ is up to the first interruption. This time it is

$$N^{-}(t+\Delta t) - N^{-}(t) = 1 \tag{34}$$

Form here

$$\lambda(t) = -\frac{N^{-}(t+\Delta t) - N^{-}(t)}{N(t)\Delta t} = \frac{1}{t_0} \tag{35}$$

Is obtained. From here it can be calculated the average time until the first interruption in the Information Search Engine in Directive Database:

$$t_0 = \frac{1}{\lambda(t)} \tag{36}$$

4. Result

The article provides a method for defining some of the operational characteristics of the information search engine in the Directive document database. At that time the life cycle of the system was investigated and it was shown that, as in most technical systems, after the system was launched, the intensity of the interruptions was slightly lower, and the system went into normal operation over time. After the period of system failures, the intensity of interruptions and failures increases again. During normal system operation, interruptions and malfunctions are incidental. The article is dedicated to exploring some of the operating characteristics of the system during normal operation. The article provides a medication for organizing system monitoring of users' requests for normal system operation. By monitoring the results of the monitoring, the system has been assigned the distribution function of the probability distribution of interruptions and the distribution functions of the probability that the system will run without interruption. Theoretically, because these functions are represented as exponential distribution functions, parameters of exponential distribution functions are also determined by the results of experimental monitoring. As a result, the intensity of system interruptions and the average time before the first disclaimer in the system are set theoretically and experimentally.

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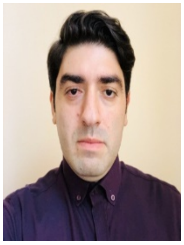

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