# INFORMATION TECHNOLOGIES AND SYSTEMS

## Concept of information

Having defined Information management as information management and management by means of information, it is necessary to agree that one of the main elements of any management of any object is information. The main thesis of the science of management - cybernetics - reads: "the management process always and in any case comes down to the transmission and processing of information." Only on the basis of information in the management system is it possible to carry out a management decision. Information acts as a connecting link between the subject and the object of management, between the subjects of management, between the internal and external management environment, therefore, information support of management is the basis on which the administrative activities of any entity, including government structures, are built.

Modern management processes are quite complex, diverse and are accompanied by the processing of large amounts of information, which is only possible with effective automated information systems. Thus, information turns out to be a key category of information management as a sphere of human activity.

In a variety of theoretical approaches, the concept of information is filled with different meanings, highlighting the individual facets of the whole system of knowledge, called the general theory of information or "informology" - the science of the processes and tasks of finding and accumulating information, its storage, processing, analysis and transformation, as well as transmission and distribution. A modern understanding of information is the result of the development of two approaches: natural science and philosophical.

**Statistical information theory.** The American engineer R. Hartley introduced a quantitative measure of information transmitted over communication channels, (the unit of information is ―bit‖). Then C. Shannon, relying on the works of Hartley and his predecessors, creates a statistical information theory. These works were a kind of response to the ongoing rapid development of

communications, such as radio, telephone, telegraph and television, and made it possible to solve the problem of optimal coding of transmitted signals to increase the efficiency of transmission channels, including their bandwidth, noise immunity, etc.

In accordance with the requests of the time, Hartley and Shannon considered information only as the ratio of signals, signs, messages to each other, that is, syntactic relations. However, the issue of scientific evaluation of information from the standpoint of its content and usefulness, and not just the volume, was no less important.

**Logical and semantic information theory.** A number of authors (I. Bar- Hillel, E.K. Voishvillo, R. Karnap, J. G. Kemeni and others) attempted to construct models of the concept of information, covering its semantic aspect, i.e., semantic, contained in the message relative to some object. In these theories, information was seen as reducing or eliminating uncertainty (entropy). Any information that reduces entropy also reduces the possibility of choosing options, i.e., the number of alternatives, states. In this case, the more alternatives a given statement excludes, the more semantic information it carries. To measure the amount of semantic content of information, the so-called thesaurus measure was most recognized. A thesaurus is a collection of information held by a user or system. Yu proposed this fundamental concept. A. Schreider, according to which the thesaurus is defined as the knowledge of the receiver of information about the external world, its ability to perceive certain messages.

**Pragmatic theories of information.** In pragmatic concepts of information, the thesaurus aspect becomes central, and in evaluating information, its value, usefulness, efficiency, profitability, and other similar qualities that influence the behavior of targeted (self-organizing, self-managing) systems (biological, social, human-machine) become the defining characteristics. In these theories, information was evaluated from the point of view of its usefulness to achieve the goal set by the user.

A striking example of pragmatic information theories is the behavioral (behavioral) model of Ackoff-Miles. The basic concept in this model was the so- called ―purposeful state‖ of the recipient of information. Moreover, it was believed that such a subject had some alternative paths with unequal efficiency to achieve his goal. Thus, it was believed that the message sent to the recipient was then informative when it changed the ―purposeful state‖ of the receiver in connection with its focus on solving a specific problem. One of the weaknesses in the Ackoff- Miles model was the inability of the receiver to evaluate false messages.

The next step in the development of pragmatic theories of information was made by the American logician D. Harrach in his works on the logical-pragmatic model of communication. Harrach's model took into account the social nature of human communication. Therefore, the messages received by the receiver had to go through a certain filter in order to reject ―unusable‖ ones and only after that criteria of pragmatic value could be applied to the remaining (―usable‖) information.

**Cybernetic concept of information theory.** Cybernetics, being the science of control and communication in living organisms, society and machines, formulated the principle of the unity of information and management. This turned out to be extremely important for the study of processes taking place in self- governing and self-organizing biological, social and machine systems.

The founder of cybernetics, Norbert Wiener, developed a concept according to which the control process in the system is a process of processing (converting) information by some central device. This information enters the central device from the sources of primary information - the sensory receptors of the system, and then is transmitted to those parts of the system where it is perceived as an order to perform a particular action. Upon completion of this action, sensory receptors are again ready to transmit information about the changed situation to perform a new action. Therefore, thanks to the movement (circulation) of information in the system, a cyclic control algorithm (sequence of actions) arises.

So, the cybernetic concept of information states that it is necessary to evaluate information as some knowledge that has one value measure in relation to the outside world (semantic aspect), and another measure - in relation to the recipient and the knowledge accumulated by him, cognitive goals and objectives (pragmatic aspect) . In addition, when transmitting information, cybernetics uses as a measure a quantitative unit - a bit (Fig. 8.1).

Syntax aspect

Semantic aspect

Pragmatic aspect

Fig. 8.1. Information Evaluation Aspects

Using the achievements of the above information theories, three measures of the amount **of information can be indicated**:

* syntactic - relates to anonymized information that does not express a semantic relationship to the object;

* semantic - refers to the information perceived by the user and included in the future in his thesaurus;

* pragmatic - evaluates the usefulness (value) of the information received to achieve the goal set by the user (Fig. 8.2).

INFORMATION

Semantic (meaning)

Syntactic (faceless)

Pragmatic (consumer)

Amount of information I

Volume of data Vd

Fig. 8.2. Information Measures

**The semantic aspect.** The consumer acquires the maximum amount of information when coordinating its semantic content with his thesaurus, when the incoming information is understandable to the user and brings him previously unknown information. The amount of information is 0 if:

* ―Everything is known‖ - the message contains information previously known (for example, two times two equals four);

* ―Nothing is known‖ - the message is in an unknown language and cannot be perceived by the user (although the amount of data received is greater than zero).

**The syntactic aspect.** The amount of data (Vd) in a message is measured by the number of characters (bits) in that message (length of information code).

The amount of information (I) about the system received in the message is measured by reducing the uncertainty about the state of the system. Uncertainty is inseparable from the concept of probability. The less likely the event, the more information carries a message about its occurrence. On the other hand, if the probability of an event is 1 (a reliable event), then the amount of information in the message about its appearance is 0.

If I is the amount of information, N is the number of possible events, pi is the probability of individual events, then the amount of information for events with different probabilities can be determined by the formula:

I = – ∑ рi log2рi , where i takes values from 1 to N (C. Shannon, 1948).

**Pragmatic aspect.** The value of the information obtained is determined by the reduction of material and / or time costs when moving towards the goal, due to the use of information. The pragmatic value of information can be negative if an increase in costs has occurred due to the use of such information.

Thus, the integrated assessment of the amount of information contains information measurements from the position of the number of characters, from the position of the amount of semantic load and from the position of the amount of utility to achieve the goal.

#### Approaches to the concept of "information":

* information is a designation of content received from the outside world in the process of our adaptation to it and the adaptation of our feelings to it;

* information is seen as reducing or eliminating uncertainty and entropy; * information is information about persons, objects, facts, events, phenomena and processes, regardless of the form of their presentation [20];

* information is determined by the Shannon formula as the reciprocal of the probability logarithm;

* information is the sum of all the spatio-temporal characteristics of matter; * information is an internal property of a material object;

* information - a message about any fact, event, phenomenon, object, etc. * information in computer science is the abstract meaning of expressions, graphic images, directions (operators) and statements;

* information is a formalized product of converting registered signals into concepts known to the subject;

* information is a connecting link between a subject, having the will and freedom of behavior, and the objective world;

* information is the basis of knowledge accumulated in the course of social development as a result of cognitive activity, as a system of concepts of reality acquired through information.

#### Information quality characteristics:

* completeness (contains everything necessary for its understanding); * clarity (expressiveness of the message in the language of the interpreter); * adequacy, accuracy, correct interpretation, reception of the transmission; * interpretability and comprehensibility of information to the interpreter; * reliability (lack of distortion);

* relevance (its correspondence to reality); * informational content and significance; * availability;

* value, utility.

#### Information Properties:

* information is intangible, but is necessarily associated with any matter,

i.e. inseparable from matter. Example: the dimensions of an object cannot exist on their own as a separate material object;

* information can be transferred from one type of matter to another. Example: the size of an item can be recorded on any material storage medium; * The main carrier of information in space is an electromagnetic wave. An electromagnetic field is simultaneously an information field. Other types of waves are also capable of transmitting information;

* there is a limit to the speed of information transfer in our universe: ~ 300,000 km / s;

* information is not energy;

* with the complication of matter, information increases and becomes more complicated. However, both matter and information have a limit of development (limit of complication) and change cyclically.

#### Information storage forms:

* static state (database);

* dynamic state (movement through communication channels).

#### Types of Information:

* information that serves the processes of production, distribution, exchange and consumption of material goods and provides a solution to the problems of **organizational** management of a company and its links is called managerial. It represents a variety of information of economic, technological, social, scientific, legal, demographic and other content;

* The most important component of management information is **economic** information, which reflects socio-economic processes in the production and non- production sectors, in all bodies and at all levels of government.

**Management information** has three features:

* consistency (reflects the surrounding reality using a system of indicators);

* cyclicity (the vast majority of processes are characterized by the repeatability of their stages);

* bulk (requires information technology for its search, storage, processing and transmission).

**Classification of management information** is possible according to various criteria, for example, characterizing the degree of correlation of information with real reality, with real processes taking place in society. In this case, official and unofficial, general and sectorial, horizontal and vertical information are distinguished. In addition, according to the criteria for compliance with the reflected phenomena, management information can be **reliable and unreliable.** Adjacent to this classification feature is the assessment of the timeliness of information about objects and processes with respect to certain points in time (on time).

Information entering the information system of public administration is called **incoming.** The information system, processing the incoming data, generates new types - **intermediate (preliminary)** and **resultant (summary)** information. Information transmitted outside this information system is called **outgoing.** If the information arrives in the information system from the control object, then such information will be **incoming internal,** if from the outside world or from other organizations (for example, information from the Presidential Administration for the regional authorities), then it is called **incoming external.** Outgoing information is similarly subdivided. Incoming internal information under the conditions of power structures is called **primary.** It arises in the process of primary accounting of operations (measuring and recording data) in the course of the activity of the control object.

Inside structural units of government, information is classified as follows:

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unit;

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the functional purpose and nature of the unit;

in relation to the message of the subject of the management activity of the

according to the type of communication of the structural unit and the

external environment.

For example, from the point of view of the reflected management functions, management information is subdivided into planning, forecasting, regulatory, design and technological, accounting, financial, audit, etc.

In relation to the processing and storage processes, information is distinguished: source, derivative, stored without processing, intermediate, result.

According to the degree of stability, management information can be divided into conditionally constant and variable. The first one is subjected to literally insignificant adjustments, for example, reference information, standards, prices, etc. The second one reflects the results of performing production and business operations and corresponds to their dynamism. Conditionally permanent information is stored on computer media and is widely used in automated data processing in economic information systems.

Information and its flows in public administration can also be broken in this

way:

* by types of sources (federal, regional and municipal levels, government

and state bodies, representatives of the president and the leadership of federal districts, republican and regional administrations and state structures, news agencies of different levels and affiliations, commercial enterprises, public organizations, citizens);

* on the quality of the content (presence / absence of information important for the implementation of certain control actions);

* quantitative characteristics (with the allocation of probabilistic, semantic and other measures of information that are used in the implementation of various management processes).

Classification features for management information are also such as amethod of transmitting information (telephone, telegraph, person, mail, e-mail, fax, radio, television); type of converter (person, machine, person and machine), alphabet (alphabetic, digital, alphanumeric), nature of data recording (fixed and not fixed), method of data recording (verbal and documented) and others.

Information is the basis of **information support** of the public administration information system. Information support is the most important element of the information system and information technology, designed to reflect information that characterizes the state of the managed facility and is the basis for making management decisions. Information support includes a unified documentation system and various information arrays (files) stored on computer media and with varying degrees of organization, as well as a combination of a single system of indicators for information flows (document management options) and for classification and coding systems of economic information.