Lecture 8. Information systems

The purpose of the lecture: introduction to the systemic foundations of information systems and information management.

Lecture plan:
Introduction
1 Information
2 Information system
3 Management information system
Conclusion
Control questions

Keywords: information, support, managers, interpretation, definition, analysis, financial risk, activity, trust, value, information system, work, decision making, organization structure, adequacy assessment, information environment, queue, self-organization, management information system, transaction processing system, provisioning, information message, decision support system, decision support system, decision-making system, expert system, intelligent system, knowledge base, procedural knowledge, information system life cycle, morphological description, functional description, functioning algorithm , Prototyping, model evaluation, ERP, client-server, multi-platform, experience, business process reengineering, Globalization, paradigm, EDM, document management system, CBR, axiom of information system management, amount of information, entropy, flow, object, understanding, pragmatics , identification, semigroup, ma thematic structures, display, tuple.

Contents of the lecture:

Introduction

Information is used for control, but it itself is subject to control actions. The main purpose of these influences is to support information flows and highways that contribute to the achievement of the set goals with limited material and energy, informational, organizational, space and time resources.

1 Information

Consider the above using the example of marketing information management.

Example. Marketing information management - planning and forecasting the behavior of a system, corporation, based on market information, information processes and information technologies in the market, in the field of business, taking into account the behavior and habits of the buyer and seller, their interactive contact, and prompt response. To understand the clients of a firm, its competitors, dealers, etc., one cannot do without marketing research. Note that such research is needed not only in commercial, but also in non-commercial organizations. The university is interested in what kind of reputation it has in the eyes of applicants and students. A

political party or organization is interested in its rating, the opinion of potential voters about its candidates.

Managers can attract highly qualified marketing researchers because it is in their own interest to receive information that allows them to make the right decisions. They should know well the technology of conducting marketing research and interpreting the information received, which consists of the following procedures: defining the problem, goals and setting their priorities; collection and analysis of primary information; analysis of secondary information; recommendations and use of results. Defining the problem – formulating the subject of marketing research: conduct information analysis and find out what information and to clarify what to collect? Analysis of secondary information - analysis of non-obsolete data that was collected earlier for purposes not related to solving the problem under study, especially data collected from independent sources, which is usually very reliable. Possible sources of secondary information: plans and financial statements; sales data; profit and loss data; customer accounts; stock data; the results of previous studies; written messages (current information); customer complaints, standards for measuring performance; periodicals; books, monographs and other non-periodical publications; commercial research organizations, etc. Collection and analysis of primary data – collection and analysis of relevant, "fresh" information to solve a specific problem under study.

It is important to answer the following questions: who or what should be investigated? what information should be collected? who should collect the data? what data collection methods to use? how much will the research cost? what is the data collection method? how long does it take to collect data? when and where to collect information? in what form to collect, how and where to store information?

Recommendations and use of the results allow you to develop and make decisions. Correctly, fully and correctly collected information allows marketers to: get benefits; reduce financial risk; define consumer relationships; monitor the external environment; coordinate strategy and tactics of behavior; evaluate the activities of others and your own; increase the credibility of advertising; get support in solutions; reinforce intuition; improve efficiency, etc. Marketing research is a part of an integrated information process and is influenced by environmental factors (competition, government, economy, etc.).

2 Information system

In many areas and in systems analysis, the concept of "information system" is important. Such a system is often identified with some kind of support (automation) system for intellectual work, in particular, information search, administration, expertise, decision-making, management, recognition, knowledge accumulation, training, etc.

Information system - a system in which its elements, purpose, resources, structure (organization) are considered mainly at the information level (although, of course, there are other levels of consideration, for example, the energy level).

Any information system has the following types of basic subsystems:

1. *information support (data) subsystem;*

2. *subsystem of intellectual support (information, knowledge);*
3. *subsystem of technical support (equipment);*
4. *subsystem of technological support (technology);*
5. *subsystem of communication support (interface);*
6. *analysis and design subsystem;*
7. *subsystem for assessing the adequacy and quality, verification;*
8. *subsystem of organizational interaction and personnel management;*
9. *logistics subsystem (planning and movement of goods and services).*

An information environment is an environment (i.e. a system and its environment) of interacting information systems, including the information updated in these systems.

Example. There are three main approaches to the use of information management in socio-economic systems.

1. *"Public relations" (PR - Public Relations), in which systems for managing socio-economic information are developed and used in order to create a more adequate and favorable environment (including all types of resources), public consciousness for the implementation of the interests of the state, monopoly and person, harmonizing their interests, sometimes contradictory. In this case, methods of polling the population, studying public opinion, advertising, forecasting and modeling are widely used (especially to increase the stability and regulation of systems).*
2. *"Combining the achievements of scientific and technological revolution and man," in which systems of mass training in the achievements of scientific and technological revolution, new information technologies, office work, etc. are developed and implemented. with the aim of human adaptation to systems with increased technical and technological capabilities, requirements for product quality and the ratio "quality - price".*
3. *"Organizational humanism", in which systems of placing workers in cultural, educational, socio-psychological, humanistic and material environments that stimulate their work are developed and implemented in order to reveal their potential capabilities and abilities.*

Example. The technological and socio-economic gap between the countries of the West and the CIS is determined, first of all, not by the lack of qualified workers, a good educational system, resources, but by the lack of an adequate system of information and economic management, its regulation, and not self-regulation (self-organization), insufficient attention to the third approach to information management. Reforms should take place not to enrich a small group of the population, but to improve the well-being of the working masses (especially the middle class - the base of any state), to ensure its creative and fruitful work. This is the most important and at the same time difficult to ensure in the context of economic reforms.

3 Management information system

A management information system is a system designed to manage both another system and within the system (i.e., as a control subsystem).

There are also 6 main types of information management systems (the type of system is determined by the purpose, resources, nature of use and subject area):

1. *Dialogue system for processing requests (Transaction Processing System) – for the implementation of current, short-term, tactical nature, often routine and rigidly structured and formalized procedures, for example, processing invoices, statements, accounts, warehouse documents, etc.*
2. *Information Provision System – for preparing short-term (usually) information messages of a tactical or strategic nature, for example, using data from a database and structured, formalized procedures.*
3. *Decision Support System – for analyzing (modeling) a real formalized situation in which the manager must make some decision, possibly calculating various options for the potential behavior of the system (varying its parameters); such systems are used in both short-term and long-term management of a tactical or strategic nature in an automated mode.*
4. *An integrated, programmable decision-making system (Programmed Decision System) is designed for automatic, in accordance with the programmatically implemented in the system, structured and formalized evaluation criteria, selection (selection) of decisions; used in both short-term and long-term management of a tactical (strategic) nature.*
5. *Expert Systems - informational consulting and / or decision-making systems that are based on structured, often poorly formalized procedures that use experience and intuition, i.e. supporting and modeling the work of experts, intellectual features; systems are used in both long-term and short-term operational forecasting and management.*
6. *Intelligent systems, or systems based on knowledge (Knowledge Based System) - support decision-making tasks in complex systems where it is necessary to use knowledge in a fairly wide range, especially in poorly formalized and poorly structured systems, fuzzy systems and with fuzzy decision criteria; these systems are the most effective and applied to reduce the problems of long-term, strategic management to problems of a tactical and short-term nature, to increase controllability, especially in conditions of multi-criteria. In contrast to expert systems, knowledge-based systems should, if possible, avoid expert and heuristic procedures and resort to risk minimization procedures. Here, the influence of the professionalism of the staff is more significant, because in the development of such systems, cooperation and mutual understanding is necessary not only for developers, but also for users, managers, and the development process itself, as a rule, occurs iteratively, iterative improvements, a gradual transition from procedural knowledge (how to do) – to non-procedural (what to do).*

A fundamental mistake with fatal consequences in information systems is making wrong strategic decisions and criteria for evaluating decisions.

Example. At the dawn of the computerization of schools, many regions made a decision: to equip schools with computers as soon as possible; as a result, many of them then could not get rid of the imperfect, unadapted for teaching tasks (KUVT, UKNTs, DVK, etc.) and get modern technology, since in fact they had technology.

A strategically correct approach in this situation would be an approach according to the principle: "we will wait until the muddy water subside, then clear water will flow."

When building (choosing, adapting) an information system, two main concepts can be used, two main approaches (the third concept is a combination of them):

- *focus on the problems that need to be solved using this information system, i.e. problem-oriented approach (or inductive approach);*
- *focus on technology that is available (updated) in a given system, environment, i.e. technology-oriented approach (or deductive approach).*

The choice of the concept depends on strategic (tactical) and (or) long-term (short-term) criteria, problems, resources.

If at first the possibilities of the available technology are studied, and then the actual problems that can be solved with their help are determined, then it is necessary to rely on a technology-oriented approach.

If, first, actual problems are identified, and then a technology is introduced that is sufficient to solve these problems, then it is necessary to rely on a problem-oriented approach.

Errors in the choice of approach (problems, technology) can lead not only to erroneous strategies and (or) tactics, but also to the complete collapse of the system.

At the same time, both concepts of building an information system depend on each other: the introduction of new technologies changes the problems being solved, and the change in the problems being solved leads to the need to introduce new technologies; both affect the decisions made.

The high cost, importance, relevance of information determine the goals and importance (priorities) in the management of information systems (in information systems).

System design (development) and use of the information system must go through the following life cycle of the information system:

1. *pre-design analysis (experience in creating other similar systems, prototypes, differences and features of the system being developed, etc.), analysis of the external manifestations of the system;*
2. *intrasystem analysis, internal analysis (analysis of system subsystems);*
3. *systemic (morphological) description (representation) of the system (description of the systemic goal, system relationships and connections with the environment, other systems and system resources – material, energy, information, organizational, human, spatial and temporal);*
4. *determination of criteria for adequacy, efficiency and sustainability (reliability);*
5. *functional description of the subsystems of the system (description of models, algorithms for the functioning of subsystems);*
6. *prototyping (mock-up description) of the system, assessment of the interaction of subsystems of the system (development of a mock - the implementation of subsystems with simplified functional descriptions, procedures, and testing*

the interaction of these mock-ups in order to satisfy the system goal), while it is possible to use "mock-ups" of criteria for adequacy, stability, efficiency;

7. *"assembly" and testing of the system - the implementation of full-fledged functional subsystems and criteria, model evaluation according to the formulated criteria;*
8. *system functioning;*
9. *defining goals for further development of the system and its applications;*
10. *system maintenance - clarification, modification, expansion of the system's capabilities in the mode of its operation (with the aim of its evolution).*

These stages are fundamental to information systems reengineering.

Example. To solve the current tasks of doing business, taking into account heterogeneous corporate interests, special enterprise resource planning (ERP) systems are used, as a rule, based on remote ("client-server") access to a single database and unified, predefined business processes, transactions, with open multi-platform architecture. ERP systems allow different organizations (geography does not matter), with different information systems to create a common integrated information system, using the experience and solutions developed by the ERP supplier.

Example. Reengineering of business processes (BRP) is especially relevant, i.e. process of reintegration and rationalization of production processes. Reengineering is not only a reduction in the dimension and complexity of the system, not only restructuring, not only a reduction in the number of management levels, not only the desire for automation, but a fundamental, systemic revision of the entire system (i.e., its problems and resources), with the aim of significant (for example, ordinal) improvement of indicators of its efficiency, stability, profitability, viability (not only strategic, but also tactical). This is the imperative of the time, of modern production (goods, services, knowledge), since problems often (before reengineering) need to be divided into hundreds of smaller ones, teams - into hundreds of smaller working groups, knowledge must be involved both specialized and of a wider range, allocate resources - for example geographically. All this must be coordinated in terms of time, space, structure (organization), and the number of managers increases dramatically.

Example. Globalization (markets, production, competition, etc.) makes its own requirements for the convergence of national management systems. A new paradigm (i.e. a system of defining concepts, views) of global management (GMP) or global telecommunications management has emerged. It can be called a system of strategic global reengineering based on knowledge, horizontal connections, corporate dynamics (the ability of a flexible online reaction of a company), customer-oriented (product, service).

The information systems industry relies on the following processes:

1. *increasing multimedia, hypermedia;*
2. *increased user friendliness;*
3. *integration;*
4. *increasing openness;*
5. *distribution;*

6. *object-oriented approach;*
7. *metabase of data and information systems;*
8. *multi-agent consideration, etc.*

Recently, the so-called corporate information systems have been considered (designed, developed and used), i.e. information systems on the scale of a corporation, organization.

Examples. Information system of pension payments to the population, information system of health care in the region, information system of exchange activities.

To develop a corporate information system, it is necessary to carry out the following activities:

1. *information survey of the corporation in order to clarify its main goals of functioning, elements, structure, directions, priorities and tasks of activity, information flows and technologies, evolutionary capabilities of the corporation, criteria for assessing the effectiveness of the system (the result of this stage is the project of the information system);*
2. *choose one of the two basic concepts for the development of an information system - problem-oriented or technology-oriented (the result of this stage is the architecture of the information system, for example, a "client-server" architecture with a remote database server, as well as instrumental and other system support, for example, OS UNIX, ORACLE);*
3. *to define the key elements, subsystems, in particular, the corporate database management subsystem, the office automation subsystem, the coordination subsystem, decision making and control, the training subsystem (the result of the stage is the structure of the system and subsystems, for example, using Lotus Notes, Action Workflow, EDMS - Electronic Document Management Systems, CBR Express).*

When developing goals, determining resources, close interaction of the manager, design, development and user link of the system is necessary. False criteria of confidentiality and information protection are unacceptable here, which always negatively affect strategic and long-term planning and forecasting, as well as unprofessional decision-making at every level.

The main slogan of the development of information systems: "The development of an information system is not carried out for the implementation (use) of the information system, but to ensure effective management, operation, planning and forecasting, the evolution of the system, which it informationally supports."

Let us give a number of statements, formulated by us meaningfully in the form of axioms for information systems management.

Axiom 1. The amount of information in any subsystem of a hierarchical system is determined (as a rule, multiplicatively) by the number of signals emanating from the zero-level subsystem (the original vertex) and reaching this subsystem (or entering this subsystem), and the entropy of these signals.

Axiom 2. The entropy of any element of the control subsystem during the transition to a new target state (when changing the target) is determined by the initial (from the zero level) information flow and the entropy of this element.

Axiom 3. The entropy of the entire control subsystem during the transition to a new target state is determined (as a rule, additively, integrally) by the entropy of all its elements.

Axiom 4. The total information flow directed to the control object during the period of its transition to a new target state is equal to the difference between the entropy of the entire control subsystem during the transition to a new target state and the energy of the control object spent by the control object for the transition to a new state.

Axiom 5. The information work of the control subsystem for transforming resources consists of two parts - the work of the control subsystem spent on compensating for the initial entropy, and the work directed at the controlled object, i.e. to keep the system in a stable state.

Axiom 6. The useful work of the control subsystem for a certain period of time must correspond to the total information flow affecting the controlled system (in accordance with Axiom 4) for the period of time under consideration.

The correspondence that allows one to pass from the abstraction "Information" to its concretization "Message" is called the interpretation of information with the help of a certain sign system, a certain alphabet, i.e. the system through which the message is presented. Interpretation of information is always associated with meaning (with semantics) and with understanding (with pragmatics). This type of correspondence is always established when the message is identified with information, when the information is updated.

Information that can be actualized in a certain information system is reflected by a certain mathematical (algebraic) structure (see "Lecture 3").

Example. Often this algebraic structure is a semigroup, and the problem of information transformation is reduced to a well-known problem in the theory of semigroups, namely, to the problem of the identity of words in free semigroups.

Interpretation of information is the transition from the representation of the elements of this mathematical structure to its semantic meaning.

Understanding is the correlation of a given mathematical structure with some elements or systems of the real world (clarification of the pragmatic, for example, economic meaning).

Any interpretation I, which corresponds to some message S, can be estimated by its information content I (S), and, thus, the interpretation is a mapping $I: R \rightarrow A$, where R are given messages, A is given information.

A set, a tuple of the form $B = \langle A, R, I \rangle$ is formally an information system.

Conclusion

The lecture considers the basic system concepts related to information systems, their types, life cycle of information system design, axioms of information systems.

Control questions

See the manual on the organization of students' independent work.