

Application of the information systems in decision-making at the different levels of an enterprise management

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Abstract. Specific features of the information support for the process of decision-making while the enterprise management are considered in the work as well as the architecture of the information systems of a certain kind has been developed. The use of the models during making the analysis in the systems of support for decision-making is developed just as the assessment of the capabilities for these systems are validated at the different levels of management. The goals of support at the high level are examined and the possibility of the use of cognitive images is described as the instrument for data visualization.

1. Introduction

The quality of the information provisioning of management is one of important factors defining functionality and efficiency of the management decisions. The absence of the specialist's support who are engaged in the information activity, managers of the top echelon result in losses of the required information, doubling in acquisition and information and hence, to a low management efficiency.

«In order to overcome summing situation it is necessary to implement a strategy including in-depth analysis of conditions (both internal and external), to focus energy on the assessment of the current technological capabilities that propose different variants of solutions» [1].

The use of the system for support of decision-making at the enterprises makes it possible to optimize the existing channels of the information acquisition and to provide more complete satisfying of the informational needs of administration and the staff as a whole [2].

The questions of the system development for support of decision-making yet remain one of the most actual problems. That is connected with the increasing role of the qualified decision-making in the process of the enterprise management. In order to understand which of the requirements are making demands to these systems and how it is necessary to realize their operation it is required to understand what is the management decision, what properties and characteristics do they have and also to specify which of the functions must be implemented by the specialists and leaders working at the selected level.



2. Materials and methods

As a rule, at the high level of management non-formalized decisions are made, i.e. on the basis of non-formalized problems. Solution with a weak structure is not formalized and is based on the intuition.

Solution is understood as:

- 1) Element of sets of the possible alternatives.
- 2) Normative document regulating activity of organization or management system.
- 3) Verbal or written instruction concerning certain enterprise, action, process or object.
- 4) Regulating consequence of actions for attaining of the set goal.
- 5) Object, number, index or something else representing accomplishment of the set goal. [3]

In this situation control decision is a control action directed at the attaining of a certain goal of organization. It means that the actual control decision is a choice that can be done by the manager or specialist in order to perform the duties specified by the occupied status.

The main goal of the decision-making person is to provide the most efficient variant of the motion to the goals stated before the organization. The distinctive features of just these managing solutions are associated with the following four parameters — these are the goals, consequences, division of labor and expertise.

Parameter of the goals means that a subject of control makes a decision not from his own needs but in order to solve the problems of a certain organization, i.e. in its own interests. Parameter of consequence takes into account the viewpoint, manager chooses the direction of activity for organization as a whole and, actually, his solutions have a considerable effect on the life of many people as well as on the operation of organization itself. Division of labor implies that the managers in organization focus their attention on solution of the appearing problem while the executives are engaged with the implementation of the made decisions. Finally, an expertise shows that in order to make a decision at a certain level special professional knowledge is required, as well as the skills and corresponding authorities.

With the account of the given parameters it is possible to make a conclusion that management at the enterprises faces a number of problems such as a pressure of terms, lack of qualification, lack of the information, rapid changes of conditions. Hence, more certain requirements to the managing solutions are formulated within the frames of enterprise.

In order to understand the essence of the problem it is necessary to involve all of the interested parties and get maximum information from them in order to perform the correct decision-making. In the difficult cases the models of the problem are usually constructed and after that possible variants of solutions are considered with their help. Solution should be made just when its implementation can result to the stated goals. Managing solutions must be really feasible and efficient, they should account for the general and partial restrictions, certain capabilities of the managed system, resources disposed at the enterprise and the real conditions of the operation

An algorithm or the stages of decision-making are difficult to formalize since during a practical accomplishment they do not follow the proposed priority. The more difficult is the problem the more stages should be realized and thus an individual process of the development and decision-making is required (Figure1).

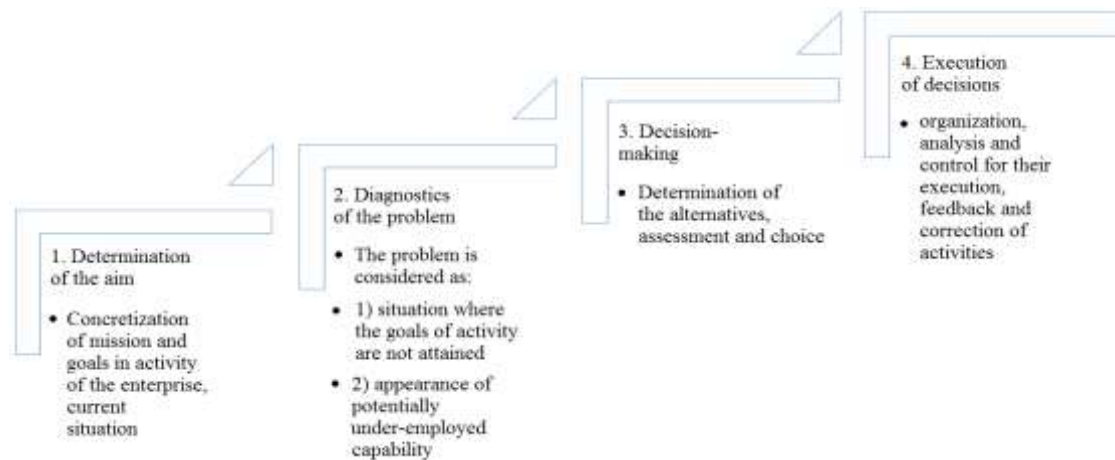


Figure 1. Process of development and decision-making.

The following stages are formally described:

1) Defining of the goal — concretization of the mission and goals of activity of the enterprises, in the current situation.

2) Diagnostics of the problem — enables to consider the problem in two possible ways: as a situation where the goals of activity are not attained or it is considered as an appearance of potentially unused capability. Both variants require management impacts, where:

Criteria — are the goals that should be attained as well as some own characteristics of solutions, parameters, in particular, cost parameters, risk level of activity, level of training.

3) Decision-making — determination of the alternatives, their validity and choice. An alternative represents a set of the possible actions or a sequence of measures that can be undertaken for solution of the formulated problem. These can be as the interconnected actions as those independent ones. Alternatives are developed basing on the previous experience or they can be developed with the involvement of the experts. Estimation of the alternatives is performed with the determination of the costs and results. While validation of the alternatives the techniques such as value analysis, methods of the operational research and various kinds of statistical researches [4].

4) Implementing of decisions — organization, analysis and control for the implementing, feedback and correction of the actions. Implementing of decision implies elimination of the problem that forms the basis. For the enterprise there is a plan of measures with the presentation of executives, their rights, obligations, control measures and other parameters. Analysis implies timely revealing of the possible deviations from the specified program as well as to find the reasons of deviations. Feedback and data correction are organized in case of necessity.

Types of the management tasks define the models that are applied for making of the calculations as well as a set of the initial information and results which will be required for implementation of support while decision-making.

The main task of the informational support of information systems — is systematization of different information obtained from the internal and external sources. For example, during decision-making the information can be obtained from the systems of the operative level — it is the internal source, transaction systems, which are based on the work with clients, paper work with primary data, data acquisition, work with the branches and agencies of the enterprise. Systems of intra-corporative electron circulation of the documents collecting primary documentation are also used as a source of information as well as the documents on the paper carriers and in the electronic form. Informational agencies, presenting information as in the electron form, as on the paper carriers are regarded as the external

sources, as well as the legislation of Russian Federation, international standards and other regulating documents, including information from the clients and companions of the enterprise. [5]

While formation of the informational warehouses first a preliminary validation concerning the amount and content of the information that it is required to keep and also requirements to the structuring of information as well as the capability of maintaining database in the actual state.

Computer system for support of decision-making represents the interactive automated system using the models of decision-making providing an access for the users to the database of the enterprise. Certain specific requirements are lodged to the systems for support of decision-making. This is connected with the fact that the analytical experts are usually interested in difficult requests associated with many aspects of analysis accounting for multiple links between the data; moreover, the requests are subjected to the restrictions for a certain period of time, list of the products, list of resources, different regional limitations and other factors.

While selecting information required for decision-making checkup of correctness is performed, as well as data consistency, filtration, aggregation of data, duplication of the data is excluded and data are reduced to the necessary format used in the chosen systems.

Information warehouse is constructed with the account of the application domain data, their structuring and necessary level of aggregation. As a rule, potential users of such warehouses are the high and middle structural units of management and also system analysts. The users can be also the specialists in formation of the analytical reports.

User interface of the system for support of decision-making require a special attention. It should provide not only the automatic mode of operation but also align for the adaptation to the changing representations of a user, to the type of analytical problems.

Modular structure of the standard analytical units, work with the big data arrays, the use of minimization principle for the information in order to present it to the user sufficient for decision-making and the capability of development of the own analytical modules prove to be a base for construction of the system for support of decision-making.

To solve non-traditional and weakly formalizable problems an exploratory unit is applied. Statistical and mathematical methods should support solving of the problems during all of the management cycle, i.e. starting from the planning stage up to the development of the correcting impacts. Special attention is attended to the planning, management accounts and decision making on the basis of validation the results for the previous periods of time.

Support of decision making assumes the presence of a serious informational support and the use of the corresponding tools. Registration of the operations is performed in the automated accounting systems, local informational systems of subdivisions or subsystems, modules of the common corporative system on the basis of approved policy of organization. Basing on the data about operations management and accounting transactions are formed as well as reports which are acquired, aggregated and as a result they are provided to the management of the company for decision-making in the management.

Thus, from the viewpoint of architecture of the informational systems for the management goals common analytical environment of the enterprise is formed that can be schematically represented in Figure 2.

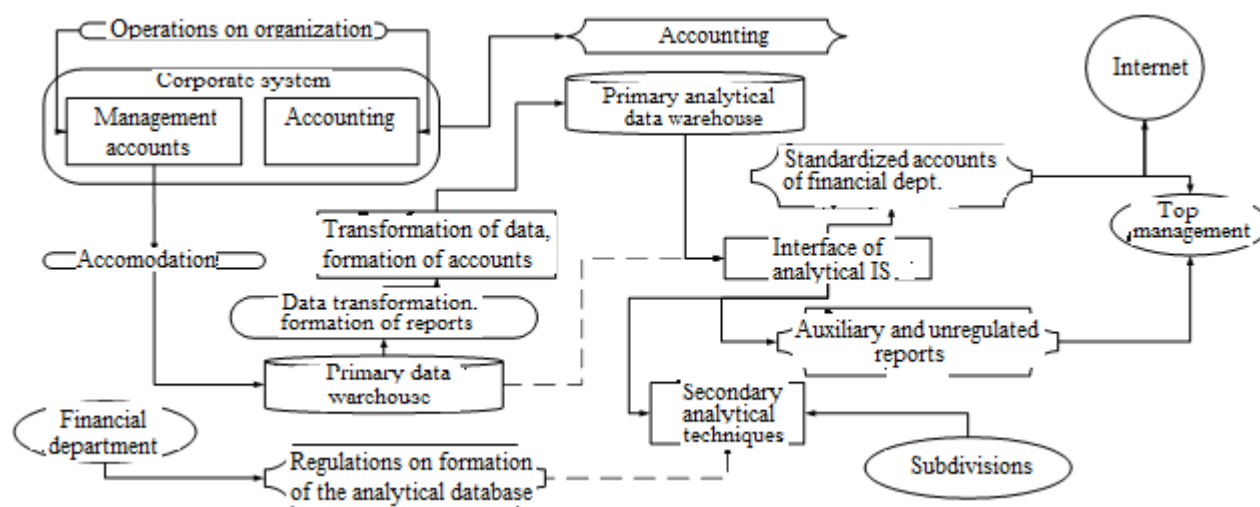


Figure 2. Common analytical environment of the enterprise.

It is stipulated that the primary management data go through the stages of syntax semantic accommodation and then they are transferred to the warehouses of the primary data. The primary data themselves are detailed for each of the operation, client's transaction, for a subdivision or enterprise in a certain area of activity.

Data in the detailed view for the decision-making, as a rule, are not used, since more often a viewpoint is required without extra details. Concrete detailing is performed only in some cases in accordance with a specific demand or request.

Multiple of the raw data is represented with the use of aggregated indexes — these are basic primary analytical indexes. They are determined just from the raw financial data, while the secondary indexes are already calculated on the base of primary indexes. A set of indexes of the primary type, as a rule, is involved in the standard analytical reports while secondary indexes are calculated basin on special techniques in accordance with the requests. Analytical techniques of data transformation are applied for the calculation of the indexes and elimination of inconsistencies in the primary financial data, surely, if such inconsistencies were revealed.

Specific feature of the informational warehouse in the systems for support in decision-making is comprised in the fact that the collected data from the other levels are presented in the warehouses; note that these data are processed in the certain way. Before loading the information into the informational warehouses it is processed, subjected to the accommodation, then it is presented in a common format, filtered and added with insufficient system-wide information, for example, with time scale. In case of necessity, information is aggregated. Note, that information should be oriented at the certain knowledge domain meaning that it should involve data on the certain object and it should be also integrated. This means consistent data storage in the common total-corporative warehouse. Now invariability of data is utilized after their entering into informational warehouse. In other words, the further work with the data is performed only in the form of data reading, using the request form. The necessary requirement to the information concerning business-object is a support of chronological order and the corresponding structuring of data.

A typical form of the aggregation of information for the management of business is the information about business processes, e.g. materials delivery, components, production distribution, manufacturing and so on. Information is presented in the form of the company's production, about its subdivisions, responsibility centers, clients, suppliers, regions as well as time parameters. In order to present structured

information the mechanism of work with metadata is applied meaning processing the data about the involved data.

Specific feature of the process for support of decision-making is just the use of iteration process. It means that a man is a structural unit of management, which uses the system for the formation of different alternatives. So, the system forms new information for the management decision-making. In order that the system could manage and solve this problem it should operate with multiple types of models and handle the data in such a way that the needed information is presented for a specialist in the form sufficient for the decision-making.

As for the architecture of the system the one supporting decision-making includes three basic components: database, models base and program subsystem comprised of the database management system and model base management system. One more element of no small importance is the handling system for the interface between the user and the system (Figure 3).

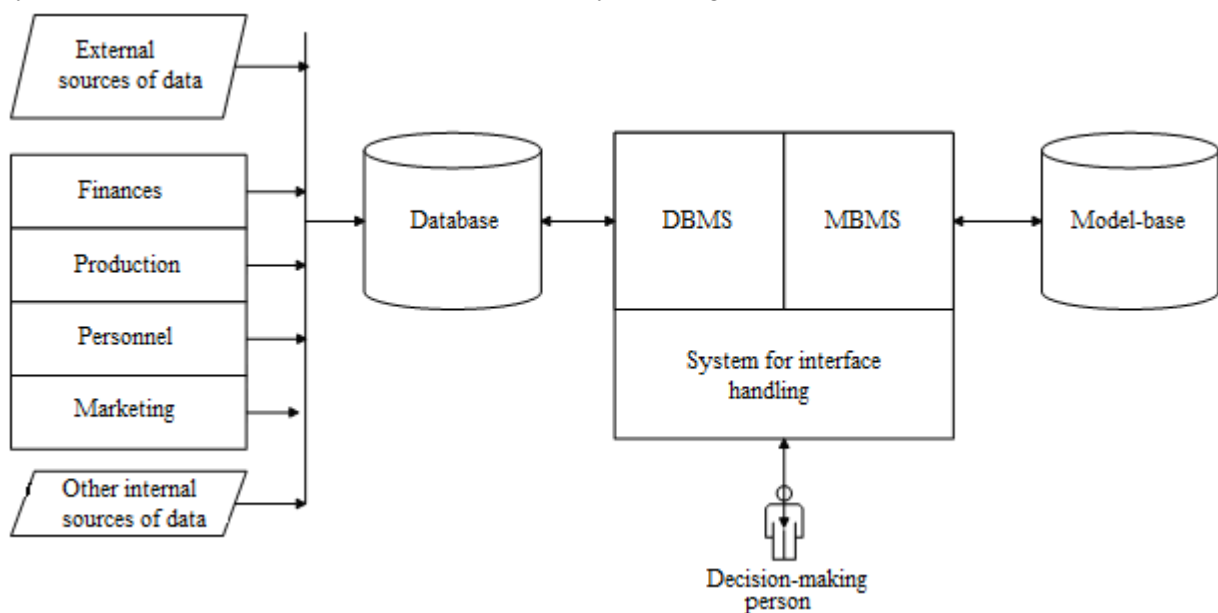


Figure 3. Architecture of the system for support of decision-making.

A part of the information that enters from the systems of the operational level is preliminarily processed. To implement this mechanism two variants can be applied:

- 1) processing of the data by the database management system itself which is involved in the system for support of decision-making;
- 2) processing out of the system requiring creation of a special database — it is more preferable for processing of the large amounts of the information at the large-scale enterprise engaged with a great number of commercial operations.

In order to accomplish decision-making it is important to get information not only from the internal sources but also from the external ones. The latter ones include the data on the competitors, on the world and national economics. This information is collected from the marketing informational systems working at the enterprise. It is stored in the common informational environment or collected with the use of special requests to the external sources of information or to the specialized organizations.[6]

In case of the need for filling of the system for support of decision-making the next source of the data is included — documents, letters, contracts and orders. When processing information concerning suppliers, consumers, key characteristics, dates the system gets new powerful source of the detailed data.

The system of database management should have the following capabilities: compilation of the combinations of data, aggregation, filtration of the data obtained from different sources, possibility for adding and exclusion of the data sources, design of the logic structure for the data in terms of a user, manipulation with unofficial data for the experimental check, possibility of the choice and utilization of additional data and provision of a complete logic independence of this database on the other databases, operating within the frameworks of the company.

The use of the models provides performing of analysis in the systems for support of decision-making. The main goal in the use of models is a description of some object or process in the goal of optimization. With the use of special algorithms the models help to find information and propose solution which is necessary for more efficient management inspiration. Application of the models provides presentation of the variants ensuring flexibility of the system under the changes of different parameters.

Strategic models in these systems are just the models which are used at the highest levels of management in order to state the goals of organization, amounts of resources, required for attaining of activity goals, forecasting of the work of competitors, the choice of variants in arrangement of the enterprises. The feature of these models is comprehensiveness, compressed aggregated presentation of the data and a lot of the indexes.

Tactical models are applied for the planning for more short period of time at the middle level of management, including, among the possible areas of the use — financial planning, planning of demands to the personnel, planning of sales, and also planning organizational structure, production, sales distribution. They can also include aggregated indexes. Solution of the tasks at the tactical level requires a preliminary analysis of information prepared at the operative level.

Operative models are already used at the lower levels of management, in particular, for solving the questions of the operative planning for months, weeks, days, hours. As a rule, for calculations of the model intra-corporative data are applied, as well as the questions of the production planning and resources management.

From the viewpoint of the informational support the system is required for the rapid access to the information that is accumulated by the enterprise, also for the use of logic models, the possibility of finding information in the database on the previous decision-making, information and knowledge of the best specialists including knowledge-base of the expert systems just as the presentation of results in the form that is most convenient for the user's perception.

Informational systems of business-planning that make it possible to prepare forecasts of financial and economic activities are related to the systems of support in decision-making at the higher level, just as to find bottle-necks in management, to calculate economic consequences of the accepted solutions. They allow coordination of work in accordance with certain project works and to enhance controllability for the chosen projects.

Basing on the entered data for different parts of business-plan, and parameters calculations financial accountancy is formed. In brief, it is a report on the flow of funds, accounting balance, profit-and-loss report. The tables of forecast financial indexes, indexes of investment activities are formed as well as the operating statements of business-plan.

Systems of business-planning allow to:

- 1) prepare real forecasts of financial and economic activity;
- 2) reveal in time the bottlenecks in the management of the enterprise using instruments of multi-variant analysis;
- 3) estimate economic consequences at the possible deviations from target plan with the help of financial models and make efficient management decision;
- 4) coordinate operation of the enterprise for the attainment of stated goals;

5) enhance managing ability of the enterprise by operative tracing of the changes in actual production from the planned one due to the operative decision-making.[7]

Development of business-plan using corresponding informational systems ensures efficient assessment of facilities, enterprise assets, estimation of necessity in fundraising, examination of different variants in the enterprise activity and corresponding decision-making on the basis of competent planning.

No less interesting is the use of the systems for support of decision-making at the other management levels. While at the high management level the main form of data presentation is tables, plots, schemes, diagrams, for the operative management level the response speed of a specialist is of a great importance. The use of cognitive images allows for the decision-making person to obtain information in the clear visual view, thus accelerating the process of perception.

Cognitive images represent graphical view of the correlation dependences between variables of the state in the knowledge domain and the images provided by the user. As an example here one can represent Chernov faces. This instrument was used in the world practice in different branches of activities, including management processes in the oil companies. Therefore, it is proposed to use Chernov faces in order to increase accuracy and to reduce perception time of the situation by man. The image that is provided to the user or operator should definitely display situation which describes certain object. It means that the clearly understood borderline states of the face elements are used allowing to determine the kind of interval, associated with the current state of the object. Here each of the elements is correlated with the border position. Thus, all of the possible presentation of faces are divided in three or more intervals: good, satisfactory and unsatisfactory.[8]

One more variant of the cognitive images that was used at the American atomic power stations is simple geometric figures. Here a number of indexes are chosen. Basic factors, such as border areas, maximum and minimum values of parameters and their norm are taken into account. The current state of the system is easily sensed by the operator, while deformation of the figures means the failure of the normal parameters of system operation or safety system (Figure 4).

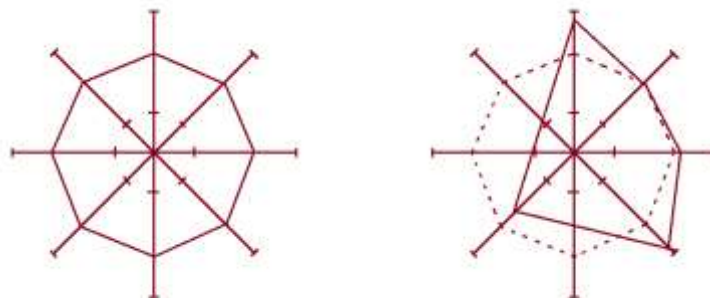


Figure 4. Cognitive images in industry: geometric figures.

The level of help to the decision-making person gradually changes from his passive support to the active one. Active support makes it possible to analyze and summarize information, motivates to a certain activity, thus increasing efficiency of the process of decision-making.[9]

The use of the corresponding informational systems is a powerful tool both as for the leader of organization as for support of decision-making at the other levels of management of the organization.

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