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## **GENERAL MODEL OF THE ELECTRONIC INFORMATION ENVIRONMENT, BASED ON THE MIRRORS CONCEPT**

*The paper considers the mirror concept for the construction of the model of the information environment in order to determine the general composition and functional units of the electronic information environment. The results of the recent studies analysis regarding the solution of the problems, dealing with the formation of the sufficiently optimal electronic information environment, adapted to the specific situation, problem and even tastes of the users prove that its target purpose is not always focused on the main tasks of the situational directions of the user's activity. The needs of the users of electronic information environment are the following information space and its situational operation field must be constructed with the possibility of easy determination of the actions at any moment, assessment of the current state of the system, accessible monitoring of the results. On the base of the theories of the information environment, organization, information systems the definition of the electronic information environment is specified as the set of the hardware and software resources, formed in a single electronic information environment for obtaining the set goals by means of realization of the determined algorithms of the activity processes automation, communication realization, data and knowledge processing with further formation of electronic resources. General model of the electronic information environment is suggested, this model represents the connected set of the models of electronic information space, containing such components (mirrors) as: mirror of the current state of the activity – system of monitoring and control; mirror of the planned (ideal) state of the activity, which is formed as the example of the indices system, description of the technological and control processes, forecast calculations for the innovation projects; decision-making risks, etc; mirrors of variational realizations, depending on the state and possibilities of the external and internal environment. Besides, the strategic mirror of the operation and development indices of the organization and/or the project shows the correspondence of the current (or forecast indices) to the strategic indices. Functional mirror of the activity processes (including automation processes) – availability of the working field of execution or/and reporting regarding technological and managerial processes. Motivation mirror of the activity processes contains the results of the best projects and the description of the best practices, indices for the comparison etc. The suggested model is also presented mathematically. Testing of the concept and the model is performed on the example of the formation of the electronic information environment of the enterprise and university.*

**Key words:** *electronic information environment, web-environment, web-site, mirror concept, information system, cloud electronic resources, vectors of electronic information environment, agents of electronic information environment.*

### **Introduction**

Electronic information environment became the obligatory attribute of human activity. Especially important role the electronic information environment plays in the processes of the professional interaction, realization of the determined tasks, formation of various electronic resources. The list of potential applications, which supplement the electronic information environment grows with every day. Limitations on the usage of such applications are formed not by technical possibilities but by the ability of people to think and use electronic tools and services [1]. The results of study the interaction of the information systems and human; creation of user-oriented design of systems interface, active development of the cross-platform synchronous applications at first sight solve the problem of the formation of rather optimal information electronic environment, adapted for the specific situations, problems and even tastes of the users. But the target designation of the electronic information environment is not always focused on the main tasks of the situational directions of the users activity. Agreeing with different authors that the electronic information environment and its situational working field must be built so that it would be possible to define what actions are possible at any moment, assess the current state of the system, have the possibility to monitor the results of the own actions, it should be noted that the

conceptual model of the system does not always correspond to the determined and realized information modules [2]. If we consider the professional electronic information environment, the conditions regarding the realization of functional tasks, data and knowledge transfer are constantly put forward to the users, and user himself acts as the customer of the information services for performing the set tasks and making a number of managerial decisions. Depending on the level of the user positioning in the system, the scale of his interaction between all the participants of the electronic information environment grows. Active development of the information community, VOIP technologies, introduction of the seamless multiscale information systems in various branches on one hand promotes the development of information technologies and formation of different virtual organizations and on the other hand it requires the development of new approaches and concepts to the formation of the electronic information environment [3].

Theory of the information environment of the organization is that the organization is considered as the living organism that is self-trained and its electronic information environment is formed according to the strategy of the organization development and realization of the functional tasks [4; 5]. We will call the organization any enterprise, institution, project (as the organization form of the activity), entrepreneurship (activity of the separate entrepreneurs both independently and in a team). Various definitions of the electronic information environment (it is also called information-communication; web-environment, etc.) contain, as a rule, its composition as the totality of the hardware and software resources but the analysis of such definitions revealed the necessity of their target specification.

Thus, electronic information environment – is the totality of the hardware and software resources, formed in a single system for achieving the determined aims by means of realization of the algorithms of the activity processes automation, realization of the communication, data and knowledge processing with further creation, storage and application of various electronic resources.

Electronic information environment is a technological base for communication, formation and processing of information, generation and storage of the data and knowledge, it uses modern local and global information networks and technologies. Such virtual space is dynamic and structured, corresponds to the aims and functional processes of the organization and every user. Formation of the electronic information environment as a rule, is performed after the introduction of the information system or/and application of the mobile and network services. It should be noted that modern electronic information network environment can be formed both from the already fabricated information systems (program applications) on the base of browsers interfaces and by means of specially developed programming products. But for various organizations the hybrid model of various programming modules integration, which adapts the existing programming modules to the corresponding strategic goals and functional tasks, is used. If the dynamic structuring of the information is needed and its usage for the decision-making, simplification of the processes of new knowledge creation, data processing, their visualization, realization of virtual communications the problem of optimization of the electronic information environment is urgent and can be solved by means of construction of the models of such environment. The models of the electronic information environment are studied by the researchers from different scientific and engineering directions. Greater part of the publications by the results of the investigations of the electronic information environment deal with the study of the electronic libraries, education environment, virtual space of the software applications, modern information systems (ERP; CRM; BPM, etc.)(3;6;7). The analysis of the publications shows that the studies are divided into such directions: study of the content and structuring of the electronic information resources; study of the functional tasks of using the “working field” of the electronic information environment; assessment of the efficiency of the information systems and resources usage; modeling and optimization of the web-environment. Problems of the formation of the complex model of the electronic information environment are considered insufficiently and require further investigation.

**The aim of the research** is the study of the mirrors concept for the formation of the model of the

electronic information environment and its usage for functional-target realization.

The subject of the research are the models of the electronic information environment and processes of their application for its realization.

Object of the research is the model of electronic information environment on the base of mirrors concept and examples of its realization.

According to the aim of the research such tasks of the research were put forward – formulate the general and mathematical models of the electronic information environment on the base of the mirrors concept; analyze the peculiarities of the determined functional-target realizations of the electronic information environment and projects of its creation.

### General model

General model of the electronic information environment is the connected set of the models of electronic information space and is presented in Fig. 1.

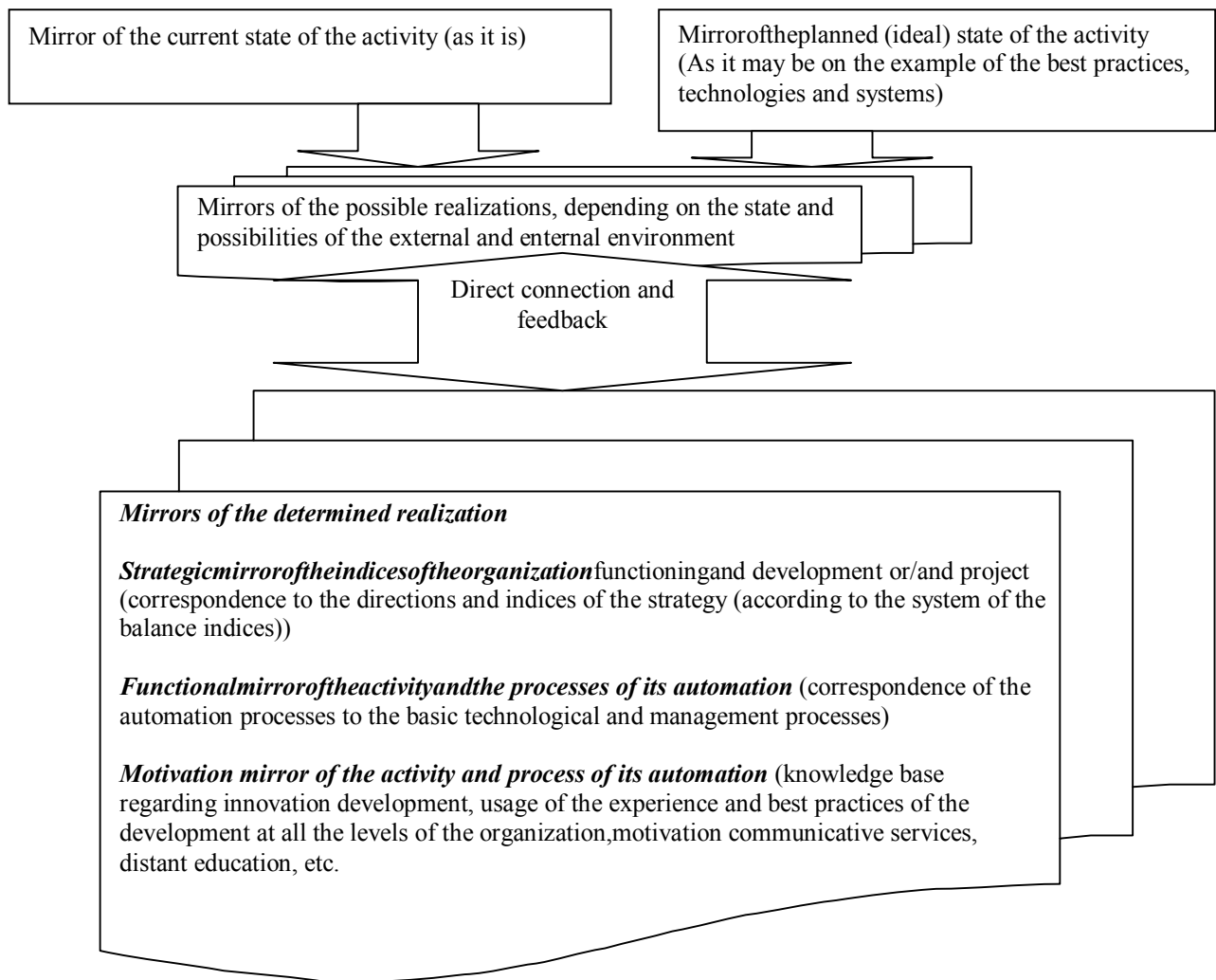


Fig. 1. General model of the mirrors of the electronic information environment of the organization

The model contains such components (of the mirror) as:

Mirror of the current state of the activity – system of monitoring and control over the execution of the technological and management problems, which records the determined indices of the activity according to the accepted system of indices. In authors opinion the most successfully realized system is the system of the balanced indices.

The mirror of the planned (ideal) state of the activity is formed as the example of the system of indices, description of the technological and managerial processes, forecast calculations for the innovation projects; contains the risks calculation of the decision-making, etc.

The mirrors of the possible realizations, depending on the state of the external and internal environment – these are the scenarios of the variational realizations, depending on the availability of the investments, readiness of the staff of the organization, market signals, etc.

Among the basic mirrors we may distinguish:

Strategic mirror of the indices of the functioning and development of the organization or/and project, which reflects the correspondence of the current (or the forecast indices) indices to the strategic ones.

Functional mirror of the activity processes including automation processes – availability of the working field of the realization or/and accounting, regarding technological and managerial processes.

Motivation mirror of the activity processes (the best practices, indices for comparison, etc.).

By means of the analysis and the results of the feedback the mirrors of the realization of electronic information environment are determined.

If we consider main circuits of electronic information control, then it is expedient to distinguish the following – strategic-control; functional-activity; functional-control; motivational. Each of the determined circuits is characterized by the information vector of the actual information, which forms the content by the vector of the information perception by the user [8].

### Mathematical model

Electronic information environment should be considered as the complex and compound module system, which may be presented in the formalized form in the following way:

$$EIS = \langle z_p, z_{pl}, z_{r1...r2}, z_m \rangle,$$

where  $z_p$  – module of the monitoring and control of the current activity;  $z_{pl}$  – planned activity module;  $z_{r1...r2}$  – module of the planned activity realization scenarios;  $z_m$  – module of the motivation circuit of the activity.

Each component can be presented in the form of such expression as:

$$Z = \langle A, ER, B \rangle,$$

where  $A$  – set of agents (programming modules);  $ER$  – set of electronic resources;  $B$  – set of connections between the agents. Connection  $B_j$  with the determined corresponding electronic resources and vectors describes the character of the information interaction of the agents  $A_i$  and  $A_j$  ( $i \neq j, i = \overline{1, N}, j = \overline{1, N}$ ).

Models of the information environment can be presented in the form of the multidimensional space, its dimensions are real data, electronic resources (documents, video-and audio; regulations of their work). Regulations provide the formation of the connections between the agents and vectors.

The mirrors concept is based on the information approach to the formation and analysis of the systems, this approach provides the reflection of the information according to the law of adequacy and reflection [9]:

$$J_{spr} = R_k(J_{spr})J_{pr} = R_k(M_{spr})M_{pr},$$

where  $J_{spr}$  – information of the perception;  $J_{pr}$  – information of the processes;  $M_{spr}$  – measuring indices of the perception;  $M_{pr}$  – measuring indices of the processes;  $R_k$  – relative filling of the

electronic resources.

Linear approximation can be presented in the following way:

$$J_{spr} = R_k J_{pr} = R_k \cdot M_{pr}$$

Reflection of the activity can be presented as the sum of information flows per unit of the information field area.

$$O = dJ/dS/(dS)^2,$$

where  $O$  – vector of the information flow reflection;  $S$  – area of the activity involvement (information field).

According to Gaussian theorem measuring indices can be determined in the following way:

$$M = \oint_S O dS;$$

or

$$J_{pr} = \oint_S O dS;$$

$$J_{spr} = \oint_S R_k O dS = \oint_S O_{spr} dS,$$

where  $O_{spr} = R_k O$  – vector of the reflection intensity;  $O_{spr}$  – vector of the activity involvement, its reflection for user's perception.

The suggested mathematical model can be used for the determination of the intensity of the information reflection, i. e., the level of the reflection involvement and usage of the information flows of the organization activity or its scenario imitation.

### Functional -target realizations

For the testing of the suggested model the following projects were selected: the system of the education process control and support of the scientific and methodical activity of the teachers JetIQVNTU [10]; system of the accounting and monitoring of the staff activity [11]; design projects control environment [12]; interaction environments in the systems of e-commerce, etc.. In the system of education process control by the mirror-monitor of the current state are the results of the teacher and students activity, in particular, scientific-methodical profile of the teacher – rating of the access to the electronic resources; citation indices – activity in the information electronic education environment; education profile of the student – electronic credit card; level of the activity in the information electronic educational environment – results of the testing. Available tools for the development of the data bases of the educational subjects, scientific repository of the university, interaction between the participants of electronic information educational environment allow the participants to have another mirror – mirror of the development of the determined directions of the activity which acts as the motivating mechanism. The important service for the development is the professional community of the teachers and students, personal blogs, online seminars, discussions, etc. Table 1 contains the types of the teacher activity and their correspondence to the modules of JetIQ VNTU system.

Table 1

**Types of teacher's activity and their involvement in JetIQ system**

Types of activity	Module of JetIQ system	Possibilities for the teacher
Education process	Class timetable	Dynamic monitoring of the teacher's timetable from PC and mobile application, colleagues timetable, students groups, finding of vacant rooms.
	File archives	The possibility to store in the system video, audio subcasts and electronic resources of large volume; provide the access to electronic resources.
	Personal Repository	The possibility to store methodical electronic resources for conducting various types of classes and provide the access for their usage; rapid publications, export and import of electronic resources.
	Navigator of the Educational Resources	The possibility to structure and supply the students with various electronic resources for studying the academic subject.
	Jet test-master	The possibility to develop tests and perform the current testing and final control.
	Electronic textbooks and manuals	The possibility to create and use e-books; include the references to them in the subject navigator.
	Electronic Grade book	The possibility to control students performance.
	Communications	Possibilities of the internal communications student-teacher, group-teacher; teacher-group; teacher-student, student-student; teacher-teacher.
Scientific methodical activity	Personal repository	Possibility to store and use methodical electronic resources. Automatic formation of the teachers report regarding the methodical works, published in the repository of the scientific-methodical department.
Scientific activity	Personal repository	Possibility to store and use scientific electronic resources. Automatic formation of the teachers report regarding the scientific papers, published in the repository.
Tutor's activity	Electronic Deans office	Monitoring of the performance and attendance of the students.
All types of the activity	Communications	Possibilities of the internal communications student-teacher, group-teacher; teacher-group; teacher-student; student-student; teacher-teacher.

Electronic information education environment on the base of modern information technologies – is the basis of one of the strategic directions of the development of the higher education institution – establishing of the electronic university. The examples of the realization of the general model of the environment on the base of the mirrors may be the information environment of the system of the accounting and staff activity monitoring as well as the design projects environment. System of the accounting and monitoring is realized in the form of the model of the activity reflection and recording of the main indices and is specified on the example of the improved and generalized Ishikawa model (Fig. 2).

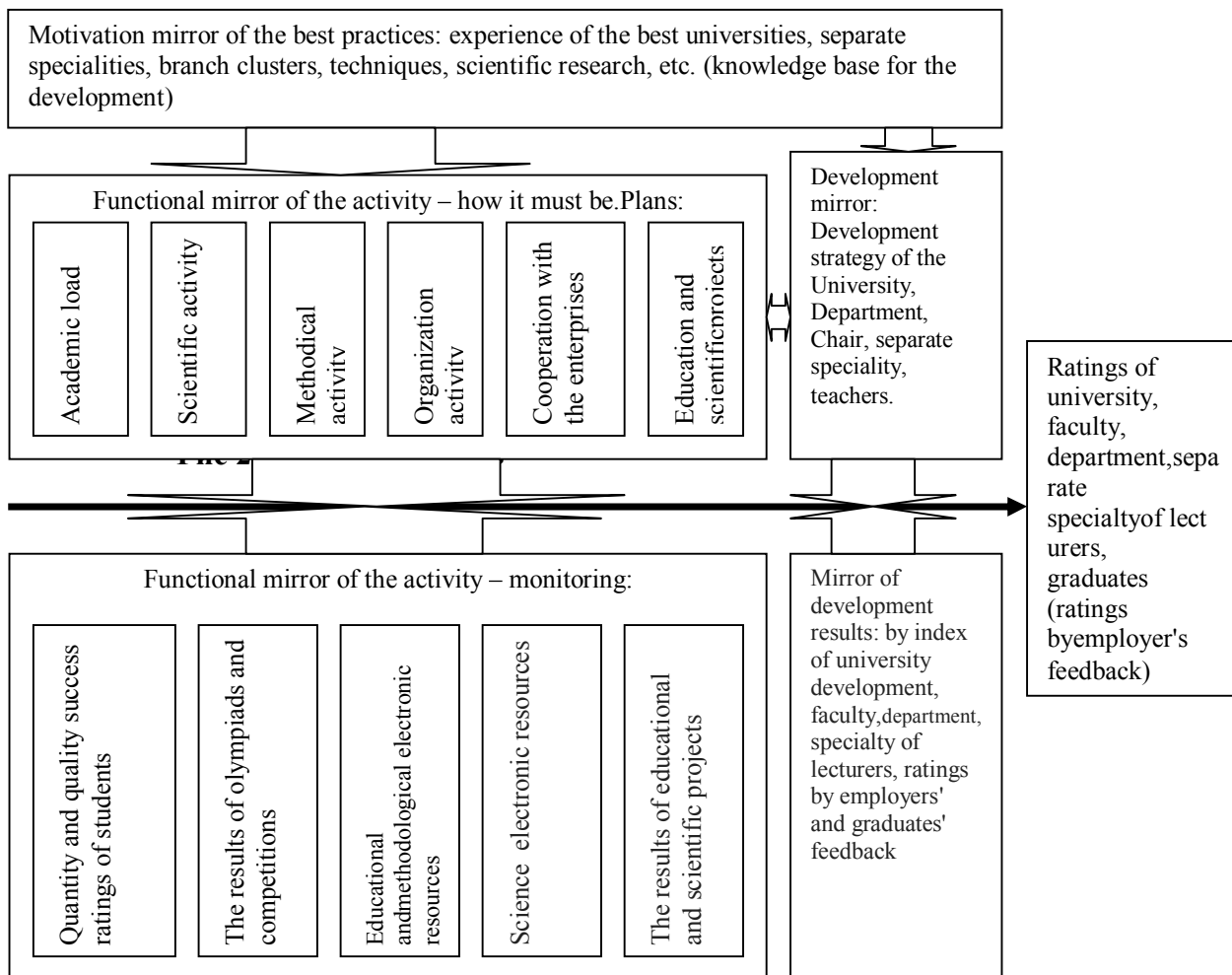


Fig. 2. Concept of the mirrors system monitoring of the teachers' activity on the example of the generalized Ishikawa-model

Model of the design projects environment also can be presented according to the suggested mirror concept. Such system contains the module of the current projects, module of the orders state and employment of the designers; blog, regarding the trends of the modern design development; pages of the references and the information about the cloud services for the designers; module of the finished projects results; module of the social community of the designers.

Thus, the systems in the proposed projects prove the actuality of using the mirrors concept, based on the understanding on the electronic information environment as the set of the reflection of the current activity and motivation services for its development. The suggested approach to the formation of the generalized models can be used for various variational realizations of the electronic information environment.

### Peculiarities of the projects of the creation of electronic information environment

The projects of creation of the electronic information environment are referred to IT-projects and, as a rule, are connected with the processes of the information systems introduction, their restructuring and upgrading. Successful realization of such projects depends on the numerous factors, among which we should mention such factors as the readiness of the organization (structure

and the transparency of the activity; understanding and support of the interested persons in the management of the organization; readiness for the perception of new technologies of the activity realization in the electronic information environment by the staff). Management of IT-projects realized by the appointed team and in special electronic information environment, according to the models of the projects management, in particular, by the models of «eye», «sunflower» [13]. Sunflower model, mainly, draws the attention to the monitoring of the project results. The development of the model from the «sunflower» to the «eye» proves the necessity to concentrate the attention on the dynamic characteristics of the project and its electronic information environment. Three components of the model are formed relatively the basic competence of the project management. Similarly to the electronic information environment it can be determined that its strategic, functional and motivation contours must comprise the objects of management; the content and the context of the environment resources; processes and their technical support; module components and users' behavior support. The presented models of knowledge in projects management and, in particular, IT-projects also correspond to the mirrors concept by the level of the project activity involvement, monitoring of the project state, competence of the participants of the project team. The experience of the implementation of the electronic information environment shows the necessity of taking into account not only the possibilities of the involvement of the directions of the organization activity by the information flows but the level of their application by the users.

### Conclusions

Mirrors concept is the basis of the general model of the electronic information environment.

Electronic information environment can be presented as a set of the hardware, software and algorithmic facilities for achieving the determined aims of the activity.

Formalized description of the electronic information environment can be presented by the mathematic tools of the systems theory and visualized by means of the information models.

The suggested concept is tested by means of the realization of the education process management systems, accounting and monitoring of the staff activity, design projects management.

The obtained results of the research are the base for the formation of the models of electronic information environment of the enterprises, institutions, virtual communities, etc.

The plan of the future studies includes the formation of the functional process models; analysis of the results of the assessment of the intensity level of the information reflection of the electronic information environment.

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