

## Technical Aspects of Creation of HEI's Service-Oriented IT-Infrastructure

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**Abstract:** A model of building IT-infrastructure of the educational institution as a set of independent specialized services is proposed. A model of interaction services based on integration technology and a unified data schema is described. The structure of a typical web-service educational institutions developed.

**Key words:** Integration, data, data schema, inquire model, web-services

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### INTRODUCTION

Complication of functions of modern educational systems in combination with rampant development of informational technologies and participation of various users' groups in higher educational establishments' work lead to necessity of creation of effective informational system of higher educational establishments. Computerization and availability of informational resources is considered as one of the most important means of implementation of a new educational doctrine (Ivashchuk *et al.*, 2015a).

Topicality of subject of the research is conditioned by inconsistency between possibilities offered by new informational technologies and practical level of their implementation in higher educational establishments. Besides, it is connected with a long-felt need in solving (with engagement of automation equipment and modern means of regulation) of the task of provision of balanced management of regions' potential (Ivashchuk *et al.*, 2015a, b). In this study, we consider the concept of building informational system of educational establishment in the form of independent mobile services, which interact with each other on the base of integration technology.

### IT-INFRASTRUCTURE OF A MODERN EDUCATIONAL INSTITUTION

In order to build an effective IT-infrastructure of a modern educational institution, it is necessary to analyze informational needs of various participants of educational processes. Analyzing higher educational establishments, one may single out the range of typical user groups that

utilize educational institution's services, the main of which are: students, school leavers and applicants, academic staff, key personnel and colleagues of educational establishments, Ministry of Education. Each group has its own informational needs, like information about educational institution's structure, information about educational process organization, information about the staff, financial information, information about available educational resources, regulatory and administrative information. It is obvious that different groups of users need different subsets of informational resources of some higher educational establishment. At the same time, it should be noted that information needs of various user groups are partially interlaced with each other (Vikhrev *et al.*, 2014; Kyvlyuk, 2014; Abel *et al.*, 2013).

For the purposes of more competent satisfaction of above described needs, it is reasonable to create an aggregate of specialized services. Considering available informational needs and on the base of studying of existing IT services that are applied in Russian and foreign higher educational establishments, we may single out the following groups of services: educational services, services for managing educational process, social and communicational services, services for supporting scientific and industrial activity, services for educational institutions' management etc.

On the base of analysis of abovementioned groups of services, we may present the structure of integrated informational system of educational institution (Fig. 1) (Morris *et al.*, 2005; Qi Yu *et al.*, 2008).

Each service in this structure represents an independent application, built on the base of the web-services technology and it solves a range of tasks

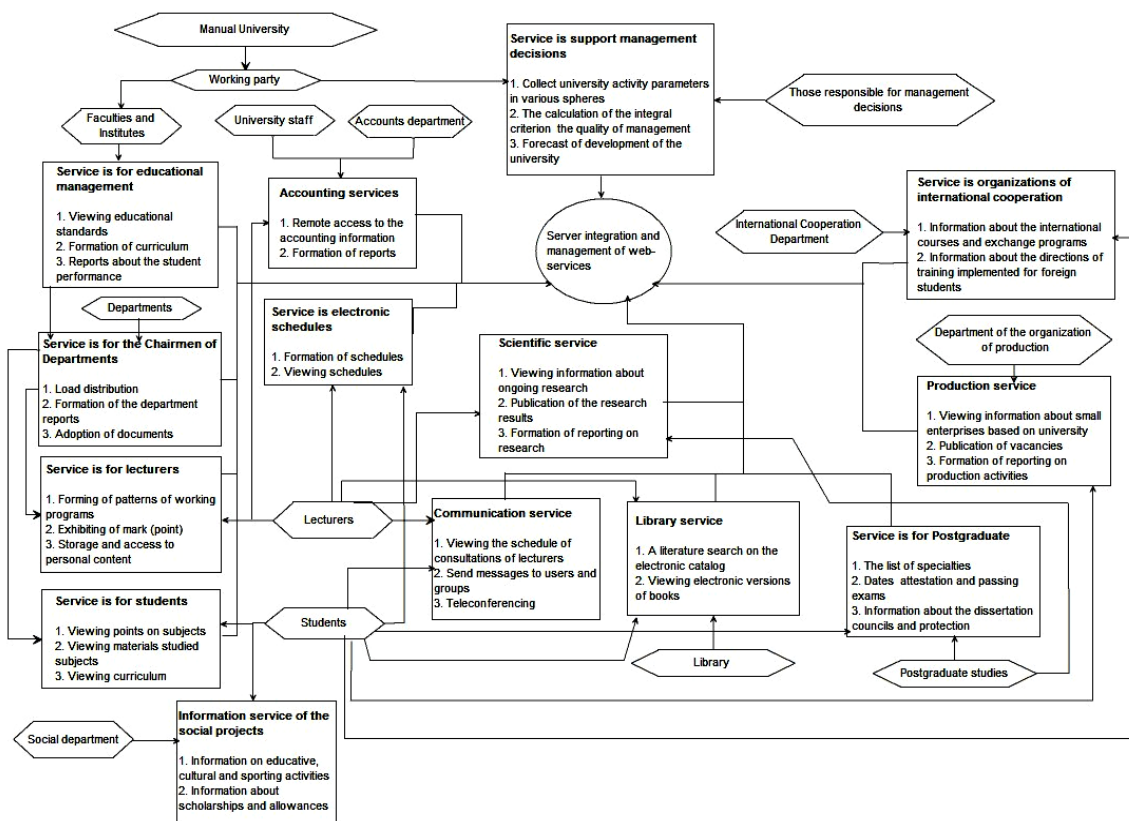


Fig. 1: Service-oriented structure of educational institution

that is specific to it. For organization of cooperation and informational exchange between various services, it is necessary to use integration technologies on the base of Integration Data Schema (IDS) (Uzharinskiy *et al.*, 2014).

Application of technology of informational resources' integration at building informational systems for higher educational establishments acquires particular topicality, considering existing trend towards consolidation of higher educational establishments by means of their reorganization and merging. Implementation of these processes in educational institutions led to some issues, connected with consolidation of their resources and streams. Complexity of this problem is defined by heterogeneity of the structure of kept informational resources and methods of their processing and utilization. Application of technologies of informational resources' integration that are offered in this article with application of unified integrational data schema will allow solving the majority of problems, connected with building unified system of consolidated higher educational establishment. At the same time, service-oriented mechanism of building informational system provides sufficient flexibility and

adaptability to peculiarities of organizations that consolidate while properly satisfying the needs of external users, including those that are included in automated system of managing human resources pool of the region (Ivashchuk *et al.*, 2015a, b).

**THE MODEL OF INTERCONNECTION BETWEEN WEB-SERVICES IN EDUCATIONAL INSTITUTION**

One of the problems that occur at building informational system of educational institution is the presence of decentralized information repositories. Various structural subdivisions use their own databases for storing information. As a result, there occurs the necessity of creation of unified centralized mechanism that would unite all available data sources.

Let us consider the model of typical web-service. By let us  $X = \{x_1, x_2, \dots, x_n\}$  define the multitude of informational objects that are stored in service's data base. Then all multitude  $X:R = \{(X_i, i = 1..M)\}$ , where  $X_i = \{x_j, 1 \leq j \leq n\}$  of the objects that are stored in all data sources may be defined as the combination of multitudes. Each service is directed at solving specialized tasks and needs corresponding informational support.

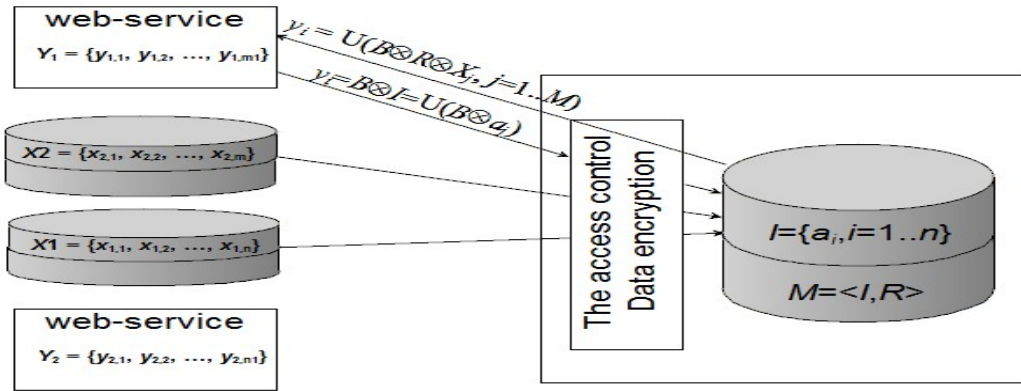


Fig. 2: Model of co-functioning of services on the base of unified data schema

Through the multitude  $Y = \{y_1, y_2, \dots, y_m\}$  we define the multitude of informational needs of this service. Often the multitude of informational needs is not conditioned by data being stored in in-house database solely. It can be said that  $Y \setminus X \neq \emptyset$ . For complete satisfaction of informational needs of a specific service, it is necessary to create a mechanism of informational exchange between various services. Integrating data schema represents such mechanism of informational exchange. By integrating data schema, we mean data schema that describes all objects of subject area and connections between them regardless of physical location of these objects in databases of particular services. Let us define the multitude of integrating data schema's objects as I.

$$I = \{a_i, i=1..n\} \quad (1)$$

Each element of integrating data schema represents a consolidation of sub aggregate of objects of each of integrating data objects in correspondence with selected condition  $a_j = 1 = (X_j, j=1..M)$ , where  $X_j = \{x_k, 1 < k < n\}$  a-sub aggregate of objects of j-source. Thus, we may say that integrating data schema is not reduced to a simple sum of objects of integrated data sources. However, at formation of the object of  $a_j$  integrating data schema as a combination of sub aggregates of objects of integrated sources, one should consider the fact that various sources have various format of data storage (Uzharinskiy *et al.*, 2014). In this connection, for performing the abovementioned operation one needs to adjust selected sub aggregates to unified format. In order to do this, let us introduce the aggregate of operations.  $R = \{r_i, i=1..l\}$ . This multitude is built on the base of extended mechanism of relation algebra, complemented with operations on the data of various formats. As a result, we will get the formula for forming objects of integrating data schema:

$$a_j = 1(R \otimes X_j, j=1..M) \quad (2)$$

Integrating data schema together with the set of operations for its formation comprise an integrating data model Physical implementation of integrating data  $M = \langle I, R \rangle$  model on integration server is an integrated data base.

Let us take a closer look at the aggregate of informational needs for selected service  $Y_i$ . Each element of this multitude  $Y_j$  is a sub aggregate of objects of integrating data schema, selected in correspondence with given conditions, Let us define the multitude of conditions, put on selected data through  $B = \{b_i, i=1..k\}$ . In this case, the query to integrating data base may be represented in the following way:

$$Y_i = B \otimes I = 1(B \otimes a_j) \quad (3)$$

Applying Eq. 3 instead of  $a_j$ , we get general formula that describes the work of integration server:

$$y_i = (B \otimes R \otimes X_j, j=1..M) \quad (4)$$

General model of services' co-function is represented at Fig. 2 (Hafiddi *et al.*, 2012). Web-service  $S_i$  which is in need of the data, forms a request  $y_i$  to integrated data base. Integration server analyzes multitude of objects that are covered by the query. For each object, queries to sources  $X_j$  are made which form object. Then data sampling is made on the base of integrated sources in correspondence with selection conditions, Obtained results are transformed to be unified in one format and are united, forming final query result. Obtained result is returned to the server.

### **TYPICAL MODEL OF WEB-SERVICE OF EDUCATIONAL INSTITUTION**

On the base of above described mechanism of web-services' co-functioning, we may define a typical structure of the service of educational institution. This structure consists of three modules. The first and the third modules are universal ones and are used by each service. Typical structure of a web-service at HEI is discussed here:

- Module of authentication and security
- Module of implementation of services' logic of work
- Module of data access on the base of integrated data base

Module of authentication and security contains methods for identification of services' users, by defining their rights as well as by providing security and data encryption while performing their transmission. Module of implementation of services' logic of work is in charge for processing and presentation of data and directly implements service's potential. Module of data access on the base of integrated database offers a universal mechanism for access to all informational resources of higher educational establishment. Application of described service structure allows simplifying the creation of new services to the extent possible at the account of using typical authentication and data access modules. All that developers need to do is just to describe the logic of service's work which implements its potential.

### **CONCLUSION**

The model of building informational system for HEI, described in this article in the form of a set of independent specialized services will help enhance the quality of satisfaction on informational needs in various user groups at the account of providing them with specialized tools for solving these tasks. Besides, developed model will help providing effective intellectual support to decision-making and actualization of effective management decisions as for balanced formation and development of staff potential in the region.

The model of co-functioning of educational institution's services' on the base of integrating data schema, offered in this work, provides a universal mechanism of accessing informational resources for all services, which simplified building and integration of new services into informational structure of higher educational establishment. It should be noted that application of offered integrational technology will help resolving the task of unification of informational resources at creation of support HEIs.

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