Analysis of technical university information system

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Abstract. The paper covers a set and interaction of the existing higher education institution automated control systems in ф state budgetary educational institution of higher professional education "Industrial University of Tyumen ". A structural interaction of the existing systems and their functions has been analyzed which has become a basis for identification of a number of system-related and local (related to separate modules) drawbacks of the university activities automation. The authors suggested a new structure of the automated control system, consisting of three major subsystems: management support; training and methodology support; distance and supplementary education support. Functionality for each subsystem has been defined in accordance with the educational institution automation requirements. The suggested structure of the ACS will solve the challenges facing the university during reorganization and optimization of the processes of management of the institution activities as a whole.

1. Introduction

The first two stages of integrational transformation at the level of the RF Ministry of Education had been accomplished by the beginning of 2016, which resulted in the establishment of 10 Federal and 29 national research universities. The third, decisive stage of the reorganization of higher education institutions has come: an establishment of regional base universities when a pool of the state leading higher education institutions will be finally formed. They will assume major responsibility for training highly qualified specialists for various branches of national economy of the Russian Federation [1].

IT penetration into basic management processes and modernization of the university management system are among the key directions of the base regional technical universities development.

One of the factors affecting the support of educational, administrative and financial activities of a technical university is a creation and development of common information space by means of modern information technologies. Because of the requirements imposed on base regional institutions in terms of educational process management and control, the old methods of record keeping do not ensure a possibility of effective managerial decision-making, which would be aimed primarily at improving the quality of specialists training [2].

Thus, in today's dynamic environment managing a technical university is impossible without an open and distributed automated control system [3].

In this regard, the task of development of the university automated control system is urgent and will allow solving the following tasks:
- record of all the university internal processes;
- analysis of key performance indicators of the institution;
- optimization of management decisions at all management levels;
- improvement of the learning service quality as the educational institution target function.

2. Materials and methods

Currently, in the Industrial University of Tyumen (IUT), there are a number of systems to automate the workflows of the institution. The automated control system of the university is presented in Fig. 1:
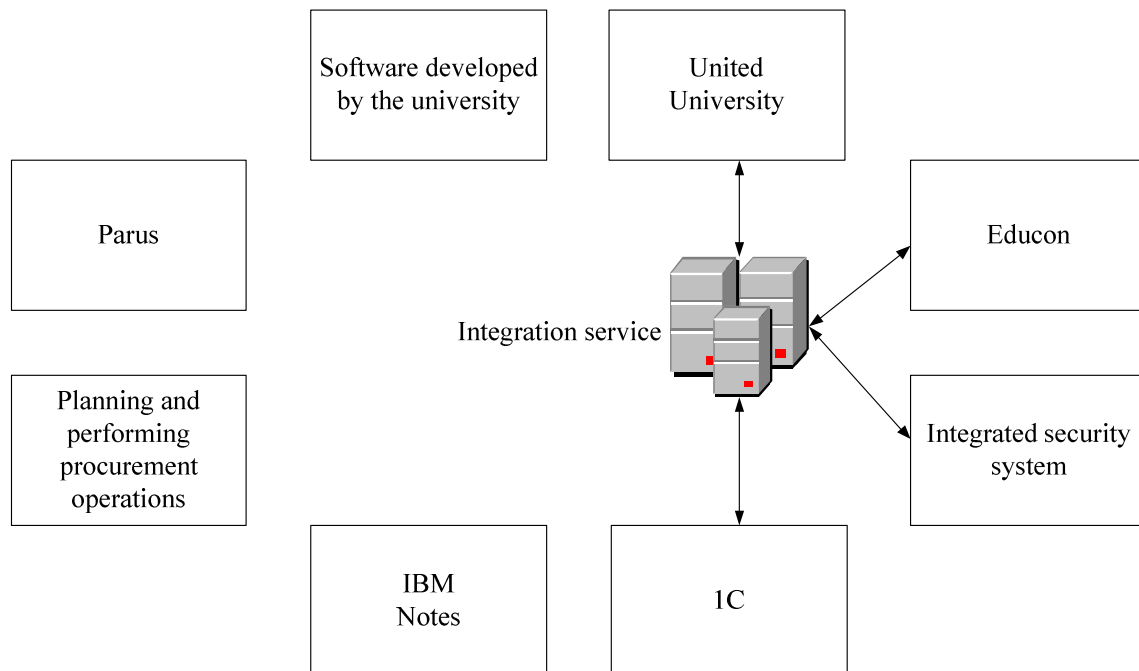
Figure 1. Current automation of the university

Thus, the university automated information system has eight distributed systems, four of which are combined by means of the integration service and four ones are not interrelated. In general, the presented system solves the following tasks.

Currently the UnitedUniversity system allows solving a number of problems related to the automation of academic activities, namely:

a) user authentication to information about students, depending on access rights and its backup [4];

b) recording and keeping personal files of applicants, students and faculty [5, 6];

c) registering training areas / specialties of higher education with the identification of education levels (masters, bachelors, specialists, graduate students), secondary vocational training specialties throughout the university in general and structural subdivisions in particular, as well as in the context of generations of state educational standards. The register includes 160 training areas / specialties (including: 103 of higher education and 57 of secondary vocational training), structured in accordance with 3 generations of educational standards, by 8 basic structural units of the university and 5 branches, as well as by 35 graduate departments and 8 secondary vocational departments;

d) keeping a directory of state education standards (32 SES, 13 FSES of higher education, 58 FSES of higher professional education and 57 FSES of secondary vocational training are in use), which includes:

- the structure of the state educational standard (components, indices, and disciplines);
- the complexity (in credit units and hours);
- a list of competencies and knowledge, skills and abilities;
- conditions of implementation of the state educational standard;
- restrictions and criteria for checking the compliance of the curricula to the standards;

e) curricula import and export in software format GosInsp (Goins) (Federal State Budgetary Institution "Information and Methodology Centre for Assessment of Educational Organizations");

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f) making statistical reports on applicants and students;

g) making analytical reports through integration with Pentaho Analysis, allowing to obtain an operational analysis based on multidimensional arrays of data (OLAP cubes);

h) automation of the university admission board;

i) keeping curricula and calculation of academic and study loads;

j) automated formation of academic calendars for all training areas/ specialties for the entire academic year based on the academic calendars in the curricula;

k) monitoring the students'progress [6].

The Educon system solves the following major tasks:

a) objectified assessment of students' knowledge;

b) distance learning support;

c) students' portfolio formation and maintenance.

The university integrated security system solves the following tasks:

a) protection of personal details by means of specialized software in accordance with the requirements of the Ministry of Education and State Commission for Academic Degrees and Titles;

b) protection of information systems and the university PC users from outside threats;

c) arrangement of the access control and management system.

A set of 1C software products includes the following subsystems:

a) "1C: Budgetary institution wages and HR, edition 1.0";

b) "1C: State institution accounting".

Block "1C: Budgetary institution wages and HR" is intended for HR record keeping and the university staff wages accounting. The system also allows making analytical and statistical reports on the university staff.

Block "1C: State institution accounting" is used for accounting automation, taking into account the budgetary organization specificity.

Software product IBM Notes allows solving the following tasks:

a) arrangement of electronic document flow within the university;

b) setting of execution of instructions;

c) arrangement and control of filling university service requests in electronic form;

d) keeping the university official documents in electronic form.

The university procurement activities planning and conducting include 2 subsystems:

a) the subsystem of procurement planning in accordance with the RF legislation. It allows automating the entire procurement activity from organizations registration and accreditation to the procedure summing up and conclusion of contracts.

b) the subsystem of keeping records of the contracts is used for agreements and state contracts records concluded by the university and their execution control,.

The system "Parus" is designed for students' scholarships calculation.

The software developed by the university is intended for calculation of income from teaching.

After analyzing the university ACS structure and functions, a number of drawbacks of both the system-based (general) and local nature have been identified, namely:

– lack of common information space as a basis of effective automated control system of a complex socio-economic facility (like a base technical university);

– lack of monitoring the system key performance indicators, and as a consequence, the impossibility of assessing the ACS effectiveness in general;

– lack of a decision support system (DSS) based on actual (operational) and objectified data from common information space in real time;

– lack of automated university property accounting, including the warehouse inventory;

– lack of synchronization between the UnitedUniversity system, the students scholarships accounting module and the scholarships calculation system;

– lack of a hostel vacancies distribution module synchronized with 1C and UnitedUniversity;

– lack of a modern electronic document flow system with the possibility of using electronic digital signature;

– lack of supplementary education activity automation;

– lack of a system of automated technical support, including the one by means of the class "helpdesk" system;

– lack of automated administration of user working environment (Active Directory).

It also requires developing the university network infrastructure through hardware and software modernization.

3. Results and Discussion

After the existing management system modernization in accordance with the identified drawbacks, it is proposed to divide the ACS into three components:

1. Training and research support system – TRSS.

2. Management support system – MSS.

3. Distance and supplementary education support system – DSESS.

The structure of the automated control system is presented in Fig.2.
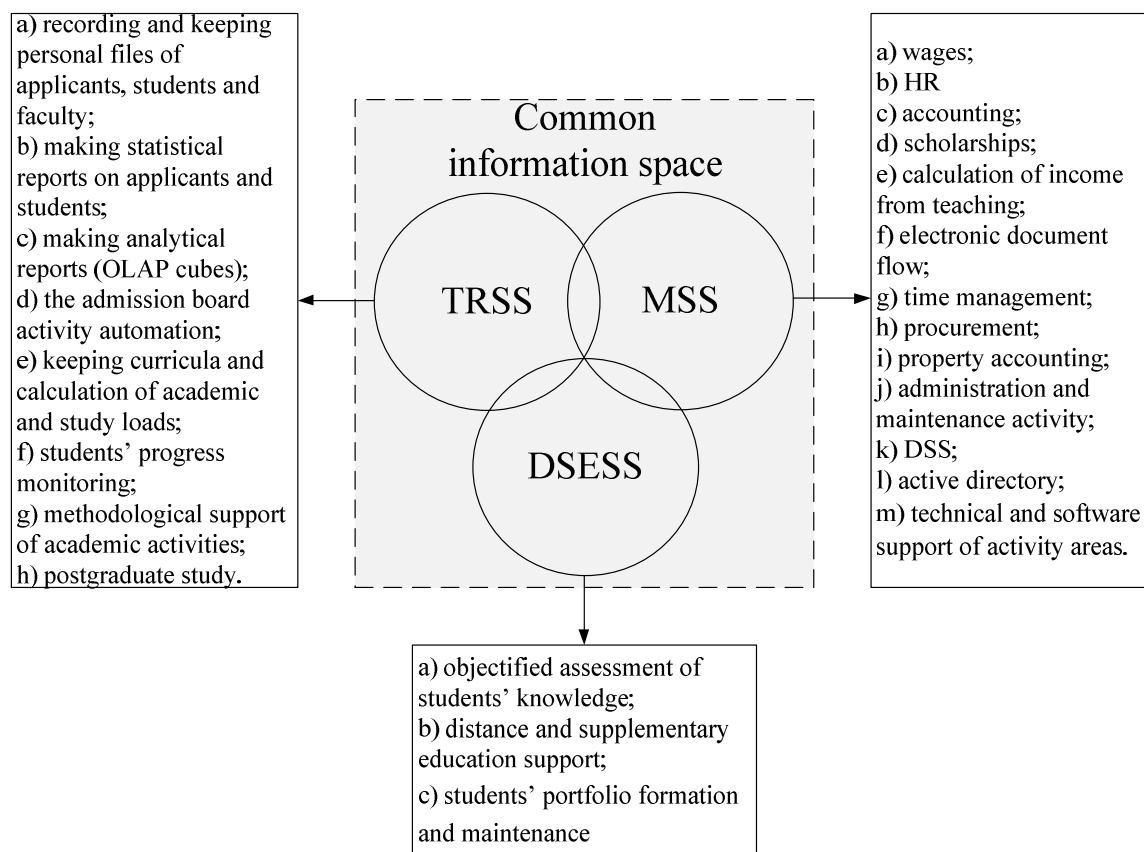
Figure 2. A structure of the automated control system

Thus, such arrangement of the automated control system will allow solving the task of support of all the activity areas characteristic of educational institutions. Information technology environment is presented in Fig.3:
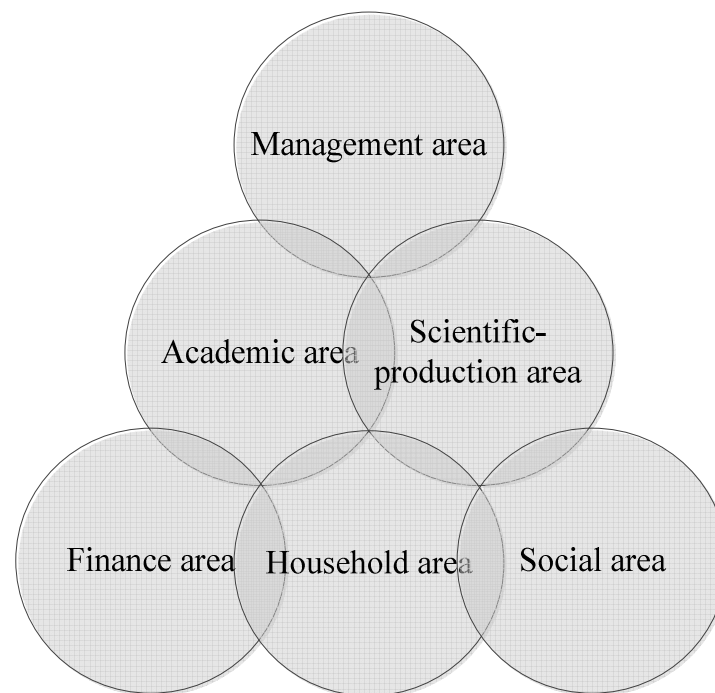
Figure 3. The university information technology environment

There are three basic approaches, within which automation and computerization of higher education institutions major activities are accomplished [7].

The first approach is based on the introduction of commercial ERP systems which are created by third-party firms that undertake the development, introduction and maintenance of automation systems by the results of inspection and optimization of customers' business processes.

The second approach presupposes a formation of automated control systems using universities' own resources. This creates an evolving system, adapted to the peculiarities of a university and providing automation of all its major departments. In this case, the university acts as both a customer and a contractor.

The third approach is based on a mixed use of customized commercial systems and software solutions developed by the university IT services. The scope of third-party firms includes mainly financial and maintenance departments. They use the tools that have approved themselves in the field of automation, for example, "1C", "Parus" and several others. Internal solutions typically relate to academic process management.

The choice of approach is an important task, which largely determines the effectiveness of a system under development.

4. Conclusion

The proposed ACS structure (Fig.2) will cover all the aspects of the university activity, which is a complex hierarchical system with a significant number of structural elements and a large number of connections between them. The proposed subsystems are directly or indirectly interlinked and form common information space, based on databases which accumulate the information about all the areas of university activity and a complex of managerial decision-making support models.

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