

GIMAR 2017**Design and Development of Automation System of Business Processes in Educational Activity**

Kulanda Duisebekova¹, Vassiliy Serbin², Galiya Ukubasova³, Zhaniya Kebekpayeva⁴, Skakova Aigul⁵, Sabina Rakhmetulayeva⁶, Aigul Shaikhanova⁷, Turar Duisebekov⁸, Dinara Kozhamzharova^{9*}

^{1, 2, 6}International Information Technology University, Almaty, Kazakhstan

^{3, 4, 5}Narxoz University, Almaty, Kazakhstan

⁷Semey State University named after Shakarim, Semey, Kazakhstan

Abstract

This article sets the creation of effective electronic document flow model and its in-troduction into an educational institution as its main objectives. Modern computing tools and document flow automation according to the rational organization of work are being used in the process. Methods of system, structural and functional analysis, comparison, analysis and synthesis, modeling and design were all used as the main methods. It is expected to develop a database to work with the proposed system in this article and organize the protection of personal data. To this purpose, we will use methods of relational algebra and block chain technology.

© 2017 The Authors. Published by Global Illuminators. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

Peer-review under responsibility of the Scientific & Review committee of GIMAR - 2017.

Keywords: System Analysis, Functional Analysis, Comparison Analysis, Synthesis, Modeling Of Business Processes

Introduction

In the conditions of rapid progress of the market relations and competitive economy the timely and correct solution of strategic and tactical tasks determines viability of firm, organization. Documentary information constitutes as a basis of management; its efficiency substantially is based on production and consumption of information. In modern society information became a full-fledged resource of production, an important element of social and political life of society. Quality of information determines the quality of management. In modern conditions paying sufficient attention to enhancement of work with documents is necessary - as management decision is always based on information the carrier of which is the document on various bases. Management of business processes is the essential task of the modern organization and solution of it reduces internal costs, improves quality of work, and allows taking control of objective accomplishment processes, to use the innovative capacity of the organization and to raise its competitiveness.

Business processes automation of handling documents guarantees efficiency in making strategic and tactical managerial decisions, provides improvement in service quality that significantly improves efficiency of organization activity (G. Booch, R. A. Maksimchuk, W. Engle, B.J. Young, J. Collen, K.A. Houston. Object-Oriented Analysis and Design with Applications (3rd Edition), Addison-Wesley Professional; 3 edition (April 30, 2007). – 720 p.) The subject chosen by us is of great current interest, as it is known that the organization of work with documents influences not only on the quality, the organization and the standard of work of managerial personnel but also on the culture of rendering services. Success of management activity in general is dependent on how documentation is professionally maintained. According to modern researches, 85% of organization's staff working hours are spent on preparation, maintenance, filling, copying and document transfer. According to ISO (International Standards Organization), management and work with documents becomes one of the main factors of competitiveness of any entity (C.Osterlund, R.J. Doland. Knowledge Flows in Heterogeneous Healthcare Information system Environments. HICSS'09. 42nd Hawaii International conference on System Sciences, p. 1-11.). It means special work with documents and data: coordination of creation processes, changes, distribution. Correctly organized administration

*All correspondence related to this article should be directed to Dinara Kozhamzharova, International Information Technology University

Email: dinara887@gmail.com

© 2017 The Authors. Published by Global Illuminators. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>)

Peer-review under responsibility of the Scientific & Review committee of GIMAR - 2017.

reduces time necessary for search, increases the accuracy and timeliness of information, and eliminates its redundancy. Growth of volumes of information and, respectively, documents, has demanded introduction of new information technologies for timely processing of documents.

The main objective of this work is the creation of efficient model of electronic document flow and its implementation in educational institutions.

Solution of the following tasks is crucial in achieving the objective of the research:

- research of a concept of information technologies, types, specifics and methods of their implementation for the purpose of enhancement of university's document workflow;
- consideration of structure of the market of software products in the field of electronic documentation control;
- classification, comparison and characteristic of these products;
- development of the main criteria of the choice of an effective automated control of documentation system;
- the problem resolution of educational institution, that is in demand of centralized work with documents by means of implementation of corporate electronic document flow;
- implementation of corporate system of electronic documentation control (corporate electronic document flow) within this educational institution.

Object of work is the model of an educational institution within which process of implementation of electronic document flow is implemented. A subject of this work are the processes, work performed during the choice of an effective automated control of documentation system, development of model of educational institution and implementation in it this system.

As the main methods, methods of the system and structurally functional analysis, comparison, the analysis and synthesis, modeling, design were applied.

Scientific novelty of work is in development of criteria of the choice of an effective automated system, on the basis of generalization of the existing theoretical and practical materials. Taking into account practical activities within specific educational institution, the model of the electronic document flow, which allows optimization of work with documents and, respectively, a management activity of educational institution are offered.

The most important elements of electronic document flow are its safety, archival storage of documents and the organization of work with the digital signature which provide effective functioning of corporate system of electronic document flow in educational institution (I.V. Gontarev, R.M. Nizhegorodcev, D.A. Novikov. Project management. Moscow.: Dibrocom, 2009. –384 p.).

The novelty of this paper is that the developed model used first time to automate business processes in the field of education. The article (Development of an Automated Information System University Management 3rd Cyprus International Conference on Educational Research (CY-ICER).Procedia Social and Behavioral Sciences Volume: 143 pp.: 550-554 Publication year: 2014. Abishov, Nurzhan; Asan, Dosmahanbet; Kanat, Amirtayev;. and others) considered the system of automation of the educational process, but the business process is not formalized. This article attempts to summarize and detail-formals call of processes in educational activities.

The novelty of this paper in the developed model, that was used for the first time to automate business processes in the field of education. In the article (Development of an Automated Information System University Management. 3rd Cyprus International Conference on Educational Research (CY-ICER). Procedia Social and Behavioral Sciences Volume: 143 pp.: 550-554 Publication year: 2014. Abishov, Nurzhan; Asan , Dosmahanbet; Kanat, Amirtayev;. and others) the authors consider the system of automation of the educational process, but the business process is not formalized. Our article is an attempt to generalize and formalize the bussiness processes in the educational activity in detail.

Problem Definition

The task of development of new client server system to register students and undergraduates for courses instead of old system is set for the head of information system of university. The new system shall allow students and undergraduates to register on courses and to view of the progress from the personal computers connected to a local area network of university. Professors shall have access to on-line system to specify courses which they will give, and to put down grades for courses, to load materials for a study. The university isn't able to replace directly all existing system. For this reason the database containing all information on courses (the directory of courses), students and undergraduates and teachers is used in the previous form. This database is supported by relational DBMS. The new system will work from the existing DB in an access mode, without updating (P.V. Senchenko. Reasoning the use of

web-oriented technologies during the development of the electronic document flow informational system: [Text]. The studying guide // Problems of the management theory and practices// 2011. – № 6. – p. 33-37).

At the beginning of each semester students and undergraduates can request the catalog of courses containing the list of the courses offered in this semester. Information on each course has to include a name of professor, the name of department and the requirement to preliminary level of training (the taken courses). The new system has to allow students to choose the necessary quantity of courses in the forthcoming semester. In addition, each student can specify alternative courses if any of the courses chosen by him will turn out to be already filled or cancelled. No more than fifteen and not less than seven students can sign up for each course (if less than seven, then the course is cancelled (conditionally)).

In each semester there is time period when students and undergraduates can change the individual curricula. At this time, students have to have access to system in order to add or remove the chosen courses. After process of registration of a student or an undergraduate is complete, the system of registration sends information to settlement system so that the student could pay tuition fee for semester and form the individual plan of work for the current semester. If the course is filled during registration, the student has to be informed on it before final formation of his personal curriculum. At the end of a semester students have to have access to system to view of the electronic sheets of progress. Upon termination of training of students and undergraduates there must be an opportunity to form a transcript. As this information is confidential, system has to provide its protection against unauthorized access.

Professors have to have access to on-line system to specify courses which they will teach and to check the list of the students who have signed up for their courses. Besides, professors have to have an opportunity to put down grades for courses and to form sheets.

To ensure effective activities of modern organizations system of electronic control with documents shall meet the following requirements:

- Scalability. The system shall support various number of users and its capability to increase capacity shall be determined only by capacity of the hardware on which it is established.
- Distribution. The architecture shall support systems interaction of territorially distributed structural divisions of the organization. At the same time various communication channels can be used as means of communication.
- Modularity. The EDFS system shall consist of the separate modules integrated among themselves that provides a possibility of step-by-step implementation of system.
- Openness. The open architecture of system, first of all, allows expanding platform of management of documents in response to emergence of new business objectives quickly. Secondly, it helps to integrate system with other application programs which are used in the organization. Thirdly, it gives opportunity to integrate control of documents with wider strategic initiatives, such as control of knowledge. The system shall have public interfaces for possible finishing and integration.
- Reliability. The system shall possess technical and the software tooling to ensure reliable and smooth functioning of system in case of different types of failures.
- Security. Control flexibility of access to all range of documents, from e-mail to debatable databases, from video clips to formalized documents of all types.
- Accessibility. Possibilities to support the access to documents through web browsers, desktop applications and other generally available types of clients. Support of different categories of users (local, remote, mobile).
- Support of standards. Support of standards at different stages of life cycle of the electronic document.
- Complex functionality (support of complete lifecycle of work with documents).

Automatic support of the distributed management of various information materials (documents) for all their lifecycle, from creation before reviewing, statement, distribution and an archiving. Providing complete lifecycle of work with documents includes automation of work with images of documents, management of records and flows of works, content management and so on (D.A. Krivenko. B.E. Belousov, M.A. Efremov, T.B. Krivenko. The management model of information flows in organizational systems // VSTU Herald. Voronezh, Volume 4, №2, 2008, pp. 118-125.).

Thus, now most of the organizations try to implement such program systems which provide not only means of forming of electronic affairs and control of versions but also have a wide range of possibilities on distribution of documents and information within all the organization. Control tools and knowledge based on web technologies provide support of the document of the oriented business processes.

The companies which as a technological basis use or relational databases (Oracle, MS SQL – "Case" and LanDocs), either the MS Exchange folders (Optima Workflow), or storage of information of own development ("IC:

Document flow"), have problems in ensuring joint operation over documents in territorially distributed corporate environment.

Mathematical Model of the System

According to the analysis, the mathematical model of EDFS (Electronic document flow system) was built and were developed its assessment methods according to various criteria.

Determination 1: Electronic document d_i is called the pair: $d_i = \langle C_i + M_i \rangle$, where C_i – is a document structure in accordance with the selected data pattern; M_i – document content.

Determination 2: Collection – is the multiplicity of electronic documents with a dedicated fixed structure, the content of which has the same thematic focus.

To unify the operations of electronic documents let us consider EDFS as a set of collections. We distinguish two types of metadata: descriptive (semantic content) and structural (structure and properties of documents by which carried out their processing). Determination of structure of the electronic document gives the first prerequisites to the construction of the EDFS architecture (Fig.1).

To optimize the architecture of the EDFS, we have solved the problem of optimizing the document flow of the EDFS. When selecting composite criteria the four variants of solutions were considered:

1. Maximizing the total speed of EDFS.
2. Minimizing the cost of transfer of documents between the structural elements via the communication channels of the system.
3. Minimizing the costs of adjustment and upgrade of electronic document.
4. Minimization of the documents volume stored in the EDFS.

While setting objectives to optimize document flow, the analysis of the possible optimization criteria was conducted, this showed that the document flow optimization can only be achieved by selecting a complex criterion:

$$P_{opt} = P_{xp} + P_{ninf} + P_n \quad (1)$$

where

P_{xp} - cost of data storage;

P_{ninf} - cost for obtaining data from external systems;

P_{npoi} - cost for obtaining data from EDFS storage.

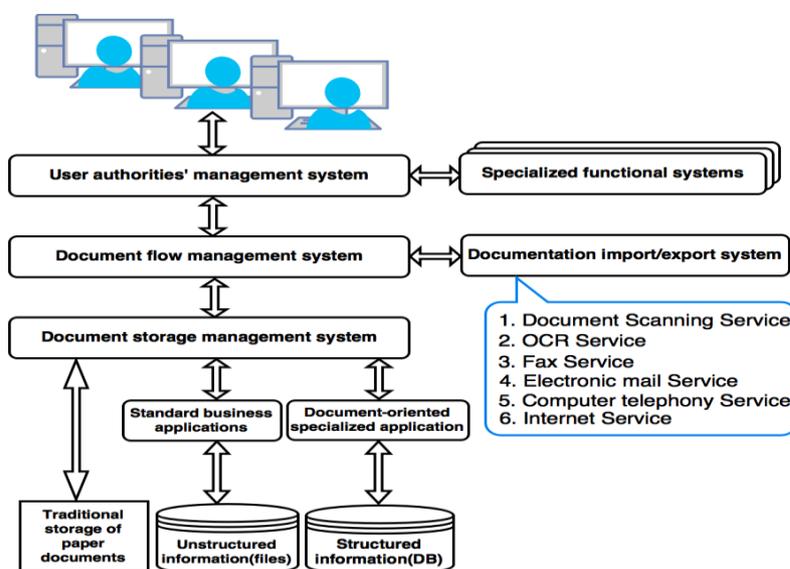


Figure 1: EDFS architecture

The following optimization objects have been identified to set the optimization problem:

- time spend to obtain the required electronic document;
- the cost of transmission of electronic documents between users, EDFS storages, other information systems;
- volumes of the electronic documents stored in EDFS;
- cost for update the electronic document.

Consideration of these objects helped to formulate the optimization problem as follows:

$$\sum_{i=1}^N \sum_{j=1}^{n_i} p_i^{xp} x_{ij} \left(\sum_{k=1}^{n'_{ij}} met_{ijk} v'_{ijk} + \sum_{k=1}^{n''_{ij}} con_{ijk} v''_{ijk} \right) + \sum_{i=1}^N \frac{1}{Q_i} \sum_{j=1}^{n_i} p_i^{nsp} t_{ij} \eta_{ij} x_{ij} + \frac{1}{Q'_i} \sum_{a=1}^N \left(\sum_{j=1}^{m_i} p_i^{npol} t_{ij} \eta'_{ij} y_{ij} (1 - x_{aj}) \right) \rightarrow \min$$

$$\sum_{i=1}^N \sum_{j=1}^{n_i} x_{ij} \left(\sum_{k=1}^{n'_{ij}} met_{ijk} v'_{ijk} + \sum_{k=1}^{n''_{ij}} con_{ijk} v''_{ijk} \right) \tag{2}$$

$$\frac{1}{Q_i} \sum_{j=1}^{n_i} t_{ij} \eta_{ij} x_{ij} \leq T_i \tag{3}$$

$$\frac{1}{Q'_i} \sum_{j=1}^{m_i} \tau_{ij} \eta'_{ij} x_{ij} \leq T'_i \tag{4}$$

$$\sum_{i=1}^N x_{ij} = r_j \tag{5}$$

where

H_i - i-th storage of SEDF; I_i - i-th information system;

$p_i^{xp} = \frac{W_i^{xp}}{V_i^{xp}}$ - cost of the information units storage in H_i ;

W_i^{xp} - cost of H_i ; V_i^{xp} - volume of H_i .

p_i^{nsp} - cost of the transmission of an information unit from H_i ;

p_i^{ninf} - cost of receiving of an information unit from

I_i ; $X = \{x_{ij}; i = 1, n; j = 1, n_N\}$; $Y = \{y_{ij}; i = 1, m; j = 1, m_M\}$

n_i - number of electronic documents in H_i ;

N –number of EDFS storages;

$$x_{ij} = \begin{cases} 1, & d_j \in H_i \\ 0, & d_j \notin H_i \end{cases}; \quad y_{ij} = \begin{cases} 1, & d_j \in I_i \\ 0, & d_j \notin I_i \end{cases}$$

$$con_{ijk} = \begin{cases} 1, & C_j^k \in H_i \\ 0, & C_j^k \notin H_i \end{cases}; \quad met_{ijk} = \begin{cases} 1, & M_j^k \in H_i \\ 0, & M_j^k \notin H_i \end{cases}$$

O_i - the amount of memory available for placement the electronic documents in H_i ;

M_j^k - k-th metadata of d_j ; C_j^k - k-th content of d_j ;

v'_{ijk} - volume of M_j^k electronic document d_j in H_i ;

- v_{ijk}'' - volume of C_j^k electronic document d_j in H_i ;
 n_{ij}' - number of metadata d_j in H_i ;
 n_{ij}'' - number of collection components, which represent the contents d_j in H_i ;
 n_{ij} - addressing frequency to d_j in H_i per unit of time;
 R_i - bandwidth of communication channel;
 m_i - total number of documents in I_i ;
 M - number of information systems;
 T_i' - the maximum admissible waiting time of electronic document from I_i ;
 Q_i' - request frequency to I_i ;
 η_{ij}' - addressing frequency to d_j in I_i per unit of time;
 $\tau_{ij} = \frac{v_{ij}}{R_i'}$ -time demanded on transfer of d_j from I_i ;
 R_i' - average bandwidth capacity of a compound communication channel, on which d_j transferred from I_i .

As a set of the variables of the task we choose: matrixes $X = \{x_{ij}; i = 1, n; j = 1, n_N\}$ and $Y = \{y_{ij}; i = 1, m; j = 1, m_M\}$ together with the electronic documents volumes v_i determined by elements of these matrixes; also R_i bandwidth of transmission channels between the user and the data storages of SDEF or information systems where the selected documents contain.

To solve the optimization problem it is necessary to find such coefficients of the equation (2) at which value of $f(x_{ij}, y_{ij}, R_i)$ becomes minimum for this set of values of matrixes of X and Y, at restrictions of memory size and receiving time of electronic documents, set by expressions (3), (4), (5), (6). One of key components of the receiving cost of electronic documents from EDFs is the cost of storage or search of the information.

Database of the System

Corporate database (DB) is created, maintained, and operated under the control of the database server Microsoft SQL Server.

In this article we will look at the development and management of a database using Microsoft SQL Server. Will discuss the strategy of access and retrieval of data, changing data with the instructions; table types and declarative data integrity; complex queries, programming in Microsoft SQL Server in a language T-SQL custom stored procedures, functions, triggers and views; methods to improve query performance, expansion of Microsoft SQL Server functionality. The main database objects are: tables, indexes, views, stored procedures and functions, triggers, etc. During the creation of database, examples of data manipulation statements with database triggers, stored procedures, etc. will be described.

In the article (K. Duysebekova, V.Serbin, A. Kuandykov, D. Kozhamzharova, S.Orazbekov, L. Alimzhanova. The Solution of Semiempirical Equation of Turbulent Diffusion in Problems of Polluting Impurity Transfer by Gauss Approach. 2016 Procedia Computer Science, pp. 372-379.) there were used an algorithm of accessing the data using developed algorithm (see Fig. 3b). After that "Atmosphere Monitoring" software was created. The program opens by running the executable file IZA.exe.

The necessary initial data will be added after the program launched: the amount of pollution sources, the initial wind speed, date, measurements of pollutants, the coordinates of the source of pollution, the height of the observation point. After that one can calculate the air pollution index for each type of pollutant and see a graph of that calculation.

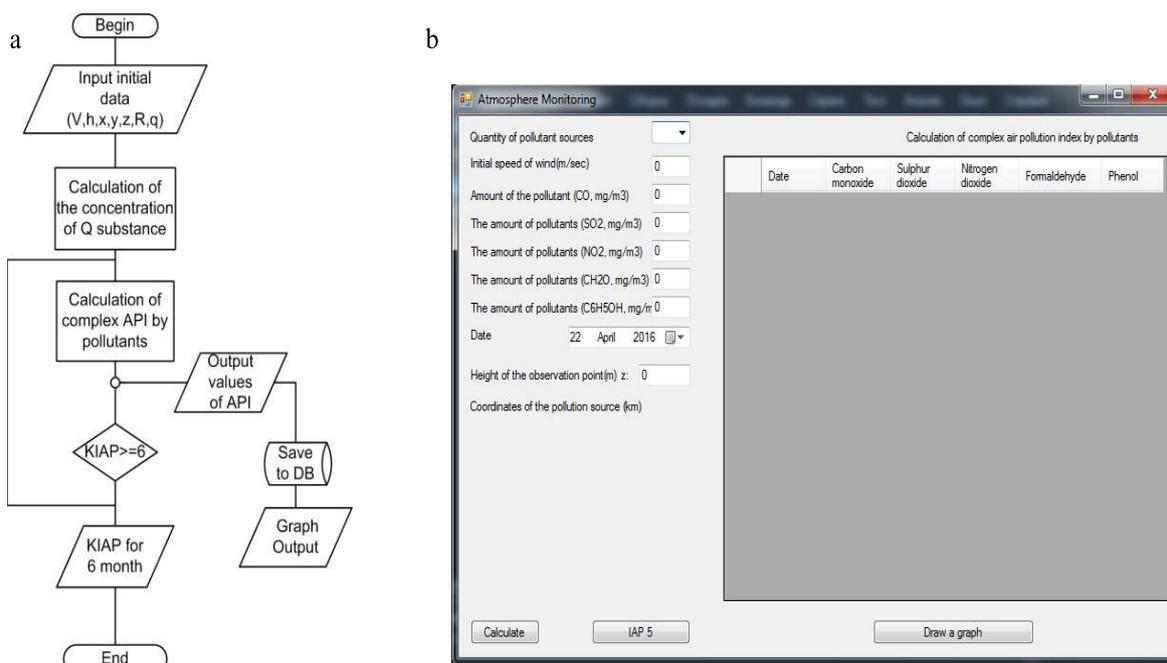


Figure 2: (a) The algorithm of the system; (b) Main window of the program.

Based on algorithm the "Atmosphere Monitoring" has been implemented as a software – to develop this program we used C Sharp (C #) programming language, on Visual Studio - Windows Form Application, for the database we took SQL Server.

The corporate database for this paper also based on SQL Server. Also it is supposed that the we will use the OLAP (Rakhmetulayeva S.B. On the problem of building a large database using OLAP. // Proceedings of the International scientific-practical conference on "Food security in Kazakhstan: Status and Prospects"- Semey, 2012.- pp.273-274.) for processing large amount of data, and for optimal formation of aggregated indicators we will use the methods presented in papers (R.K. Uskenbayeva, Y.I. Cho, G.B. Bektemyssova, N.K. Mukazhanov, D.K. Kozhamzharova, B.K. Kurmangaliyeva. Multidimensional indexing structure development for the optimal formation of aggregated indicators in OLAP hypercube. 2014 14th International Conference on Control, Automation and Systems (ICCAS), pp. 1466-1470, 2014/10/22, IEEE.) and (R.K. Uskenbayeva, A.A. Kuandykov, C.Y. Im, Z.B. Kalpeyeva, D.K. Kozhamzharova. Organization of computing processes in the large heterogeneous distributed systems. 2013 44th International Symposium on Robotics (ISR), pp. 1-4.).

Discussion

We have developed a automation model of business processes in the educational activities, but this model is universal. It can be used in other areas, like robotics(Kuandykov A.A., Kassenkhan A.A., Kozhamzharova D.K., Mukazhanov N.K., Kalpeeva Zh.B, Sholpanbaev A.T.The formalization of the problem area, implementation and maintenance of business process by a group of unmanned vehicles. International Journal of Computer Technology and Applications, - 2013. Vol. № 4(5). – pp. 759-763. And Uskenbayeva, R.K., Kuandykov, A.A., Young Im Cho, Kozhamzharova D.K. The intelligent modeling of unmanned vehicles for solving the tasks of risk

Management in the business processes. International Symposium on Artificial Life and Robotics, AROB 19th 2014 January 22-24, 2014, B-Con PLAZA, Beppu, JAPAN, 935-939 pp. and Uskenbayeva, R.K.,Kuandykov, A.A.,Cho, Y.I.,Kozhamzharova, D.K.,Baimuratov, O.A. Main principles of task distribution in multi-agent systems and defining basic parameters. 2014 International Conference on Control, Automation and Systems (ICCAS), October 22-25 at KINTEX, Korea, Publication Year: 2014 , Page(s): 1471 - 1474, DOI: 10.1109/ICCAS.2014.6987793, Print ISBN: 978-8-9932-1506-9.), with only a change in the input data, stored in the data warehouse without adding changes to the model itself. Also for the first time to protect the personal data there will be used blockchain technology (Rod Collins.Blockchain: A New Architecture for Digital Content. ECONTENT Volume: 39 Issue: 8 pp.: 22-23 Publication year: NOV-DEC 2016.).

Conclusion

The architecture of a common corporate system of electronic control of documents includes:

- system kernel;
- set of the functional subsystems.

During implementation by services the architecture of all decision acquired the following structure:

- at the bottom level there are general-system data: information on users of all systems (LDAP (Lightweight Directory Access Protocol), MS (AD and other), also at this level happens authorization and authentication of users and access to the general reference manuals of an information system is also organized;
- over the general data there are applications creating business logic. These applications work independently from each other as general information is stored at the bottom level available to all applications;
- interfaces of all systems come down in the common portal and are represented in the common interface of the user; the user gets access to all systems through a web browser that provides uniform authorization and habitualness of interfaces.

We chose such method because the similar architecture of an information system allows us to increase services in a short time, to use different systems without concern of problems of incompatibility, to carry out the small stages closing private tasks.

Benefits, Certainly, were Obvious:

1. in case of addition of new service there was no need to change the business processes which are already realized in the software;
2. as addition of set of services is implemented in the form of the sequence of small stages, as a result we receive the finished decision. Thanks to it if we had a need to postpone work for later period or to refuse further work, the system remained with the same set of functionality which allowed to solve specific objectives;
3. during implementation and in subsequent we used the web interface which allowed to envelop all organization, without performing works on setup of client places.

References

- G. Booch., Maksimchuk, R. A., W. Engle, B.J. Young, J. Collen, Houston, K.A.(2007). *Object-oriented analysis and design with applications* (3rd Ed.), London, UK: Addison-Wesley Professional.
- Gontarev, R.M. Nizhegorodcev, & D.A. Novikov. (2009). *Project management*. Moscow: Dibrocom,
- Senchenko, P. V. (2011). *Reasoning the use of web-oriented technologies during the development of the electronic document flow informational system: The studying guide Problems of the management theory and practices*. 6, 33-37.
- Krivenko, D. A., Belousov, B. E., Efremov, M. A., & Krivenko. T. B. (2008). *The management model of information flows in organizational systems* *VSTU Herald. Voronezh*, 4(2), 118-125.
- Osterlund, C. & Doland. R. J. (2009). Knowledge Flows in Heterogeneous Healthcare Information system Environments. In *42nd Hawaii International conference on System Sciences*. 1-11.
- Abishov, N., Asan, D., Kanat, A., & Erkisheva, Z. (2014). Development of an Automated Information System University Management. *Procedia-Social and Behavioral Sciences*, 143, 550-554.
- Blockchain, (2016). A new architecture for digital content. *Econtent*, 39(8) 22-23.
- Uskenbayeva, R. K., Kuandykov, A. A., Im, C. Y., Kalpeyeva, Z. B., & Kozhamzharova, D. K. (2013, October). Organization of computing processes in the large heterogeneous distributed systems. In *Robotics (ISR), 2013 44th International Symposium on* (pp. 1-4). IEEE.
- Kuandykov, A. A., Kassenkhan, A. A., Kozhamzharova, D. K., Mukazhanov, N. K., Kalpeeva, Z. B., Sholpanbaev A.T. (2013). The formalization of the problem area, implementation and maintenance of business process by a group of unmanned vehicles. *International Journal of Computer Technology and Applications*, 4(5), 759-763.
- Uskenbayeva, R. K., Kuandykov, A. A., Cho, Y. I., Kozhamzharova, D. K. (2014). *The intelligent modeling of unmanned vehicles for solving the tasks of risk management in the business processes*. International Symposium on Artificial Life and Robotics, AROB 19th 2014 January 22-24, B-Con PLAZA, Beppu, JAPAN, 935-939 pp.
- Uskenbayeva, R. K., Cho, Y. I., Bektemyssova, G. B., Mukazhanov, N. K., Kozhamzharova, D. K., & Kurmangaliyeva, B. K. (2014, October). Multidimensional indexing structure development for the optimal formation of aggregated indicators in OLAP hypercube. In *Control, Automation and Systems (ICCAS), 2014 14th International Conference on* (pp. 1466-1470), IEEE.

- Uskenbayeva, R. K., Kuandykov, A. A., Cho, Y. I., Kozhamzharova, D. K., & Baimuratov, O. A. (2014, October). Main principles of task distribution in multi-agent systems and defining basic parameters. In *Control, Automation and Systems (ICCAS), 2014 14th International Conference on* (pp. 1471-1474). IEEE.
- Duysebekova, K., Serbin, V., Kuandykov, A., Duysebekov, T., Alimanova, M., Orazbekov, S., ... & Alimzhanova, L. (2016). The Solution of Semi-empirical Equation of Turbulent Diffusion in Problems of Polluting Impurity Transfer by Gauss Approach. *Procedia Computer Science*, 94, 372-379.
- Rakhmetulayeva, S. B. (2012). On the problem of building a large database using OLAP. In *Proceedings of the International scientific-practical conference on "Food security in Kazakhstan: Status and Prospects"*- Semey, pp.273-274.