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Application of the cloud-based service of business intelligence in the information infrastructure of the higher education institution

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In this article, an approach to solving the problem of strategic management of a university using an information-analytical system is proposed. The purpose of this article is to describe the roles and ways users interact with the information and analysis system. Methodological basis of the research was made by the technologies of data mining, table and graphic methods of information visualization and also business intelligence tools. As a tool for solving practical problems, the Power BI service is used that allows creating interactive panels and reports on the most important metrics. The practical importance of the materials presented in this article is the definition of the main information flows, the role of the quality management system and the place of the analytical service in the management organization of the university. Methods of storing and transferring data using cloud technologies and data cubes are described. The place of the information-analytical system in the unified corporate information system of the university is determined. The examples of the implementation of the information-analytical system of Al-Farabi KazNU on Power BI cloud platform are presented. **Keywords**: effective ways of university management, scientific and educational activity, information-analytical system, Power BI.

ЖОО ақпараттық инфрақұрылымында бизнес-аналитика бұлт қызметін қолдану

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Мақалада ақпараттық-аналитикалық жүйелерді қолдана отырып жоғары оқу орнын тиімді басқару жолын ұсынады. Мақаланың мақсаты ақпараттық-аналитикалық жүйелер мен қолданушылардың өзара байланыс тәсілдері және рөлдерін сипаттау болып табылады. Зерттеудің әдіснамалық негізін мәліметтердің интеллектуалды анализ технологиялары, ақпаратты визуализациялаудыі кестелік және графикалық әдістері, сонымен қатар, бизнес-аналитика құралдары құрады. Практикалық тапсырмаларды орындау құралы ретінде Power BI қызметі қолданылады, ол интербелсенді панельдер мен маңызды метрикалар есебін құруға мүмкіндік береді. Мақалада келтірілген материалдардың практикалық маңызы негізгі ақпарат ағындарын, сапаны бақылау жүйесінің рөлін және жоо басқаруды ұйымдастырудағы аналитикалық қызметтің маңызын анықтау болып табылады. Бұлтты технологиялар мен мәліметтер кубтары арқылы мәліметтерді сақтау және тасымалдау әдістері сипатталды. Жоо корпоративті ақпараттық жүйесіндегі ақпараттық-аналитикалық жүйенің орны анықталды. Әл-Фараби атындағы ҚазҰУ ақпараттық-аналитикалық жүйесінің Power BI бұлтты платформасында жүзеге асырылу мысалдары келтірілді.

Түйін сөздер: ЖОО тиімді басқару жолдары, ғылыми және білім беру қызметі, ақпараттық-аналитикалық жүйе, Power BI.

Применение облачной службы бизнес-аналитики в информационной инфраструктуре ВУЗа

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В данной статье предложен подход решения задачи стратегического управления вузом с использованием информационно-аналитической системы. Цель данной статьи заключается в описании ролей и способов взаимодействия пользователей с информационно-аналитической системой. Методологическую основу исследования составили технологии интеллектуального анализа данных, табличные и графические приемы визуализации информации, а также средства бизнес-аналитики. В качестве инструментария для решения практических задач используется служба Power BI, позволяющая создавать интерактивные панели и отчёты о наиболее важных метриках. Практическая значимость материалов, представленных в данной статье является определение основных информационных потоков, роль системы менеджмента качества и место аналитической службы в организации управления вузом. Описаны методы хранения и передачи данных с помощью облачных технологий и кубов данных. Определено место информационно-аналитической системы в единой корпоративной информационной системе вуза. Представлены примеры реализации информационно-аналитической системы КазНУ на облачной платформе Power BI.

Ключевые слова: эффективные способы управления вузом, научно-образовательная деятельность, информационно-аналитическая система, Power BI.

1 Introduction

A management of the university, an improvement of the quality of the scientific and educational process is a complex task that requires systematic and timely analysis of comprehensive and reliable information on the status and problems of the university activities, that is possible only as a result of the introduction of modern information technologies in the management of the university and their continuous improvement. Therefore, higher education institutions are constantly searching for effective ways of managing scientific and educational activities (SEA), in this regard, the information infrastructure of the university is developing.

Information infrastructure is represented as a set of solutions of the university's own developments, which are mainly aimed at automating educational activities, using distance education technologies, information sites and individual local developments, with third-party solutions, such as: automation of financial and economic activities, electronic document management systems, use of management software for administration of key resources and services, training software and software solutions for managing IT resources.

The university strategy should be linked with a set of activity goals that describe what should be done well to implement the strategy. Each of the activities of the university, taking into account the tasks to be implemented, can be characterized by a set of indicators that allow to record the state of work in this direction and the dynamics of its development. The most significant are the indicators that characterize the state of the main resources of the university.

Goals of the university should be developed based on the status of indicators, and the formation on their basis of an indicative plan for the development of the university for the future period. The expression of the targets in the form of indicators that characterize the socially and scientifically significant results of the university SEA will allow to evaluate and plan the desired state of development of the educational system, create a monitoring system that includes the process of collecting, monitoring and making management decisions in real time, hat will solve the problem of measuring the achievement of the goal through the result.

Along with the performance of analytical functions, indicators are a strong instrument of control action. The indicators record what is controlled in the managed system, what changes in the characteristics of the system become the subject of reporting and, accordingly, the primary focus of the management bodies. Through the target values of indicators, the vector of development of the system is set: some changes in the characteristics of the system are encouraged, while others, on the contrary, are punished.

Today, the requirements to the management of the university are increasing, which causes the inclusion of information and analytical systems in the management loop. The information and analytical system in the management system of the scientific and educational activities of the university should not only provide the administrative management of the university information on the current and prospective state, but also identify problem areas for the functioning of the university SEA, and develop corrective actions to strengthen the work in this direction.

2 Literature review

Information-analytical systems, like business intelligence, are quite a new direction in the study of the company's development prospects. The main sources that reveal the theoretical aspects of data organization for storage and analysis are the works of Alekseeva T.V., Ameridi Yu.V., Luzhetskyi MG (As of May 19, 2017 Alekseyeva T.V., Electronic book), Kornipaev I. (Kornipayev I., 2013: 118), Hull E., Jackson K. , Dick D. (Hull E., 2011: 229), Laffenguell D., Weidrig D. (Laffenguell, 2016: 418), Khimonin Y.U. (Khimonin Y., 2009), Moss L. (Moss Larissa T., 2003: 576) presenting in their works the basic principles of work and requirements for software. The methodology for constructing business models and describing the functional requirements for the system is described in the papers of Ranjan J. (Ranjan J., 2005: 60-70), Kobern A. (Kobern A., 2002: 263), Cooper A. (Cooper Alan, 2004: 328), Minto B. (Minto Barbara, 2008: 272), Wigers K. (Karl E. Wiegers, 2014: 736), Osterwalder A., Pigneur Y. (Osterwalder Alexander, 2011: 288), Barilenko V.I. (Barilenko V.I., 2009: 414), Schmits D. (Schmitz Dominik, 2010: 346). Practical implementation of information and analytical solutions platforms is described in the works of Ethan M. Rasiel I.M., Friga P.N. (Ethan M., 2009: 224), Paklin N.B., Oreshkov V.I. (Paklin N. B., 2013: 704), Ralston B. (Ralston Barry, 2011: 277), Larson B. (Larson Brian, 2009: 741), and a group of authors led by Desmeister B. (Desmeijter Browne, 2010: 549). The main qualities that should be paid attention and developed for the analyst are described in the works of Pererva A.D., Ivanova V., Yepishina E.V. (Pererva A., 2012: 304), Goel S. (Goel S., 2013: 11), Robert A(As of May 20 2017, Robert Alvin, electronic book), in the analytical report of Oracle (The project analytics framework Oracle Business, 2012: 18), Daly M. (As of May 16 2017, Daly Marshall, electronic book), Eckerson W., Hackathorn R., McGivern M., Twogood C., Watson G (Eckerson W., 2009: 40-48).

Analyzing these sources, the main goals and tasks of automation of the information and analytical system were identified; the implementation environment and hierarchy of levels of access to data were chosen. As a system of data sources, corporate information systems have been adopted, such as "Univer "Science "1C System of electronic documentation (SED) "Directum System of access control (SAC) "Perco Excel spreadsheets. As a platform for implementation is selected a subsystem of cloud access Power BI.

3 Materials and methods

3.1 Formulation of the problem

The Information and Analytical System (IAS) is a modern, highly effective tool for supporting the adoption of strategic, tactical and operational management decisions based on a visual and timely provision of the entire set of data to users responsible for analyzing the state of affairs and making management decisions (As of May 19, 2017 Alekseyeva T.V., Electronic book).

The complex of information and analytical systems affects the entire management vertical: corporate reporting, financial and economic planning and strategic planning.

The main purpose of the IAS is dynamic representation and multidimensional analysis of historical and current data, analysis of trends, modeling and forecasting the results of various

managerial decisions (As of May 19, 2017 Alekseyeva T.V., Electronic book).

The purpose of IAS development in the corporate information system (CIS) loop of the university is to create an aggregating system for extracting data from various sources of CIS, transforming them and unloading them into the storage, in order to build up operational and intellectual data analysis for their effective consumer perception.

The corporate information management system of the university CIS is a set of programs aimed at automation and management of various business processes of the university, based on the process approach that allows to systematically develop each direction of the university activity and organize work on the creation and maintenance of software development by the staff of information departments of the university (Mutanov G.M., 2012: 164), . (Mutanov G.M., 2013: 276), (Mutanov G.M., 2014: 158).

The result of the use of IAS tools are (As of May 19, 2017 Alekseyeva T.V., Electronic book):

– Regulatory analytical reports focused on the needs of users of different categories;

– means of interactive analysis of information and rapid construction of reports by non-programmers using the usual domain concepts

The presence of IAS in the university CIS circuit will help to solve such problems as: 1) compilation of consolidated reports and provision of consolidated information on the activity of the university (key performance indicators, the dynamics of their changes and trends); 2) carrying out a comprehensive assessment of the university activities based on the constant monitoring of its four most important aspects (educational process, research activities, educational process, international activity, finance, relations with the outside world, innovations); 3) operational monitoring of the main activities of the university and decision-making.

Nowadays cloud technologies are rapidly spreading into business structures, IDC analysts confirm that cloud technologies help businesses grow faster. Cloud platforms for business intelligence make it possible to make the results of data processing and analysis available, to quickly introduce the results of analysis into the business processes of the organization. Thus, we believe that for the development of IAS in the outline of the university information infrastructure, it is necessary to use a cloud-based business intelligence service, like Microsoft Power BI.

3.2 Architecture of cloud-based business intelligence service

Power BI is a set of business intelligence tools for analyzing data and providing valuable information. Power BI information panels are a single center with real-time data update available on all devices, in which business users get a complete view of the most important metrics (link to BI site). Benefits of Power BI (As of May 12 2017, Chto takoye Power BI?, electronic resource):

– All organization data on the same dashboard.

– Creating excellent interactive reports (table presentation, visualization, the ability to share reports)

– Coordinated analysis throughout the organization (reliable reusable data models to ensure consistency in reports and analytics in your organization).

– Convenient embedding of business intelligence directly into the application (the ability to embed on the pages of the site, PowerPoint presentations).

– Ubiquitous access to data (connect to hundreds of data sources, regardless of their location and type).

Power BI can combine all organization data, both cloud and local. Using Power BI gateways, you can connect SQL Server databases, Analysis Services models and many other data sources to the same information panels in Power BI. With Power BI you can safely publish reports to your organization and configure automatic updates to ensure that all users receive up-to-date information (As of May 12 2017, Chto takoye Power BI?, electronic resource).

The figure 1. shows the architecture of Power BI cloud platform.

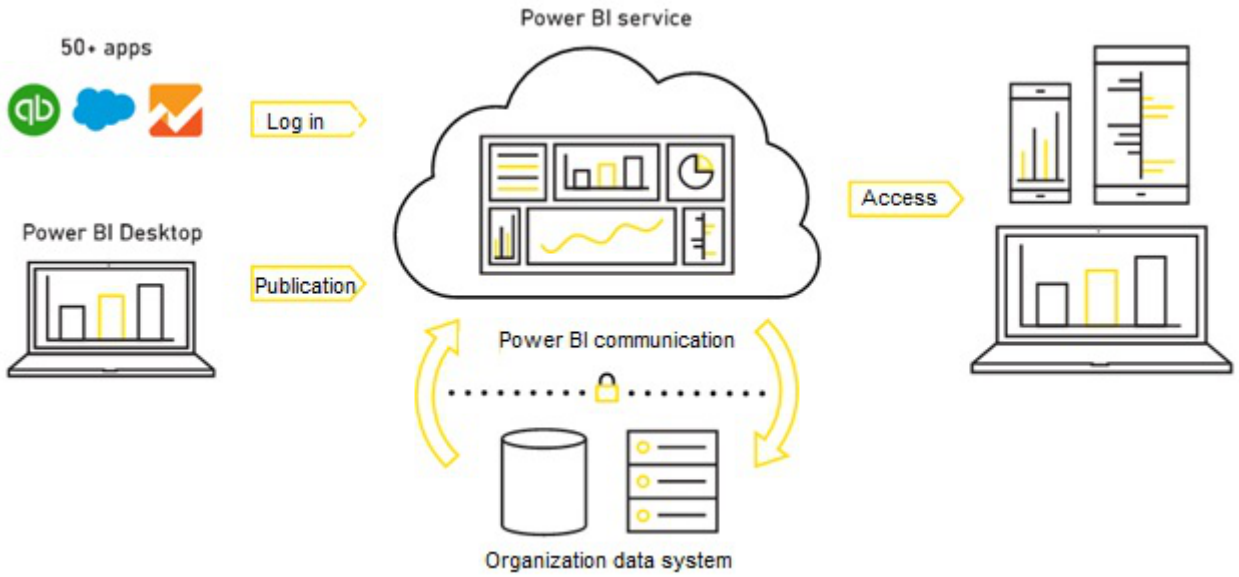

Figure 1 – Architecture of Power BI cloud platform.

To use the Power BI cloud platform in the university CIS framework, you must adhere to the following principles: (As of May 19, 2017 Alekseyeva T.V., Electronic book):

– consolidation of all information processes of the university;

– embedding the system in the already established organizational structure of the university;

– coordination of efforts of all divisions in the performance of assigned tasks;

– openness of the system for further development;

– integrated use of all available methods of analysis;

– information ethics - "from everyone - to the common safe and from it to everyone".

Currently in Al-Farabi Kazakh National University (further KazNU) information systems are used in the information infrastructure: systems of in-house development (IS "UNIVER-the system of automation of the educational process, "Science the system of accounting for research activities, System of indicative planning and rating based on IS "UNIVER");System of electronic documentation "Directum"; System of accounting and personnel records ("1C: Enterprise 8.2"); System of access control "Perco 2.0"; System of statistical reporting of the contact center "VoIPTime Contact Center".

These information systems were integrated with Power BI cloud platform, with the aim of building IAS in the KazNU CIS contour (figure 2).

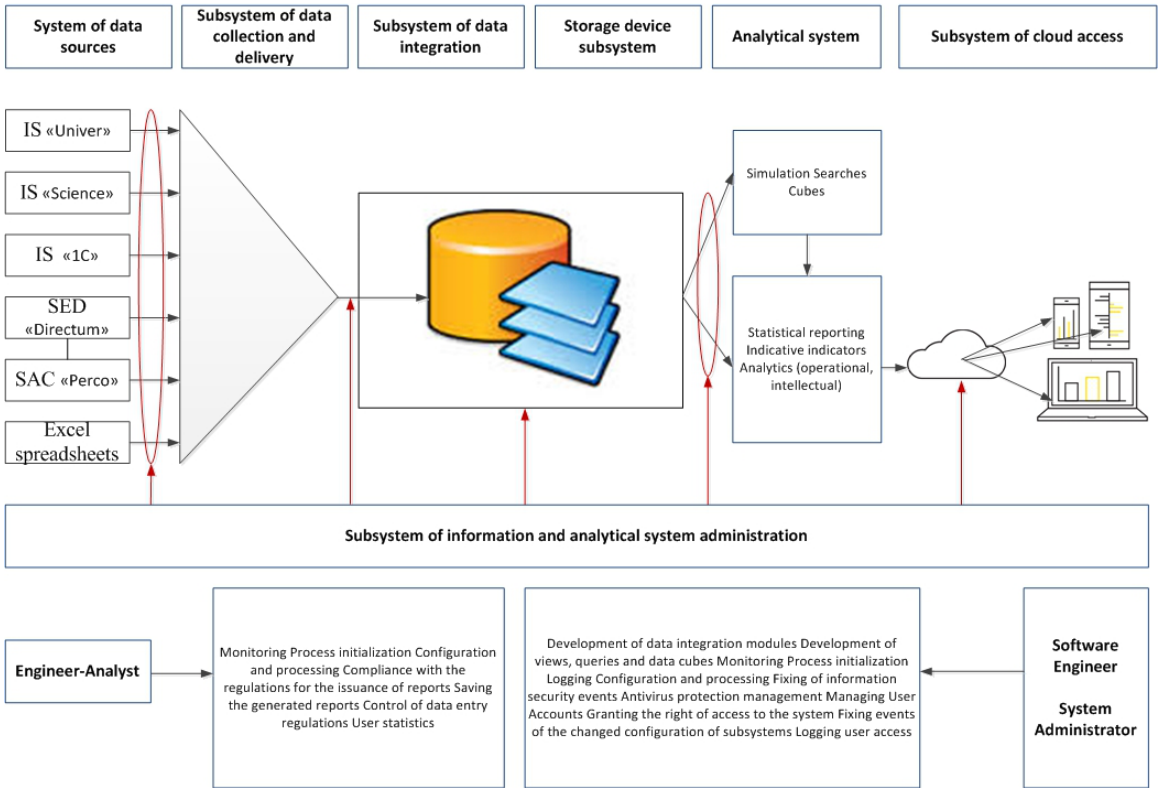

Figure 2 – IAS architecture of KazNU CIS.

As you can see from figure 2, at the level of the administration subsystem, work is carried out: on the configuration of business intelligence services, the development of presentations at the data presentation level. In this IAS architecture (figure 2), roles are clearly positioned:

– The role of a software engineer: the Development of data integration modules; Development of views, queries and data cubes; Monitoring of data representations; Process initialization; Logging of system processes; Configuration and processing of data scenarios; Fixing information security events; Fixing events of the changed configuration of subsystems.

– The role of the system administrator: Managing antivirus protection; User account management; Granting users the right to access the system; Log user access.

– The role of the analyst engineer: Monitoring of data representation; Process initialization; Configuration and processing of data scenarios; Implementation of regulations for the issuance of reports; Saving generated reports; Control of the data entry regulations; User statistics.

For proper organization of data, and configuration of dashboards, as well as the formation of data processing scenarios, it is very important to understand the data structure model in the university IAS (figure 3). Such a hierarchical representation of the data model is based on the fact that there is a system of indicative planning and a rating system in the outline of the university CIS. It is aimed at assessing the activities of teaching staff, departments and faculties. In addition, in the IS "UNIVER"and "SCIENCE"are implemented systems for automating the statistical reporting of the educational process and accounting for research activities. From such systems as: "1C: Enterprise 8.2 "Directum "Perco 2.0 "VoIPTime Contact Center"primary data are being unloaded to build forms of operational reporting. For each data category from figure 3, a methodology for calculating the indicator should be provided, in order to configure data processing scenarios and build dashboards for the cloud-based business intelligence service (Mamykova ZH.D, 2013: 64-70).

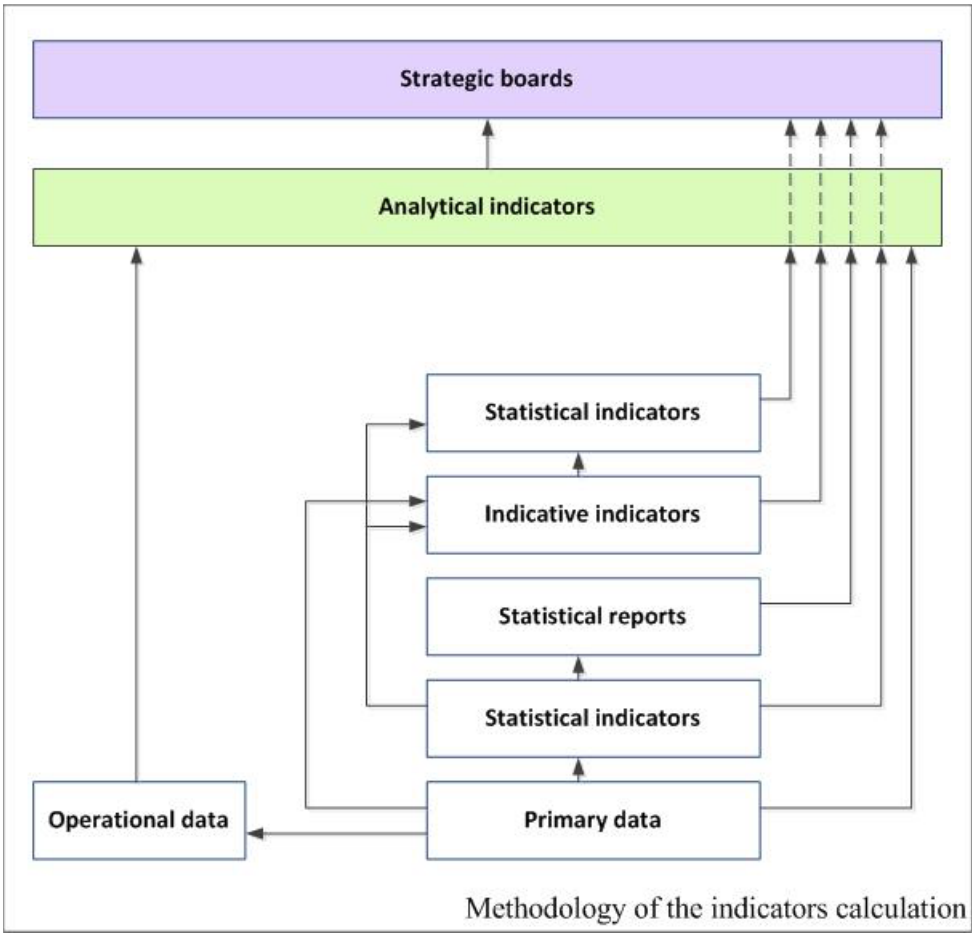

Figure 3 – Model of the data structure in KazNU IAS.

As a system of indicators for building a cloud business intelligence service, the following categories of indicators were used: statistical indicators (educational process, research work,

social work, international activity); Financial and economic indicators, personnel records; Indicators of indicative planning and rating; Indicators of administrative and organizational activities (work time records, workflow indicators, QMS indicators, indicators of IT services provision); Indicators of the accreditation of the university; Indicators of the University Strategy; Indicators of operational monitoring of production and economic activities and security services.

4 Results and discussion

4.1 The role of the analytical service in the management of the university

In Al-Farabi KazNU the Center for Situational Management (CSM) was established. Tasks of the CSM: 1) information and analytical support of the university; 2) monitoring of the educational process; 3) prompt response to the emergence of extraordinary situations.

Figure 4 shows the model of the CSM analytical service work that works closely with the working groups of departments (in the areas of the educational process, research work, educational process, financial and business and production activities, administrative and organizational management, international activities and strategic management, QMS, IT services). The analytical service should be guided by the normative and methodological documents of the university (these are the Provisions of departments, QMS procedures, instructions, regulatory documentation of the departmental ministry, strategic documents of the university). Engineers-analysts of the analytical service of the CSM have access to databases of key subsystems of the university CIS. To organize the work of the analytical service, a methodology for collecting reports on indicators and methodology for constructing analytical reporting have been developed.

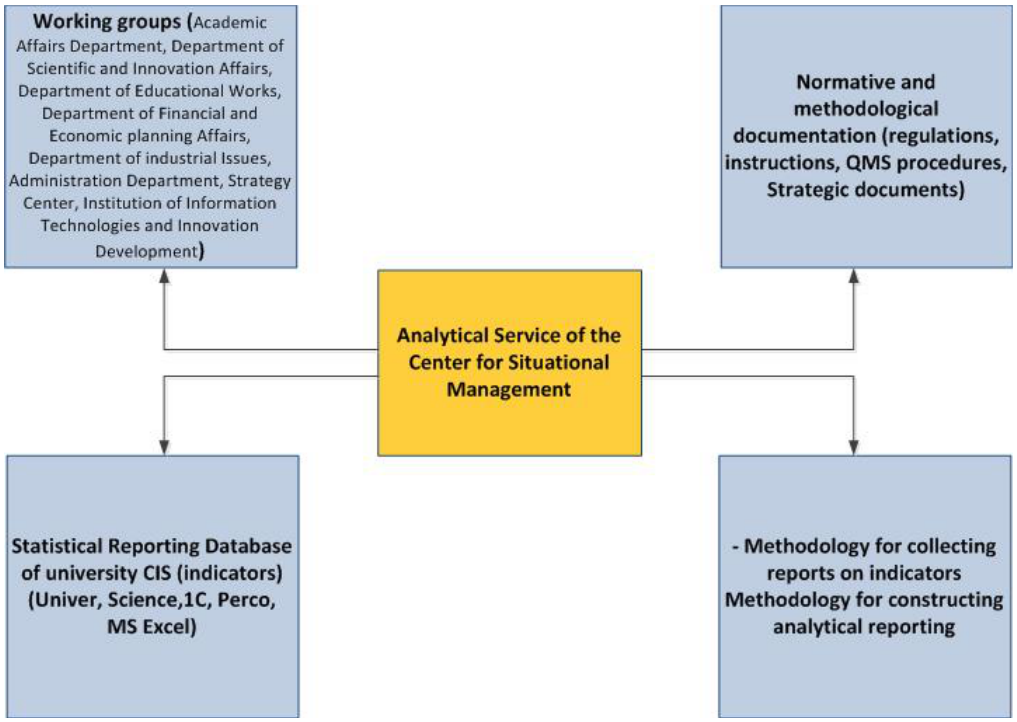

Figure 4 – The state model of the analytical service.

Figure 5 presents the model of access of the university management to visual data representations, according to the university system of indicators. As you can see from figure 5, the data is processed, according to the following steps: data collection from the departments (automatically from the CIS information systems, by preparing MS Excel files); Reporting (configuring dashboards); Monitoring of activities; Delivery reporting (role model access). What are the benefits of the pro-rector in the areas of activity: operational monitoring of activities; Monitoring of the development strategy of the university in the main areas. For the rector of the university all indicators for monitoring are available, in order to monitor the state of development of the university. The Director of the CSM can carry out operational monitoring in all areas of the university activities, as well as promptly respond to the emerged extraordinary situations.

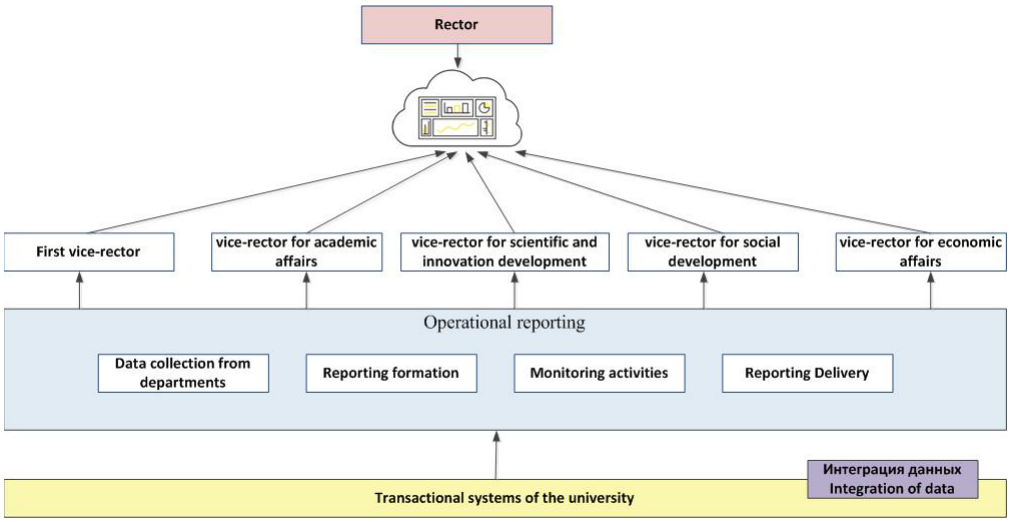

Figure 5 – The model of access to the data of the university management.

During the implementation of the project on the use of cloud services in business intelligence in the university CIS, we came to the conclusion that it is necessary to organize new business processes (figure 6), as: Analysis of models and monitoring of the performance indicators of the university; Development of a set of measures to develop the activities of the university; Assessment of the effectiveness of the university. To solve this task, a working group was formed with the participation of QMS specialists to develop the above-mentioned business processes. The organization of these business processes will require the development of certain procedures and instructions for the quality work of users.

Each department of the university, in organizing its processes, should allocate performance indicators and primary data, specify where the data is generated (in which system, in which reports, at what intervals). This information should be reflected in the documented procedures of the unit and the business process. In addition, each unit should identify the person responsible for collecting, analyzing and recording data for a particular line of business.

At the QMS level, it is necessary to develop a documented procedure "Collection, analysis of primary data and analysts on the main activity of the university with the goal of consolidating a single indicator bank and creating a system of role access to data categories, a reliable data source. An analysis of the work done allows us to talk about the need for a culture of "data collection and analysis the development of the "situation-action map"methodology.

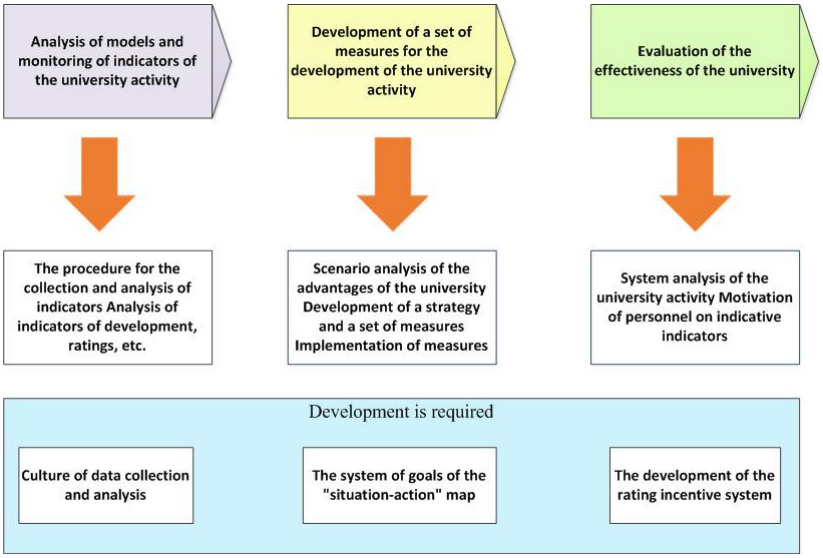

Figure 6 – Organization of new processes in the business process map of the university.

In figure 7. the results of the implementation of IAS KazNU on Power BI cloud platform are presented.

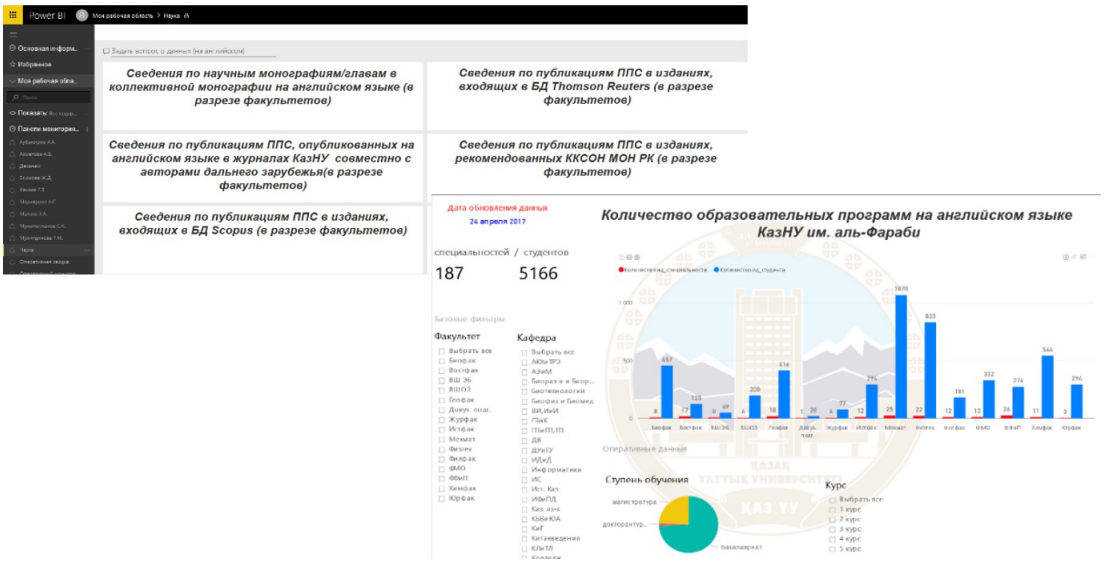

Figure 7 – Power BI dashboard, report visualization.

5 Conclusion

Summarizing the results of this article, we will list the advantages of introducing IAS into the corporate information system of the university:

1) IAS that created on the basis of PowerBI business intelligence system allows you to provide operational and statistical data consolidated from various sources of data.

2) IAS allows you to visualize the performance indicators of the university and, as a consequence, evaluate the effectiveness of the university.

3) The role of QMS in this system is to develop unified procedures for collecting primary data for further analysis and decision making.

4) The role of the analytical service is to organize interaction with the working groups of departments for the operational collection, reporting and monitoring of the activities of the units and structures of the institution.

5) The role of a software engineer is to develop views, queries and data cubes, as well as control the integrity of the information presented.

6) Via to the implementation of cloud storage of information and the provision of reports, the process of obtaining data by decision-makers is simplified.

Thus, the use of cloud technologies for analyzing, storing and transferring data can easily be embedded in the information infrastructure of the university thereby ensuring ease in obtaining the necessary information. This approach to presenting data seriously saves time in making strategic decisions to the head of the organization, providing a complete picture of the scientific, educational and financial activities of the institution.

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