

АҚПАРАТТЫҚ ЖҮЙЕЛЕР
ИНФОРМАЦИОННЫЕ СИСТЕМЫ
INFORMATION SYSTEMS

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DEVELOPMENT OF A SCENARIO ANALYSIS OF THE APPLICATION OF THE INFORMATION AND ANALYSIS SYSTEM

АҚПАРАТТЫҚ-АНАЛИТИКАЛЫҚ ЖҮЙЕНІ ҚОЛДАНУДЫҢ СЦЕНАРИЙЛІК ТАЛДАУЫН ӨЗІРЛЕУ

РАЗРАБОТКА СЦЕНАРНОГО АНАЛИЗА ПРИМЕНЕНИЯ ИНФОРМАЦИОННО-АНАЛИТИЧЕСКОЙ СИСТЕМЫ

Abstract. The formation and maintenance of analytical reports are one of the key factors in the management of any organization, because it allows you to quickly understand the state of affairs of the company, contribute to the control of internal and external processes of the company, assess risks, etc. In business intelligence systems, there are two approaches to building analytical reports: functional and scenario approaches. This article describes both methods, however, more attention is devoted to the scenario approach. The scenarios of self-analysis of data of analytical reports by users of the Information and analytical system of the organization are presented. Moreover, the article demonstrates a complete example of performing one of the scenario analyses, with the results and conclusions of the analysis performed. Based on the described scenario analysis, a methodology for generating analytical reports was developed, which will serve as a template for the development of regulated company reports.

Keywords: a functional approach, scenario approach, scenario analysis, analytical report, information-analytical system.

Аңдатпа. Аналитикалық есептілікті қалыптастыру және жүргізу кез келген ұйымды басқарудың негізгі факторларының бірі болып табылады, өйткені бұл компанияның жағдайын тез түсінуге, компанияның ішкі және сыртқы процестерін бақылауға, тәуекелдерді бағалауға және т.б. мүмкіндік береді. Бұл мақалада екі әдіс те сипатталған, бірақ сценарий тәсіліне көбірек көңіл бөлінеді. Ұйымның ақпараттық-аналитикалық жүйесінің пайдаланушылары аналитикалық есептердің деректерін өз бетінше талдау сценарийлерін ұсынады. Сонымен қатар, мақалада сценарийлік талдаудың

біреуін орындаудың толық мысалы, жасалған талдаудың нәтижелері мен қорытындылары көрсетілген. Сипатталған сценарийлік талдау негізінде аналитикалық есептерді қалыптастыру әдістемесі жасалды, ол компанияның регламенттелген есептерін әзірлеу үлгісі болады.

Түйін сөздер: функционалды әдіс, сценарийлік әдіс, сценарийлік талдау, аналитикалық есеп, ақпараттық-аналитикалық жүйе.

Аннотация. Формирование и ведение аналитической отчетности является одним из ключевых факторов в управлении любой организацией, т.к. это позволяет быстро понимать состояние дел компании, способствует контролю внутренних и внешних процессов компании, оценивать риски и др. В системах бизнес-аналитики выделяются два подхода построения аналитических отчетов: функциональный и сценарный подходы. В данной статье описаны оба метода, однако, большее внимание посвящено сценарному подходу. Представлены сценарии самостоятельного анализа данных аналитических отчетов пользователями Информационно-аналитической системы организации. Более того, в статье продемонстрирован полный пример выполнения одного из сценарного анализа, с результатами и выводами проделанного анализа. На основе описанного сценарного анализа была разработана методика формирования аналитических отчетов, которая послужит шаблоном разработки регламентированных отчетов компании.

Ключевые слова: Ключевые слова, ключевые слова.

Introduction. The formation of analytical reporting is one of the critical factors in the management of any organization. The effectiveness of enterprise management is primarily determined by the quality of information held by management. The quality of data, in turn, is measured in its reliability, relevance, and accessibility in the necessary section. It is these criteria that are the key ones in developing statutory analytical reporting. Moreover, the tools that will process the collected data are essential. The development of analytical reporting allows an understanding of what is happening inside and outside the firm. Information for executives can be conveyed in fragments, which can often be disjointed and incomplete. The organization of analytical reporting allows companies to obtain valuable information that will enable the business to develop effectively and avoid various risks. The organization of analytical reporting allows for solving such tasks as:

- control of processes within the company
- decision-making
- business process management
- risk assessment
- adjusting work processes.

Organizations in different industries – manufacturing, trade, services, and others with analytical reporting and business intelligence tools can assess demand, forecast, and manage the business.

There are two approaches to building analytical reports in business intelligence systems: functional and scenario-based. When applying the functional approach, first of all, it is necessary to identify the area of interest around the work area, such as education, finance, economics, trade, marketing, and others. Then, all indicators and measurements related to the selected work area are added to the summary table. Subsequently, it is possible to build analytical reports based on the received data and to compare any indicators in any breakdown (for example, for different periods).

To use a scenario-based approach and generate reports, it is necessary first to define all the elements of the planned report and which aspects and issues it will cover. In such reports, the user can set filters and time limits. The advantage of this method is that the visualization is tailored to the specific task, and there is a limited set of routes that the user can follow. The most common route is the drill-down format - from the general to the particular.

Moreover, when developing analytical reports, it is important to consider the level of information provided to the user, as there are different levels of information. The first level is a summary of the organization's state of affairs for each area of its activities. This level allows for identifying the presence of a problem in a particular section of the report.

The second level is local work with information. I.e., detailed consideration of the problem revealed at the first level, any sphere of activity of the organization.

The third level is the information that allows one to start solving the problem. This requires a factor analysis to determine the circumstances that contributed to the problem [1].

Literature review. In scenario analysis, there are such concepts as "scenario" and "scenario approach". Naturally, there are many different views on the definition of these concepts. However, they all agree that scenario building fulfills two main tasks. The first task is to highlight key moments of the development of the object under study and to elaborate on various qualitative variants of its dynamics. The second task is to conduct a comprehensive analysis and assessment of each of the received options to study its structural features and possible consequences of its implementation [2].

According to A. Thompson and A. Strickland, scenarios are a way to analyze a complex environment with many significant and affecting trends and events [3].

The primary tool for compiling scenarios is scenario analysis, which is designed to identify a set of detailed descriptions of the sequence of events that can lead to the desired or planned end state or to possible outcomes in the development options the scenario considers [4]. This method is used to select the option of strategic management of processes with high uncertainty in a reasonably rapidly changing environment.

Scenario writing is not only a planning tool. It is also a practical learning tool. Thinking in scenarios helps us understand the logic of events, identify driving forces, key factors, key figures, and our ability to have any impact.

One of the first who successfully applied scenario analysis in practice was P. Wack of Royal Dutch Shell in 1970. Analysts of this organization were engaged in studying various scenarios of the development of the global external environment, taking into account the possibility of rising oil prices by the OPEC countries. Thanks to their research, they predicted the first oil crisis and were well prepared for it. As a result, the company, which was not even in the top ten oil companies in the world after the market emerged from the crisis, found itself in the top five most robust [2].

Also, in the late 1970s, scenarios began to be practiced by representatives of the Stanford Research Institute Hawken, Ogilvy, and Schwartz. For building scenarios, they considered the design of alternative options for developing the situation in the future, making it possible to make correct and responsible managerial decisions. They coined the term "change management" (variables whose changes affect the realization of scenario outcomes). The researchers considered economic, energy, and cost indicators as manageable variables [5].

In 1980, Bell, Merkhofer, and Keaney considered using scenarios as a basis for strategic decision-making [2].

In 1983, studies showed that the scenario method was one of the three most popular long-term planning methods and is used in 68% of large companies [2].

In general, scenario analysis and scenario planning in companies and organizations are limited to trying to imagine or assess the consequences of alternative decisions. Companies ask themselves what the effects of, for example, a particular transaction or actions of someone's competitors might be. However, systematic work on scenarios of events in the external world is rarely done because this work requires more time and knowledge. In an organization, someone

has to be responsible for the continuity of the process. One or more people have to draw conclusions from the scenarios and analyze the possible consequences for the choice of strategies, etc.

Materials and methods of research. Effective management of Kazakh National University named after Al-Farabi (KazNU) today is carried out using modern business-process management technologies based on analytical systems. KazNU developed the Information and Analytical System (IAS) to implement this process, which affects all managerial activities of the university, corporate reporting, and strategic and operational planning.

The purpose of this system is to generate analytical and regulated reporting and to visualize data on academic performance, scientific activities, finance, and other priority areas of the university, which can be accessed at every point on our campus.

The development of IAS requires an environment that would allow merging data from disparate systems into one, significantly reduce labor costs for report production and improve the quality of information for strategic decision-making. Such an opportunity is provided by business intelligence systems developed based on cloud platforms designed to obtain real-time operational information for making strategic decisions. There are many platforms of BI systems, such as Microsoft Business Intelligence, Oracle Business Intelligence, SAP Business Objects, QlikView, Qlik Sense, Deductor, and Prognoz Platform.

Analysis of BI systems has led to the conclusion that the platform Microsoft Power BI is best suited for the education system because it provides a rapid analysis of large amounts of data, and can visualize the results of the array of data processing with the possibility of personal configuration, supports the ability to work with data, by placing data on the LDAP server, provides secure publishing of information panels and views them from any device with Internet access, it is a system of building a report

Based on the results of comparing the functionality of Power BI with other BI tools like Qlik and Tableau, it is concluded that Power BI is superior on the following points:

- Availability
- Data handling capabilities - data loading, conversion, and unloading (ETL)
- Diversity of statistical measurements and indicators
- Visualizations
- Collapses
- Integrations
- Convenience
- Data up-to-date - automatic data update
- Data security and confidentiality

Power BI is an online service developed by Microsoft for business intelligence, which is a modern, highly effective tool to support strategic, tactical, and operational management decisions based on the visual and operational provision of the entire set of necessary data to users responsible for the analysis of the state of the organization and making management decisions [6]. Power BI allows the creation of regulated analytical reporting forms focused on the needs of users of different categories and customized visualizations. There is also a mobile application Power BI, available on various OS for continuous monitoring of the state of affairs and immediate response to extraordinary situations. It is also worth noting that Gartner recognizes Microsoft as the leader for fourteen consecutive years in the Analytics and Business Intelligence Platforms category in the Gartner Magic Quadrant for 2021 [7].

According to the analysis results, the university selected Microsoft Power BI as a visual presentation and data analysis tool. The following activities were carried out to implement this product:

- Connecting the information processes of the university;
- Building analytics systems into the organizational structure of the university;
- Systematization of external and internal reporting;
- Comprehensive use of data analytics and cloud technologies.

Power BI allows the use of data from various KazNU KIS sources, including:

- in-house developed systems (IS «UNIVER» – a system of educational process automation, IS «Science» – a system of scientific-research activity accounting, indicative planning, and rating systems based on IS «UNIVER»);
- electronic document management system «Directum»;
- accounting and personnel accounting system ("1C: Enterprise 8.2");
- Perco 2.0 time recording system;
- VoIPTime Contact Center statistical reporting system.
- To develop regulated reports with real-time data display, it was necessary:
- Create a catalog of reports according to university user requirements;
- Develop scenarios for the use of reports, for independent analysis and research of data by users;
- Develop a methodology for generating analytical reports based on scenario analysis;

Applying scenario analysis when viewing analytical reports, each user can independently analyze the current state of affairs of interest, identify existing problem areas and evaluate the results of making certain decisions.

Description and implementation of scenario analysis. Scenario analysis in analytics is one of the methods for researching the current state of an organization's operations, identifying problem areas, and making management decisions for users of analytical reports. Problems in any organization can be detected with the help of scenario analysis diagnostics. The advantage of this method is that the visualization is tailored to the specific task, and there is a limited set of routes that the user can take. The most common way is the general-to-private format.

The scenario analysis route map describes in detail the algorithm and order of analysis for each route point.

The waypoint shows the start and end points of the route, how to move between them and the results of each moment, where the scenario analysis study starts from (name and report number), what filters are set up and what impact is obtained, from which you can go to the next waypoint in the route.

Scenario analysis is developed based on the purpose of research to be conducted on its basis. For the IAS KazNU a number of scenario analyses are created in the main areas of educational activities of the university: the academic performance of students in the context of the results of final examinations, the academic performance of students in the context of teachers' work, research activities of teachers, etc.

Let us consider one of the scenario analyses developed on the example of analytical reports of Al-Farabi Kazakh National University.

The purpose of this scenario analysis is an overview study of students' performance on the results of the examination session in the context of faculties, disciplines, or students and to determine the factors affecting the performance. Each scenario analysis considers its object and subject of the study based on the set research goal. In the scenario under consideration, the thing of analysis is a learner, and the issue is a student's performance in the examination session. For each scenario analysis, there is a scheme of execution and a route map in the form of a table describing each scenario item in detail.

Figure 2 shows a flowchart of this scenario analysis.

This scenario scheme will be discussed in detail in the next chapter of this article.

Example of scenario analysis implementation. This chapter of the paper demonstrates an example of the implementation of scenario analysis «Student Success by Examination Session Results».

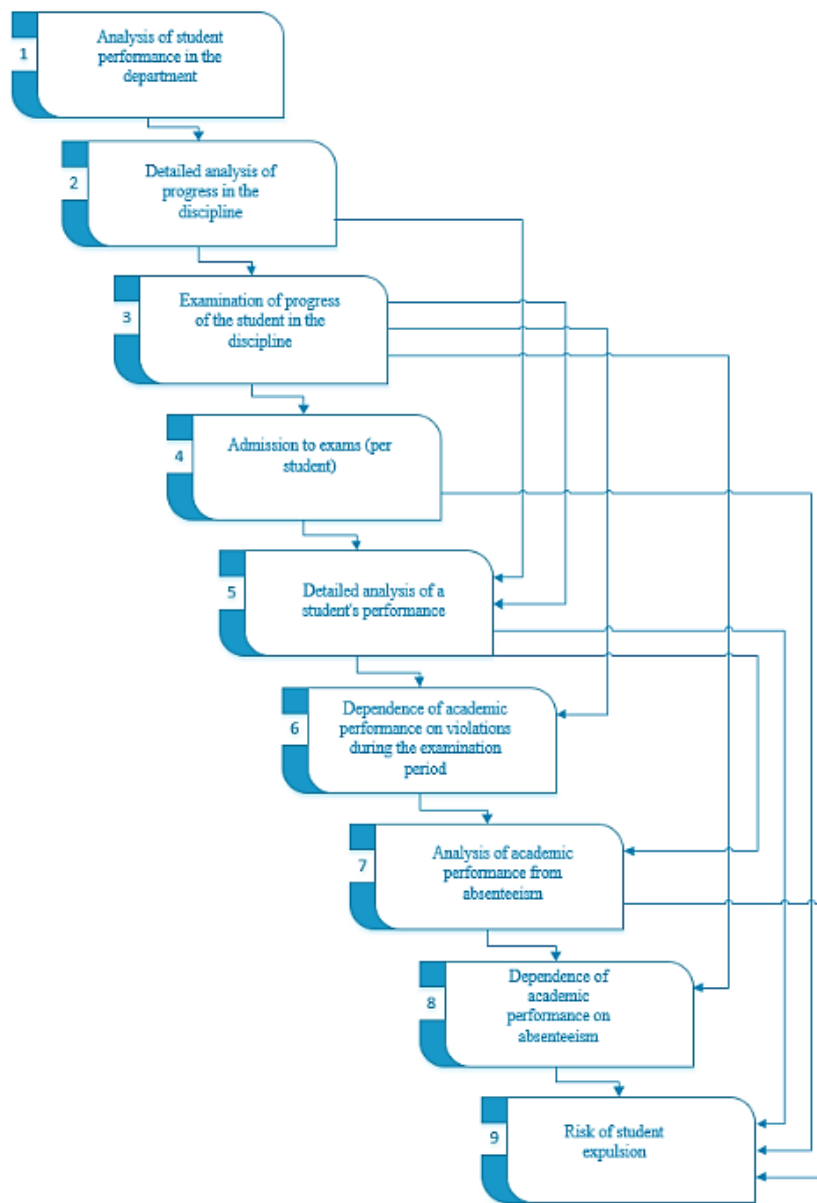


Figure 1. Schematic diagram of the scenario analysis "Student progress based on the results of the examination session"

Let's consider the «Qualitative analysis of academic performance by exam results» report from the monitoring panel «Educational activity of the University». The report interface is shown in Figure 2.

The report shows the overall picture of the university's performance across all faculties in

absolute and relative terms.

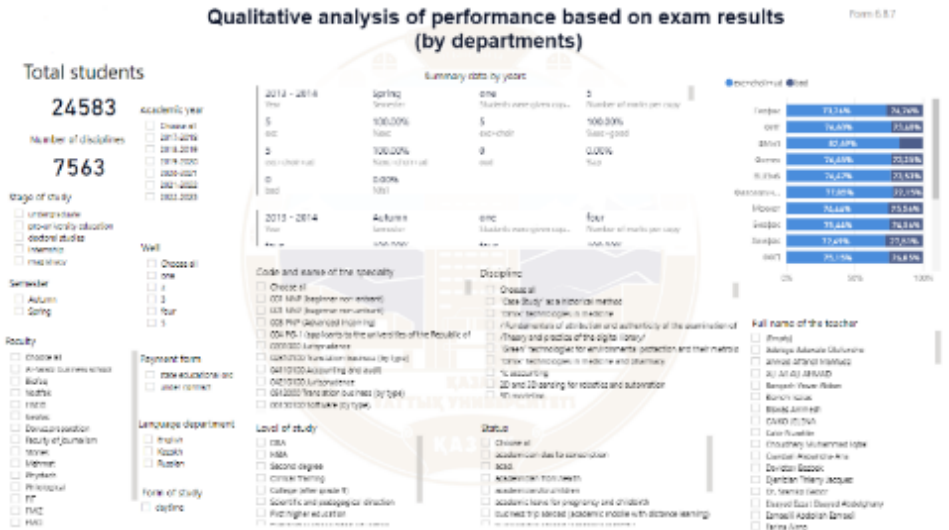


Figure 2. Qualitative analysis of learning outcomes from examinations

For a more detailed look at the performance of this report, the filters of interest are selected as shown in Figure 3.

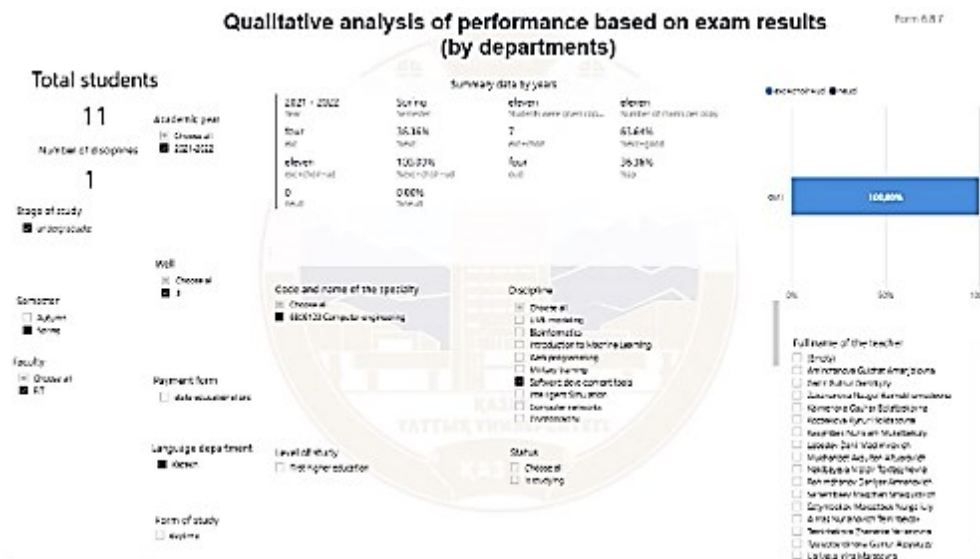


Figure 3. Qualitative analysis of performance in exams with choice of filters

Filters are selected by any information of interest presented on the report canvas.

As a result of the selection of the filters we are interested in, we will get information on the progress for a particular academic year in a specific specialty or discipline at a selected department.

In the center of the report we can see the number of students who have passed the exam, the number of subjects and the number of grades received in the exam, as well as the number and

percentage of grades «excellent», «excellent+good», «excellent+good+academic», «abit», «fail» for the academic year, semester, grade level, course, a form of payment, language training, specialty, discipline, grade level and status that interests us.

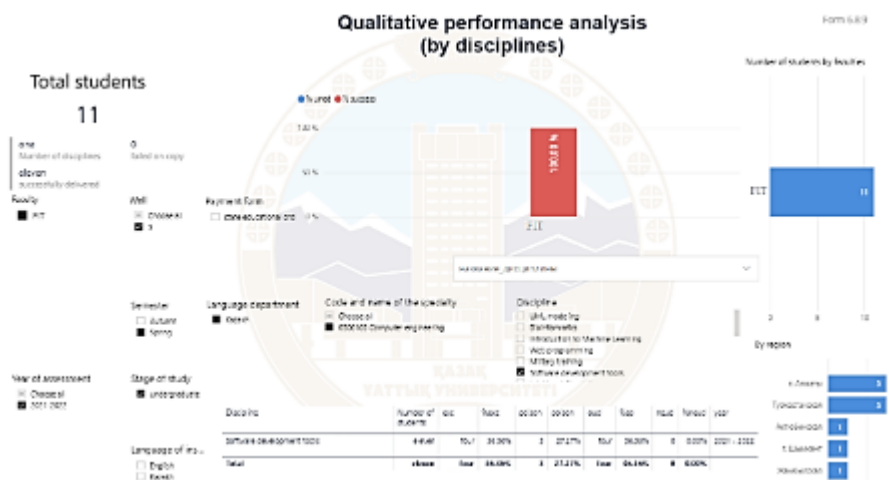


Figure 4. Qualitative analysis of learning achievements (by discipline)

For a more detailed consideration of the progress of the discipline, the graph of the report «Qualitative analysis of progress (by discipline)» clearly shows the relative (%) performance of students studying in this discipline, as well as the total number of students in the faculty studying in the chosen discipline. In addition, the total number of good (good+good+d) and unsatisfactory grades received in the exam. The table at the bottom of the report shows the different numbers of grades (good, excellent, oud, and fail) and their relative scores (Figure 4).

In addition, on the histogram of the report, by including a descending or ascending sorting of performance, as shown in Figure 5, you can see which department, course, grade, or significant has the lowest or highest performance (Figure 6-8).

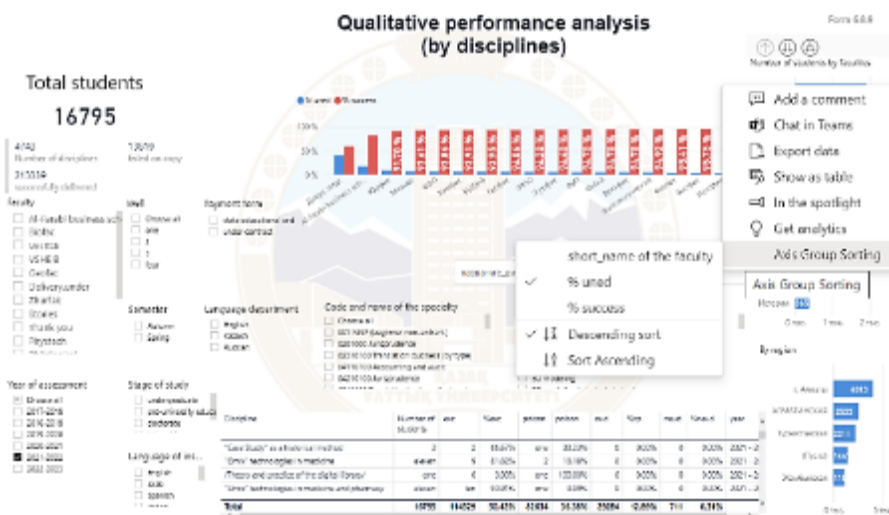


Figure 5. Selecting data sorting

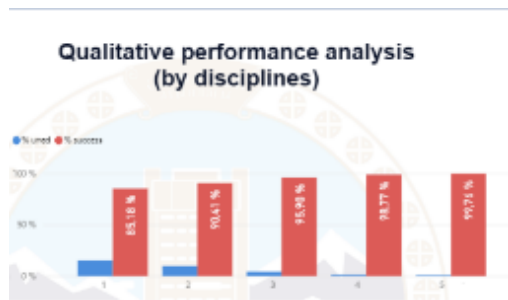


Figure 6. Sorting failure by course

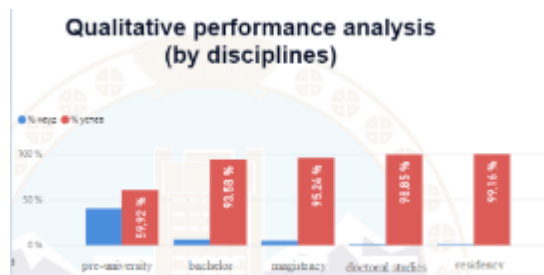


Figure 7. Sorting failure by grade level

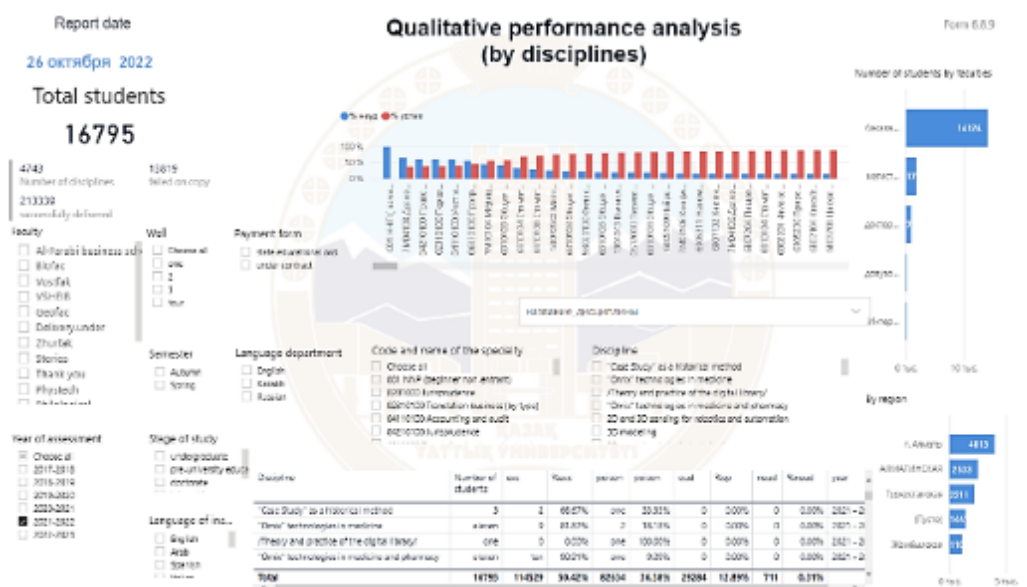


Figure 8. Sorting failure by specialty

Suppose you need to see more detailed information on a particular student, by entering the name, in the report "Examination session data on the student". In that case, you can view the score for the final exam on the selected discipline and the final grade for the discipline (Figure 9) of the particular student.

Sorting in descending or ascending order, e.g., by final grade, we will see the names of students with the lowest or highest academic performance in the chosen discipline.

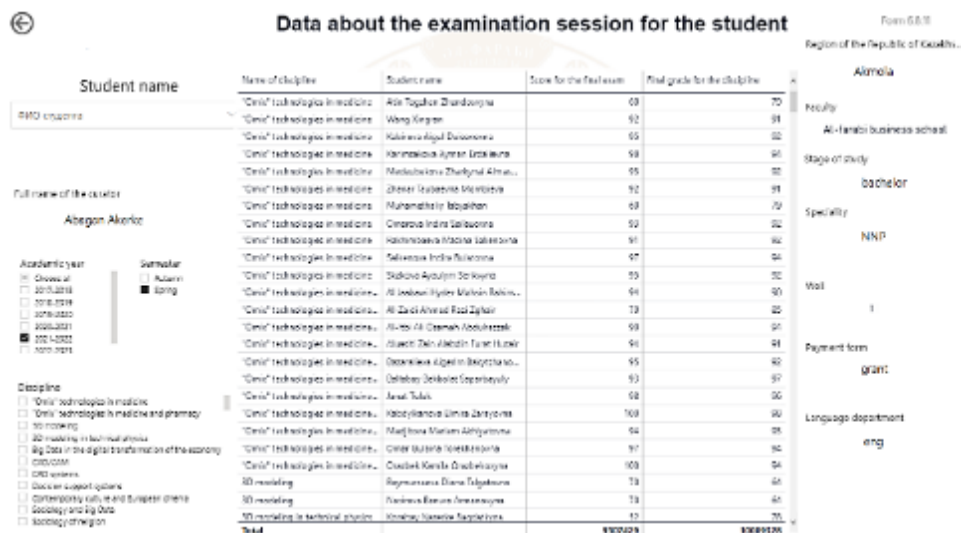


Figure 9. Data on the examination session by student

To see if students with zero or poor performance have been admitted to an exam, see the «Exam Eligibility Data by Student» report (Figure 10).



Figure 10. Examination clearance data by student

Selecting the academic year, discipline, and admission type, e.g., admission type «no», we see the names of students who are not admitted to the exam in the selected discipline.

In addition, comprehensive information on students' progress can be viewed in the report «Qualitative analysis of progress (by student)», shown in Figure 11.

When you enter a student's name on the histogram (the center of the report) and table (bottom right corner of the report), we see the student's marks for RK1, MT, RK2, Examination, Total for the year and semester in a particular discipline, or the entire academic year.

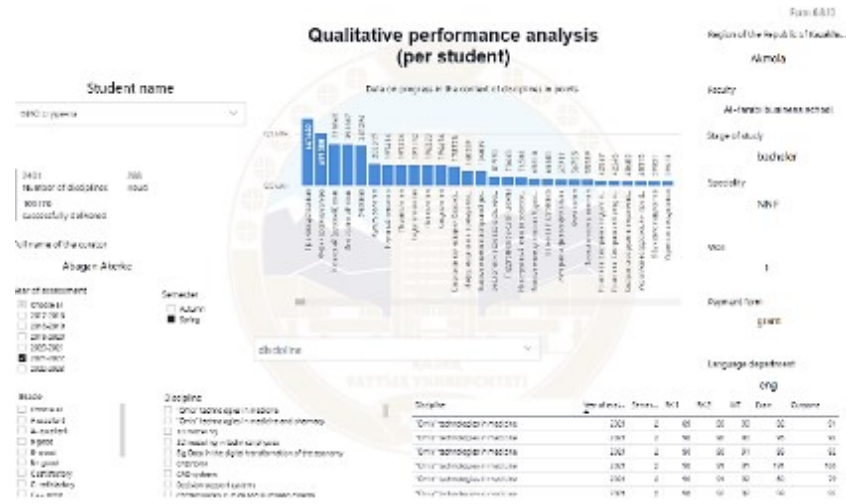


Figure 11. Data on student performance

When sorting in descending or ascending order, e.g., by final grade, we see the names of students with the lowest and highest grades.

Suppose we are interested in whether low student performance is not related to disciplinary violations during the examination session or missing classes. In that case, the answers to these questions can be found in the reports «Number of detected violations by students during the examination session» and «Analysis of students' absences from classes».

Violations by learners during the examination session are viewed in the report «Number of identified violations by learners during the examination session (by students)» (Figure 12).

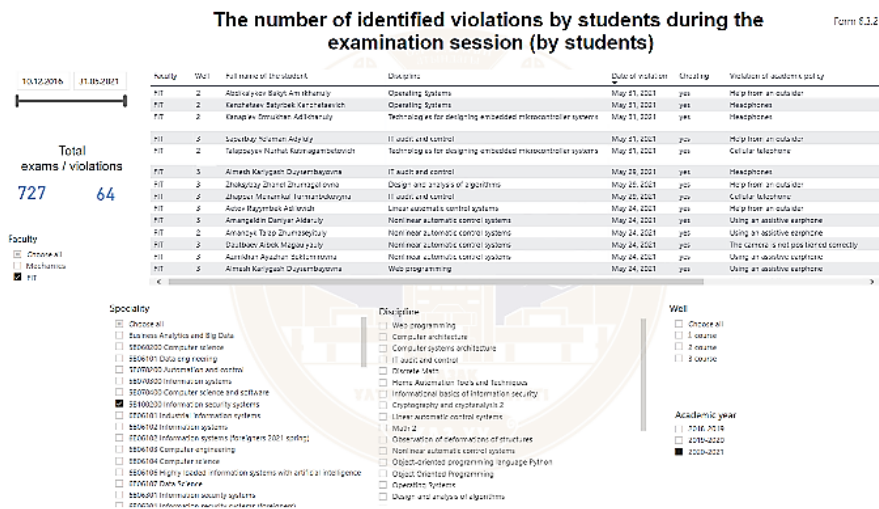


Figure 12. Violations by learners during the examination session

By selecting filters by faculty, academic year, specialty, and discipline in the report table, we can see the date of exam, number of violations, type of violations, and names of violating students.

Knowing the names of the students who violated the examination rules, it becomes clear what led to the failure of students in the past discipline.

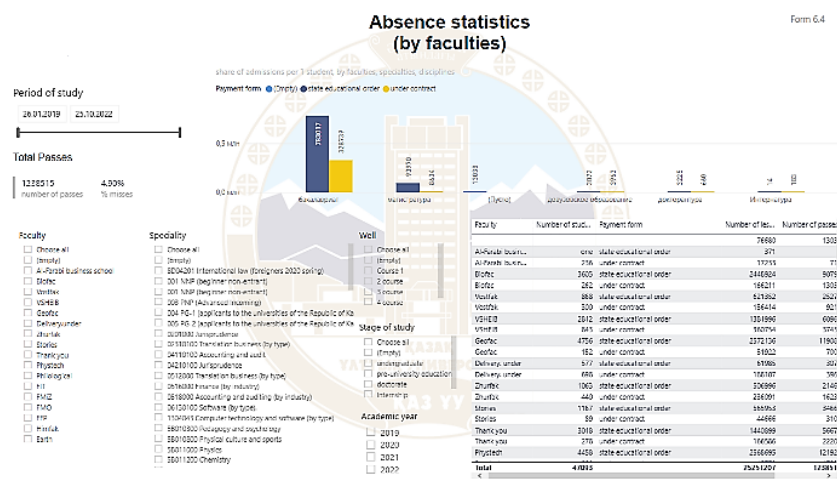


Figure 13. Statistics of absenteeism (by faculty)

In the report «Statistics of absence from classes (by faculty)» it is possible to view the number of classes, number of absences, % of absences from courses at the faculty and specialty of interest, and also on the histogram to see the total number of absences by faculty, level of study, specialty.

More detailed information on each student's absences can see in the report «Statistics of absences and academic performance» (Figure 14), as well as comparing absences and academic performance.

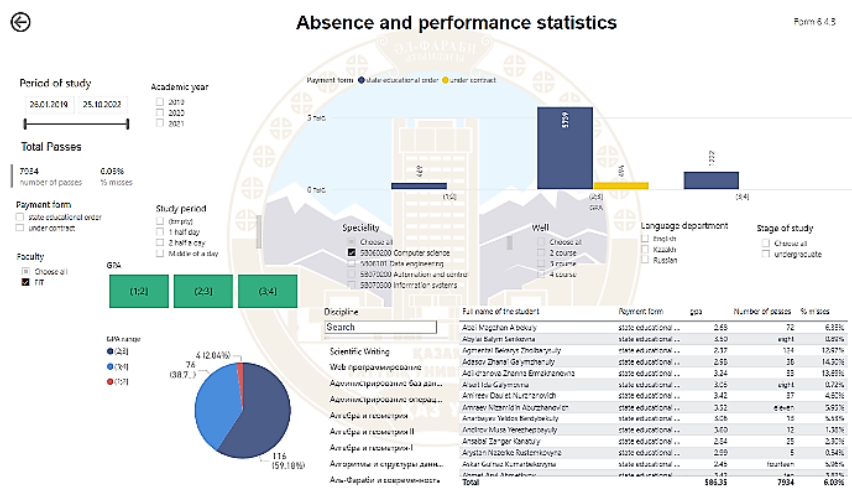


Figure 14. Statistics on absenteeism and academic performance

The «Statistics of absence and academic performance» report in the histogram shows the total number of absences by GPA. The table shows the number of absences, % of absences, and GPA per student (student's name).

After selecting the faculty, academic year, specialty, and discipline, we see the names of students, their number of absences, and progress in the report table.

By sorting the number of absences in descending order or ascending order, one can see the

students' names with the highest number of absences and compare this to their grade point average (GPA).

In the report «Statistics of absenteeism and academic performance» we saw an academic performance by the average grade point of each student. In the report «Qualitative analysis of academic performance (by student)» scores of students on milestone control, examination, and final grade, but for more accurate results of academic performance, and especially failure, and getting students to the risk of expulsion, consider the report «Risk analysis of student expulsion» (Figure 15).

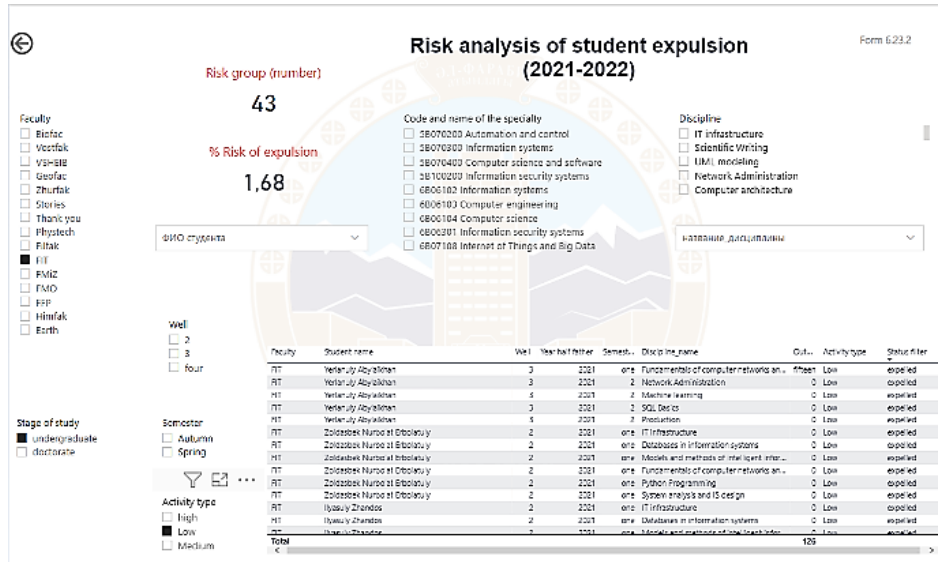


Figure 15. Analysis of the risk of student expulsion

The report «Analysis of the risk of expulsion of students» has a threshold of fewer than 20 points, i.e., the table shows a list of students who have a final grade of fewer than 20 points and also shows the activity of students.

If you select filters by department, grade, semester, course, and type of student activity, you will see the names of students who are candidates for expulsion.

These students are worth paying attention to the deans, supervisors, and professors who read the chosen discipline.

Results. As a result of this work, four scenario analyses were developed based on sixty-eight analytical reporting forms. The use of these scenarios will allow users to work independently and, moreover, non-analyst users can independently conduct research, detect «weaknesses», «strengths» and problems of the current state of affairs of the organization and their work.

Conclusion. 95% of business intelligence system implementations use a functional approach to reporting. It is because it is simpler and faster, leading to analysis. However, its efficiency depends entirely on the user. Obviously, in every company, some people know exactly what should be analyzed to define the company's state clearly. Still, their resources are minimal, and it is not always a priority for them to perform regular analytics. As a result, the average user may use sub-optimal or even erroneous approaches to data analysis.

The development of scenario analyses will enable analytical reporting organizations to improve «analytical literacy» among non-analytical staff and expand the applicability of the

information-analytical system. In result, each user can research their line of business, thereby discovering and eliminating identified problems and challenges.

About 90% of problems in any organization can be detected using scenario analysis diagnostics. But, of course, an expert group of experienced business analysts can detect them even without a scenario. Still, for other users, the scenario approach will be the best solution for optimizing the work with analytical reporting [1].

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