ALGORITHM FOR MANAGEMENT OF ELECTRONIC PAYMENT SYSTEMS BASED ON ASSESSMENT OF THEIR EFFICIENCY

The development of both domestic and global electronic payment systems (EPS) continues, they are becoming more and more in demand, penetrating more and more deeply into all spheres of the economy and society, which changes the usual business models, structures of traditional industries and approaches to management. In this regard, the task of accounting for the assessment of the effectiveness of payment systems is updated. The evaluation contributes to a deeper understanding of their functioning, identification of problems and the potential for their solution. This helps to develop strategies for optimization, improvement of user experience and introduction of new technologies in the life of EPS.

Management of electronic payment systems based on the assessment of their effectiveness is a strategic approach to the management of electronic payment systems, which is based on the continuous assessment and analysis of their work in order to optimize processes, improve the quality of service and achieve more effective performance indicators.

The algorithm that reflects the specifics of EPS management, the basis of which is the overall efficiency indicator, should have the following structural stages:


First, it is necessary to determine the indicators that will allow measuring the effectiveness of the electronic payment system. To date, KPI indicators can include: average transaction processing time; payment conversion; the possibility of canceling the transaction; transaction security level; level of risk management; the intuitiveness of the EPS interface; transaction processing cost; the dependence of the possibility of carrying out operations on the availability of external communication lines; the possibility of making mutual payments by participants and using the received funds immediately after the transaction; the need for access to the central database for operations between participants, availability and characteristics of the limit for similar operations, etc.

2. Data collection.

The next stage consists in collecting data on the operation of the electronic payment system, without which it is impossible to evaluate the effectiveness of the system. Data collection provides factual information about the operation of the payment system, which allows analysis, optimization and informed decisions to improve its performance. The choice of KPI for collecting the necessary data should be adapted to specific business processes depending on the type and goals of the EPS. Each selected indicator helps to quantify and evaluate a certain aspect of the system's operation, which will provide an objective basis for management decisions. Here are some types of tools that can be used to collect data about the performance of an electronic payment system:
1) logging in. Any system writes logs about various events and operations, such as transactions, authorizations, errors, etc. Logs are a valuable source of information for performance analysis and identification of EPS functioning problems;

2) performance monitoring. Prometheus, Grafana, Datadog, New Relic, Splunk and other software products that allow you to collect, store, process and analyze machine data about server load, response time, transaction volume, cache state and other network performance parameters;

3) transactional analytics – enables you to gain valuable insights into key transactional metrics, user segmentation and user behavior. To implement transaction analytics in EPS, specialized data collection and analysis programs such as Google Analytics, Mixpanel, Amplitude, Tableau, Microsoft Power BI and others;

4) request tracing – helps track the path that each request or transaction takes in the system. It allows you to identify bottlenecks, analyze performance, detect errors under conditions of high load and complex system architecture. There are several request tracers such as Jaeger, Zipkin, OpenTelemetry and AppDynamics. They allow you to create «traces» («traces of requests»), which constitute logs and information about each stage of request processing;

5) error monitoring systems - help detect, track and respond to errors, exceptions in the code, problems in the system. Error monitoring systems include: Sentry, Rollbar, New Relic, Dynatrace, AppDynamics, Bugsnag, Airbrake Raygun and others;

6) event management systems – allow the system to respond to events in real time, process data streams, and create complex analytical scenarios. These systems include: Apache Kafka, Amazon Kinesis, Azure Event Hubs, Google Cloud Pub/Sub, RabbitMQ, Apache Pulsar, NATS, Confluent Platform and others;

7) security monitoring systems - help detect suspicious activity and protect user data from fraud. Security monitoring systems include: Splunk, IBM QRadar, McAfee Enterprise Security Manager, AlienVault USM, Qualys, Trustwave SpiderLabs, Trend Micro Deep Security, Fortinet FortiSIEM, Symantec Security Analytics, Darktrace and others. The choice of a security monitoring system depends on many factors, including security requirements, budget, the size of the EPS and its infrastructure;

8) data analysis systems - perform in-depth data analysis, based on the results of which complex reports are generated. They help turn accumulated data into valuable insights, which allows you to make more informed management decisions and optimize processes in the environment of EPS operation. The following software products are used for in-depth analysis: Tableau, Microsoft Power BI, QlikView, Qlik Sense, Google Data Studio, Looker, Sisense, Domo, Splunk and others.

9) network activity monitoring – allows you to analyze network traffic and detect anomalies, connection problems, attacks and other unwanted events. The following programs are used to monitor network activity: Wireshark, Nagios, SolarWinds Network Performance Monitor, PRTG Network Monitor and others.

The choice of tools for collecting data on the operation of an electronic payment system depends on the KPI and specific objectives of data collection, the scale of the system and the requirements for analysis. It is worth noting that, taking into account the foreign origin of most programs that allow data collection, it is necessary to check their compliance with the requirements of domestic information legislation before use. It is also worth emphasizing the need to use licensed software and ignore sanctioned Russian software products.

3. Data analysis.

After data collection, their analysis is carried out to determine those aspects of the electronic payment system that need improvement. Data analysis is not a one-time process, it, like any other management stage, includes separate sub-stages.

1) preparation of data for analysis - includes processing and preparation of collected data. When working with EPS, this sub-stage is characterized by the need to clean data from errors,
eliminate duplicates, convert formats and other steps in order to give the data a readable form and prepare them for analysis;

2) detection («identification») of aspects - consists in determining specific aspects of the system's operation that require analysis. These can be areas such as transaction processing speed, failure rate, costs, customer satisfaction, etc.;

3) data visualization - includes the construction of graphs, charts, calculation of statistical indicators and other methods for identifying patterns and trends inherent in EPS. Various tools can be used for visualization, including software;

4) detection of vulnerabilities (critical points) in the system;

5) determination of optimization opportunities.

Data analysis allows you to identify trends, problems and potential areas for improving the payment system. It is a key stage in performance management, as it allows management decisions to be made based on actual data. For example, an analysis of transaction processing time data found that the average processing time for large transactions exceeds the average time for small payments. Possible ways of optimization: medium-term perspective – purchase and connection of additional computing capacities; short-term perspective - redistribution of available computing power involved in small transactions.

4. Making a decision.

On the basis of data analysis, which revealed shortcomings and bottlenecks in the infrastructure of the system, options for further modernization and optimization, decisions are made about the necessary changes aimed at increasing the efficiency of the EPS. In the decision-making process, the priority of system changes is established. It is worth emphasizing that some problems may be of a more critical nature and require immediate solutions, while others may be considered in terms of long-term strategies. Decisions made are fixed in the «Action Plan», which includes steps for the implementation of the chosen decisions. These can be technical improvements, software updates, staff training, changes in transaction processing processes, etc.

5. Implementation of the decision.

1) coordination - consists in the coordination of the implemented solution with the technical and operational teams, the system development team, etc., which will be involved in the change process;

2) development and testing of the implemented solution;

3) testing - before full implementation of changes, testing is carried out under controlled conditions to ensure their correct operation and to minimize possible risks to EPS.

6. Monitoring and evaluation.

After the implementation of changes, monitoring is carried out in order to assess their impact on the effectiveness of the system. If the changes led to the achievement of the set goals and improvement of KPI, then the adopted management decision is considered successful. Otherwise, an adjustment may be necessary.

When evaluating the efficiency of the electronic payment system (Eeps), in our opinion, it is advisable to use an approach based on the formation of an integral indicator of the evaluation of efficiency based on the index method of calculation. In this case, the formula will look like this:

\[ E_{eeps} = KPI_1 \times KPI_2 \times KPI_3 \times ... \times KPI_n, \]  

where: \( KPI_i \) – the level of reaching the limit value of the i-th KPI, at which the functioning of the EPS is effective, and \( i \in [1, N] \);

\( n \) – the number of key indicators selected for the purpose of evaluating the effectiveness of the EPS.

The advantages of the proposed approach are the simplicity of calculation and the ability to comprehensively evaluate the results of the functioning of the electronic payment system. Disadvantages: to calculate the integral indicator, it is necessary to determine the limit values of
each KPI; the approach does not take into account the degree of significance of each individual indicator in the overall assessment of efficiency; values of the integral indicator can fluctuate significantly.

A more accurate measurement of the effectiveness of the electronic payment system based on the proposed approach can be made based on the addition of formula 1. «weighting factors» for each KPI indicator. This will make it possible to take into account the importance of each individual indicator in the assessment of the effectiveness of the electronic payment system and thereby implement a systematic approach to the assessment of the effectiveness of the electronic payment system.

\[ E_{eps} = k_1 \text{KPI}_1 \times k_2 \text{KPI}_2 \times k_3 \text{KPI}_3 \times \ldots \times k_n \text{KPI}_n, \]  

where: \( k_i \) – the «weight factor» of the estimated private EPS efficiency indicator.

Among the advantages of the supplemented formula we can include: taking into account the importance of each factor; reasonable selection of KPIs that affect the efficiency of the EPS; the use of procedures for comparing the significance of indicators in order to determine the main parameters of the system. Among the shortcomings, the following should be highlighted: the need for additional development of formalized procedures for ranking indicators; the need to carry out work on determining the system of «weighting coefficients».

To monitor the effectiveness of changes, the same indicators that were defined as general KPIs of a specific EPS are taken. The obtained data is compared with previous KPI indicators. So, if the goal was to reduce transaction processing time, then the average values before and after changes made to the system are compared. The received data is analyzed, during which a conclusion is drawn as to how much the changes affected the performance indicators of the payment system. The conclusion includes the identification of improvements or problems that, as before, require their solution. In general, the achieved results are compared with the set goals and expectations, taking into account the resources spent on the entire process. If the results of the monitoring do not meet the expectations and set goals, it may require adjustment of the decision made. Based on data analysis, it is determined in which areas additional improvements or changes are needed. So, if the changes in the fraud detection system did not lead to the expected reduction in fraudulent transactions, this indicates the ineffectiveness of the new algorithms. In this case, the team returns to analyzing the data and identifying new approaches to solving the problem.

The process of managing electronic payment systems based on the assessment of their effectiveness is a continuous process that allows you to adapt management decisions in accordance with the real results and needs of the electronic payment system.

An approach based on performance evaluation helps companies and organizations more clearly build a strategy for the development of their electronic payment systems, improving the quality of customer service, optimizing processes and improving the overall competitiveness of the system. In the above material, we tried to objectively reveal the need to manage electronic payment systems based on an assessment of their effectiveness. The main, in our opinion, structural stages in EPS management were highlighted, which included: determination of key performance indicators; data collection; data analysis; decision-making; implementation of decisions; monitoring and evaluation. In the course of the research, we came to the conclusion that the process of EPS management at the stage of development of the information society involves a process of constant optimization. This process is a key element of successful system management, allowing it to adapt to dynamic conditions, monitor new trends and maintain a high level of efficiency in the long term. The team responsible for the payment system must regularly perform data analysis, even after implementing changes. It helps to identify new trends, anomalies or changes in indicators; to adapt KPIs taking into account the new priorities of system functioning; to look for new ways to optimize the system, aimed at reducing transaction processing time, reducing costs, etc.; adapt the system to new technologies and much more. The electronic
payments industry is constantly evolving, and new technologies can provide new opportunities to improve the efficiency of EPS. Thus, the introduction of artificial intelligence technologies already significantly improves the security of transactions carried out using EPS.

References: