“Development of the methodology for the comprehensive assessment of banking services quality”

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DEVELOPMENT OF THE METHODOLOGY FOR THE COMPREHENSIVE ASSESSMENT OF BANKING SERVICES QUALITY

Abstract

The crisis in the world financial markets, the capitalization of bank profits, the size of which is insufficient to maintain the existing level of the banking system of Kazakhstan, has actualized the quality problem not only in terms of forming credit portfolios of banks, managing banking risks, but also offering high-quality banking services.

Despite the fact that the banking services quality cannot directly affect the financial sphere, the production sphere, and also affect the sharp decline in the economy, the economic losses from poor banking services can significantly increase, causing significant losses to banks. At the same time, it should be considered that the financial losses of the firms as active participants in financial markets are significant in the amount of losses. Consequently, the banking services quality can cause not directly, but indirectly both the success of the banking business and the possible losses of banks. In order to manage the quality of banking services, it is necessary to have certain methods for analyzing and assessing the quality of banking services. This article attempts to solve this issue.

Using various research methods, based on obtaining real assessments of respondents, the present paper gives a methodology for the comprehensive assessment of banking services quality. The developed mechanism includes consolidation of organizational and methodological and economic and statistical methods of research: a five-step SERVQUAL model, integral and general indices, a multiple queue system, instruments of correlation and regression analysis that determine the level of customer satisfaction and problem characteristics of the quality of services offered.

Keywords banks, services, quality, methodology, coefficient

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INTRODUCTION

As the economy of Kazakhstan develops, the relevance of banking services quality problems in banks is growing in a competitive environment. The organization of the bank's activities raises the issue of developing a measure system to assess and manage the banking services quality, which will allow the bank the flexible maneuver with available information, material and financial resources when solving strategic and tactical tasks.

From a scientific point of view, the quality is now quite new object of management. Together with this, the modern representation of the concept of quality, its parameters do not meet the market requirements. This necessitates the scientific comprehension and practical development of new effective forms and methods, the formation of methodological approaches in assessing the banking services quality through an appropriate quantitative toolkit.

Searching for effective functioning forms and methods of domestic banks is an urgent problem in which quality issues are in one of the leading positions. These facts make it possible to relate the given problem to the number of the most relevant in modern science.

The purpose of the research is to develop a comprehensive assessment of banking services quality, which is oriented to measure the degree of customer requirements satisfaction.

1. RECENT RESEARCH AND PUBLICATIONS ANALYSIS

The complexity and multidimensional nature of the problems of assessing the banking services quality are due to a wide range of issues when organizational and methodological tools in commercial banks are underdeveloped.

The problems of the theory of service quality were studied on the basis of research and works by Choga, Mapanga, and Munapo (2017), Oskooii and Albonaiemi (2017), Akkucuk and Teuman (2016), Mylonakis (2009), Deming (1994), Gronroos (1982), Lee (2000), and McDougall (2000).

The works by the Russian and Ukrainian scientists have been used to comprehensively disclose the research topic: Chernyshev (2004), Andreyev (1998), Novatorov (2001), Korolev, Rabinovich, and Shmoilova (1985), Frenkel (1989).

At the same time, the problem of aggravation of the banking competition for attracting potential customers and retaining the existing ones causes an extreme urgency of the quality problem, raises the need for practical development of new effective forms and methods in assessing the quality of banking services through the appropriate quantitative instruments.

2. KEY RESEARCH RESULTS

The necessary quality measurement indicator of banking services is the desired, necessary, and possible level of service quality which takes into account specific expectations and requirements of customers. The quality management of banking services is a type of activity aimed to meet the requirements and expectations of consumers set for the quality of banking services. It depends on the degree of interaction and optimality of internal relations (Chernyshev, 2004). Therefore, it will be true that in the case of determining the opinions of customers on the quality of the services provided by a bank, it is possible to adjust internal communications in the best possible way.

To assess the quality of banking services, it seems advisable to use a system of indicators or a comprehensive assessment of banking services quality, which is based on the principle of quantitative assessment, which gives a fair presentation of the quality level of the management object. The algorithm of its implementation can be presented in the scheme (see Figure 1).

The primary information for assessing the banking services quality according to the methodology includes the interview data on two consumer groups: legal entities and individuals serviced in the Kazakhstani bank under investigation. The initial data for assessing the banking services quality are the results of the questionnaire. Questionnaires are compiled in accordance with the SERVQUAL methodology principles (Andreyev, 1998).

The processing of the questionnaire data consists in calculating the indicator (score) of expectation, perception and importance, as well as the quality factor as a difference in perceptions and expectations for each criterion (Novatorov, 2001).

Evaluation of the SERVQUAL methodology applied to the sphere of banking services within the framework of research has proved its effectiveness by revealing the most bottlenecks in the bank's activity. Based on the results obtained, the relative picture of quality in the bank under investigation and the most problematic quality

Note: Prepared by the authors.

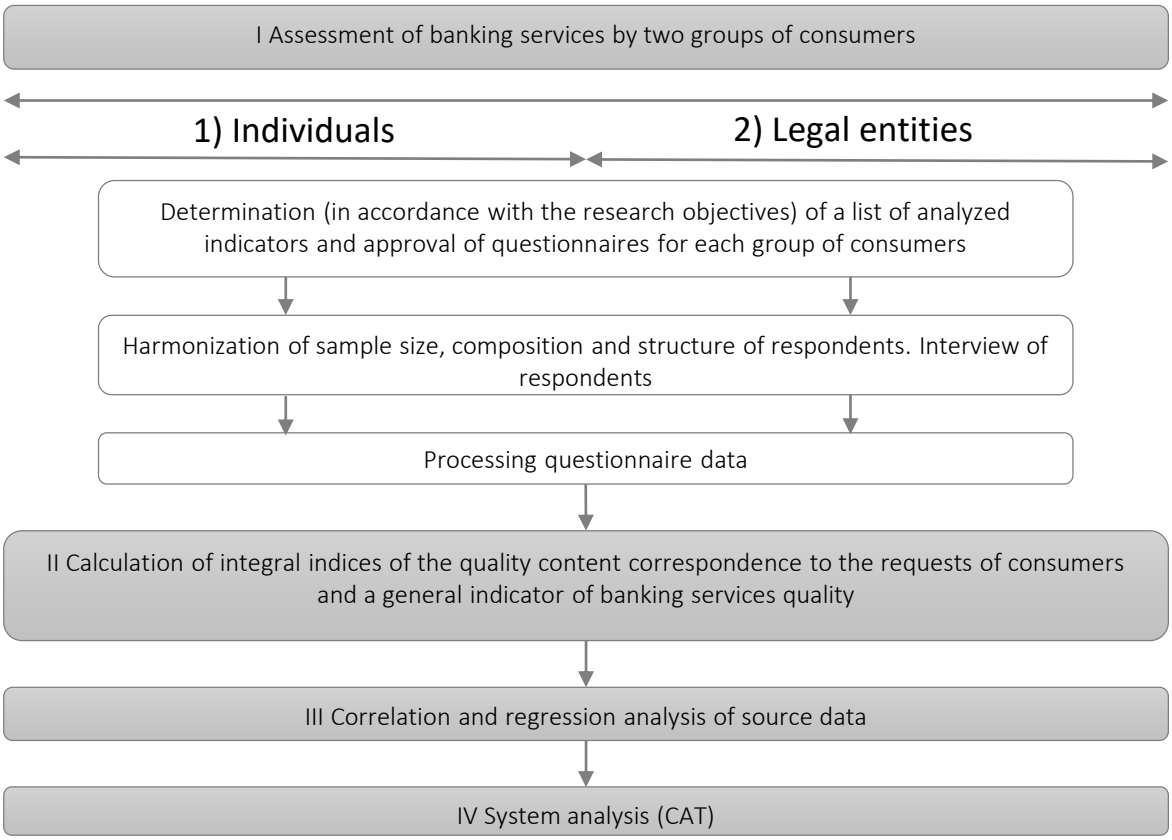

Figure 1. Algorithm scheme of a methodology for the comprehensive assessment of banking services quality

characteristics are determined. Therefore, for a more in-depth analysis of problem areas, it seems necessary to conduct a comprehensive assessment of banking services quality.

Based on the values of parametric indicators of banking services quality, a general (complex) and integral (characterizing the quality conformance from the position of one of the groups of consumers) indicator is determined in the following sequence:

1. The weighting (importance by qualitative parameters) is calculated according to the formula:

$$q_i = \frac{P_i}{E_i}, \quad (1)$$

where P_i, E_i is the consumer perception and expectation of quality according to the i criterion.

2. The weighting / importance of each parameter is determined by the formula:

$$K_i = \frac{I_i}{\sum_{i=1}^{N} I_i}, \quad (2)$$

where I_i is the consumer estimate of the importance of the i criterion of service quality.

3. Based on the results of the indicators obtained, the integral index is determined, based on the opinion of the respondents, according to the formula:

$$Q_j = \sum_{i=1}^{N} q_i \cdot K_i, \quad (3)$$

where Q_j is the integral quality index of a banking service calculated based on the interview results of the j consumer group; q_i is the special service quality index by the i criterion; K_i is the index of importance of the i criterion of quality.

4. For a more objective assessment, taking into account the opinion of all groups of respondents,

the average integral indicator of banking services quality is calculated according to five quality criteria: tangibles, reliability, responsiveness, assurance, and empathy.

$$Q = \frac{\sum_{i=1}^{5} Q_j}{5}. \quad (4)$$

5. To obtain a general index on qualitative parameter on the basis of the integral indicators obtained, we use the formula:

$$Q = \sqrt{Q_{ind} \cdot Q_{le}}, \quad (5)$$

where Q is the general index of the conformity of the content and quality of banking services; Q_{ind}, Q_{le} are the integral indices of the conformity of the content and quality of banking services, respectively, calculated by the results of individuals and legal entities interview.

The calculated values of the integral and general index determine the level of satisfaction of the bank's customers, and the possibility of applying the indicator to develop recommendations for improving the quality of banking services.

Given the results of the questionnaire of the two groups of respondents, the values of the general and integral indicators of the service quality are determined. The results of calculation are shown in Table 1.

Due to its general sense the quality indicator Q reflects the difference between the expected service and delivered service per unit of perception from the result of the consumption of banking services on quality parameters. Accordingly, the level of respondents' satisfaction with the five quality criteria is estimated according to Table 2.

Table 1. Values of general and integral quality indicators

Analyzed criteria	Legal entities			Individuals		
	Parameter weight $q = \frac{P}{E}$	Weight of each parameter $KI = \frac{I}{SI}$	Intergral index Qj	Parameter weight $q = \frac{P}{E}$	Weight of each parameter $KI = \frac{I}{SI}$	Intergral index Qj
Tangibles						
The bank has modern office machines and equipment	0.84	0.04	0.04	0.80	0.05	0.04
Interior of premises in a bank in excellent condition	0.87	0.04	0.04	0.85	0.04	0.04
The staff is nice looking and neat	0.99	0.05	0.04	0.94	0.05	0.04
The appearance of the bank's information materials (booklets, prospectuses) is attractive	0.93	0.04	0.04	0.93	0.04	0.04
Total	3.62	0.18	0.16	3.53	0.18	0.16
Reliability						
The bank provides its services at the promised time	0.90	0.05	0.04	0.89	0.05	0.04
If customers have problems, then the bank sincerely tries to solve them	0.94	0.04	0.04	0.88	0.04	0.04
The bank has a reliable reputation	1.01	0.05	0.05	0.99	0.05	0.05
The bank provides its services to customers accurately and on time	0.87	0.05	0.04	0.90	0.05	0.04
The bank avoids mistakes and inaccuracies in its operations	0.86	0.05	0.04	0.92	0.05	0.04
Total	4.58	0.23	0.21	4.59	0.24	0.21
Responsiveness						
The staff is disciplined	0.97	0.05	0.04	0.92	0.05	0.04
The staff provides services quickly and efficiently	0.89	0.05	0.04	0.93	0.05	0.04
The staff always helps clients to solve their problems	0.88	0.04	0.04	0.90	0.04	0.04
The staff responds quickly to customer requests	0.89	0.05	0.04	0.89	0.05	0.04
Total	3.63	0.18	0.17	3.64	0.19	0.16

Table 1 (cont). Values of general and integral quality indicators

Analyzed criteria	Legal entities			Individuals		
	Parameter weight $q = \frac{P}{E}$	Weight of each parameter $KI = \frac{I}{SI}$	Intergral index Qj	Parameter weight $q = \frac{P}{E}$	Weight of each parameter $KI = \frac{I}{SI}$	Intergral index Qj
Assurance						
There is an atmosphere of trust and understanding between clients and the staff	0.91	0.05	0.04	0.88	0.05	0.04
Customers feel safe in the relationship with the bank	0.93	0.05	0.04	0.91	0.05	0.04
The staff is polite in their dealings with customers	0.87	0.05	0.04	0.92	0.05	0.04
The management of the bank renders all kinds of support to the staff for effective customer service	1.00	0.05	0.05	0.89	0.05	0.04
Total	3.71	0.19	0.17	3.60	0.20	0.16
Empathy						
The bank shows an individual approach to each client	0.92	0.05	0.04	0.93	0.05	0.04
The staff is personally involved in resolving customer problems	0.95	0.04	0.04	0.89	0.04	0.04
The staff knows the needs of their customers	0.96	0.04	0.04	0.92	0.04	0.04
The staff is focused on the problems of customers	0.94	0.05	0.04	0.91	0.04	0.04
The bank has operating hours convenient to all customers	0.88	0.05	0.04	0.82	0.05	0.04
Total	4.65	0.23	0.21	4.48	0.22	0.20
Average integral quality index			0.18			0.18
Integral index of a group of respondents		0.92			0.89	
Q general quality index			0.90			

Note: Prepared and calculated by the authors.

Table 2. Evaluation of banking services quality compliance with the requirements of consumers

Source: Novatorov (2012).

Quality index range	Grades of assessing the banking services quality
From 0.80 to 1.00	Standard
From 0.60 to 0.79	Satisfactory
Less than 0.59	Critical

Obviously, the value of the general quality index of the bank under investigation is 0.90, and the integral quality indices are close to unity (0.92 for legal entities and 0.89 for individuals), this means a standard level of quality of services.

The result of further research is a detailed assessment of each of the factors (parameters) impact of the five main criteria for the banking services quality on the level of the performance indicator. In this connection, the probability theory methods and mathematical statistics are used, which allow us to discover regularities hidden among randomness. Data processing has been performed using the "correlation and regression analysis" in the Microsoft Excel.

"Modelling on the basis of regression equations can be reduced either to the construction of one equation with the inclusion of a large number of factor characteristics or to the construction of a system of equations. In the latter case, a system of statistically unrelated equations is obtained; however, the entire system is connected by a single chain of cause-effect relationships" (Korolev, 1985).

In the research, a general question is used as an outcome, for example: "How, in general, do you evaluate the quality of service?" Factor characteristics are twenty-two indicators within the five quality criteria/dimensions in the framework of the SERVQUAL methodology.

After selecting the effective and factor attributes, the preconditions for the multicollinearity phenom-

enon occurrence are checked. This phenomenon often represents a perceptible threat to the correct identification and effective evaluation of interrelations (Frenkel, 1989).

For this, it is advisable to use a method based on the analysis of paired correlation coefficients, which indicate estimates of the constraint equations accuracy (reliability) and the validity of their application.

The analysis of the obtained correlation coefficients calculated for the factor indices within the framework of the five quality criteria indicates the presence of collinear factor indices, i.e.:

- indicators X_1 (criterion of tangibles) and X_4 (criterion of assurance) in the assessments of legal entities, as well as indicators X_1 (criterion of tangibles) and X_2 (criterion of reliability) in the estimates of individuals have a strong relationship of intra-factor indicators;
- indicators X_2 (reliability criteria) and X_3 (responsiveness criteria) in the assessments of legal entities, as well as X_2 (reliability criteria) and X_5 (empathy criteria) in the estimates of individuals have a strong relationship of intra-factor indicators;
- indicators X_3 (responsiveness criteria) and X_4 (assurance criteria) in the assessments of legal entities, as well as X_3 (responsiveness criteria) and X_5 (empathy criteria) in the estimates of individuals have a strong relationship of intra-factor indicators.

It is believed that the two indicators are collinear if the pair correlation coefficient is not less than 0.8 (Frenkel, 1989).

As we can see, all factor indicators are strongly influenced, therefore, in order to eliminate multicollinearity, all representatives of the specified groups are included in the regression model.

After selecting and determining the most influential factors for the effective indicator of service quality, their communication form, the analysis of the initial statistical information, it is necessary to proceed to multi-step regression analysis based on the elimination of nonessential factors according to the Student's t-test (t-statistics).

By this criterion, the hypothesis is tested whether the regression coefficient α_j is significantly different from zero for some given level of significance £, which shows the probability of rejecting the correct hypothesis. At the same time, the lower the level of significance, the less is the indicated probability. In our research, we take £ = 0.05. The table value of Student's t-test is 2.02. The connection is considered confirmed if the Student's t-test is ≥ 2.02.

The result of multi-step regression analysis in the construction of a model for assessing the banking services quality is the elimination of statistically insignificant factor indicators of the multiple regression equation. In the research, the model takes the following form:

$$Y_{le} = -1.784 + 0.178X_1 + 0.335X_2 + 0.228X_3 + \\ +0.311X_4 + 0.359\ X_5;$$

$$Y_{ind} = -0.882 + 0.186X_1 + 0.312X_2 + 0.165X_3 + \\ +0.244\ X_4 + 0.317\ X_5.$$

Statistical verification has showed the adequacy of models. The calculated value of Fisher's F-criterion for the model of assessing the banking services quality of legal entities is 107.306, and for individuals – 208.048, with a tabular value for legal entities F_{le} (0.05, 5, 41) = 2.42 and individuals F_{ind} (0.05, 5, 168) = 2.27.

The coefficient of multiple correlations is equal for both legal entities and individuals 0.964 and 0.928, respectively, which indicates that these factor indicators are relatively closely related to the effective indicator.

The coefficient of multiple determination R_2, which is equal to 0.929 for legal entities and 0.861 for individuals, indicates that the variation of the resultant indicator in the study set of divisions by 92.9% and 86.1% is the result of the variability of all factors included in the model.

A fragment of the main calculations and conclusions for the model of the quality management system for banking services of legal entities and individuals is presented in Table 3.

Table 3. The main indicators of the model for assessing banking services quality of two groups of respondents

Indicators	Constraint equation	Student's t-test	Correlation coefficient	Multiple coefficient of correlation R	Multiple coefficient of determination R2	Fisher's F-criterion	Average partial elasticity coefficients Ei
1	2	3	4	5	6	7	8
Indicators of the model of the quality management system of banking services of legal entities							
Tangibles criteria	$Y= -1.784+ +0.178X_1+ +0.335X_2+ +0.228X_3+ +0.311X_4+ +0.359X_5$	2.330	0.778	0.964	0.929	107.306	0.171
Reliability criteria		3.196	0.879				0.338
Responsiveness criteria		2.186	0.865				0.227
Assurance criteria		2.458	0.892				0.306
Empathy criteria		3.421	0.879				0.352
Indicators of the model of the quality management system of the banking services of individuals							
Tangibles criteria	$Y= -0.882 +0.186X_1+ +0.312X_2+ +0.165X_3+ +0.244X_4+ +0.317X_5$	3.893	0.806	0.928	0.861	208.048	0.178
Reliability criteria		4.277	0.857				0.312
Responsiveness criteria		2.588	0.797				0.160
Assurance criteria		3.707	0.840				0.239
Empathy criteria		4.707	0.854				0.241

Note: Calculated by the authors.

Calculations on the considered set of respondents have showed that all factor indicators are significant for legal entities and individuals:

- X_1 – tangibles criteria;
- X_2 – reliability criteria;
- X_3 – responsiveness criteria;
- X_4 – assurance criteria;
- X_5 – empathy criteria.

The resulted regression equation helps to draw the following conclusions: the direction of the factors influence included in the model does not contradict an economic sense.

As for legal entities: increased materiality criterion factors by 1 unit involves increased banking services quality by 17.8, increased reliability criterion factors by 1 unit involves increased quality by 33.5, increased responsiveness criterion factors by 1 unit involves increased quality by 22.8, increased conviction criterion factors by 1 unit involves an increase by 31.1, increased sympathy criterion factors by 1 unit involves increased banking services quality by 35.9.

As for individuals: increased materiality criterion factors by 1 unit involves increased banking services quality by 18.6, increased reliability criterion factors by 1 unit involves increased quality by 31.2, increased responsiveness criterion factors by 1 unit involves increased quality by 16.5, increased conviction criterion factors by 1 unit involves an increase by 24.4, increased sympathy criterion factors by 1 unit involves increased banking services quality by 31.7.

Comparing directly the regression coefficients in the multiple regression equation gives an idea of the degree of influence of the factor characteristics on the performance indicator only when they are expressed in the same units and have approximately the same variability. For this purpose, it is proposed to use a whole system of indicators: average frequency coefficients of elasticity, beta coefficients and delta coefficients (Frenkel, 1989).

The research has used the average partial coefficient of elasticity (E_i), which allows to measure the percentage of the changed effective indicator with an increase in each factor by the same relative value – by 1%. This interpretation is very convenient and understandable for every economist.

The greatest influence on the effective quality indicator according to the estimates of legal entities

from the factor indicators included in the regression equation is the sympathy criterion (its increase by 1% would cause an increased satisfaction with the banking services quality by 0.352%), the reliability criterion (its increase by 1% would cause an increased quality satisfaction by 0.338%) and the conviction criterion (its increase by 1% would cause an increased quality satisfaction by 0.306%). Increased parameters of the responsiveness and materiality criteria by 1% would cause an increased satisfaction with the banking services quality by 0.227% and 0.171%, respectively.

In the regression model, built for individuals, a significant (essential) factor indicator was the reliability criterion (its increase by 1% would cause an increase quality satisfaction by 0.312%). An increased conviction criterion by 1% will cause an increased satisfaction with the banking services quality by 0.239%. An increased sympathy criterion by 1% will involve an increased satisfaction of individuals by 0.241%. An increased responsiveness and materiality criteria by 1% will cause an increased satisfaction with the banking services quality by 0.178% and 0.160%.

Thus, we have identified the main factor indicators affecting the quality management effectiveness of banking services in the bank under study. They should be focused on first. Their change (with the exception of the factor indicator X_1 – the materiality criterion) largely depends on decisions in bank's management system, and is not associated with significant capital investments.

It should be noted that the model allows the establishment of only the level of the phenomena under study corresponding to the chosen factors. But since it is practically difficult to single out all the factors that affect the quality of banking services, the deviations of the actual values of the analyzed indicators from the calculated ones can be explained by the action of unaccounted factors. Including more factors in the model significantly increases its adequacy.

It should be remembered that these models are static, that is, when they were constructed, the time factor was not taken into account. Therefore, the propagation of the regularities established through these models will give large extrapolation errors for long periods of time (since the shape and direction of the relationship may change). The predictive properties of regression models are manifested only under certain conditions and cannot spill even over to the same type of phenomena that occur under different conditions.

The system, as an economic entity, performs primarily a productive function in order to obtain profit. Proceeding from that, let's consider the efficiency of the credit departments which service individuals and legal entities of a Kazakhstan bank, whose purpose is to conclude the maximum possible number of loan agreements.

To determine the process of servicing, the optimal allocation of working hours in the bank's credit management, economic and mathematical models should be used. Unsatisfactory assessments of some quality parameters identified on the basis of the survey, allow the proceeding to a quantitative assessment of system analysis.

The bank is a system, since it is a set of elements (subsystems) that are in relationships and connections with each other and form a certain integrity (unity). Under these conditions, the elements (for example, the bank's credit department) themselves can be considered as systems, and the system under study – as an element of a more complex system – the bank.

The system of credit departments is designed for a reusable use when solving similar tasks with the service processes that arise while this, it means that this system is a queuing system (QS) (Gronroos, 1982).

The QS consists of a certain number of serving units, which are called service channels. The system can be single-channel or multi-channel. In our case, the service channels are 3 managers in the credit department for individuals and 2 managers in the credit department for legal entities. According to the number of channels, the considered QS can be characterized as multi-channel.

Applications are received from the QS usually not regularly, but by accident, forming a so-called random flow of applications (requests). Applications in this system will be customers. The applications

are serviced also for some continuous random time. The random nature of the applications flow and the service time is the reason of that the QS is not loaded evenly: at some time, it is accumulated, while in other periods the QS is working with underload or stands idle.

Credit departments are classified as lossless QSs (with unlimited waiting) with a limited queue length. In the waiting QS, the application, came at the moment when all channels are busy, does not go away, but is in the service queue.

The credit department of the analyzed bank has 6 managers, the credit department for individuals – 3 managers and the credit department for legal entities – 3 managers. Working hours are from 9:00 am to 6:00 pm, with a lunch break from 1:00 pm to 2:00 pm. Customers are served until 4:00 pm. From 4:00 pm to 6:00 pm – the working hours of the department with loan agreements and other documentation. Customers apply to for advice or for loans. The possibility of leaving the queue is very low, if the customer does not come before lunch, then he comes in the afternoon.

An important characteristic of the QS is the load intensity, which shows the agreement degree between the incoming and outcoming flows of the service channel applications and determines the queuing system stability (Fomin, 2005).

Having grouped the flow data of the bank's customers, indicating the registration of their number and the servicing time per minute in the credit departments during the operational day, the following results have been obtained (Table 4).

Table 4. Number of bank's customers flow

Bank's credit departments	Number of customer flow (pers.)		
	1	2	3
On servicing of individuals	15	14	6
On servicing of legal entities	6	3	1

Note: Calculated by the authors.

1. We define the intensity of the incoming flow of bank customers per hour of the credit department operation, using the Pearson criterion with a significance level $\alpha = 0.05$:

$$\lambda = \bar{k} = \frac{\sum_{i=1}^{3} k_i f_i}{\sum_{i=1}^{3} f_i}, \quad (6)$$

- $\lambda = 1.743$ cust./min in the credit department for individuals;
- $\lambda = 1.500$ cust./min in the credit department for legal entities.

2. We calculate the theoretical frequencies (Table 5):

$$f_i^T = N \frac{\lambda \cdot k_i}{k_i!} \cdot e^{-\lambda}, \quad (7)$$

where $N = \sum_{i=1}^{3} f_i$.

Table 5. Value of theoretical frequencies for the customers flow

Bank's credit departments	Theoretical frequencies		
	1	2	3
On servicing of individuals	10.664	10.664	5.332
On servicing of legal entities	3.344	3.344	1.672

Note: Calculated by the authors.

3. The observed values of Pearson's criterion are defined as follows:

$$\chi^2_{obs} = \sum \frac{(f_i - f_i^T)^2}{f_i}, \quad (8)$$

- $\chi^2_{obs} = 2.889$ in the credit department for individuals;
- $\chi^2_{obs} = 2.415$ in the credit department for legal entities.

4. According to a given significance level $\alpha = 0.05$ and the number of freedom degrees $\nu = n - 2$, where n – the number of groups in the series of critical distribution points χ^2 is determined to be $\chi^2_{kp}(\alpha, \lambda) / \chi^2_{kp}(0.05; 1) = 3.840$ for the department for servicing individuals and for the department for servicing legal entities.

5. Since $\chi^2_{obs} < \chi^2_{cr}$, then it can be considered (in this case this condition is satisfied to be: 2.889 < 3.840 and 2.415 < 3.840), the incoming customer flow is described by the Poisson distribution law with the intensity λ.

Table 6 presents the data of the per-minute customer service time in the bank's credit departments.

Table 6. Bank customer service time

Interval No.	Service interval time Dt, min.	Frequency f (individuals)	Frequency f (legal entities)
1	0-5	4	1
2	5-10	6	2
3	10-15	10	5
4	15-20	17	3
5	20-25	12	2
6	25-30	5	2
7	30-35	4	
8	35-40	3	

Note: Calculated by the authors.

We define the average time $\bar{t}_{serv}$ and service intensity μ of customers of two departments, then, based on the Pearson criterion, with the significance level $\alpha = 0.05$, let us justify the assumption that the service time is distributed according to the exponential law.

For each interval Δt_1, we calculate its mean by the formula:

$$t_i = \frac{\overline{t_{i-1}} + \overline{t_i}}{2} (i = 1...3). \quad (9)$$

Table 7. Average customer service time interval

Bank's credit departments	Interval number							
	1	2	3	4	5	6	7	8
On servicing of individuals	2.5	7.5	12.5	17.5	22.5	27.5	32.5	37.5
On servicing of legal entities	2.5	7.5	12.5	17.5	22.5	27.5		

Note: Calculated by the authors.

Average service time $\bar{t}_{serv}$ and service intensity μ are calculated as follows:

$$\bar{t}_{serv} = \frac{\sum_{i=1}^{3} \bar{t}_i \cdot f_i}{\sum_{i=1}^{3} f_i}, \quad (10)$$

- $\bar{t}_{serv}$ = 18.484 min. in the credit department for individuals;
- $\bar{t}_{serv}$ = 15.500 min. in the credit department for legal entities

$$\mu = \frac{1}{t_{serv}}, \quad (11)$$

- $\mu = 0.054$ cust./min., 3.246 cust./hour in the credit department for individuals;
- $\mu = 0.065$ cust./min., 3.871 cust./hour in the credit department for legal entities.

Theoretical frequencies are determined by the formula:

$$f_i^T = N \cdot (e^{\mu \cdot t_{i-1}} - e^{\mu \cdot t_i}), \quad (12)$$

where $N = \sum_{i=1}^{3} f_i$

Table 8. Theoretical frequencies value for customer service time intervals

Bank's credit departments	Interval number							
	1	2	3	4	5	6	7	8
On servicing of individuals	3	6	11	14	13	8	4	1
On servicing of legal entities	1	2	4	4	3	1		

Note: Calculated by the authors.

The observed value of the Pearson criterion is calculated by the formula:

$$\chi^2_{obs} = \sum_{i=1}^{3} \frac{(f_i - f_i^T)^2}{f_i^T} \quad (13)$$

- χ^2_{obs}=5.16 in the credit department for individuals;
- χ^2_{obs}=1.87 in the credit department for legal entities.

6. According to a given significance level $\alpha = 0.05$ and the number of freedom degrees $\nu = n - 2$, where *n* is the number of groups in the series (in our case, $n = 8$ for individuals and $n = 6$ for legal entities). According to the table of χ^2 – distribution critical points values, it is defined:

Table 9. Performance characteristics of the bank's credit departments, represented by the multichannel waiting QS

No.	Parameters	Designation	Name of units in the credit department for individuals	Name of units in the credit department for legal entities
1	Load intensity	$\rho = \frac{\lambda}{\mu} = \lambda \cdot \overline{t_{serv}}$	0.739	0.775
2	Share of managers' idle time	$\rho_0 = 1 - \rho$	0.261	0.225
3	Probability that managers are busy with work	$\rho_{bus} = 1 - \rho_0$	0.739	0.775
4	Average number of customers in the queue	$L_{queue} = \frac{\rho^2}{1-\rho}$	2.836	3.444
5	Average waiting time in the queue	$T_{queue} = \frac{L_{queue}}{\lambda}$	1.627	2.296

Note: Calculated by the authors.

- $\frac{\chi^2_{cr}(\alpha,\lambda)}{\chi^2_{cr}(0.05;6)} = 12.59$ in the credit department for individuals;
- $\frac{\chi^2_{cr}(\alpha,\lambda)}{\chi^2_{cr}(0.05;4)} = 9.5$ in the credit department for legal entities.

We compare if $\chi^2_{obs} < \chi^2_{cr}$, then we can assume that the customer service time is distributed according to the exponential law with the intensity μ, since in this case this condition is fulfilled to be: 5.16 < 12.59 and 1.87 < 9.5.

Table 9 gives the performance characteristics of the bank's credit departments, described by the multichannel QS with the unlimited waiting.

CONCLUSION

The proposed comprehensive assessment methodology of the banking services quality, including the SERVQUAL methodology synthesis with additional indicators, allows to identify the pattern between all five quality criteria and the confirmation of the significance of the factor indicators resulted during the study of the two respondents groups. As additional indicators, the following are used: general satisfaction assessment, calculation of integral indices of the correspondence of the quality content to consumer requests, general indicator of the banking services quality, tools of correlation and regression analysis methods. The main quality criteria are: materiality, reliability, responsiveness, conviction, and empathy. The especially important are the reliability and empathy indicators, as they have confirmed their importance in constructing the regression model.

We have determined that the reliability criterion strongly influences the materiality, sympathy and responsiveness criteria. The last criterion affects the qualitative conviction criterion. The empathy criterion, in turn, affects the reliability and responsiveness criteria. As it can be seen from the conducted research, the identified reliability and empathy quality parameters are not only highly significant for the bank customers, but also significantly affect each other, and, consequently, the provision of high-quality banking services. Based on this, we can say that these parameters are decisive in cooperation with the bank. Therefore, in order to achieve an effective quality management system for banking services, the listed factor indicators should be taken into account first.

The analysis of the bank's credit departments presented by the multi-channel waiting QS has showed that with the existing opportunities for lending customers and incoming applications, the bank is able to effectively serve its customers. The system works satisfactorily, because $\rho < 1$, then the operating mode of the system is stable, in the credit department for individuals 26% of the working time are not employed by managers, and the remaining 74% are engaged in work, the queue length of 2 or 3 customers is small, and the average waiting time in queue is only 1.627 minutes; in the credit department for legal entities, 22% of the working time are not employed by managers, and the remaining 78% are engaged in work, the queue length is 1, 2, 3 customers, and the average waiting time in the queue is 2.296 min.

As can be seen, studying the customers flow can help the bank more efficiently organize the queuing system work, the work of managers during the working day, achieve a more even their loading, and improve the labor efficiency.

The methodology for a comprehensive assessment of the banking services quality can be applied during computational experiments, in studies whose purpose is to elucidate a possible picture of future development and to predict the values of some variables depending on changes in others. Consequently, the research tool is practically meaningful in its factor structure, and hence universal, in various services market sectors.

REFERENCES

1. Andreyev, I. (1998). Criteria of competitiveness of homogeneous banking services. *Marketing, 1,* 38-40.
2. Chernyshev, B. (2004). Management in service economy: essence and content. *Problems of Management Theory and Practice, 1,* 109. Retrieved from http://ecsocman.hse.ru/text/16692755/
3. Choga, I., Mapanga, A., & Munapo, E. (2017). Factors impeding the use of banking services in rural Southern African states. *Banks and Bank Systems, 12*(3), 228-236. https://doi.org/10.21511/bbs.12(3-1).2017.07
4. Deming W. E. (1982). *Out of the Crisis. New Paradigm for Managing People, Systems and Processes* (528 p.). Cambridge, Mass: MIT.
5. Fomin, G. P. (2005). *Mathematical methods and models in commercial activity:* A textbook for university students studied in economics specialties. Moscow: Finance and Statistics.
6. Frenkel, A. A. (1989). *Prediction of labor productivity: methods and models.* Moscow: Economics.
7. Gronroos, Ch. (1982). *Strategic management and marketing in the service sector.* Swedish School of Economics and Business Administration, Helsingfors, Finland.
8. Korolev, Yu. G., Rabinovich, P. M., & Shmoilova, R. A. (1985). *Statistical Modeling and Forecasting.* Moscow: MESI.
9. Lee, H., Lee, Y., & Yoo, D. (2000). The determinants of perceived service quality and its relationship with satisfaction. *Journal of Services Marketing, 14*(3), 217-231. https://doi.org/10.1108/08876040010327220
10. McDougall, G. H. G., & Levesque, T. (2000). Analyzing customer satisfaction with service quality in life insurance services. *Journal of Targeting, Measurement and Analysis for Marketing, 18*(3-4), 221-238. Retrieved from https://link.springer.com/article/10.1057/jt.2010.17
11. Mylonakis, J. (2009). Private banking services, private banking customers' profile and their investment behavioral preferences. *Banks and Bank Systems, 4*(1). Retrieved from https://businessperspectives.org/journals/banks-and-bank-systems/issue-160/private-banking-services-private-banking-customers-profile-and-their-investment-behavioral-preferences
12. Novatorov, E., & Novitskaya, V. (2012). Modification and empirical verification of the methodology for measuring the quality of SERVQUAL services for banking services. *Marketing and Finance, 1.*
13. Oskooii, N., & Albonaiemi, E. (2017). Measuring the customer satisfaction based on SERVQUAL model (case study: Mellat Bank in Tehran city). *Innovative Marketing, 13*(2), 13-22. https://doi.org/10.21511/im.13(2).2017.02
14. Ulas Akkucuk, & Behcet Teuman (2016). Assessing service quality in online banking services. *Problems and Perspectives in Management, 14*(2-1), 183-191. https://doi.org/10.21511/ppm.14(2-1).2016.07