Modeling efficiency of the State Financial Monitoring Service in the context of counteraction to money laundering and terrorism financing

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Abstract

This article considers the peculiarities of scientific and methodical approach construction to the evaluation of the State Financial Monitoring Service effectiveness as a component of the national system for Prevention and Counteraction to Legalization (Laundering) of the Proceeds of Crime or Terrorism Financing. The mechanism of functioning of the State Financial Monitoring Service of Ukraine is treated as a queueing system. Namely, denials of service requests, which provides for a possibility to form a queue with unlimited waiting and no limit on the queue length. Practical approbation was obtained with respect to the characteristics of the input and output service flows, indicators for assessing the stability and efficiency of the state regulation system and supervision under investigation.

Keywords: efficiency assessment, risk, counteraction to money laundering and terrorism financing, queueing system with failures, state regulation.

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Developing the methodology for assessing the efficiency of the State Financial Monitoring Service of Ukraine, it should be noted that its specificity consists in studying the effectiveness of this government body in terms of timely and effective response to information that may indicate the legalization of criminal proceeds, terrorism financing and proliferation of weapons of mass destruction. Proceeding from this, the use of the queueing system as the most adequate tool for the implementation of the assigned tasks is topical. The queueing system allows to estimate the level of effectiveness of the response of the controlling body to information, received from the subjects of primary monitoring. That is, the selected mathematical tools allow assessing the timeliness and level of effectiveness of the response of the State Financial Monitoring Service of Ukraine to received reports of financial violations.

Literature review

There is a significant amount of theoretical and methodological developments devoted to the specifics of assessing economic and financial risks in the modern scientific literature. This problem is investigated and developed by such scientists as M.I. Bondar, T.A. Vasil'eva, I.Yu. Ivchenko, A.V. Smaglo, V.V. Vitlinsky, S.A. Dmitrov, A.V. Kuzmenko (A.V. Merenkova), T.A. Medvid', I.Yu. Ivchenko, S.M. Ilyashenko. However, the unsolved problem remains not directly the assessment of economic and financial risks, but the reactions of government regulatory bodies to identified risks. It becomes necessary to form the methodological basis for assessing the effectiveness of the State Financial Monitoring Service of Ukraine in terms of the efficiency and effectiveness of its activities. The *aim of the study* is the development of a scientific and methodical approach to the effectiveness of the State Financial Monitoring Service as a subsystem of the National System for the Prevention and Counteraction to Legalization (Laundering) of the Proceeds of Crime or Terrorist Financing based on application of a queueing system.

Main results of investigation

The methodological bases of the assessment of the effectiveness of the State Financial Monitoring Service in question provide an assessment of processing level of the stream of applications receipt from primary monitoring subjects. The subjects of primary financial monitoring are banks, insurance companies, private pension funds, credit unions, pawnshops, joint investment institutions. That is, the proposed methodology should evaluate the information that is sent to the State Financial Monitoring Service associated with the relevant illegal financial transactions and their participants, as well as consider the irregularity and randomness of applications receipt, that is, the possibility of a queue for processing information and service channels' stoppage.

Based on the analysis of the above aspects, it can be concluded that the system of the State Financial Monitoring Service of Ukraine should be considered a queueing system (QS) with denial of service requests that allows for the formation of a queue with unlimited waiting and no limit on the queue length.

Thus, when presenting the system of the State Financial Monitoring Service of Ukraine, as a queueing system, it is necessary to determine the basic parameters of its functioning. Thus, the characteristics of the input stream of the queueing system are information on financial transactions and their participants and information on a number of databases necessary for the performance of financial intelligence functions; the characteristics of the service stream of queueing system requests are information about the measures taken based on the analysis of the above information and data; characteristics of the output stream of the queueing system are information on the implementation of measures taken, that is, information that will characterize the results of the previous actions of the State Financial Monitoring Service. In addition, the indicators of the effectiveness of its activities, that is, the indicators for assessing the sustainability and efficiency of the functioning of the system of the State Financial Monitoring Service of Ukraine, are of great importance in describing the functioning of the queueing system and they are presented in Table 1.

Table 1. Indicators for assessing the sustainability and efficiency of the system functioning of the State Financial Monitoring Service of Ukraine

	Quantitative characteristics of indicators		
Incoming data			
Intensity of the input fstream			
Intensity of service			
Length of the queue			
Stability of the system (the density of the flow of applications)			
Intensity of the output stream			
System efficiency			
Estimated data			
Number of service channels	1	…	n
Loading level of QS			
The probability of the absence of requests in the system			
Probability of failure			
Relative channel capacity			
Absolute channel capacity			
Probability of queue formation			
The average number of occupied channels			
Coefficient of channel occupancy			
Coefficient of channel stoppage			
Average number of requests in the queue			
Average waiting time in the queue			
Average time for service requests			
Average time of application stay in the system			
System maintenance costs			
The average amount of losses identified as a result of violations			

Having entered before a set of assumptions, let's consider the essence and technique of calculation of each indicator of a quantitative characteristic in queueing system of the offered model.

Let requests in a form of information on financial transactions and their participants enter the QS with a request for processing by chance, that is, it can be assumed that the probability of receipt of an application for any negligible time interval $\lfloor t, t+\tau \rfloor$ is proportional to τ with some inseparable coefficient λ. At the same time, the probability of absence at least of one service request for a given period of time can be defined as $1-\lambda\tau$.

So, considering this fact, in the theory of probability it is considered to be:

1. Time intervals τ between two consecutive receipts of orders are subject to exponential distribution

$$\varphi(t) = \lambda * \exp(-\lambda * \tau), t \geq 0. \tag{1}$$

2. The probability that for any time interval the flow of receipt of processing applications will be equal to *k* is determined as follows:

$$P_t = \frac{(\lambda t)^k}{k!} \exp(-\lambda t), \quad n = 1,2,... \tag{2}$$

where λ is the intensity of the input stream of information about financial transactions and their participants.

Thus, taking into account for the given QS the implementation of the above points, it can be concluded that the input stream is Poisson.

Continuing the coverage of the assumptions of the proposed model, we note the following aspects:

1) The random waiting time for an application in the processing queue can be considered to be distributed exponentially:

$$f(t) = \lambda * \exp(-v * t_q), \tag{3}$$

where v is the intensity of the of the queue movement, that is, the average number of applications received for processing per unit time; t_q is an average waiting time in queue.

2) The output stream of applications that have been processed, associated with the service flow requests in the SQ channel and subject to exponential distribution law with density:

$$F(t_o) = \mu * \exp(-\mu * t_0), \tag{4}$$

where μ is the service intensity, that is, the average number of applications processed per unit time; t_0 is average service time for one application for identified financial irregularities.

So, let's move directly to the essence and methods of calculating each of the indicators of the quantitative characteristics in the queueing system.

Intensity of input stream defines the number of units of information on financial transactions and their participants identified per unit time (year, half year, quarter, month, day, hour) and is calculated as the sum of the products of the number of receipts of applications (requests) for the frequency of receipts, observed in the study, divided (weighted) by the total number of receipts of applications i.e.:

$$\lambda = \frac{\sum_{i=1}^{n} k_i * f_i}{\sum_{i=1}^{n} f_i}, \tag{5}$$

where λ is intensity of input stream; k_i is a number of receipt of applications (requests); f_i is a frequency of receipt of applications (requests).

Calculating the intensity of the QS input stream involves the implementation of a preliminary determination of the input information block in the context of its individual components presented in Table 2, which contains both a list of characteristics of the input stream (graph A) and money term (graphs 1, 3, 5), and quantification (graphs 2, 4, 6) of individual components.

Table 2. Information on financial transactions and their participants and information on a number of databases coming to the State Financial Monitoring Service of Ukraine (characteristics of the input flow of the queueing system)

Indicators	Period 1		…		Period m	
	Amount	Quantity	…	…	Amount	Quantity
A	1	2	3	4	5	6
Number of received financial transactions subject to financial monitoring, including:						
➢ with signs of mandatory financial monitoring						
➢ with signs of internal financial monitoring						
➢ with signs of mandatory and internal financial monitoring						
➢ tracking (monitoring) of financial transactions						
Number of financial transactions provided by banks						
Number of financial transactions provided by non-banking institutions						

Table 3. Indicators characterizing the processing of incoming information flow

Indicators	Period 1	…	Period m
A	1	2	3
Number of received financial transactions subject to financial monitoring, including:			
➢ the quantity of transactions, not registered due to providing information with errors			
Number of messages selected to form the record			
Number of request files sent to banking institutions			
Number of financial transactions for which the request files were sent			
The number of decisions and orders of the State Financial Monitoring Service of Ukraine to stop financial operations			
Number of regulated requests in the Unified State Information System			

Table 4. The intensity of the input stream of the system of State Financial Monitoring Service of Ukraine as the service system

Indicator	Numerical characteristics
A	1
Number of information units per year	
Number of information units per half a year	
Number of information units per quarter	
Number of information units per month	
Number of information units per day	
Number of information units per hour	

The derived indicator of the intensity of the input stream in the queueing system of the State Financial Monitoring Service of Ukraine, the average time of receipt of one application is defined as a value back to the intensity of the input stream, namely:

$$t_{rec.} = \frac{1}{\lambda}, \quad (6)$$

where $t_{rec.}$ is an average time of receipt of one application; λ is an intensity of incoming flow.

Service intensity is the indicator that reflects the average number of applications processed per unit time and is calculated as the ratio of the sum of the number of processed applications (requests) multiplied by the frequency of their receipts to the total number of receipts of applications, is determined by formula:

$$\mu = \frac{\sum_{i=1}^{n} t_i * f_i}{\sum_{i=1}^{n} f_i}, \tag{7}$$

where μ is a service application rate; t_i is a number of applications processed (requests); f_i is a frequency of receipt of applications (requests).

The value, inversely proportional to the intensity of servicing the application in the queueing system of the State Financial Monitoring Service of Ukraine, is the indicator such as an average service time of one application, which is calculated as follows:

$$t_{exec.} = \frac{1}{\mu}, \tag{8}$$

where $t_{exec.}$ is an average service time of one application; μ is a service intensity of one application.

According to the results of the research, it was revealed that with the value of $\lambda < \mu$, that is, when the intensity of the input stream is less than the intensity of the service of the application, there are no delays in resolving the issues, because the explanation of the situation occurs before the next application is received.

The queue length represents the variable calculated as the difference between the intensity of the input stream and the intensity of service application, that is:

$$m = \lambda - \mu, \tag{9}$$

where m is a queue length; λ is the intensity of the input stream; μ is the intensity of service application.

One of the key indicators of the queueing system, which binds such values as the intensity of the input stream and the intensity of service applications, is the density of the flow of applications, characterizing the flow density of applications, that is, the average number of claims, corresponding to the average time of application service. This value shows the degree of consistency between the input stream of applications and the intensity of the service of these applications, and is determined by formula:

$$\rho = \frac{\lambda}{\mu}, \tag{10}$$

where ρ is an application flow density; λ is the intensity of input stream; μ is the intensity of application service.

Analyzing the application flow density, it can be concluded that the process of application service is stable, provided that the intensity of the load is less than the number of service channels. If the density of the stream is equal to or greater than the number of service channels, the average length of the queue will grow in the system under investigation, and, accordingly, the average waiting time for receipt of applications of information processing, and therefore the queueing system will be unstable.

In parallel with the described indicators, which form the array of input information of the queueing system, the value of the control variable during the calculation of the next block of indicators of the activity analysis of the system under consideration is the number of service channels. This amount is proposed to be determined on the basis of existing number of functioning units of the State Financial Monitoring Service of Ukraine, as well as those information processing channels characterizing law enforcement restrictions and courts.

The derived index from the of the flow density of applications and the number of service channels is the load level of the queueing system, defined as follows:

$$X = \frac{\rho}{n}, \tag{11}$$

where X is the loading level of QS; ρ is a flow density of applications; n is a number of service channels.

The system in question can be characterized as a system in a stationary, stable state with a loading level of less than one. Under this condition, the service queue is not created, the probability of receipt of a certain number of requests within the specified time interval depends on its duration.

The next but no less important indicator of the functioning of the system of the State Financial Monitoring Service of Ukraine as a queueing system is the probability of the absence of requests in the system that can be determined using the following relationship:

$$P_0 = \left| \sum_{k=0}^{n} \frac{\rho^k}{n!} + \frac{\rho^{n+1} * \left(1 - \left(\frac{\rho}{n}\right)^m\right)}{n!\, n * \left(1 - \frac{\rho}{n}\right)} \right|^{-1} \quad where \quad \rho = \frac{\lambda}{\mu}. \tag{12}$$

At the same time, we assume that when $n-$ QS runs in the standby mode for servicing and restrictions on the length of the queue, that is, there can be no more *m* requests in the queue; the input stream of applications of processing is subject to the Poisson distribution law with intensity λ while the time for service requirements is distributed according to the exponential law with intensity μ.

Failure probability is the characteristic of QS, which indicates the probability of denial of service request (application) in the case when the system receives processing applications, that is, the amount of the number of applications that can be processed in the light of the queue, and the number of applications that are not processed and receive a refusal. This indicator is calculated by the following mathematics:

$$P_{fail.} = P_{n+m} = \frac{\rho^{n+m}}{n!\, n^m} P_0. \tag{13}$$

Relative channel capacity is an indicator that characterizes the probability of servicing an application received and calculated using the formula:

$$P_{serv.} = 1 - P_{fail.} \tag{14}$$

where $P_{exam.}$ is a relative channel capacity; $P_{fail.}$ is a failure probability.

The indicator of absolute channel capacity reflects the number of processed applications (requests) per unit time, is determined by the product of the intensity of the input stream and relative channel capacity, that is:

$$A = \lambda * P_{fail.} \tag{15}$$

where A is an absolute channel capacity; λ is an intensity of input stream; $P_{fail.}$ is a failure probability.

The probability of queue formation is calculated by formula:

$$P_ч = \sum_{k=n}^{n+m-1} p_k = \frac{\rho^n}{n!} * \frac{\left(1 - \left(\frac{\rho}{n}\right)^m\right)}{1 - \frac{\rho}{n}} * P_0. \tag{16}$$

The use of this formula is reasonable in the event that the fact of the queue formation is possible, that is, when the receipt of the next application occurs at the time of having at least *n* applications in processing system. Quantitatively, this fact can be described by the receipt of n, $n + 1$, $n + 2, \ldots n + m - 1$ of service applications.

In addition, considering that applications are received in QS independently of each other, the probability of simultaneous occupancy of all service channels is equal to the sum of probabilities P_n, P_{n+1}, $P_{n+2}, \ldots P_{n+m-1}$. In parallel with these aspects, it should be noted that in the case of $m = 0$, we obtain a QS with failures, and in the case $m \to \infty$, we get the QS with the expectation without the limit on the length of the queue.

The verage number of occupied channels is defined as the ratio of absolute channel capacity to service intensity of the application, because A is the intensity of application service stream and each channel can serve μ number of applications. The average number of occupied channels is also calculated by multiplying the density of the application stream by the relative channel capacity. The indicator studied is determined by formula:

$$N_{aver.} = \frac{A}{\mu} = \rho P_{exam.} \tag{17}$$

where $N_{aver.}$ is the average number of occupied channels; A is an absolute channel capacity; μ is the intensity of application service; ρ is the application flow density; $P_{exam.}$ is a relative channel capacity.

Coefficient of channel occupancy characterizes the degree of channels use and is calculated by producing the loading level of QS and the relative channel capacity, or as the ratio of the average number of applications to the number of service channels, i.e.:

$$K_{occup.} = X * P_{exam.} = \frac{z_{aver.}}{n} \tag{18}$$

where $K_{occup.}$ is the coefficient of channel occupancy; X is the level of QS load; $z_{aver.}$ is an average number of applications; $P_{exam.}$ is a relative channel capacity; n is the number of service channels.

In calculating the coefficient of the channel stoppage, three approaches are singled out:

$$K_{stop.} = 1 - K_{occup.} = 1 - \frac{N_{aver.}}{n} = 1 - X * P_{exam.} \tag{19}$$

where $K_{stop.}$ is the coefficient of the channel stoppage; $K_{occup.}$ is the coefficient of channel occupancy; $N_{aver.}$ is an average number of occupied channels; n is the number of service channels; X is the level of QS load; $P_{exam.}$ is a relative channel capacity.

Average number of requests in the queue:

$$L_{aver.} = 1 * P_{n+1} + 2 * P_{n+2} + \ldots + m * P_{n+m} = \frac{\rho^{n+1}}{n!\, n} * \frac{1 - \left(\frac{\rho}{n}\right)^m * \left(m + 1 - m\frac{\rho}{n}\right)}{\left(1 - \frac{\rho}{n}\right)^2} P_0 \tag{20}$$

Average waiting time in queue occurs when service request arrives at the time of occupancy of all requests processing channels and the simultaneous absence of queue, i.e., the waiting time will average $1/n\mu$; if there is one request in the queue, the average waiting time will be $2/n\mu$, etc. Considering the described principle of forming the transformation chain, we get the formula for calculating the average wait time in the queue:

$$T_{aver.(wait.time)} = (1/n\mu)P_n + (2/n\mu)P_{n+1} + \ldots + (m/n\mu)P_{n+m+1} = \frac{\rho^n}{n!\, n\, \mu} * \frac{1 - \left(\frac{\rho}{n}\right)^m * \left(m + 1 - m\frac{\rho}{n}\right)}{\left(1 - \frac{\rho}{n}\right)^2} * P_0 \tag{21}$$

An average time for service requests is the value, defined as the ratio of relative channel capacity to application service intensity, is calculated by formula:

$$T_{aver.(exam.)} = \frac{P_{exam.}}{\mu} \tag{22}$$

where $T_{aver.(exam.)}$ is the average time for service requests; $P_{exam.}$ is a relative channel capacity; μ is the application service intensity.

Average time of application stay in the system is an indicator calculated by summing the average waiting time in the queue and the average time for servicing the requests, i.e.:

$$T_{aver.QS} = T_{aver.(stay\ time)} + T_{aver.(exam.)} \quad (23)$$

where $T_{aver.QS}$ is the average time of application stay in the system; $T_{aver.(stay\ time)}$ is an verage waiting time in queue; $T_{aver.(exam.)}$ is an average time for service requests.

Considering all the contradictory aspects of the queueing system operation, a general criterion can be an indicator characterizing its economic efficiency. This indicator considers the costs of reversibility and the cost of applications, which will take on a minimum value with a minimum of total costs for system maintenance. When carrying out the cost estimation, it is necessary to consider not only the costs associated with failures, but also the costs associated with the channel stoppage, the cost of queueing system operation. Consequently, system maintenance costs are calculated by formula:

$$\begin{aligned} C_{costs} &= (C_{conv.\,costs} + C_{appl.\,costs} \Rightarrow \min) = \\ &(C_{oper.} * N_{aver.} + C_{stop.} * (n - N_{aver.}) + C_{fail.} * P_{fail.} * \lambda + C_{syst.} * T_{aver.\,QS}) \Rightarrow \min \end{aligned} \quad (24)$$

where C_{costs} – system maintenance costs; $C_{conv.\,costs}$ – convertibility costs; $C_{appl\,costs}$ – application costs; $C_{oper.}$ – costs associated with system operation; $N_{aver.}$ – the average number of occupied channels; $C_{stop.}$ – Costs associated with channels stoppage in system service; n – number of service channels; $C_{fail.}$ – costs associated with service failure; $P_{fail.}$ – the probability of failure; λ – the intensity of the input stream; $C_{syst.}$ – expenses related to the application stay in the queueing system; $T_{aver.\,QS}$ – average time of application stay in the system.

System efficiency is the ratio between the intensity of the output and input streamsin QS.

Table 5. Information on the implementation of measures taken based on the results of control measures (characteristic of the output stream of the queueing system)

Indicators	Period 1		…		Period m	
	Amount	Quantity	…	…	Amount	Quantity
A	1	2	3	4	5	6
Number of formed records						
Number of summarized materials submitted to law enforcement agencies						
Number of additional summarized materials submitted to law enforcement agencies						
Number of summarized materials, on which criminal proceedings have been initiated						
Number of criminal proceedings initiated under summarized materials						
Number of summarized materials used in criminal trials						
Number of criminal proceedings in which summarized materials were used						
The number of criminal cases with conviction, initiated by summarized materials						
The number of responses to foreign Financial Intelligence Unit (FIU)						

Table 6. The intensity of the output stream of the system of the State Financial Monitoring Service of Ukraine, as a queueing system

Indicator	Numerical characteristic
A	1
Number of units of information per year	
Number of units of information per half year	
Number of units of information per quarter	
Number of units of information per month	
Number of units of information per day	
Number of units of information per hour	

Presenting the work system of the State Financial Monitoring Service of Ukraine as a queing system, it is necessary to determine the basic parameters of its functioning. Thus, the characteristics of the input stream of the queueing system are information on financial transactions and their participants, as well as information on a number of databases necessary to perform the functions of financial intelligence (Table 7); characteristics of the service flow of requests of the queueing system are the information on the measures taken based on the analysis of the above information and data (Table 8); characteristics of the output stream of the queueing system are information on the implementation of the measures taken based on the analysis of the above information and data (Table 9). In addition, the indicators of the effectiveness of its activities, that is, the indicators for assessing the sustainability and efficiency of the functioning of the system of the State Financial Monitoring Service of Ukraine, are important in describing the processes of the functioning of the queueing system, and they are presented in Table 8 on average for considered period from 2011 to 2015.

The intensity of the input stream determines the number of units of information about financial transactions and their participants, as well as information on a number of databases identified per unit of time (year, half year, quarter, month, day, hour) and is calculated as the sum of products of the number of applications (requests) on the frequency of receipts, observed in the study, is divided (weighted) by the total number of receipts of applications. Guided by this approach, we obtain the calculated data presented in Table 7.

Table 7. Information on financial transactions and their participants passed to the State Financial Monitoring Service of Ukraine (characteristic of the input stream in the queueing system)

Indicators A	2011	2012	2013	2014	2015
Number of received financial transactions subject to financial monitoring, including:					
➢ with signs of compulsory financial monitoring	581213	620974	653645	780234	3873967
➢ with signs of internal financial monitoring	241155	277795	312898	490617	407462
➢ with signs of compulsory and internal financial monitoring	5050	6780	12075	12167	67888
➢ tracking (monitoring) of financial transactions	252033	62272	3523	4478	7800
Number of financial transactions provided by banks	1062215	943862	954380	1260508	4312637
Number of financial transactions provided by non-banking institutions	33668	31537	35957	36816	44137

Table 8. The intensity of the input stream in the system of the State Financial Monitoring Service of Ukraine, as a queueing system for 2011

Indicator	Numerical characteristic
A	1
Number of units of information per year	362555,67
Number of units of information per half year	181277,83
Number of units of information per quarter	90638,92
Number of units of information per month	30212,97
Number of units of information per day	1007,10
Number of units of information per hour	41,96

In formulating practical recommendations for the application of queueing theory in determining the efficiency of the State Financial Monitoring Service of Ukraine, let's turn to the calculation of the next indicator - the service intensity based on Table 9.

Table 9. Information on control measures taken
(the characteristic of the service flow of requests in the queueing system)

Indicators A	2011	2012	2013	2014	2015
Number of received financial transactions subject to financial monitoring, including:					
➢ the number of transactions not taken into account by providing information with failures	16432	7578	8196	9860	34717
The number of messages selected for record creation	205543	100912	117976	200824	280525
Number of request files sent to banking institutions	В/Д	12931	14747	47940	22745
Number of financial transactions for which the request files were sent	В/Д	14283	9979	4803	1440
The number of decisions and orders of the State Financial Monitoring Service of Ukraine to stop financial operations	91	126	471	2406	3313
Number of regulated requests to Unified State Information System	4130434	4701275	2130615	1767638	0 (not implemented in 2015)
Number of requests to foreign FIU	467	433	439	458	421

Service intensity is the indicator that reflects the average number of requests processed per unit of time and is calculated as the ratio of the sum of the number of processed applications (requests) multiplied by the frequency of their receipts to the total number of receipts of applications. Thus, the average number of applications processed per unit time is 870593,40 per year, 435296,70 per half year, 217648,35 per quarter, 72549,45 per month, 2418,32 per day and 100,76 per hour (Table 10).

Table 10. The intensity of the system service of the State Financial Monitoring Service of Ukraine, as a queueing system for 2011

Indicator	Numerical characteristic
A	1
Number of units of information per year	870593.40
Number of units of information per half year	435296.70
Number of units of information per quarter	217648.35
Number of units of information per month	72549.45
Number of units of information per day	2418.32
Number of units of information per hour	100.76

The next stage in the formation of practical recommendations for the application of queueing theory in determining the efficiency of the State Financial Monitoring Service of Ukraine is to calculate the intensity of the output stream, based on the data in Table 11.

Analyzing the number of units of information on financial transactions and their participants and information from a number of databases identified per unit time according to the intensity of the output stream of the system of the State Financial Monitoring Service of Ukraine, we note that the number of units of information in the output stream (Table 12) is 357.00 per year, 178.50 per half year, 89.25 per quarter, 29.75 per month, 0.99 per day, 0.04 per hour.

Table 11. Characteristics of the input stream of the queueing system

9	2011	2012	2013	2014	2015
Number of formed records	1841	1896	1999	1970	1951
Number of summarized materials submitted to law enforcement agencies	323	588	588	476	364
Number of additional summarized materials submitted to law enforcement agencies	257	131	234	298	322

Table 11 (cont.). Characteristics of the input stream of the queueing system

9	2011	2012	2013	2014	2015
Number of summarized materials, on which criminal proceedings have been initiated	115	77	497	291	125
Number of criminal proceedings initiated under summarized materials	118	84	519	299	126
Number of summarized materials used in criminal trials	191	161	294	293	233
Number of criminal proceedings in which summarized materials were used	142	339	294	241	230
The number of criminal cases with conviction, initiated by summarized materials	37	99	115	79	58
The number of responses to foreign FIU	189	172	173	253	285

Table 12. The intensity of the output stream in the system of the State Financial Monitoring Service of Ukraine, as a queueing system for 2011

Indicator	Numerical characteristic
A	1
Number of units of information per year	357,00
Number of units of information per half year	178,50
Number of units of information per quarter	89,25
Number of units of information per month	29,75
Number of units of information per day	0,99
Number of units of information per hour	0,04

In parallel with the described parameters, which form an array of input information of the queueing system, the number of service channels is the value which acts as a control variable when calculating the next block of indicators in the analysis of the system activity under consideration, it is proposed to determine this value in the range of 30 to 44.

The derived indicator of the density of application stream and the number of service channels is the loading level of the queueing system, which is determined by the ratio of the stream of requests to the number of service channels. In turn, the the application density stream characterizes the intensity of the load, that is, the average of the requests, corresponding to the average time of service. This value shows the degree of consistency between the input stream of applications and the service intensity of these applications. On average, over the period from 2011 to 2015, the level of loading in the system of the State Financial Monitoring Service of Ukraine decreased from 0.42 particles per unit with the number of service channels in the amount of 30 units to 1.00 particles per unit with the number of service channels in the amount of 44 units.

Another, but not less important, indicator of the system functioning of the State Financial Monitoring Service of Ukraine, as queueing system is the probability of absence of requests in the system for the period from 2011 to 2015 which acquired almost zero values although this showing varied from 0.56 units at the number of service channels in the amount of 30 units to 0.88 with the number of service channels in the volume of 44 units.

The probability of failure is the characteristic of the QS, it indicates the probability of denial of request (application) service in the event that the system receives $n + m$ processing requests, that is, the sum of the number of applications that can be processed in the queue and the number of applications that are not processed and will be refused. This indicator for the period from 2011 to 2015 also took almost zero values, as well as the probability of absence of requests in the system, except for 2011 and 2012, when this indicator takes the value of 0.63 and 0.71 of the particle unit.

Turning to the analysis of the indicator - the relative channel capacity, namely, the indicator characterizing the probability of service of received application, is equal to unity of the showing for the period from 2011 to 2015. The estimated value of this indicator is 64% to 72%, that is, the number of actually processed applications (requests) per unit of time is from 64 to 72 applications.

The next indicator of the probability of queue formation on the average for the period from 2011 to 2015 varies from 1 with the number of service channels in the amount of 30 units to 0 with the number of service channels in the amount of 44 units.

The average number of occupied channels is defined as the ratio of the absolute channel capacity to the service intensity of the application, and is between 1.48 and 29. In turn, the coefficient of channel occupancy characterizes the degree of channel use, is calculated by the product of the QS load level and channel capacity, or as the ratio of the average number of applications to the number of service channels. The calculated value of this indicator is from 0.74 to 0.98.

The average wait time in the queue, starting with the number of service channels in the volume of 33 units, acquires zero value, although the average time for servicing requests is on the average 0.57 per particle unit.

The results of practical implementation of the theory of queueing service in determining the effectiveness of the State Financial Monitoring Service are shown in Table 13.

Table 13. Systematizing the results of subsystems performance assessment of the National System – the State Service for Financial Monitoring

Types of performance evaluation					
Evaluating the effectiveness of the State Financial Monitoring Service	0.0010	0.0012	0.0016	0.0011	0.0003

Conclusions directions for further research

Thus, the proposed scientific and methodological approach allows us to conclude that the State Service for Financial Monitoring is very poorly performed. In addition, the performance indicator has a negative tendency to decrease. It should be noted that this low value of the integral index was formed because of an ineffective work of the state regulatory body at all stages of its functioning, since problems are present both in the operational efficiency (described by the input stream), and in the effectiveness of the measures taken (described by the service flow), and in the level of the result obtained from applied measures (described by the output stream). It should also be mentioned that the developed scientific and methodological approach is universal and can be used to evaluate the efficiency of any public authority or commercial structure, whose activities relate to three components: input information, its service and findings in the form of an output stream.

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