

In my paper, Z.I. Flikop “**Some Problems with a Design of Hierarchical Management Systems**” [in Russian], *Mehanizatcia i avtomatizatcia ypravlenia*, 1971 # 5, I have proposed the criterion for the evaluation efficiency of multiphase queuing systems that consist of different type of servers and provide service to different type of elements (customers). I do not have this paper, however I have a book A. L. Lifshits, E.A. Mal'tc “*Statistical Modeling of Queuing System*” [in Russian], Moscow, 1971 that cited this criterion from my paper.

The criterion is:

$$W = \sum_{l=1}^k C_l \sum_{m_l=0}^{\infty} m_l P_{m_l} + \sum_{j=1}^n C'_j \sum_{s_j=0}^{s_j} s'_j P_{s'_j} + \sum_{j=1}^n C_j^s \sum_{s_j=0}^{s_j} (s_j - s'_j) P_{s_j}$$

where:

C_l - is a cost (per unit of time) associated with a waiting time in the queue of a customer of an l type;

k – is a number of customer types;

m_l - is a number of l type customers, that currently are servicing by the system and also being in all queues of all phases of a system;

P_{m_l} - is a probability that m customers of an l type currently are servicing by all phases of the system and also being in all queues of all phases of the system;

C'_j - is a cost (per unit of time) associated with idling of a j type server;

n – is a number of server types;

C_j - is a cost (per unit of time) associated with a servicing of a customer by a server of a j type;

s_j - is a number of servers of j type;

s'_j - is a number of idling servers of a j type;

P_{s_j} - is a probability that customer is being served by a j type server;

$P_{s'_j}$ - is a probability that j type server is idle;

$\sum_{l=1}^k C_l \sum_{m_l=0}^{\infty} m_l P_{m_l}$ - is cost associated with time that customers spend in the system;

$\sum_{j=1}^n C_j' \sum_{s_j=0}^{s_j} s_j' P_{s_j}'$ - is a cost associated with idling of servers;

$\sum_{j=1}^n C_j^s \sum_{s_j=0}^{s_j} (s_j - s_j') P_{s_j}$ - is a cost associated with usage of a servicing system.

In addition to the criterion, A.L. Lifshits and E.A. Malinik in their book gave the following explanation:

$\sum_{m_l=0}^{\infty} m_l P_{m_l}$ - is an average number of customers of type l that are in the system;

$\sum_{s_j=0}^{s_j} s_j' P_{s_j}'$ - is an average number of idling servers of type j ;

$\sum_{s_j=0}^{s_j} (s_j - s_j') P_{s_j}$ - is an average numbers of working servers of type j ;