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DISPATCHING OF AUTOMOBILE SERVICE SYSTEMS

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ABSTRACT:
Basic problems of the processes' management and dispatch in condition of automobile service system are considered in the paper. The authors submit an algorithm and a program in Excel for determination the value of system's parameters.

KEYWORDS:
Dispatching center, automobile service systems, algorithm

1. INTRODUCTION

The algorithm described in this paper is made on the base of information concerning the operation of taxi-cab transport system and system for emergency medical care in condition of a big town.

The system, designed for management of automobile fleet of a service system, contains subsystem for preparation of the transport processes.

In conjunction with the development of up-to-date information technologies the systems mentioned above have continuous developed and improved.

2. MODELING OF A REAL SYSTEM FOR TRANSPORT SERVICING

There can be separate two basic moments for which it is necessary to manage and to dispatch the processes in transport servicing system: management of mobility fleet and management of the transport process.

The management of mobility fleet includes all activities connected with: the choice of vehicle, making technological plan for the vehicles' work as well as the operative management and control of transport processes' implementation on the base of given or additionally formed conditions for transport accomplishment.

Some typical characteristics of the system, designed for management of automobile fleet are shown at figure 1.

To solve a task in the process of planning, the modeling of real systems is the most used method.

Comparing the separate characteristics of the real system and the created model in generally we can write the following:

$$Z(D_{opt}) \neq Z(P_{opt}) \tag{1}$$

$$\Delta Z = \left| Z(P_{opt}) - Z(M_{opt}) \right| \tag{2}$$

where $Z(D_{opt})$ is the value of criterion function for optimal decision of the model;

$Z(P_{opt})$ – is the value of criterion function for optimal decision of the process.

In generally the task consist in minimization of (2), i.e.:

$$\min \Delta Z = \left| Z(P_{opt}) - Z(M_{opt}) \right|$$

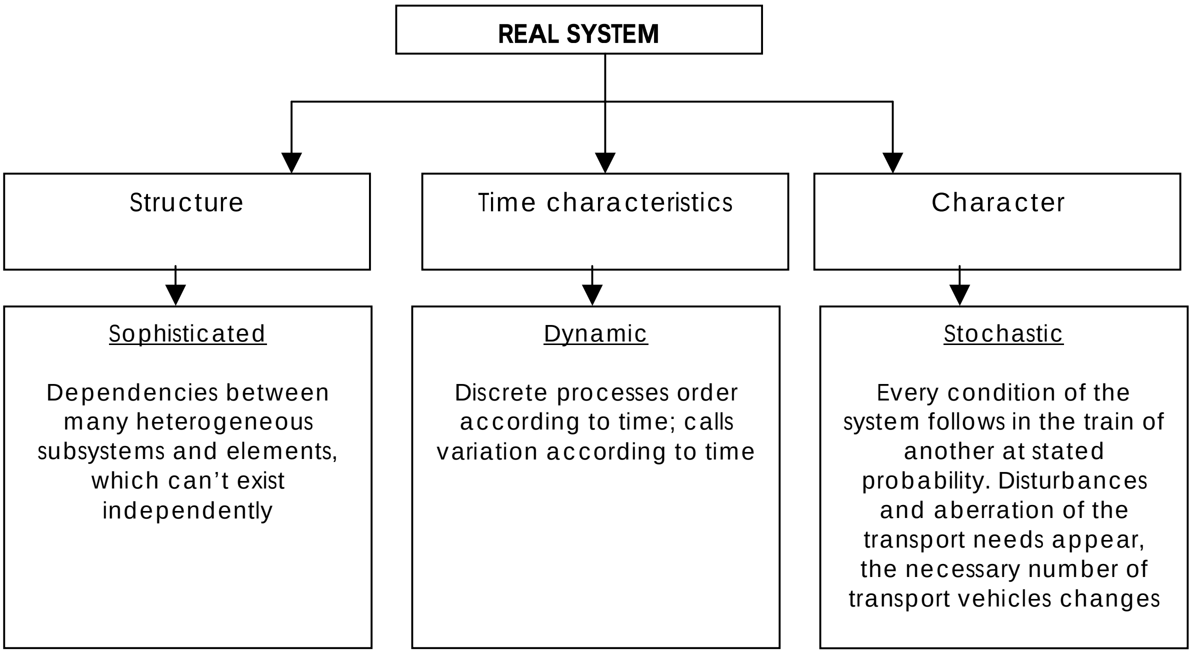

FIGURE 1. Typical characteristics of the system, designed for management of automobile fleet

Management of transport processes. Because of the stochastic and dynamic character of the transport processes the stochastic and mathematical models and algorithms are most appropriate for their description. Adaptive algorithms for management are often used for determination of different parameters of the transport process. Typical for the adaptive management of transport is:

- collecting of information that concerns current values of parameters which characterize the transport process;
- forming of appropriate commands for management.

In order to overcome to a certain extent the stochastic character of the system, it is necessary to separate the tasks on different simplified tasks (figure 2):

- transportation planning;
- vehicle disposition;
- operational management and control (dispatching).

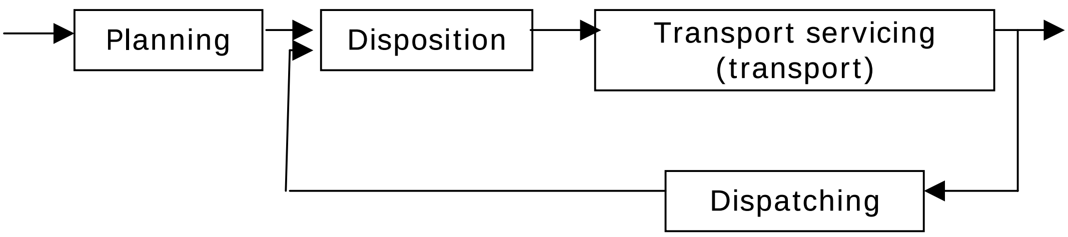

FIGURE 2. Different simplified tasks

On the basis of the accepted average parameters concerning transport servicing we can plan the transport processes. When disposition of the vehicles is made we take into account all the changes that had come in the systems' condition, like order cancellation, additional circumstances and etc.

The so called process "dispatching", shown on figure 2, allows calls disposition and elimination of disturbances and changes taking place while servicing the calls entering the systems. When we say disturbances we mean: car accidents, movement stoppages along some streets, damages and failures of the transport vehicles ant etc. The transport servicing management and control takes place in real time. That's why the commands concerning the management of transport servicing have to be formed for comparatively short period of time.

Preliminarily investigation of calls flow entering the system allows better planning of the transport vehicles number needed for servicing the processes in the system.

3. ALGORITHM FOR PARAMETERS VALUES DETERMINATION OF SERVICING SYSTEMS

The transport servicing system of calls in case of taxi-cab transport system and emergency medical care system can be examined like mass servicing system. Using the mass servicing theory we can specify the dependence between factors that determine the functional possibilities of this system and its effectiveness.

The casual character of the call flow for both of systems is described with exponential distribution law.

The call distribution density in the circumstances of a taxi-cab transport company is shown on figure 3. The call distribution density in the circumstances of emergency medical care center is shown on figure 4.

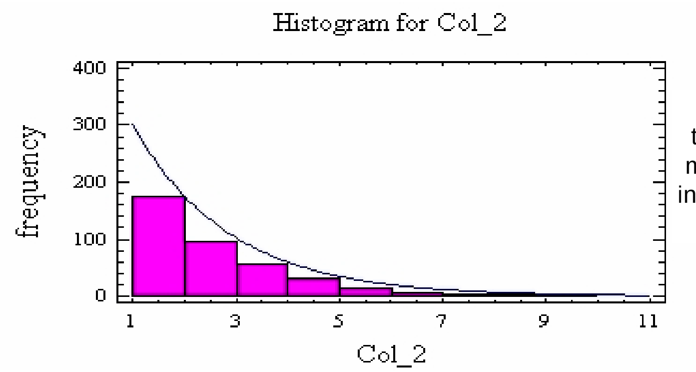

FIGURE 3. Distribution density of time intervals between two calls made between 7 and 10 o'clock in the circumstances of a taxi-cab transport company in Ruse

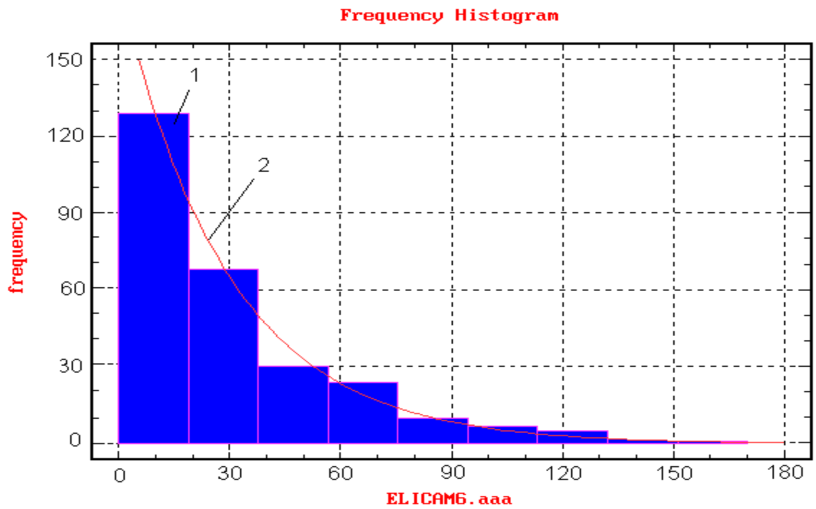

FIGURE 4. Distribution density of calls made between 7 am and 7 pm o'clock in the circumstances of emergency medical care center in Ruse

For both of the systems is important to determine the values of such parameters like:

- probable state of the system;
- refusal probability of order servicing;
- relative and absolute traffic capacity;
- average number of occupied transport vehicles.

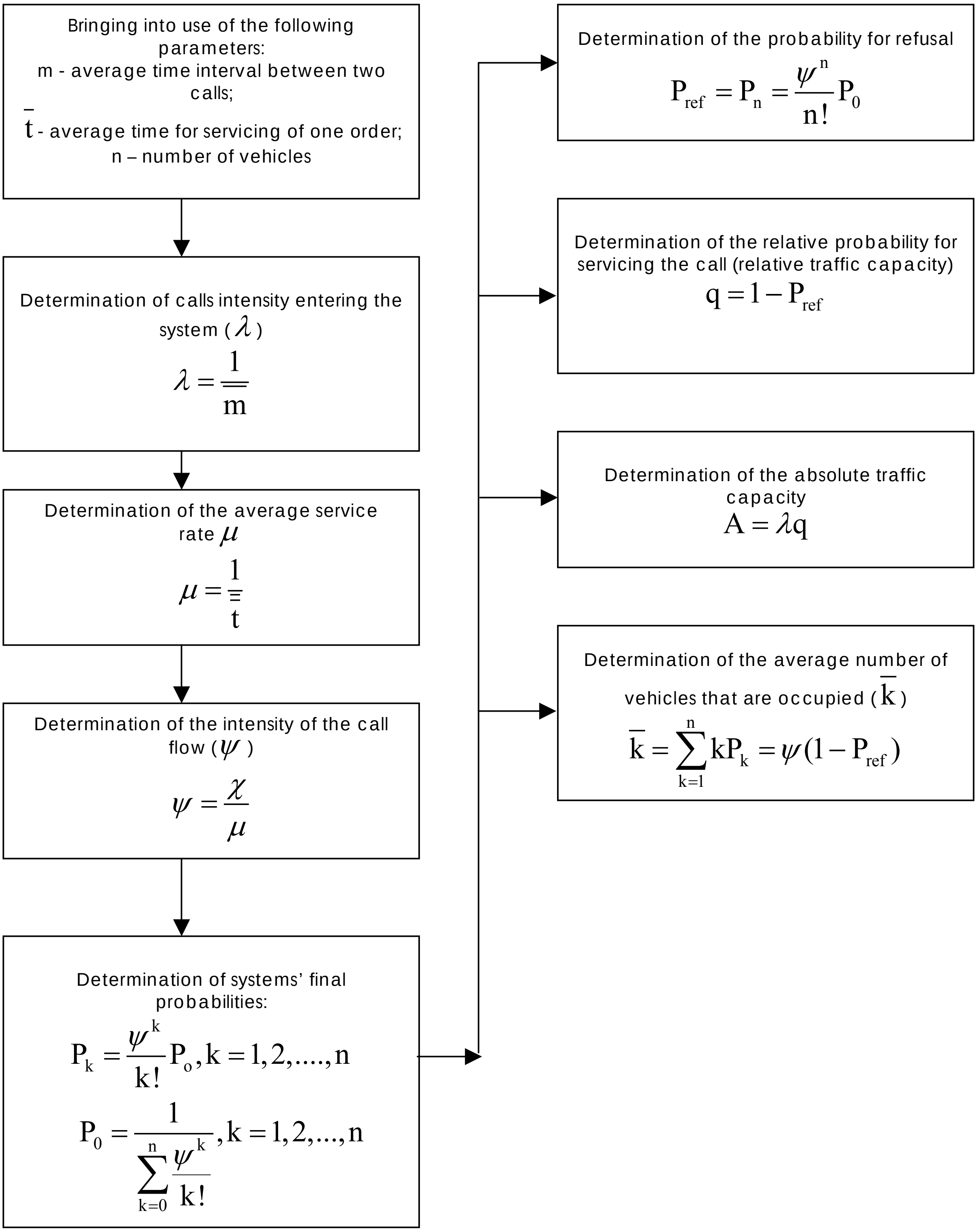

FIGURE 5. The algorithm

The algorithm for determination of those values in case of systems with refusals is shown on figure 5. The calls enter the systems in a moment when all the vehicles are occupied and because all lines are occupied at the time of arrival of a call, the call is lost and leaves the system immediately without being served.

By using Visual Basic of Microsoft Excel we determine the parameters' values (fig. 6).

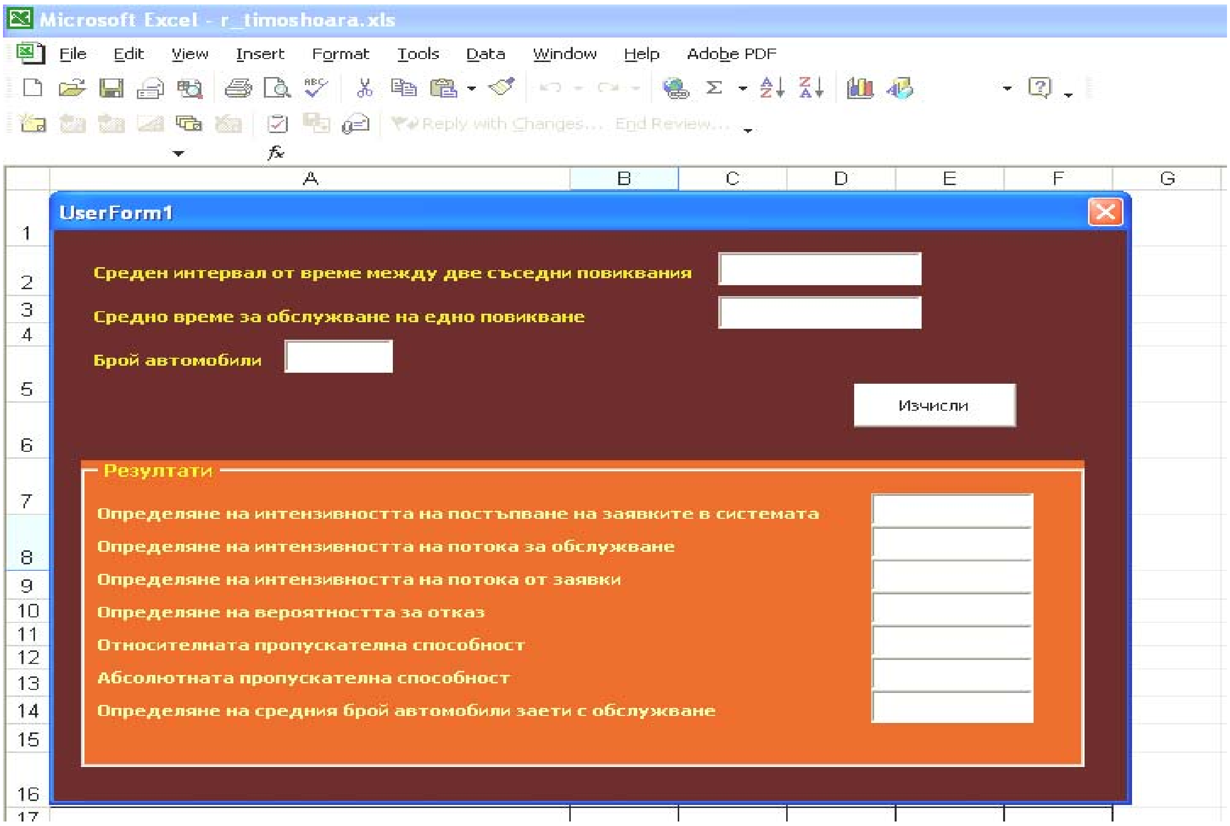

FIGURE 6. THE PARAMETERS' VALUES IN VISUAL BASIC OF MICROSOFT EXCEL

The systems examined in this paper have a big social importance. Setting the number of vehicles is a very important decision. Setting the proper vehicle number will lead to servicing without refusals, i.e. $P_{ref} = 0$.

The solution of the problem is received by using the function *Goal Seek* of Excel.

In *Set Cell* we enter: the cell address in which the value of the refusal probability is wrote, i.e. the value of the cell that we are going to optimize.

In *To Value* we enter: the value that we want to receive which in our case is zero (0).

In *By changing cell* we enter: the cell address where we want to enter the number of vehicles, i.e. the cell which value will be changed.

4. CONCLUSION

It is necessary to analyze without delay the condition of the servicing transport systems when we plan and manage the processes taking place. The proposed algorithm allows receiving good results, which will be used for setting the parameters values. By using Microsoft Excel, scientists from Transport Department of Russe University worked out a program for the algorithm mentioned above. Planning of the systems' functioning is possible by means of that program.

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