Modeling activity zone road transport container terminal in the port

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Abstract: **The zone of serving the foreign trucks is inseparable part of the harbor container terminal and its operation influences directly the achieved financial results. In the process of modelling, it is viewed as an independent system. The worked out analytical and simulation models are the main tools in making the right managerial decisions, which are based on a deep analysis of the operational characteristics of the analyzed system.**

Key words: **combined freight, zone of serving foreign trucks, analytical and simulation model.**

The zone of serving the foreign trucks is inseparable part of the harbor container terminal and its operation influences directly the business turnover and the achieved financial results. As a result, it is necessarily to research and shape the incoming trucks and to define the main parameters, which, in turn, determine the needed workforce, expenses for wages, expenses for the hauler, and the duration of the work day.

The simultaneous examination of both, the analytical and simulation models, checks whether those models follow the operational logic of the examined system, which is a necessary condition for their use as tools in making the right managerial decisions that are based on a deep analysis of the operational characteristics of the analyzed system.

We see the zone of serving the foreign auto transportation in the harbor transportation channel as an open multichannel system for mass servicing in which the orders come irregularly with two parallel servicing mechanisms and methods FCFS (first come, first serve). The servicing mechanisms are of similar type and have the same productivity level.

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The incoming/receiving of trucks is shaped as Poisson Process and the serving is an independent variable with the so called Poisson distribution.

In analyzing the system, the main functions will be held by L_q, W_q and by the use of serving mechanisms. The average number of orders in the tail L_q estimates the appropriate measures of the waiting zone, and the average time of staying at the tail W_q helps in computing the expenses originating from waiting for being served, in determining the degree to which the serving mechanisms are utilized and the operational expenses of the autoloaders.

We assume that the intensity of incoming trucks equals $\lambda = 5$ trucks/ h and the average time for serving equals $\bar{t}_{s.} = 18$ minutes.

The serving zone of foreign trucks in the transportation channel works 5 days per week and 8 hours per day from Monday till Friday.

The serving of the incoming trucks in the harbor transportation area could be represented with the following two models, corresponding to the existing situation in the analyzed terminal. They are used in defining the operational characteristics and their main purposed is to compare them and determine the advantages of each one of the characteristics.

Model 1: With separate tails in front of the serving mechanisms- the analyzed system is represented through two systems M/M/1: M/M/2=2*M/M/1 (Figure1)

The system is seen as a sum of two parallel sub-systems.

Assume: The incoming stream of trucks with intensity λ is divided into two streams, respectively with ratio 50:50.

$$\lambda = \sum_{i=1}^{2} \lambda_i \text{ And } \lambda_1 = \lambda_2 = 0.5 * 5 = 2.5$$

The distribution of the incoming stream is determined by the organization of the work in the examined system.

Model 2: With a common tail in front of the serving mechanisms – M/M/2. (Figure 2)

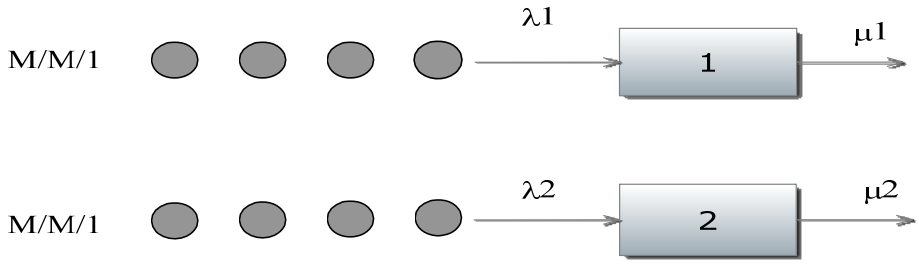

Figure.1. Model: M/M/2=2*M/M/1

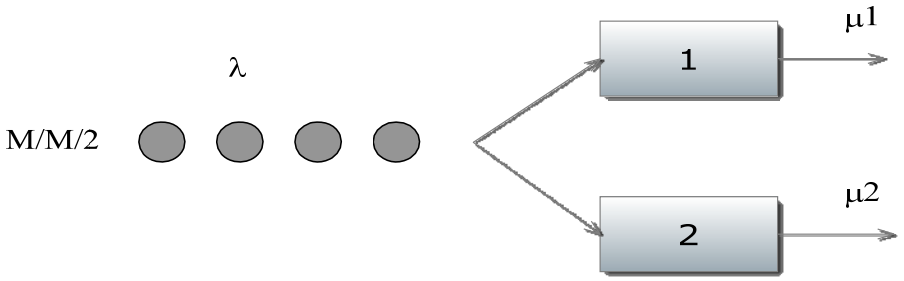

Figure.2. Model: M/M/2

The analytical model gives only equilibrium results which determine the operational characteristics as a function of the intensity of the incoming of trucks and the number of serving mechanisms. However, it does not give the opportunity the effect of the change of the time distribution to be examined. Specialized software helps in checking the accuracy of the results received from the analytical model of the examined system [6]. The end results, which are came up to after an analytical decision, function as a check of the worked out simulation models.

The creating of a simulation model of the existing system gives a chance for a better understanding and managing the scrutinized processes. The deep and detailed analysis of the use of the serving mechanisms and the waiting time of the trucks in the automobile zone provides us an opportunity to determine the weak sides of the system.

In working out the simulation model, the program plan ARENA is applied.

In tables 1 and 2 the final results are summarized.

Model: M/M/2=2*M/M/1

Table 1. Comparing the results in M/M/2=2*M/M/1

Parameter	Analytical model	Model in Arena
W_q, min	54	51,5748
W, min	72	69,5523
L_q, num	4,500	2,1707
L, num	6,000	5,8326
ρ	0.75	0,7456

Model: M/M/2

Table 2. Comparing the results in M/M/2

Parameter	Analytical model	Model in Arena
W_q ,min	23,142	23,615
W ,min	41,142	41,5504
L_q ,num	1.9288	1,9890
L , num	3.4287	3,4883
ρ	0,75	0,7497

W - average time a unit spends in the system;

L - average number of units in the system;

The similarity of the results that we got from the two models assures us that the worked out models are correct and accurate.

In shaping in ARENA, we see two alternatives of the model M/M/2=2*M/M/1:

Model 1-1 – the incoming stream of trucks with intensity λ is divided into two streams, respectively in a ratio of 50:50 and Model 1-2 – the last truck that came is moved to the shorter tail.

Table 3. Comparing the results in applying the different models.

The Results of a simulation in ARENA			
parameter	**Model 1-1**	**Model 1-2**	**Model 2**
W , min	69,5523	45,1627	41,5504
W_q ,min	51,5748	27,2364	23,6115
$\bar{t}_{s.}$,min	17,9775	17,9262	17,9388
L_q ,num	2,1707	1,14765	1,9890
L ,num	5,8326	3,7960	3,4883
ρ	0,7456	0,7504	0,7497

VI. CONCLUSION

The summarized results received after a simulation of the models in ARENA, represented in table 3, show that the best alternative, given the existing infrastructure in the examined transportation channel, is the according to which the trucks wait serving in a common tail in front of the serving mechanisms. This alternative reaches the optimal numbers for time for staying in the tail and time for staying in the system.

The worked out models describe different alternatives of a possible organization in the existing infrastructure and they are part of the methods for research of the zone for serving the foreign trucks.

Since the logistics processes occurring in the transportation channels, in which interaction among the different types of transportation are accomplished, are analogical, the worked out models could be used as an universal contributing to the taking of the right managerial decisions given different combinations of inputs.

REFERENCES

[1]. Kachauniv T., Borisov A., Interaction between modes, TU " Todor Kableshkov" , S., 2009
[2]. Makedonska D., Kazakov N., Dimitrov I, Fundamentals of Logistics, Translogistik, Sofia, 2001
[3]. Averell M., Kelyton D., Iminatsionnoe modelirovanie, Peter, Moscow, 2004
[4]. Altiok T., Melamed B., Simulation modeling and analysis with Arena, www.seas.gwu.edu
[5]. Statistics for Port Burgas
[6]. www.ualberta.ca