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SIMULATION MODELING OF FREIGHT FORWARDING SERVICES RENDERED BY AN INTERNATIONAL LOGISTICS COMPANY

ИМИТАЦИОННОЕ МОДЕЛИРОВАНИЕ ОКАЗАНИЯ ТРАНСПОРТНО-ЭКСПЕДИТОРСКИХ УСЛУГ МЕЖДУНАРОДНОЙ ЛОГИСТИЧЕСКОЙ КОМПАНИЕЙ

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Abstract. *The efficiency of freight forwarding companies` performance is determined by the qualitative, quantitative, and cost indicators characterizing service provision to economic entities. The article presents a simulation model of freight forwarding services developed in GPSS World simulation system to determine the average processing time of incoming requests depending on the type of clients; research and comparison of the efficiency of two directions of requests depending on transportation; determine the total customer service time depending on the department; explore and improve the efficiency of logistics company by optimizing the construction of transport and logistics services.*

Keywords: *freight forwarding activities, queuing system, service request.*

Introduction.

Transport provides full satisfaction of the needs of national economy and population in transportation. More than half of the volume of traffic is carried out road transport, since it is the most mobile and maneuverable. It also allows the delivery of goods from places of production to places of consumption.

In order to increase the volume of cargo transportation by road, it is important to provide high-quality freight forwarding services to potential customers, since at present the object of research of the transport market is the customer and his needs. The more profitable the transportation is, the more interested the customer is.

The main criteria for choosing a freight forwarding company are:

- the cost of transportation (total transportation costs, taking into account transport tariffs);
- speed of transportation (total travel time: from the starting point of departure to the final destination);
- reliability of transportation (delivery of cargo in one piece at the specified time and place).

In addition to the main criteria, the following additional criteria can be identified, which should also be taken into account when choosing freight forwarding companies:

- quality of services provided;
- the possibility of providing special equipment for the transportation of certain categories of goods (dangerous, fragile, requiring a certain temperature regime of goods);
- customer orientation (system of discounts and special offers);
- possibility of delivery of cargo "door to door";

– reputation in the transport services market (good customer history and positive feedback);
– qualification of personnel;
– cargo monitoring (the ability to track the transportation process);
– compliance with the requirements and quality standards of the transportation process;
– mandatory insurance compensation in case of loss / damage of cargo;
– financial stability of the carrier;
– availability of additional services to ensure an increased level of security of the transported cargo (insurance, information support, additional packaging);
– many years of experience in the transport services market.

A freight forwarding company`s performance is analyzed according to indicators characterizing its activity areas where the company`s performance before and after the implementation of specific measures is compared. Each of the company`s goals requires the analysis of a number of indicators that allows making managerial decisions on the economic feasibility of the proposed actions, their benefits, and risks [1].

The most common aspects that are usually subject to constant reforms in freight forwarding companies` operation are workforce and material-and-technical capacity management. Potential measures that are considered to optimize the staffing level in order to provide complex and timely freight forwarding service provision, as well as derive economic benefits from the operation are the assessment of costs, revenues, and profits generated from the activity [1].

Statement of basic materials.

The most important factor is the duration and quality of service provision. To plan this business process, we consider it appropriate to rationally organize freight forwarding services rendered by an international logistics company.

The aim of the work is to develop a simulation model of freight forwarding services developed in GPSS World simulation system [2, 3, 4] to

– determine the average processing time of incoming requests depending on the type of clients (VIP client, client, one-time application);
– research and comparison of the efficiency of two directions of requests depending on transportation (export, import);
– determine the total customer service time depending on the department;
– explore and improve the efficiency of logistics company by optimizing the construction of the workflow for provision of transport and logistics services.

To justify the choice of the optimal structure of an international logistics company and optimize the processing of incoming requests, a mathematical model of queuing system is proposed. The proposed queuing model is implemented in GPSS World simulation system [2, 3, 4] (Fig. 1).

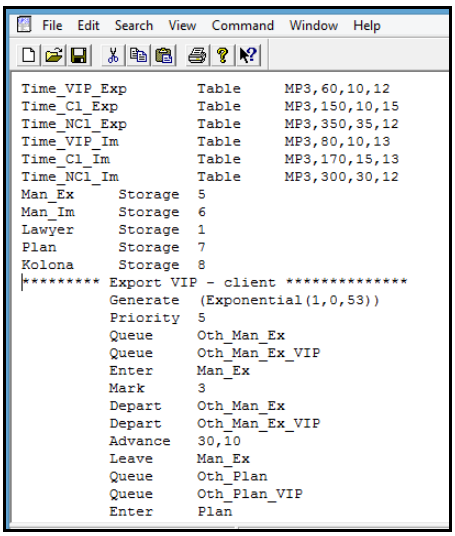

Fig. 1 Program listing

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As a result of the simulation, the following statistics on queues and devices were obtained:

QUEUE	MAX	CONT.	ENTRY	ENTRY(0)	AVE.CONT.	AVE.TIME	AVE.(-0)	RETRY
OTH_MAN_EX	18	0	65836	25639	1.538	23.553	38.575	0
OTH_MAN_IM	9	0	38600	35450	0.057	1.476	18.089	0
OTH_LAW	6	0	20839	14066	0.091	4.397	13.528	0
OTH_PLAN	20	2	104429	60178	0.774	7.469	17.626	0
OTH_KOL	37	0	104420	30044	2.985	28.818	40.458	0
OTH_MAN_EX_VIP	7	0	19231	7476	0.158	8.284	13.553	0
OTH_MAN_EX_CL	12	0	36096	14034	0.675	18.843	30.829	0
OTH_MAN_IM_VIP	6	0	12578	11521	0.013	1.014	12.064	0
OTH_PLAN_VIP	6	1	31807	17545	0.111	3.520	7.851	0
OTH_MAN_IM_CL	5	0	15691	14475	0.021	1.345	17.350	0
OTH_PLAN_CL	10	1	51783	29880	0.326	6.336	14.980	0
OTH_KOL_VIP	7	0	31804	9008	0.226	7.161	9.990	0
OTH_MAN_EX_NCL	15	0	10509	4129	0.706	67.670	111.465	0
OTH_KOL_CL	10	0	51778	14807	0.771	15.019	21.034	0
OTH_MAN_IM_NCL	7	0	10331	9454	0.023	2.239	26.374	0
OTH_PLAN_NCL	13	0	20839	12753	0.337	16.311	42.037	0
OTH_KOL_NCL	33	0	20838	6229	1.988	96.159	137.159	0

STORAGE	CAP.	REM.	MIN.	MAX.	ENTRIES	AVL.	AVE.C.	UTIL.	RETRY	DELAY
MAN_EX	5	1	0	5	65836	1	4.180	0.836	0	0
MAN_IM	6	3	0	6	38600	1	2.868	0.478	0	0
LAWYER	1	1	0	1	20839	1	0.311	0.311	0	0
PLAN	7	0	0	7	104427	1	5.547	0.792	0	2
KOLONA	8	1	0	8	104420	1	7.358	0.920	0	0

As a result of the simulation, the average service time of an incoming request is shown in Table 1.

According to the reports obtained as a result of modeling the processing of incoming requests, the main indicators of the simulation results are determined and the amount of time loss of requests for service requests in queues is calculated (Table 2).

Table 1 - Results of modeling the processing of incoming requests from customers

Operations for processing incoming requests	Average maintenance time, min (MEAN)	Mean square deviation, min (STD.DEV.)
VIP client (export)	115,015	13,428
Regular client (export)	202,247	23,299
One-time client (export)	464,731	172,401
VIP client (import)	141,712	15,616
Regular client (import)	235,656	40,373
One-time client (import)	429,148	173,825

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Table 2 - Main indicators of simulation results

	Output parameters	Client Manager	Lawyer	Planning Department	Transport Department
EXPORT	Average work completion time (min)	90,55	24,397	58,47	101,82
	Average queue lengths for request processing (request)	1,5	0,091	0,77	2,99
	The number of requests served without downtime in the queue (%)	38,94	67,5	57,63	28,77
	Waiting time of the client in the queue (min)	23,55	4,397	7,47	28,82
	Load factor	0,836	0,31	0,79	0,92
	Number of employees to process the request (people)	4,18	0,31	5,55	7,36
	Number of employees in departments (people)	5	1	7	8
IMPORT	Average work completion time (min)	71,47	14,397	69,77	97,37
	Average queue lengths for request processing (request)	0,057	0,091	0,77	2,99
	The number of requests served without downtime in the queue (%)	91,84	67,5	57,63	28,77
	Waiting time of the client in the queue (min)	1,47	4,397	7,47	28,82
	Load factor	0,478	0,31	0,79	0,92
	Number of employees to process the request (people)	2,87	0,31	5,55	7,36
	Number of employees in departments (people)	6	1	7	8

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Having analyzed the calculation results, we can see that the "bottleneck" for this flow of requests is the number of client managers in the export department and the number of employees in the transport department, the increase of which will increase the throughput and reduce the time of customer service and request processing. While the number of jobs for client managers in the import department can be reduced.

Conclusions.

The developed simulation model can be used to determine the optimal structure of a logistics company in the provision of forwarding services.

In determining the optimal number of employees to work with service consumers, a company's management should take into account the quantitative and qualitative indicators of their activities, but the most important aspect of any logistics organization`s operation is, of course, financial indicators.

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Аннотация. *В целях увеличения объемов перевозки грузов автомобильным транспортом важное значение имеет качественное транспортно-экспедиционное обслуживание потенциальных клиентов, так как в настоящее время объектом исследования транспортного рынка является клиент и его потребности.*

В статье представлена имитационная модели оказания экспедиторских услуг международной логистической компанией в системе имитационного моделирования GPSS World для определения среднего времени обработки входящих заявок в зависимости от типа клиентов (VIP-клиент, клиент, разовая заявка); исследования и сравнения эффективности двух направлений заявок в зависимости от перевозки (экспорт, импорт); определения общего времени обслуживания клиентов в зависимости от отдела; исследования и повышения эффективности работы логистической компании за счет оптимизации построения рабочего процесса. Разработанная имитационная модель может быть использована для определения оптимальной структуры организации работы логистической компании при оказании экспедиторских услуг.

Ключевые слова: *транспортно-экспедиторская деятельность, системы массового обслуживания, заявка на обслуживание.*

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