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SIMULATION OF THE OPERATION OF THE MOBILE EQUIPMENT STORE «RK-TEL»

In this paper, the relevance of optimizing business processes by computer modeling methods is considered. The term simulation modeling was investigated. As a result of studying the literature, the GPSS modeling language was selected and based on it, the work of the mobile equipment store «RK-Tel» in Atyrau was simulated during the working day. Based on the results of the work carried out, we determined the dependence of the probability of service failures and the length of queues created for cashiers on the number of consultants, the intensity of service and the arrival of customers. As a result of the simulation, results were obtained on the possible optimization of the process and effective customer service. As a result of the study, it was found that at the current parameters, the efficiency of the system will be increased. The work of the mobile equipment store «RK-Tel» was optimized by introducing an additional cash register. It is shown that with the addition of an additional cash register, the store can serve all customers, and the number of people in the queue has decreased. This study allowed us to optimize the operation of the store, eliminate failures and reduce the waiting time in the queue.

Keywords: simulation modeling, modeling, GPSS, optimization, store optimization, mobile equipment store.

Introduction

From models of technical, technological, and operational structures to questions of human existence and the world, computer simulation has found realistic use in all fields of human life. Rather than learning from your own or others' errors, it is preferable to consolidate and evaluate your understanding of actual life with the results of a simulation model. The aim of this project is to

improve [1,2] the operation of the «RK-Tel» mobile equipment store in Atyrau. Currently, each of us shops for phones, accessories, and other products at a cellular equipment store. There are always queues in cellular equipment stores for which a consumer does not want to lose time; thus, for the shop to be appealing to consumers, it must be arranged in such a manner that the user spends the least amount of time in the queue.

Materials and methods

We suggest that you approach this problem using the GPSS tool [3,4], which allows you to evaluate both the job and the results of each organization's activities. It allows you to predict the results of the created organization's activities and provides a high-level analysis of the project's viability. It also allows you to test the model's accuracy as the input data is changed. At the cell equipment store, there is a cashier, as well as a consultant for loaning money and a consultant for selling tablets. A large number of contractors are permitted to work behind the counter. When a customer comes into the shop (the flood of new clients is distributed rapidly with some intensity λ), a consultant immediately meets him to counsel him on the order he is making; if the consultant is busy, the client waits for his release. If there are still a lot of people in line, the customer sits or exits. The customer's wait time for the consultancy is dictated by the consultant's quality of service (μ). After meeting, the client goes to the cashier to pay for his transaction; if the cashier is occupied, the client waits for his release. The amount of time a cashier spends servicing customers is dictated by the cashier's operation's severity (i). After paying for their order, the person departs. On a day off, we spent 8 hours observing the cashiers and advisors at the mobile equipment shop «RK-Tel» [5].

The cash register method in the «RK-Tel» shop is a multi-channel CFR with failures. Every 4 ± 2 minutes, a customer appears by the cashier, and one customer takes 10 ± 2 minutes to serve. Given that the consumer queue serves two windows, deciding on its features is critical (see Figure 1). The lines in Figure 1 represent possible application (i.e. customer) travel paths, while the triangles represent the application queue. In the layout of the required statistics, we will provide the risk of disappointment, that is, the possibility that an incoming customer will find a queue of ten customers in the store and leave [6].

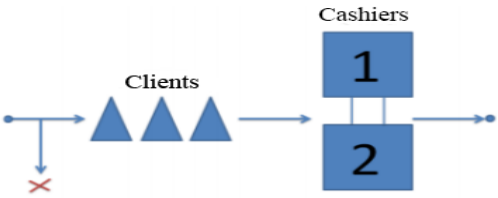

Figure 1 – The operation of the cash register in the «RK-Tel» store

According to the schematic representation of the «RK-Tel» shop, the GPSS language model for it can be written as follows (see Figure 2):

```
10 OCHER STORAGE 2
20 GENERATE 4,2
30 TEST l Q1,10,OTKAZ
40 QUEUE 1
50 ENTER OCHER
60 DEPART 1
70 ADVANCE 10,2
80 LEAVE OCHER
90 TERMINATE
100 OTKAZ TERMINATE
110 GENERATE 480
120 TERMINATE 1
```

Figure 2 – «RK-Tel» store model in GPSS language

This model's transactions behave exactly like those of the simulated store's customers. When the OCHER memory's two units are still full, transactions from the GENERATE block will fail in the ENTER block and must wait for the memory to be unlocked, just as consumers must wait for one of the two cashiers to be released. The following is how the TEST block is used. The condition indicated by the letter L after the word TEST, i.e. the condition «less than», is tested when a transaction enters this block. The values to compare are set in the TEST block's fields A and B. As a result of checking condition Q110, the transaction will obey the OTKAZ mark - which will be lost by the model's line 100. This is the time it takes for a customer trapped in a line of 10 customers to leave [7].

START TIME	END TIME	BLOCKS	FACILITIES	STORAGES
0.000	480.000	11	0	1

NAME	VALUE
OCHER	10000.000
OTKAZ	9.000

LABEL	LOC	BLOCK TYPE	ENTRY COUNT	CURRENT COUNT	RETRY
	1	GENERATE	120	0	0
	2	TEST	120	0	0
	3	QUEUE	104	10	0
	4	ENTER	94	0	0
	5	DEPART	94	0	0
	6	ADVANCE	94	2	0
	7	LEAVE	92	0	0
	8	TERMINATE	92	0	0
OTKAZ	9	TERMINATE	16	0	0
	10	GENERATE	1	0	0
	11	TERMINATE	1	0	0

QUEUE	MAX	CONT.	ENTRY	ENTRY(0)	AVE.CONT.	AVE.TIME	AVE.(-0)	RETRY
1	10	10	104	2	7.800	36.002	36.708	0

STORAGE	CAP.	REM.	MIN.	MAX.	ENTRIES	AVL.	AVE.C.	UTIL.	RETRY	DELAY
OCHER	2	0	0	2	94	1	1.967	0.983	0	10

FEC XN	PRI	BDT	ASSEM	CURRENT	NEXT	PARAMETER	VALUE
107	0	480.153	107	6	7		
122	0	482.549	122	0	1		
109	0	490.121	109	6	7		
123	0	960.000	123	0	10		

Figure 3 – Report on the research of the «RK-Tel» store model

Let's look at the research report in detail. During the simulation, the ENTRY COUNT column displays the number of transactions that passed through each block of the model. So, the GENERATE block generated 120 transactions, resulting in a rush of customers to the store within 8 hours. In the OTKAZ block, 16 transactions were lost. You can get an estimation of the likelihood of failure from here: = 16/120=0.13. The employee load factor is 0.983, indicating that cashiers are fully employed. We recommend adding one cash register to increase the store's performance. Let's pretend that customers arrive at the store every 4 ± 2 minutes, and we need to figure out what the customer line looks like, thinking that they'll be served by three cashier consultants. We also cut the line from 10 to 6 participants.

```
10 OCHER STORAGE 3
20 GENERATE 4,2
30 TEST 1 Q1,6,OTKAZ
40 QUEUE 1
50 ENTER OCHER
60 DEPART 1
70 ADVANCE 10,2
80 LEAVE OCHER
90 TERMINATE
100 OTKAZ TERMINATE
110 GENERATE 480
120 TERMINATE 1
```

Figure 4 – Optimized model of the «RK-Tel» store

This model's purchases are identical to those of the simulated store's clients. When all three units in the OCHER memory are filled, transactions from the GENERATE block are unable to access the ENTER block and must wait for the memory to be opened, just as consumers must wait for one of the six store locations to become accessible [8,9].

Results

START TIME	END TIME	BLOCKS	FACILITIES	STORAGES
0.000	480.000	11	0	1

NAME	VALUE
OCHER	10000.000
OTKAZ	9.000

LABEL	LOC	BLOCK TYPE	ENTRY COUNT	CURRENT COUNT	RETRY
	1	GENERATE	117	0	0
	2	TEST	117	0	0
	3	QUEUE	117	0	0
	4	ENTER	117	0	0
	5	DEPART	117	0	0
	6	ADVANCE	117	3	0
	7	LEAVE	114	0	0
	8	TERMINATE	114	0	0
OTKAZ	9	TERMINATE	0	0	0
	10	GENERATE	1	0	0
	11	TERMINATE	1	0	0

QUEUE	MAX	CONT.	ENTRY	ENTRY(0)	AVE.CONT.	AVE.TIME	AVE.(-0)	RETRY
1	1	0	117	95	0.063	0.259	1.377	0

STORAGE	CAP.	REM.	MIN.	MAX.	ENTRIES	AVL.	AVE.C.	UTIL.	RETRY	DELAY
OCHER	3	0	0	3	117	1	2.402	0.801	0	0

FEC XN	PRI	BDT	ASSEM	CURRENT	NEXT	PARAMETER	VALUE
119	0	481.561	119	0	1		
116	0	483.156	116	6	7		
117	0	486.492	117	6	7		
118	0	489.293	118	6	7		
120	0	960.000	120	0	10		

Figure 5 – Report on the research of the optimized store model «RK-Tel»

We can see in the research report that as the number of cash registers grows, OTKAZ = 0 appears in the graph. The GENERATE block generated 117 purchases, which corresponded to the number of customers who visited the store within the first eight hours. There were no customers in the queue at the close of business hours. The employee load factor fell to 0.801 percent. The theory of queuing is discussed in this article. We studied the GPSS methods, which enable us to assess the function as well as the outcomes of any organization's activities. On the case of the mobile equipment store [10] «RK-Tel,» we looked at the multi-channel CFR with failures in depth.

Conclusion

As a result, the optimization of the customer flow in the store with an improvement in the performance of the customer flow was considered in this article, which was based on simulation modeling. In the GPSS programming language, a simulation model was developed. The outcomes were collected, and they were usually better. We looked at the literature on GPSS device service and used it to model the operation of a cellular equipment store during the working day. We also discovered that the number of consultants, the intensity of service, and the arrival of customers all influence the likelihood of service delays and the duration of queues formed for cashiers. By adding a second cash register to the mobile equipment store «RK-Tel» in Atyrau, we were able to improve its performance. We've shown that by adding a cash register, the shop can now accommodate all customers, and the number of people in line has shrunk. The store's service was streamlined as a result of this activity, failures were eliminated, and queue wait times were shortened.

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«РК-ТЕЛ» ҰЯЛЫ ТЕХНИКА ДҮКЕНІНІҢ ЖҰМЫСЫН МОДЕЛЬДЕУ

Бұл жұмыста компьютерлік модельдеу әдістерімен бизнес-процестерді оңтайландырудың өзектілігі қарастырылады. Модельдеу термині зерттелді. Әдебиетті оқу қорытындысы бойынша GPSS модельдеу тілі таңдалды және оның негізінде Атырау қаласында жұмыс күні ішінде «РК-Тел» мобильді техника дүкенінің жұмысы модельденді. Жүргізілген жұмыс нәтижелері бойынша қызмет көрсетудегі іркілістер ықтималдығының және кассирлерге жасалатын кезектер ұзындығының консультанттар санына, қызмет көрсету қарқындылығына және клиенттердің келуіне тәуелділігі анықталды. Модельдеу нәтижесінде процесті оңтайландыру және клиенттерге тиімді қызмет көрсету нәтижелері алынды. Зерттеу нәтижесінде жүйенің ағымдағы параметрлері кезінде пәк жоғарылайтыны анықталды. Қосымша кассалық аппаратты енгізу арқылы «РК-Тел» мобильді техника дүкенінің жұмысын оңтайландыру жүргізілді. Қосымша кассаның қосылуымен дүкен барлық сатып алушыларға қызмет ете алатындығы және кезекте тұрған адамдардың саны азайғаны көрсетілген. Бұл зерттеу дүкеннің жұмысын оңтайландыруға, сәтсіздіктерді жоюға және кезек күту уақытын азайтуға мүмкіндік берді.

Кілтті сөздер: имитациялық модельдеу, модельдеу, GPSS модельдеу тілі, оңтайландыру, дүкенді оңтайландыру, мобильді жабдықтар дүкені.

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МОДЕЛИРОВАНИЕ РАБОТЫ МАГАЗИНА СОТОВОЙ СВЯЗИ «РК-ТЕЛ»

В данной работе рассмотрена актуальность оптимизации бизнес-процессов методами компьютерного моделирования. Был исследован термин имитационное моделирование. По итогу изучения литературы был выбран язык моделирования GPSS и на ее основе проведено моделирование работы магазина мобильной техники «РК-Тел» в г. Атырау в течение рабочего дня. По результатам проведенной работы определили зависимость вероятности сбоев обслуживания и длины очередей, создаваемых к кассирам, от количества консультантов, интенсивности обслуживания и прибытия клиентов. В результате моделирования были получены результаты по возможной оптимизации процесса и эффективному обслуживанию клиентов. В результате исследования было установлено, что при текущих параметрах КПД системы будет повышен. Проведена оптимизация работы магазина мобильной техники «РК-Тел» путем введения дополнительного кассового аппарата. Показано, что с добавлением дополнительной кассы магазин может обслуживать всех покупателей, а количество людей в очереди уменьшилось. Данное исследование позволило оптимизировать работу магазина, устранить сбои и уменьшить время ожидания в очереди.

Ключевые слова: имитационное моделирование, моделирование, GPSS, оптимизация, оптимизация магазина, магазин мобильной связи.

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