Application of the Discrete-Event Simulation When Optimizing of Business Processes in Trading Companies

Maxat Bokambayev, Bella Tussupova, Aisha Mamyrova, Erlan Izbasarov

Abstract—Optimization of business processes in trading companies is reviewed in the report. There is the presentation of the "Wholesale Customer Order Handling Process" business process model applicable for small and medium businesses. It is proposed to apply the algorithm for automation of the customer order processing which will significantly reduce labor costs and time expenditures and increase the profitability of companies. An optimized business process is an element of the information system of accounting of spare parts trading network activity. The considered algorithm may find application in the trading industry as well.

Keywords—Business processes, discrete-event simulation.

I. INTRODUCTION

THE growth of GDP in developing countries observed in recent years [7] has led to improvement of social conditions, in particular, is evidenced in increase of purchasing power of the population. Positive macroeconomic trends are reflected also in the automotive market: Increased sales, both of the vehicles and spare parts to them. As a consequence of an increasing number of customers and goods turnovers raise highly important issue of business process automation for commercial companies.

Effectiveness of business processes automation in commercial companies is covered by scientific approach, namely, application of models and methods by one of the areas of discrete-event simulation. It assumes that labor cost and time expenditure are optimized in business processes: "Waiting", "Customer order receiving and handling", "Transportation of cargo", "Goods acceptance at warehouse" etc. This paper considers application of discrete event simulation on "Customer order handling" business process for example, the accounting information system (AIS) of spare parts trading industry.

II. PROPOSED MODEL

"Customer order handling" business process before optimization looks as follows: customers learn about company from television advertising, newspapers, radio, recommendations of familiar people, after that customers come to the store, get some advice on spare parts and start sale registration. For sale registration user of the AIS, i.e. sales manager shall create "Document: Order", which displays information about the requested spare parts: Title of spare parts, price, quantity availability on the local stock, the price and quantity at a remote warehouse, etc. Shape of the AIS object is "Document: Application" that presented in Fig. 1 below:

Nonauthorized	d order						N≌	Nº 0100000013 Dated 06.01.2014					5 🖽		
Main informatio	n						_	Choose brand	d —						
Organization	TSP LLP						9	Toyota				۹			
Vendor	ORYNBASAR LLP						9	Spare-part	Spare-part 3						
Contract	Without contract						Q.	Inventory #				Order	0		
Warehouse	01_Almaty						×		List of processings						
Price (type)	Almaty (Razvilka)						×	Reflect al	Reflect all columns in the Inventory # 1				table		
VIN / FRAME:	PART NUMBER						1	Discount card							
Bank account	1013 АГФ АО "Qazag Banki" (Развилка) 3120						×	Activate discount card							
V C Inv. #	(cust Inv. # (ven		2 10		[Total 19 0		RICE	cal Vendor	Vendo	r name	P	rice logo	_		
	48531421	. 2		19 0		-	RICE	cal Vendor	Vendo	r name	P	rice logo			
1 0 48531 2 0 90480	48531421	. 2	2 10	19 0	. 19 0	-		cal Vendor	Vendo	er name	P	rice logo			
1 0 48531 2 0 90480 </td <td>48531421</td> <td>. 2</td> <td>2 10</td> <td>19 0</td> <td>. 19 0</td> <td>-</td> <td></td> <td>cal Vendor</td> <td>Vendo</td> <td>r name</td> <td>P</td> <td>rice logo</td> <td></td>	48531421	. 2	2 10	19 0	. 19 0	-		cal Vendor	Vendo	r name	P	rice logo			
1 0 48531 2 0 90480	48531421	. 2	2 10	19 0	. 19 0	-		cal Vendor	Vendo	r name	P	rice logo			
1 0 4853 2 0 90480 </td <td>1421 48531421 1-300 90480300 90480300 20 681.00</td> <td>. 2</td> <td>2 10</td> <td>19 0</td> <td>. 19 0</td> <td>-</td> <td></td> <td>cal Vendor</td> <td>Vendo</td> <td>r name</td> <td>P</td> <td>rice logo</td> <td></td>	1421 48531421 1-300 90480300 90480300 20 681.00	. 2	2 10	19 0	. 19 0	-		cal Vendor	Vendo	r name	P	rice logo			
10 48531	-421 48531421 -300 90480300	. 2	2 10	19 0	. 19 0	-		cal Vendor	Vendo	r name	P	rice logo			

Fig. 1 Shape of the object "Order"

After the object "Document: Order" was created sales manager creates "Document: Customer order" that selects information from earlier created "Document: Order". Shape of the object is shown in Fig. 2.

M. B., B.T., A. B., and E. I. are with the Kazakhstan National Technological University, Almaty, PO box 050013, Kazakhstan (phone: +77272927301; e-mail: maxat.bokambayev@gmail.com, bella_t2004@ mail.ru, aisha.mamyrova@gmail.com, erlan.izbasarov@gmail.com).

Customer order: Realization.	Commission. Posted					_ [×
Operations LPrices and curr. A	ctions 🔹 👍 🔯 😽	🚹 🛃 💺 -		Ar 📱	3		» ▼
Number 01S0000003 or Organization TSP LLP	06.01.2014 9:04:52						
Customer ORYNBASAR LLP	Q	Contract	Without	t contract			đ
Shipment date 🖾 🖡	Payment 06.01.2014 🖽	Cus	stomer's det	bt not calc	ulated		Q,
Warehouse	T ×	Bank account	1013 A	лгф A0 "(Qazaq Ba	inki" (Развил	đ
Goods Services	Additional Automati	ic discounts					
1223 <u>2</u> 8111	Complete •	Selection Amer	nd 🦵	Kit comp	onents		
Nº Inventory # Hoventory	description	Model # . Amo	ount 🕴	Measure 👔	Q	Price	%
1 4853142131 48531421			2,000 u		1,000	10 043,18	
2 9048030025 90480300	25 [GROMMET] [0,015]		4,000 u	init	1,000	420,66	
5							Σ
Price type 'ALMATY				TOT	AL (KZT	20 681	00
Fride type ALMATT					AL (NZI) F(incl.):		
				VA	(incl.).	2 215	.82
Comments:							
Kalinyuk Ivan Aleksandrovich		Invoice/chec	ck P	rint , 🗸	OK	Post Clos	e

Fig. 2 Shape of the form "Document: Customer order"

In case customer confirms intentions on purchase the next step of sales manager was to print out "Invoice / Pay slip" from the object "Document: Customer order" and sends to pay on cashier.

As per of the conditions of internal policy established by the trading company: If the customer wants to buy goods possessed in stock, customer shall pay 100 % of invoiced spare parts, if spare parts possessed on outbound stock (remote storage), customer should pay 50 % of the invoice. After 50% of invoice was paid by customer and the abovementioned AIS objects were created by sales manager cashier stamps "Prepayment is done" on the "Invoice / Pay slip", which is issued to the customer. At the end of the day the store manager runs a special algorithm "Handling: Formation of Customer Order", previously developed in the accounting system, which consolidated application for the entire day and forms Purchase Order", which "Document: automatically downloaded from the so-called "invoice" and sent to provider via e-mail. Shape of the object "Document: Purchase Order" is shown in Fig. 3:

lumber:	9920000013		от: 06.01.2014 14:	03:50	63								
organization:	tion: TOO «TSP» (Развилка)												
endor:	01 РАЗВИЛКА				Q C	Contract:		Order					
flow		8	Payment:		63		Customer's debt not calculated on this deal						
arehouse:	01 АЛМАТЫ (Ра	x B	ank account:	1013 АГФ АО "Qazaq Banki" (Развилка) 3120									
oods (44 items	Services (0 ite	M Additional											
	description		Complete - Sel	Am		Sum	56VAT	VAT amount	Total	Order	^		
		~	2,000 unit	1,000	8 698,97			1 864.07		94 Customer's order	9920000		
1 0280156	273 abc												
1 0280156 2 131524			2,000 unit	1,000	4 623.08			990.66			a 99Z0000		
	xyz	-				9 246,16	Rate		9 246.				
2 131524 3 1350218 4 2423750	xyz 0.klm 8.[filter		2.000 unit 6.000 unit 3.000 unit	1.000 1.000 1.000	4 623.08 3 037.35 4 110.20	9 246,16 18 224,10 12 330,60	Rate Rate Rate	990.66 1 952.58 1 321.14	9 246. 18 224. 12 330.	16 Customer's order 10 Customer's order 60 Customer's order	99Z0000 99Z0000 99Z0000		
2 131524 3 1350218 4 2423750 5 2467 do	xyz 0 klm 8 [*filter or		2,000 unit 6,000 unit 3,000 unit 10,000 unit	1.000 1.000 1.000 1.000	4 623.08 3 037.35 4 110.20 1 112.26	9 246.16 18 224.10 12 330.60 11 122.60	Rate Rate Rate	990.66 1 952.58 1 321.14 1 191.71	9 246. 18 224. 12 330. 11 122.	16 Customer's order 10 Customer's order 60 Customer's order 60 Customer's order	99Z0000 99Z0000 99Z0000 99Z0000		
2 131524 1 3 1350218 4 2423750 5 2467 ldo	xyz 0.klm 8.[filter		2.000 unit 6.000 unit 3.000 unit	1.000 1.000 1.000	4 623.08 3 037.35 4 110.20	9 246.16 18 224.10 12 330.60 11 122.60	Rate Rate Rate	990.66 1 952.58 1 321.14	9 246. 18 224. 12 330. 11 122.	16 Customer's order 10 Customer's order 60 Customer's order	99Z0000 99Z0000 99Z0000		
2 131524 1 3 1350218 4 2423750 5 2467 ldo 6 3483008	xyz 0 klm 8 [*filter or		2,000 unit 6,000 unit 3,000 unit 10,000 unit	1.000 1.000 1.000 1.000	4 623.08 3 037.35 4 110.20 1 112.26	9 246.16 18 224.10 12 330.60 11 122.60	Rate Rate Rate	990.66 1 952.58 1 321.14 1 191.71	9 246. 18 224. 12 330. 11 122.	16 Customer's order 10 Customer's order 60 Customer's order 60 Customer's order	1 99Z0000 99Z0000 99Z0000 99Z0000 99Z0000 99Z0000		

Fig. 3 Object form "Document: Purchase order"

On the next day after receiving "Purchase order" supplier starts packaging and delivery of ordered spare parts. The supplier regulated delivery time in 7 days. Along with this, vendor sends an invoice containing the information on sent spare parts to trading company via e-mail. Upon arrival of the shipment 4 employees of trading company within 5 days were carried out its receipt and acceptance at warehouse, and then customers were informed by phone on availability of the goods they ordered. The client came back to the store and pays remaining 50 % of "invoice / pay slip" to cashier after that cashier stamps "Vacation of goods allowed" on " Invoice / Pay slip". At the end of the business process 2 employees transfer spare parts to customers within 3 days. "Processing of customer's orders" business process before optimization shown schematically in Fig. 4.

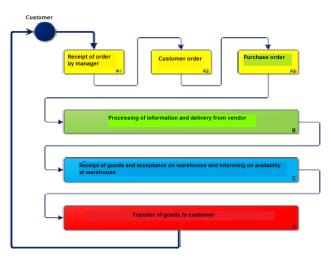


Fig. 4 Business process "Processing of client's order" before optimization of the business process

In formalizing this model the main criterion for commercial company was the time spent by the customer order fulfillment, which must be minimized [1]-[6]

$$t_j^r = t_j^o + t_j^v + t_j^d + t_j^w + t_j^t \rightarrow \min (1)$$

whereas:

 t_{i}^{o} - time consumed by manager for creation of Client order

 t_j^v - time consumed by manager for creation on Purchase order for vendor



 l_j - estimated time on freight transportation of goods (maximum estimate time on accomplishment of delivery is 7 days)

 ι_j - time consumed on receipt and acceptance of goods by warehouse

 t_j^t - time consumed on transfer of goods to client (maximum 3 days on transfer)

j - number of the order

Business Process Optimization Model Using Accounting Information System

After analysis of the business process optimization was done, Figs. 5 and 6 graphically present the advantages appeared after optimizing business process "Processing of customer's orders".

			WHOLESALE CUSTOMER ORDER RECEIPT AND HANDLING BUSINESS PROCESS																
		A1	Manager receive order from customer																
		A2		Creation of document "Customer order" in AIS															
		A3					order" in A												
		В		Processing of information and delivery from Vendor															
		С		Acceptanc	e of goods	and accept	ance at war	ehouse of	ordere	d good	s, informin	g on availa	bility						
		D		Transfer o	f ordered g	oods to cus	tomer												
	-									_								_	
slag	16	1				7					5				3				
-		1	2	3	4	5	6	7		8	9	10	11	12	13	14	15	16	
		A1																	
	Steps	A2	в									c					D		
		AB																	
Employees	7	1				0							4				2		

Fig. 5 Receipt and processing of wholesale clients' order business process – before optimization of labor time costs

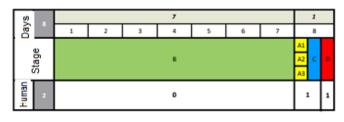


Fig. 6 Receipt and processing of wholesale clients' order business process – after optimization of labor time costs

Optimization consists of two main moments:

- 1) The customer through web-application orders goods directly from the supplier, but price includes margin of trading company
- An automated mechanism in the accounting information system (AIS), entitled "Processing of goods ordered."

Once the customers themselves ordered goods on the site of the provider also complements and organizes the delivery of goods by truck to the warehouse of trading company in 7 days (Phase "B" in Fig. 5). In step "C" - the adoption of custom goods are loaded in the AIS vendor invoice using "Processing: Upload of ordered goods" (Fig. 7).



Fig. 7 Shape of the form "Processing: Upload of ordered goods"

During execution of automated mechanism by warehouse employee in the AIS reception is registered to the account at the warehouse received the ordered spare parts. At this point, due to the existing AIS contact information about customers, pre-filled sales managers to client e-mail addresses to send letters that their ordered spare parts will be available and customers can get them. Lists of goods in the accompanying documents attached to e-mails. Also, through the mechanism of "Processing: Upload of goods ordered" a chain of backdating documents, according to those shown in Fig. 5 stages: "A1", "A2", "A3". At the end of an optimized business process, step «D»:

- using the above mechanism in the AIS creates a "Document: Shipment," locking outflow of goods from a warehouse and transfer them to the client
- 2) Perform a physical loading of goods arrived in freight customer and transfer printed accompanying documents to order the product.

Business process model after optimization is presented in Fig. 8 below:

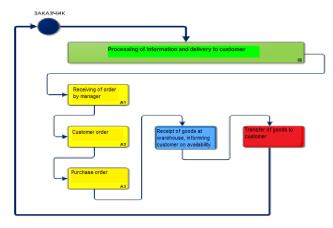


Fig. 8 Business process "Handling of customer order" after optimization

III. CONCLUSION

The optimization of the original model (1), the time spent by the customer order fulfillment, is greatly reduced due to [1]-[6]:

$$t_j^r = t_j^v + t_j^d + t_j^t \tag{2}$$

whereas:

 t_j^{v} - time consumed by managed on creation of purchase order for vendor, significantly decreases due to client's order formed by clients themselves

 t_j^d - time consumed on freight transportation of goods (maximum days on accomplishment of delivery is 7 days)

 t_j^{j} - time spent on the formation of the documents accompanying the goods, warehousing and delivery of goods to customers with three days reduced to one day;

i - number of the order

Obviously, at steps "A1", "A2", "A3", "C", "D" optimization performed substantially. The implementation process takes just one day, you have to use just 2 employees: sales manager and employee stock. In general, the optimization of business process time was 8 days, compared to

16 days. Employees involved throughout the process -2 to 7. Temporary costs reduced by 50 % and labor reduced by more than 71%. This example model can be used by trading companies' generalist practitioners wholesale goods to order.

REFERENCES

- YablochnikovY.I., MolochnikovV.I., FominaY.N. Re-engineering of business processes of project and production/ Study book – Saint Petersburg: St. Petersburg National Research University of Information Technologies, Mechanics & Optics, 2008 – page 152
- Kirillovih Y.S. Graphical objects of quality management system / Study book – Yekaterinburg: Ural State Forest Engineering University, 2010 – page 119
- [3] Dorenskaya I.N. Improvement of business processes in retail trading organizations in consumable cooperation. Author's abstract of PhD dissertation, candidate to PhD – Belgorod: Belgorod University of Cooperation, Economics and Law, 2010 – page 15
- [4] ShukaevD.N.Computer simulation. Almaty: RIC 2004
- [5] Kelton B. Lowe A. Simulation. St. Petersburg. : Peter , 2004
- [6] VarfolomeevV.I.Algorithmic modeling elements of economic systems. -Moscow: Finance and Statistics, 2000.
- [7] Valentina Pasquali. World's GDP Growth by Region Global Finance, 2013.