# Modeling of the Process of Purchasing a Public Transport Card through Generalized Nets

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Abstract: The following article considers a two-way scheme of the sale and purchase of a public transport card, purchased from a ticket center – from a cashier and from an automatic machine. Keywords: Generalized nets, Modelling, Payments. AMS Classification: 68Q85.

### **1** Introduction

Nowadays all people use public transportation to travel from point A to point B. Every municipality provides its citizens with two possible ways of purchasing a public transport card. First, the person chooses where to purchase the card from – from a cashier or from an automatic machine. If they choose to buy from a cashier, consequently they must choose between paying in cash or by card. At the automatic machine a person can pay only by card. The cashier verifies that the client's information is correct. According to the chosen package, a check-up is made to make sure that the amount of money paid is enough. After all the information input, a final check is made to assure the accuracy of the filled-in data and finally the card is issued.

## 2 Generalized nets model

- $Z_1$  The client's choice;
- $Z_2$  The cashier checks the payment method;
- $Z_3$  Verification of personal information;
- $Z_4$  Verification of ticket package;
- $Z_5$  Verification of amount of payment;
- $Z_6$  Final check-up of information accuracy.

The transition  $Z_1$  checks the client's choice – whether to turn to a cashier - core  $L_2$  or to be assisted by an automatic machine – core  $L_3$ . Through position  $L_1$  in the model enters  $\alpha$ -core with the characteristic "subscriber".

$$Z_{1} = \langle \{ L_{1} \}, \{ L_{2}, L_{3} \}, R_{1} \land (L_{1}) \rangle$$
$$R_{1} = \frac{L_{2} \qquad L_{3}}{L_{1} \qquad W_{1,2} \qquad W_{1,3}}$$

where:

 $W_{1,2}$  = ,,The client has chosen to be assisted by a cashier";

 $W_{1,3}$  = "The client has chosen to be assisted by an automatic machine".

The transition  $Z_2$  checks whether the client has chosen to pay in cash –  $L_4$  or by card –  $L_5$ . Since the payment by card must be reported separately, it is labeled as a subnet.

$$Z_2 = \langle \{L_2\}, \{L_4, L_5\}, R_2, \land (L_2) \rangle$$
$$R_2 = \frac{\begin{vmatrix} L_4 & L_5 \\ L_2 & W_{2,4} & W_{2,5} \end{vmatrix}$$

where:

 $W_{2,4}$  = "The client has chosen payment method – cash";  $W_{2,5}$  = " The client has chosen payment method – by card".

The transition  $Z_3$  performs a check-up for correctly filled information. A new core  $L_6$  enters, which has the characteristic "subscriber data" – for example PIN (Personal Identification Number), full name, status. Transition  $L_7$  demands the input of data, until it is correct.

$$Z_3 = \langle \{L_4, L_5, L_6, L_7, L_3\}, \{L_7, L_8\}, R_3, \lor (L_4, L_5, L_6, L_7, L_3) \rangle$$

R –		$L_7$	$L_8$
$n_3 -$	$\overline{L_4}$	false	true
	$L_5$	false	true
	$L_6$	$W_{6,7}$	true
	$L_7$	true	$W_{7,8}$
	$L_3$	false	true

where:

 $W_{6,7}$  = "Incorrect data";  $W_{7,8}$  = "Data is correct".

Transition  $Z_4$  checks if the chosen ticket package corresponds to the particular client. Core  $L_9$  receives the characteristic "Ticket package".

$$Z_4 = \langle \{L_8, L_9, L_{10}\}, \{L_{10}, L_{11}\}, R_4, \lor (L_8, L_9, L_{10}) \rangle$$

$$R_{4} = \frac{\begin{array}{|c|c|c|c|c|} L_{10} & L_{11} \\ \hline L_{8} & false & true \\ L_{9} & W_{9,10} & true \\ \hline L_{10} & true & W_{10,11} \\ \hline L_{17} & false & true \end{array}}$$

where:

 $W_{9,10}$  = "The chosen impulses are incorrect";

 $W_{10,11}$ = "Impulses are chosen correctly";

Transition  $Z_5$  checks if the amount of money paid is enough. Core  $L_{12}$  receives the characteristic "Payment".

$$Z_{5} = \langle \{L_{8}, L_{9}, L_{10}\}, \{L_{10}, L_{11}\}, R_{5}, \lor (L_{11}, L_{12}, L_{13}) \rangle$$
$$R_{5} = \frac{|L_{13} \quad L_{14}}{|L_{11} \quad false \quad true}$$
$$L_{12} \quad W_{12,13} \quad true$$
$$L_{13} \quad true \quad W_{13,14}$$

where:

 $W_{12,13}$  = "The sum is insufficient";  $W_{13,14}$ = "The sum is accepted".

Transition  $Z_6$  performs a check-up of the data about the particular client, the chosen ticket package and the sum paid. Core  $L_{16}$  has the characteristic "Card issued".

 $L_{17}$  – receives the characteristic "Declined";

$$Z_{6} = \langle \{L_{14}, L_{15}\}, \{L_{15}, L_{16}\}, R_{6}, \land (L_{14}, L_{15}) \rangle$$
$$R_{6} = \frac{L_{15}}{L_{14}} \frac{L_{15}}{W_{14,15}} \frac{L_{16}}{false} \frac{L_{17}}{W_{14,17}}$$
$$L_{15} \quad true \quad W_{15,16} \quad W_{15,17}$$

where:

 $W_{14,15}$  = "Mandatory check of final result";  $W_{15,16}$  = "Card issued to subscriber";  $W_{14,17}$  = "Return to data input";  $W_{15,17}$  = "Error in data".

#### **3** Conclusion

The article considers a two-way scheme of the sale and purchase of a public transport card, purchased from a ticket center – from a cashier and from an automatic machine. The given model allows for a consideration of the different possible ways of purchasing, payment and issuing of a public transport card. By inputting real data, this model can be used to draw actual statistics about

the number of clients using the services of cashiers and automatic machines. The information derived can allow us to make conclusions on how to modify the options for better customer service.

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