Generalized Net Model
of the Building a Website

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Abstract: The proposed Generalized net model describes the process of website construction. It includes the preferences of the clients according to the website design and functionalities. The ability of website problems detection is considered. The presented generalized net can be used for analyzing and monitoring the website development process.
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1   Introduction

The theory of generalized nets is presented in [4, 6, 7]. During the years a lot of publications extending its aspects are written [9]. In the generalized net theory, the conditions of the process are visualized by transitions which are shown in the Figure 1.
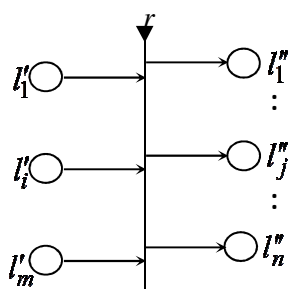

Figure 1. A GN-transition

A transition may contain m input places and n output places where m, $n \geq 1$. The formal description of the transition is given:

$$Z = \langle L', L'', t_1, t_2, r, M, \square \rangle,$$

where: L' and L'' are the sets containing finite, non-empty places. These places represent transition's inputs and outputs. t_1 is the current time-moment when the transition is firing. t_2 is the current value of the duration of the active state of the transition. r is an index matrix representing

the condition of the transition to determine which tokens will transfer from the input places to the output places; M is an index matrix of the capacities of transition's arcs. $\square$ is an object having a form similar to a Boolean expression. It determines how the places will enter in the transition: together or separately [4, 6, 7].

2 Generalized Net Model of the Process of Building a Website

The applications of generalized nets can be found in the area of data mining, pattern recognition, neural networks, genetic algorithms, databases, OLAP [1–3, 8]. In the current research work a generalized net model of the building a website process is constructed (Figure 2). It contains the following set of transitions:

$$A = \{Z_1, Z_2, Z_3, Z_4, Z_5, Z_6, Z_7, Z_8, Z_9, Z_{10}\},$$

where:

- Z_1 - "entering clients with website orders";
- Z_2 - "suggesting of possible designs";
- Z_3 - "entering DB with employees";
- Z_4 - "the client provides content and functionality requirements of the website";
- Z_5 - "discussing the design of the website";
- Z_6 - "approving the design";
- Z_7 - "programming of the website";
- Z_8 - "testing the website";
- Z_9 - "starting the website";
- Z_{10} - "providing maintenance of the website".

Initially in the GN there are three tokens in places L_5, L_8 and L_{16} with the following characteristics:

"*DB with website orders from clients*" in place L_5,
"*DB with possible designs*" in place L_8,
"*DB with employees*" in place L_{16}.

These tokens will be in their own places during all the time of GN functioning. They are generating new tokens at certain time moments which entering in places L_2, L_3, L_4, L_7, L_{10}, L_{11}, L_{12}, L_{13}, L_{14}, L_{15}.

Token enters the net via place L_1 with initial characteristic: "*new client with website order*". Transition Z_1 has the following form:

$$Z_1 = \langle\{L_1, L_5\}, \{L_2, L_3, L_4, L_5\}, R_1, \vee(L_1, L_5)\rangle,$$

where

$$R_1 = \begin{array}{c|cccc}
 & L_2 & L_3 & L_4 & L_5 \\
\hline
L_1 & false & false & false & true \\
L_5 & W_{5,2} & W_{5,3} & W_{5,4} & W_{5,5}
\end{array}$$

and

$W_{5,2} = W_{5,3} = W_{5,4}$ - "there is selected client with a website order";
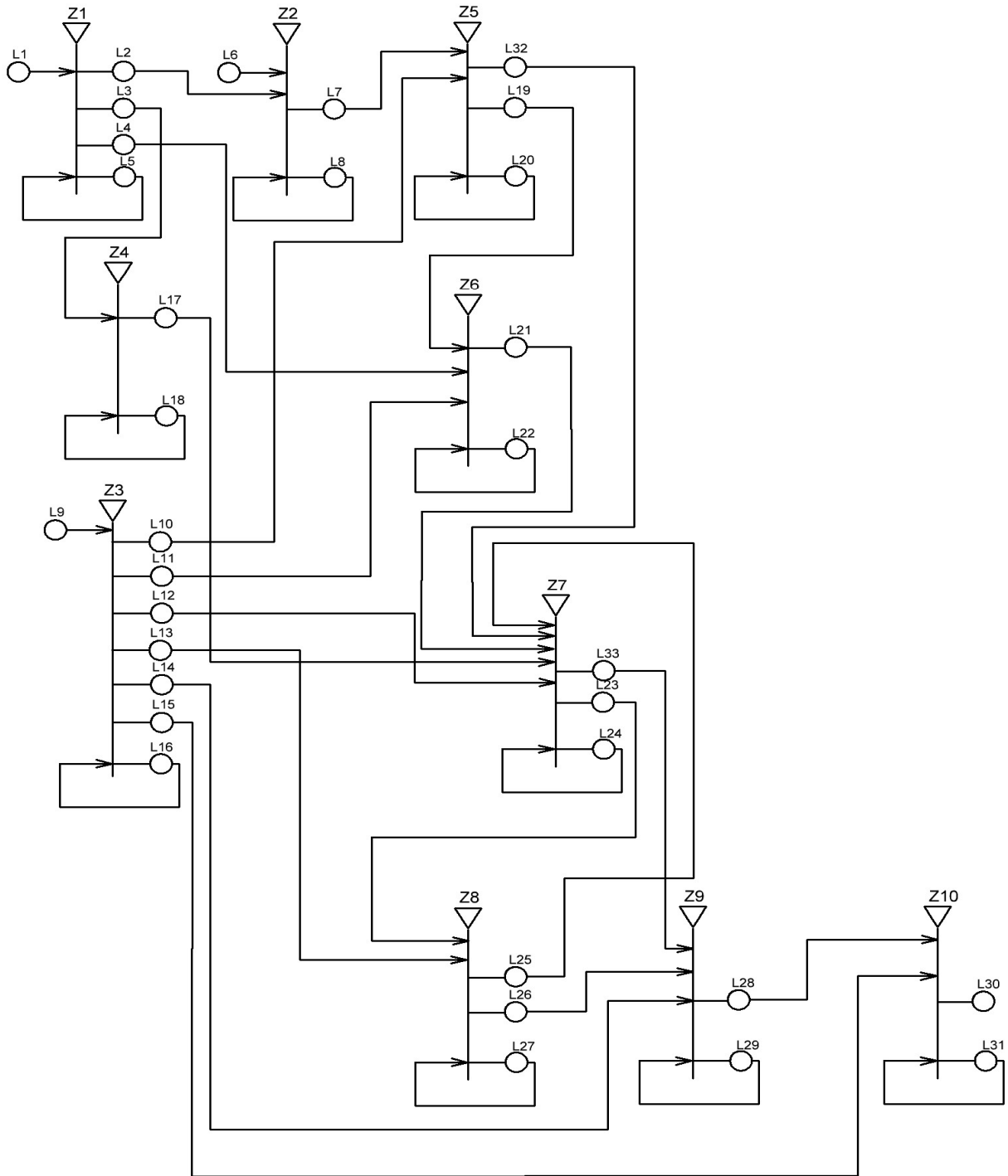$W_{5,5} = (W_{5,2} \wedge W_{5,3} \wedge W_{5,4})$.

Figure 2. Generalized net model of "building a website"

The tokens entering in place L_5 do not receive new characteristics. The tokens from place L_5 generate three new tokens, which enter in places L_2, L_3, L_4 with the following characteristics:

"*chosen design by client*" in place L_2,

"*information for the content and functionality of the website*" in place L_3,

"*approved design*" in place L_4.

Token enters the net via place L_6 with initial characteristic: "*new possible design*".
Transition Z_2 has the following form:

$$Z_2 = \langle \{L_2, L_6, L_8\}, \{L_7, L_8\}, R_2, \vee(L_2, L_6, L_8) \rangle$$

where

$$R_2 = \begin{array}{c|cc} & L_7 & L_8 \\ \hline L_6 & false & true \\ L_2 & false & true \\ L_8 & W_{8,7} & W_{8,8} \end{array}$$

and

$W_{8,7} = $ "there is selected design by client";

$W_{8,8} = \neg W_{8,7}$.

The tokens entering in place L_8 do not receive new characteristics. The tokens from place L_8 generate one new token, which enters in place L_7 with the following characteristic:

"*selected design by client*".

Token enters the net via place L_9 with initial characteristic: "*new employee*".
Transition Z_3 has the following form:

$$Z_3 = \langle \{L_9, L_{16}\}, \{L_{10}, L_{11}, L_{12}, L_{13}, L_{14}, L_{15}, L_{16}\}, R_3, \vee(L_9, L_{16}) \rangle$$

where

$$R_3 = \begin{array}{c|ccccccc} & L_{10} & L_{11} & L_{12} & L_{13} & L_{14} & L_{15} & L_{16} \\ \hline L_9 & false & false & false & false & false & false & true \\ L_{16} & W_{16,10} & W_{16,11} & W_{16,12} & W_{16,13} & W_{16,14} & W_{16,15} & W_{16,16} \end{array}$$

and

$W_{16,10} = W_{16,12} = W_{16,13} = W_{16,14} - $ "there is a selected employee for work on the website";

$W_{16,11} = $ "there is a selected employee for approval of the website";

$W_{16,15} = $ "there is a selected employee for maintenance of the website";

$W_{16,16} = \neg (W_{16,10} \wedge W_{16,11} \wedge W_{16,12} \wedge W_{16,13} \wedge W_{16,14} \wedge W_{16,15})$.

The tokens entering in place L_{16} do not receive new characteristics. The token from place L_{16} generate new tokens, which enter in places L_{10}, L_{11}, L_{12}, L_{13}, L_{14} and L_{15} with the following characteristics:

"*selected employee for work on the website*" in place L_{10},
"*selected employee for approval of the design*" in place L_{11},
"*selected employee for programming of the website*" in place L_{12},
"*selected employee for testing of the website*" in place L_{13},
"*selected employee for starting the website*" in place L_{14},
"*selected employee for maintenance of the website*" in place L_{15}.

Transition Z_4 has the following from:

$$Z_4 = \langle \{L_3, L_{17}, L_{18}\}, \{L_{17}, L_{18}\}, R_4, \vee(L_3, L_{17}, L_{18}) \rangle$$

where

$$R_4 = \begin{array}{c|cc} & L_{17} & L_{18} \\ \hline L_3 & false & true \\ L_{17} & false & true \\ L_{18} & W_{18,17} & W_{18,18} \end{array}$$

and

$W_{18,17}$ = "there are client requirements for the content and functionality of the website";

$W_{18,18}$ = ¬ $W_{18,17}$.

The tokens entering in place L_{18} do not receive new characteristics. The tokens from place L_{18} generates new token, which enters in place L_{17} with the following characteristic:

"*Requirements for the content and functionality of the website*".

Transition Z_5 has the following form:

$$Z_5 = \langle \{L_7, L_{10}, L_{20}\}, \{L_{19}, L_{20}, L_{32}\}, R_5, \vee(L_7, L_{10}, L_{20}) \rangle$$

where

$$R_5 = \begin{array}{c|ccc} & L_{19} & L_{20} & L_{32} \\ \hline L_7 & false & true & false \\ L_{10} & false & true & false \\ L_{20} & W_{20,19} & W_{20,20} & W_{20,32} \end{array}$$

$W_{20,19}$ = "there is a completed design";

$W_{20,32}$ = "the design doesn't need approval";

$W_{20,20}$ = ¬ ($W_{20,19} \wedge W_{20,32}$).

The tokens entering in place L_{20} do not receive new characteristics. The tokens from place L_{20} generate two new tokens, which enter in places L_{19} and L_{32} with the following characteristics:

"*completed design for approval*" in place L_{19} and

"*completed design without need of approval*" in place L_{32}.

Transition Z_6 has the following form:

$$Z_6 = \langle \{L_4, L_{11}, L_{16}, L_{22}\}, \{L_{21}, L_{22}\}, R_6, \vee(L_4, L_{11}, L_{16}, L_{22}) \rangle$$

where

$$R_6 = \begin{array}{c|cc} & L_{21} & L_{22} \\ \hline L_4 & false & true \\ L_{11} & false & true \\ L_{16} & false & true \\ L_{22} & W_{22,21} & W_{22,22} \end{array}$$

and

$W_{22,21}$ = "there is an approved design";

$W_{22,22}$ = ¬$W_{22,21}$.

The tokens entering in place L_{22} do not receive new characteristics. The token from place L_{22} generate one new token, which enters in place L_{21} with the following characteristic:

"*approved design*".

Transition Z_7 has the following form:

$$Z_7 = \langle \{L_{12}, L_{17}, L_{21}, L_{25}, L_{30}, L_{24}, L_{32}\}, \{L_{23}, L_{24}, L_{33}\}, R_7, \vee(L_{12}, L_{17}, L_{21}, L_{25}, L_{30}, L_{24}, L_{32}) \rangle$$

where

$$R_7 = \begin{array}{c|ccc} & L_{23} & L_{33} & L_{24} \\ \hline L_{12} & false & false & true \\ L_{17} & false & false & true \\ L_{21} & false & false & true \\ L_{25} & false & false & true \\ L_{30} & false & false & true \\ L_{32} & false & false & true \\ L_{24} & W_{24,23} & W_{24,33} & W_{24,24} \end{array}$$

and

$W_{24,23}$ = "there is a website programmed";

$W_{24,33}$ = "there is not necessity of testing";

$W_{24,24} = \neg (W_{24,23} \wedge W_{24,33})$.

The tokens entering in place L_{24} do not receive new characteristics. The token from place L_{24} generates two new tokens, which enter in place L_{23} and L_{33} with the following characteristics:

" *website programmed*" in place L_{21},

" *website without testing*" in place L_{33}.

Transition Z_8 has the following form:

$$Z_8 = \langle \{L_{13}, L_{23}, L_{27}\}, \{L_{25}, L_{26}, L_{27}\}, R_8, \vee(L_{13}, L_{23}, L_{27}) \rangle$$

where

$$R_8 = \begin{array}{c|ccc} & L_{25} & L_{26} & L_{27} \\ \hline L_{13} & false & true & false \\ L_{23} & false & true & false \\ L_{27} & W_{27,25} & W_{27,26} & W_{27,27} \end{array}$$

and

$W_{27,25}$ = "there is a problem in the website";

$W_{27,26}$ = "there is a website tested";

$W_{27,27} = \neg (W_{27,25} \wedge W_{27,26})$.

The tokens entering in place L_{27} do not receive new characteristics. The token from place L_{27} generates two new tokens, which enter in place L_{25} and L_{26} with the following characteristics:

"*website with problem*" in place L_{25},

" *website tested*" in place L_{26}.

Transition Z_9 has the following form:

$$Z_9 = \langle \{L_{14}, L_{26}, L_{29}, L_{33}\}, \{L_{28}, L_{29}\}, R_9, \vee(L_{14}, L_{26}, L_{29}, L_{33}) \rangle$$

where

$$R_9 = \begin{array}{c|cc} & L_{28} & L_{29} \\ \hline L_{14} & false & true \\ L_{26} & false & true \\ L_{33} & false & true \\ L_{29} & W_{29,28} & W_{29,29} \end{array}$$

and

$W_{29,28}$ = "there is a website launched";

$W_{29,29} = \neg\ W_{29,28}$.

The tokens entering in place L_{29} do not receive new characteristics. The token from place L_{29} generates new token, which enters in place L_{28} with the following characteristic:

"*website launched*".

Transition Z_{10} has the following form:

$$Z_{10} = \langle \{L_{15}, L_{28}, L_{31}\},\ \{L_{30}, L_{31}\},\ R_{10}, \vee(L_{15}, L_{28}, L_{31}) \rangle$$

where

$$R_{10} = \begin{array}{c|cc} & L_{30} & L_{31} \\ \hline L_{15} & false & true \\ L_{28} & false & true \\ L_{31} & W_{31,30} & W_{31,31} \end{array}$$

and

$W_{31,30}$ = " there is a problem encountered during maintenance";

$W_{31,31} = \neg\ W_{31,30}$.

The tokens entering in place L_{31} do not receive new characteristics. The token from place L_{31} generates new token, which enters in place L_{30} with the following characteristic:

" *website with a problem encountered during maintenance*"

3 Conclusion

The constructed generalized net model describes the process of "building a website". It has the ability to skip the step of approving the website design. It presents testing step for correcting occurred errors. The generalized net model can be used for monitoring and optimizing the process of website development.

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