Ninth Int. Workshop on GNs, Sofia, 4 July 2008, 71-79

TOWARDS A MODEL OF DIGITAL UNIVERSITY: A GENERALIZED NET MODEL OF UPDATE EXISTING TIMETABLE

A. Shannon[1,2], D. Orozova[3,4], E. Sotirova[4,5], K. Atanassov[4], M. Krawczak[6], P. Chountas[7], P. Georgiev[4], R. Nikolov[8], S. Sotirov[5], T. Kim[9]

[1] KvB Institute of Technology, North Sydney, 2060, Australia
e-mail: tony@kvb.edu.au
[2] Warrane College, University of New South Wales, Kensington, 1465, Australia
email: tony@warrane.unsw.edu.au
[3] Free University of Bourgas, Bourgas-8000, Bulgaria, e-mail: orozova@bfu.bg
[4] CLBME - Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Bl. 105, Sofia-1113, Bulgaria
email: krat@bas.bg, prg@clbme.bas.bg
[5] "Prof. Asen Zlatarov" University, Bourgas-8000, Bulgaria
e-mail: esotirova@btu.bg, ssotirov@btu.bg
[6] Systems Research Institute – Polish Academy of Sciences,Wyzsza Szkola Informatyki Stosowanej i Zarzadzania, Warsaw, Poland, e-mail: krawczak@ibspan.waw.pl
[7] University of Westminster, School of Computer Science, DKM Group London, UK, chountp@westminster.ac.uk
[8] Faculty of Mathematics and Informatics, University of Sofia "St. Kliment Ohridski" roumen@fmi.uni-sofia.bg
[9] Division of General Education-Mathematics, Kangwoon University, Seoul 139-704, S. KOREA (e-mails: tkkim@kw.ac.kr, tkim@knu.ac.kr

Keywords: Generalized nets, University, E-Learning.

Summary
In a series of research papers, the authors have studied some of the most important models of a contemporary universities, such as: *research university*, *entrepreneurial university* and *digital university* and construct their Generalized Net (GN) models. The paper is based on the case-studies of Sofia University, Technical University of Munich and University of Edinburgh. The main focus is put the analysis of the processes of the functioning of a university which effectively integrates Information and Communication Technologies (ICT) in all university activities. A concrete example based on the process of course administration at University of Edinburgh is considered. This university is in a process of development an integrated information system covering most of the university activities. The opportunity of using GNs as a tool for modeling such processes is analyzed as well.

1. Introduction

The economist Fritz Machlup is considered as the pioneer who developed the concept of the information society and also discovered the so called *information economics* [6]. Marchup considers university, being the center of knowledge production and teaching, as a "knowledge factory", equated to an industry [7]. In order to fulfil its role and to be competitive (loacally

and globally), the *university-enterprise* should be managed in an enterprise-like way and implement an integrated *Enterprise Resource Planning* (ERP) system.

The ninth annual EDUCAUSE Current Issues Campus Computing Survey [4] results highlighted the most critical challenges that the campus information technology leaders are facing in 2008, namely: security and Enterprise Resource Planning (ERP) systems along with change management and eLearning. For 2008 the committee introduced the following issues and subtopics:

- ***E-Learning/Distributed Teaching and Learning:*** Developing infrastructure to support learning technologies; Supporting distance learning and virtual campuses; Using active, collaborative, and immersive learning environments; Aligning technology use with student expectations and institutional mission; Integrating emerging tools (podcasts, immersive environments, mobile computing); Realigning policies, organizational structures, and procedures; Supporting information and technology fluency/literacy; Integrating library, learning, and support resources; Promoting the effective use of technology in instruction; Supporting faculty development; Conducting assessment and evaluation of e-learning programs, instruction, and student learning; Developing and managing e-portfolios;
- ***Support Services/Service Delivery Models:*** Providing 24 × 7 help desk; Establishing service level agreements (SLAs) with internal clients; Centralizing versus distributing support; Developing standards for support services; Developing "smarter" support models (knowledge bases, self-help tools); Managing customer relationships; Individualizing/personalizing support; Testing (functional, load, integrity) applications with automated scripts prior to "going live"; Monitoring services end-to-end to assess end-user experiences; Handling incidents/alerts efficiently and effectively when problems occur; Establishing/negotiating SLAs and organizational level agreements (OLAs);
- ***Communications/Public Relations for IT (new for 2008):*** Developing a communications plan for IT; Sending regular, targeted communications to faculty, staff, and students; Communicating with the millennium student; Communicating the value of IT, internally and externally; Dealing with the press/media; Maintaining internal IT communications; Explaining the return on technology investments to leadership and stakeholders; Evaluating and implementing IT Infrastructure Library (ITIL) practices and standards.

There exist some European higher education projects aiming at integrating the ICT into all university activities. For example Technical University in Munich is developing a Digital University project [3]. The university realigns its ICT strategically in co-operation with the Leibniz Supercomputing Centre. This realignment is accomplished under guidance of the Chief Information Officer (CIO) in accordance with the overall university strategy by means of closely interconnected projects in the areas of organisation, campus management, eLearning and ICT infrastructure. They found a basis of success in standardisation of the organisational and technical solutions as well as the university-wide integration of all groups involved.

In 2004 University of Edinburgh started a "*change project which would include the implementation of a new student system, as well as fundamentally reviewing the way processes were carried out to identify shared solutions*" [5]. The primary objective of the project is to develop a "*streamlined, modern approach to interacting with enquirers,*

applicants and students which reflects our international standing and the calibre of our teaching and research". This will involve:

- Using online technology to communicate with speed and facilitate global access
- Reducing paperwork so that the focus is on core University activities - teaching, research and supporting students and the university
- Developing integrated, efficient processes to be used across the university
- Sharing a single student system that provides accurate student information to everyone who needs it.

2. A GN-models

The present paper describes the processes of update existing timetable and the allocation the academic staff to courses/classes. The aim of the constructed GN-model (see Fig. 1) is to model the process, aiming at its optimization [1, 2]. This GN-model also extends the GN-model of produce course timetable from [10]. It is a subnet that corresponds to the transition Z_2 from the GN-model from [10].

2.1. GN model of process of Update Existing Timetable

The GN-model contains 5 transitions and 18 places, collected in two groups and related to the two types of the tokens that will enter respective types of places:

α - tokens and *l*-places represent the input data necessary for producing of course timetable,

β - tokens and *t*-places represent the timetable.

For brevity, we shall use the notation α- and β-tokens instead of α_i- and β_j-tokens, where *i, j* are numerations of the respective tokens.

In the beginning β-token stays in place t_1 with initial characteristic:

"Initial (existing) timetable".

In the next time-moments this token will split into two. One of them, let it be the original β-token, will continue to stay in place t_1, while the other β-token will move to transition Z_2^2, passing via transition Z_2^1.

Also initially β-token stays in place t_1^1 with initial characteristic:

"Central and non central rooms".

In the next time-moments this token will split into three. One of them, let it be the original β-token, will continue to stay in place t_1^1, while the other β-tokens will move to transitions Z_2^3 and Z_2^4, passing via transition Z_2^2.

The α-tokens with characteristics

"Concrete parameters of the updated course delivery data"

"Course requirement",

"Teaching load model",

and

"Student number information"

enter the net via places l_3, l_6, l_9 and l_{10}, respectively.

The β-token with characteristic

"Revision query"

enter the net via place t_5.

The forms of the transitions are the following.

Transition Z_2^1 describes the process of the allocation the academic staff to courses/classes.

$$Z_2^1 = <\{t_1, t_5, l_3, l_6, l_9, l_{10}\}, \{t_1, l_{11}, l_{12}\}, r_2^1, \vee(\wedge(l_3, l_6, l_9, l_{10}), t_1, t_5)>$$

where:

r_2^1	t_1	l_{11}	l_{12}
t_1	*true*	$W_{1,11}^l$	*false*
t_5	*true*	*false*	*false*
l_3	*true*	*false*	*false*
l_6	*true*	*false*	*false*
l_9	*true*	*false*	*false*
l_{10}	*true*	*false*	*true*

$W_{1,11}^l$ = "Academic staff is allocated".

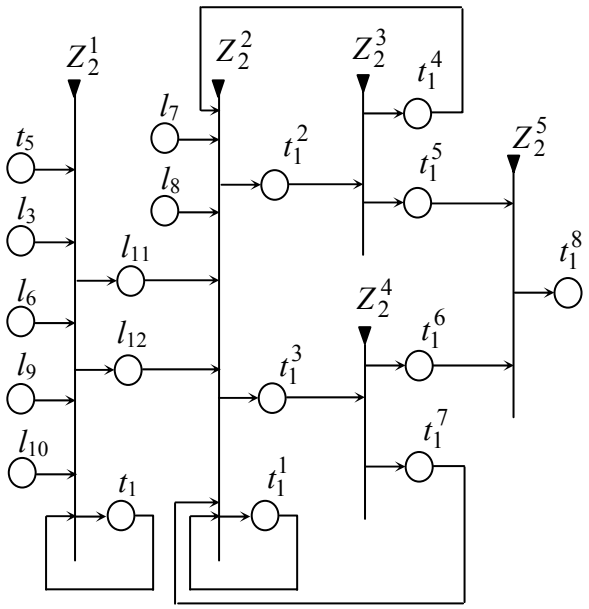

Figure 1: GN model of process of Update Existing Timetable

The α-token coming from place l_{10} will split into two. One of them let it be the original α-token, will enter place t_1. The other α-token will enter place l_{12} and it does not obtain new characteristics.

All tokens that enter transition Z_2^1 will unite with the original token in place t_1. All information will be put as an initial characteristic of a α-token, generated by the original token, which will enter place l_{12} with characteristic:

"Allocated academic staff".

Transition Z_2^2 describes the process of the allocation the courses/classes to rooms.

The α-tokens with characteristics

"Student requirement",

and

"Non central rooms available",

enter the net via places l_7 and l_8 respectively.

$Z_2^2 = <\{ l_7, l_8, l_{11}, l_{12}, t_1^1, t_1^4, t_1^7\}, \{t_1^1, t_1^2, t_1^3\}, r_2^2, \vee(\wedge(l_7, l_8, l_{11}, l_{12}), t_1^1, t_1^4, t_1^7)>,$

where:

$r_2^2 =$

	t_1^1	t_1^2	t_1^3
l_7	*true*	*false*	*false*
l_8	*true*	*false*	*false*
l_{11}	*true*	*false*	*false*
l_{12}	*true*	*false*	*false*
t_1^1	*true*	$W_{1,2}^t$	$W_{1,3}^t$
t_1^4	*true*	*false*	*false*
t_1^7	*true*	*false*	*false*

,

$W_{1,2}^t$ = "There is a request for non central rooms",

$W_{1,3}^t$ = "There is a request for central rooms".

All tokens that enter transition Z_2^2 will unite with the original token from place t_1^1. The β-tokens that enter places t_1^2 and t_1^3 obtains characteristics

"Request to book non central rooms"

and

"Request to book central rooms".

Transition Z_2^3 describes the process of the booking the courses/classes to non central rooms.

$Z_2^3 = <\{t_1^2\}, \{t_1^4, t_1^5\}, r_2^3, \wedge(t_1^2)>,$

where:

$r_2^3 =$

	t_1^4	t_1^5
t_1^2	$W_{2,4}^t$	$W_{2,5}^t$

.

$W_{2,4}^t$ = "Non central room is not booked";

$W_{2,5}^t = \neg W_{2,4}^t$.

The β-tokens obtains the characteristics:

"Unconfirmed non central room booking"

in place t_1^4 and

"Confirmed non central room booking"

in place t_1^5.

Transition Z_2^3 describes the process of the booking the courses/classes to central rooms.

$Z_2^4 = <\{t_1^3\}, \{t_1^6, t_1^7\}, r_2^4, \wedge(t_1^3)>,$

where:

$$r_2^4 = \begin{array}{c|cc} & t_1^6 & t_1^7 \\ \hline t_1^3 & W_{3,6}^t & W_{3,7}^t \end{array}.$$

$W_{3,6}^t$ = “Central room is booked”;

$W_{3,7}^t = \neg W_{3,6}^t$.

The β-tokens obtains the characteristics:

“Confirmed central room booking”

in place t_1^6 and

“Unconfirmed central room booking”

in place t_1^7.

Transition Z_2^5 describes the conformation of the booking the courses/classes to rooms.

$$Z_2^5 = <\{t_1^6, t_1^7\}, \{t_1^8\}, r_2^5, \wedge(t_1^6, t_1^7)>,$$

where:

$$r_2^5 = \begin{array}{c|c} & t_1^8 \\ \hline t_1^6 & true \\ t_1^7 & true \end{array}.$$

The β-tokens obtains the characteristics:

“Completed timetable”

in place t_1^8.

2.2. GN model of process of the allocation the academic staff to courses/classes.

The GN-model from Figure 2 is a subnet that corresponds to the transition Z_2^1 from the GN-model form Figure 1.

The positions t_1, t_5, l_3, l_6, l_9, l_{10} and l_{12} from Figure 2 have the same initial characteristics as a Figure 1.

$$Z_2^{1'} = <\{t_5\}, \{t_1', t_2'\}, r_2^{1'}, \wedge(t_5)>,$$

where:

$$r_2^{1'} = \begin{array}{c|cc} & t_1' & t_2' \\ \hline t_5 & true & true \end{array}.$$

The β-token do not obtain new characteristics in places t_1' and t_2'.

Transition $Z_2^{1'}$ describes the process of allocation of course organizer/course secretary.

$$Z_2^{1''} = <\{l_3, l_6, l_{10}, t_1, t_1'\}, \{t_1, t_3', t_4'\}, r_2^{1''}, \vee(\wedge(l_3, l_6, l_{10}, t_1'), t_1)>,$$

where:

$r_2^{1\,''} =$

	t_1	t_3'	t_4'
l_3	*true*	*false*	*false*
l_6	*true*	*false*	*false*
l_{10}	*true*	*false*	*false*
t_1	*true*	$W_{1,3}'$	$W_{1,4}'$
t_1'	*true*	*false*	*false*

.

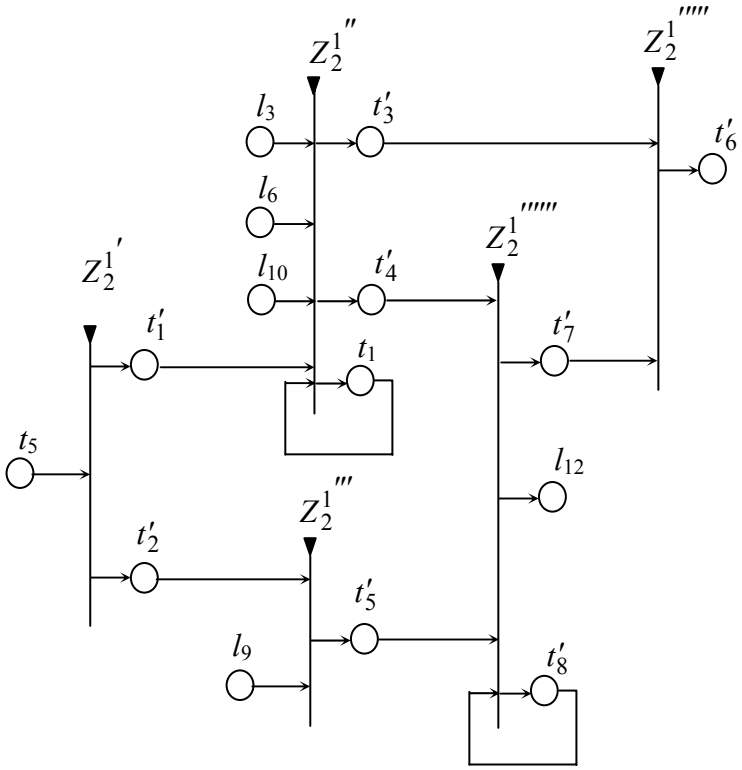

Figure 2: GN model of process of the allocation the academic staff to courses/classes

$W_{1,3}'$ = "The course organizer is allocated",

$W_{1,4}'$ = "The course secretary is allocated",

The β-tokens obtains the characteristics:

"Course organizer"

in place t_3' and

"Course secretary"

in place t_4'.

Transition $Z_2^{1\,'''}$ describes the process of allocation of lecturers.

$$Z_2^{1\,'''} = <\{t_2', l_9\}, \{t_5'\}, r_2^{1\,'''}, \wedge(t_2', l_9)>,$$

where:

$$r_2^5 = \begin{array}{c|c} & t_5' \\ \hline t_2' & true \\ l_9 & true \end{array}.$$

The β-tokens obtains the characteristics:

"Allocation lecturer"

in place t_5'.

Transition $Z_2^{1\,''''}$ describes the process of updating WebCT.

$$Z_2^{1\,''''} = <\{t_3', t_7'\}, \{t_7'\}, r_2^{1\,''''}, \wedge(t_3', t_7')>,$$

where:

$$r_2^{1\,''''} = \begin{array}{c|c} & t_6' \\ \hline t_3' & true \\ t_7' & true \end{array}.$$

The β-tokens obtains the characteristics:

"Updated WebCT"

in place t_6'.

Transition $Z_2^{1\,'''''}$ describes the granting access to WebCT.

$$Z_2^{1\,'''''} = <\{t_4', t_5', t_8'\}, \{t_7', t_8', l_{12}\}, r_2^{1\,'''''}, \vee(\wedge(t_4', t_5'), t_8')>,$$

where:

$$r_2^{1\,'''''} = \begin{array}{c|ccc} & t_7' & t_8' & l_{12} \\ \hline t_4' & false & true & false \\ t_5' & false & true & false \\ t_8' & W_{8,7}' & false & W_{8,12}' \end{array}.$$

$W_{8,7}'$ = "There is information to the WebCT",

$W_{8,12}'$ = "The academic staff is allocated".

The β-tokens obtains the characteristics:

"Information to the WebCT"

in place t_7'.

3. Conclusion

The GN-model constructed in this way is the one in a series of research exercises which the authors are currently preparing and which are a continuation of the previous ones, collated in [8, 9, 10].

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