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Modelling the process of PhD preparation using generalized nets

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Abstract: In a series of research papers, the authors have been studying some of the most important processes of university operations by means of Generalized Net (GN) models. The main focus in this paper is to analyse the processes in the preparation of PhD candidates.
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1 Introduction

In a series of papers, collected in the book [6], the operations of an idealized university have been analysed and described by modelling with Generalized Nets (GNs, see [1, 2]). The

rapid growth of university education in general, and the onset of the Bologna Process in particular, have made these considerations more urgent. Moreover, the preparation of doctoral candidates in this era of growth necessitates more detailed analyses of the preparation of these candidates [8].

In Chapter Five in [6], the process of promotion through the higher education hierarchy (universities and scientific institutes) was described. The information we use about the processes involved is derived from our own countries. There are certain small differences between university staff and scientific institute staff in different countries, but, for the sake of brevity and simplicity, we shall ignore these. Throughout the discussion, by "Academic Institution" (AI) we shall mean either a university or a scientific institute.

The more important fact is that the scientific degrees and titles in the separate countries are different. In the monograph [6], schematic summaries are given to illustrate the order in which these titles and degrees, as stipulated in Argentina, Australia, Belgium, Bulgaria, Greece, Korea, Lebanon, Poland, Portugal, Romania, Slovakia, the UK and the USA.

2 A GN-model of the PhD development

The GN-model (see Fig. 1) contains 8 transitions and 22 places. The generalized net is a set of transitions:

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

where the transitions represent:

- Z_1 – Submission of documents for PhD examination;
- Z_2 – Examination for enrollment in the PhD;
- Z_3 – The process of evaluation, ranking the candidates' evaluations and determining the candidates;
- Z_4 – Preparation for the PhD exams;
- Z_5 – Check the deadline for taking the PhD exams;
- Z_6 – Submission of the PhD thesis;
- Z_7 – Selection of thesis reviewers;
- Z_8 – A thesis defense.

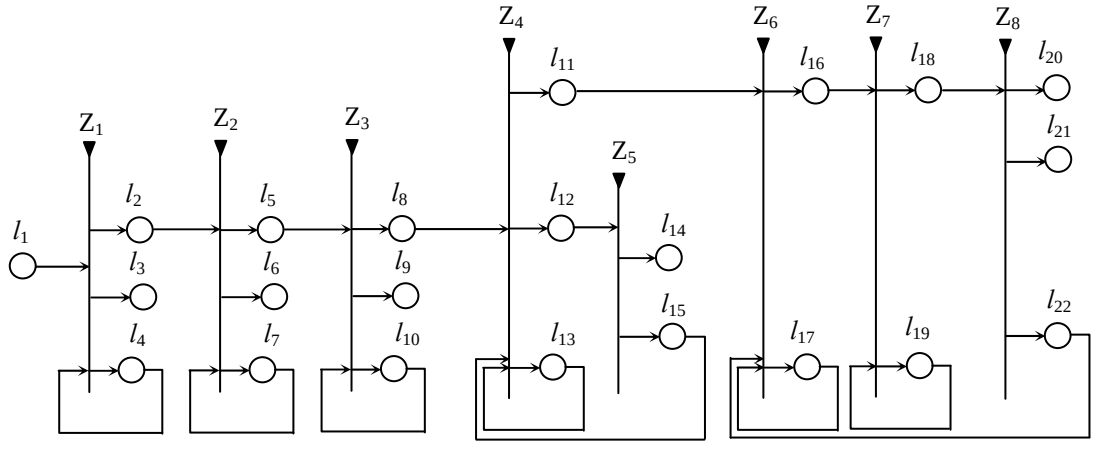

Figure 1. GN-model of the PhD development

The tokens $\omega_1, \omega_2, \ldots, \omega_n$ enter the GN through place p_1 with characteristics: “Candidate: name, date, competition documents”.

The forms of the transitions are the following.

$$Z_1 = \langle \{p_1, p_4\}, \{p_2, p_3, p_4\}, R_1 \rangle,$$

$$R_1 = \begin{array}{c|ccc} & p_2 & p_3 & p_4 \\ \hline p_1 & false & false & true \\ p_4 & w_{4,2} & w_{4,3} & w_{4,4} \end{array},$$

where

- $w_{4,2}$ = “The time for submission documents has expired and the Commission has assessed that submitted documents are accurate”,
- $w_{4,3}$ = “The time for submission documents has expired and Commission has assessed that submitted documents are not accurate”,
- $w_{4,4}$ = “The time for submission documents has not expired”.

The tokens do not obtain any characteristic in place p_4 and they obtain the characteristic respectively: “The candidate is approved” in place p_2, and “The candidate fails” in place p_3.

$$Z_2 = \langle \{p_2, p_7\}, \{p_5, p_6, p_7\}, R_2 \rangle,$$

$$R_2 = \begin{array}{c|ccc} & p_5 & p_6 & p_7 \\ \hline p_2 & false & false & true \\ p_7 & w_{7,5} & w_{7,6} & w_{7,7} \end{array},$$

where

- $w_{7,5}$ = “Examination has taken place and the estimation is positive”,
- $w_{7,6}$ = “Examination has taken place and the estimation is negative”,
- $w_{7,7}$ = “The moment of examination has not yet taken place”.

The tokens do not obtain any characteristic in place p_7 and they obtain in place p_5 and p_6 the characteristic respectively: “Name of the candidate, positive estimation”, and “Name of the candidate, negative estimation”.

$$Z_3 = \langle \{p_5, p_{10}\}, \{p_8, p_9, p_{10}\}, R_3 \rangle,$$

$$R_3 = \begin{array}{c|ccc} & p_8 & p_9 & p_{10} \\ \hline p_5 & false & false & true \\ p_{10} & w_{10,8} & w_{10,9} & w_{10,10} \end{array},$$

where

- $w_{10,8}$ = “The Commission has made a positive final decision”,
- $w_{10,9}$ = “The Commission has made a negative final decision”,
- $w_{10,10}$ = “The Commission has not yet made its final decision”.

The tokens do not obtain any characteristic in place p_{10} and they obtain in places p_8 and p_9 the characteristic respectively: “The candidate is finally approved”, and “The candidate is rejected”.

$$Z_4 = \langle \{p_8, p_{13}, p_{15}\}, \{p_{11}, p_{12}, p_{13}\}, R_4 \rangle,$$

$$R_4 = \begin{array}{c|ccc} & p_{11} & p_{12} & p_{13} \\ \hline p_8 & false & false & true \\ p_{13} & w_{13,11} & w_{13,12} & w_{13,13} \\ p_{15} & false & false & true \end{array},$$

where

- $w_{13,11}$ = “The PhD student has passed all of his/her examinations”,
- $w_{13,12}$ = “The PhD student has some of his/her examinations untaken”,
- $w_{13,13}$ = “Exam session has not yet finished”.

The tokens do not obtain any characteristic in place p_{13} and they obtain in places p_{11} and p_{12} the characteristic respectively: “The PhD student takes all exams and obtains all its educational credit units”, and “The candidate has untaken exam (exams)”.

$$Z_5 = \langle \{p_{12}\}, \{p_{14}, p_{15}\}, R_5 \rangle,$$

$$R_5 = \begin{array}{c|cc} & p_{14} & p_{15} \\ \hline p_{12} & w_{12,14} & w_{12,15} \end{array},$$

where

- $w_{12,14}$ = “The time of education of PhD student is finished”,
- $w_{12,15} = \neg\, w_{12,14}$, where $\neg P$ is the negation of predicate P.

The tokens that enter places p_{14} and p_{15} obtain the characteristic respectively: “The time of education of PhD student has finished but he/she has not passed all exams”, and “The time of education of PhD student has not finished but he/she has not passed all exams”.

$$Z_6 = \langle \{p_{11}, p_{17}, p_{24}\}, \{p_{16}, p_{17}\}, R_6 \rangle,$$

$$R_6 = \begin{array}{c|cc} & p_{16} & p_{17} \\ \hline p_{11} & \mathit{false} & \mathit{true} \\ p_{17} & w_{17,16} & w_{17,17} \\ p_{24} & \mathit{false} & \mathit{true} \end{array},$$

where

- $w_{17,16}$ = “The thesis is ready”,
- $w_{17,17} = \neg\, w_{17,16}$.

The tokens do not obtain any characteristic in place p_{17} and they obtain in place p_{16} the characteristic: “The PhD student has prepared his/her thesis”.

$$Z_7 = \langle \{p_{16}, p_{19}\}, \{p_{18}, p_{19}\}, R_7 \rangle$$

$$R_7 = \begin{array}{c|cc} & p_{18} & p_{19} \\ \hline p_{16} & \mathit{false} & \mathit{true} \\ p_{19} & w_{19,18} & w_{19,19} \end{array},$$

where

- $w_{19,18}$ = “The reviewers are determined”,
- $w_{19,19} = \neg\, w_{19,18}$.

The tokens obtain in places p_{18} and p_{19} the characteristics “The examination reports of the thesis”, and “The chosen reviewers for current thesis”.

$$Z_8 = \langle \{p_{18}\}, \{p_{20}, p_{21}, p_{22}\}, R_8 \rangle$$

$$R_8 = \begin{array}{c|ccc} & p_{20} & p_{21} & p_{22} \\ \hline p_{18} & w_{18,20} & w_{18,21} & w_{18,22} \end{array},$$

where

- $w_{18,20}$ = “The defense is successful”,

- $w_{18,21}$ = "The defense is not successful and the student does not have possibility for another one",
- $w_{18,22}$ = "The defense is not successful, and the student has possibility for another one".

The tokens that enter places p_{20}, p_{21} and p_{22} obtain, respectively, the characteristics: "The defense is successful" in p_{20}, "The defense is not successful and the PhD student not has the possibility for next defense" in p_{21}, and "The defense is not successful, but the PhD student has the possibility for next defense" in p_{22}.

3 Conclusion

In the present paper, we have constructed a GN-model to represent the salient features process of the preparation of doctoral candidates.

This GN can be used to study the dynamics of PhD-candidate development. It can also be used for the monitoring of the process of the PhD development in that it provides the possibility to trace all stages of the students' education, including the timing of the selection of candidates. Moreover, this model can be utilized for simulation purposes, particularly in workshops for the preparation of doctoral advisers and supervisors [7, 8].

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