Modern Approaches in Fuzzy Sets, Intuitionistic Fuzzy Sets, Generalized Nets and Related Topics Volume II: Applications

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Assessment finance approach from the glance of a generalized net model, implemented in a structural unit of a financial institution

George Shahpazov

Institute of Information and Communication Technologies

Bulgarian Academy of Sciences

Acad. G. Bonchev Str., Bl. 2, 1113 Sofia, Bulgaria

atlhemus@abv.bg

Lyubka Doukovska

Institute of Information and Communication Technologies

Bulgarian Academy of Sciences

Acad. G. Bonchev Str., Bl. 2, 1113 Sofia, Bulgaria

doukovska@iit.bas.bg

Vassia Atanassova

Institute of Information and Communication Technologies

Bulgarian Academy of Sciences

Acad. G. Bonchev Str., Bl. 2, 1113 Sofia, Bulgaria

vassia.atanassova@gmail.com

Abstract

In the present paper, an application of the apparatus of generalized nets is proposed for modeling of the mechanism of financial support of small and medium-sized enterprises (SME). The model aspects of internal financial structural units functionalities are reflected, and it is offered how the concept of the generalized nets (GN) can be applied to the process of evaluating creditworthiness of the SMEs applications for bank loans, from the banks perspective.

1   Introduction

The most popular source of financing among commercial banks and leasing companies is public procurement. Statistics show that about 15% of SMEs take advantage of public procurement, [3].

The present paper traces the most important steps of the process of evaluation of a business project proposal, applying for bank financing. The research model is offered how the concept of the generalized nets (GN) can be applied to the process of evaluating creditworthiness of the SMEs.

Generalized Nets (GN) [1, 2] are extensions of Petri nets and other modifications of them. They are tools intended for the detailed modelling of parallel processes. A GN is a collection of transitions and places ordered according to some rules. The places are marked by circles. The set of places to the left of the vertical line (the transition) are called input places, and those to the right are called output places. For each transition, there is an index matrix with elements called predicates. Some GN-places contain tokens dynamic elements entering the net with initial characteristics and getting new ones while moving within the net. Tokens proceed from an input to an output place of the transition if the predicate corresponding to this pair of places in the index matrix is evaluated as true. Every token has its own identifier and collects its own history that could influence the development of the whole process modelled by the GNs.

The so constructed GN model describes the most important steps of the process of evaluation of a business project proposal intended for financing. In the present paper, the authors plan to elaborate the model in the aspect related to the process of decision making within the frames of the bank administration.

In order to analyse the achieved results from our previous works, we consider effectiveness of the use of the GN model. In paper [4], it has been shown that given the development stage and nature of the SMEs in Bulgaria the most suitable instruments created by Funds management have to be as plain and simple as possible. Sophisticated financial products generally create mistrust on the local market.

In paper [5], an application of the GNs apparatus for assistive technology and the advantages of using such model for SMEs financial support mechanism are discussed.

In paper [6], in the model aspects of internal financial structural units functionalities are reflected, and it is offered how the concept of intuitionistic fuzziness can be applied to the process of evaluating the creditworthiness of the SMEs applications for bank loans, from the banks perspective.

As a continuation of our paper [5], in the current paper, we are going to provide an analysis of the next step of process of project evaluation beyond the first level of competence in a financial institution.

As in previous paper provided, part of initially generated project applications where approved and financed at Branch level. The rest of the projects where then provided to the Headquarters of the Bank for further review and higher hierarchy final decision on the applications.

As all unapproved Branch level projects reach the Headquarter office of the Bank, they are registered internally in the internal Records Department, and receive authentic application entry number. Then they are distributed between the following Departments for further analysis: Credit Operations and Credit Risk Department, Legal Department, and Security Department. All of them should provide additional opinions and comment on each project. Each department is in position to request additional information for each project, as the requests goes through the Branch personnel, instead of directly from client. Financial institutions internal rules and regulation for project assessment disallow direct communication between potential borrower and experts from Headquarter office. This is done with the special purpose of evaluating projects solely on provided written application forms and supportive documents and declarations.

As communications between borrowers and banks representative (including Branch manager) from first level of competence are part of the procedure, projects received at Headquarters level are assessed strictly against provided written data. The possibility of verbal or any kind of influence over experts from Headquarters is restricted due to likelihood of incorrect opinion or proposal at decision making time.

In this paper, the process of Headquarters Department evaluation will be addressed, along with further assessment by Credit council of the Bank, intermediate decision by Management Board and reception of final decision by Supervisory Board.

Once projects are distributed between Departments, experts begin the review of the completeness of each application, as first step of the decision making process.

Any lack of information or supportive documents are then requested from Branch representatives. Once received, verified and determined that the documents and the supportive data provided by Branch level are sufficient the addi-

tional assessment of creditworthiness, credit risk and potential other risks of the project and potential borrower is done. Each department receives a certain amount of time to analyze each project, as application and supportive data is shared between Departments. As preliminary assessment at Headquarters level is done by Experts, projects are then prepared for next step of evaluation Credit Council.

The Credit Council is an internally structured committee, which is obliged to perform a comprehensive discussion on each assessed project, and to either request additional data, or prepare the application for the next step of competence. The Council constitutes from Bank staff, usually Heads the above mentioned departments, who are authorized by Management Board to perform such project reviews, and precede an official statement to both Management and Supervisory Board. Considering the fact that Credit Council opinion on financial instruments granting, is taken as most significant one (in terms of detailed analysis of each project application), both next step decisions is going to be based mostly on motives addressed by Credit Council with few exceptions.

When a project discussion is complete and the committee has decided to continue the application forward, a supportive form is prepared and presented to Management Board for sign off. In cases where the Council do not fully agree on certain elements of project application, then its sent back to Headquarters Departments for further processing, or when the committee disagree with the presented project it is rejected and the potential borrower is informed officially for the final decision.

As the Management Board receive the project and supportive official forms from the Headquarters Department and Credit Council, a protocol of each meeting is prepared and Board Members provide their opinion, which is recorded and finalized. If the Board members opinion is positive, then the minutes from the Board meeting is prepared for the final step Supervisory Board.

The Supervisory Board very seldom will react different and make any adjustments on previous levels of competence, but in some cases (again rare) might take a different approach of certain project financing. As top level in the hierarchy of the financial institution, such decision is permissible and usually well-grounded. In such events, top Board members dispose with information on either the borrower, the project itself, or the economic environment, which is not available for all other levels of competence, and the usual outcome is rejection of project.

2 A Generalized Net Model

Initially, in the GN (see Fig. 1), four tokens $\alpha, \beta, \gamma, \delta$ stay in places $l_6, l_{10}, l_{15}, l_{20}$, with initial characteristics, respectively,

"Headquarters of the Bank – Departments of competence",

"Credit Council",
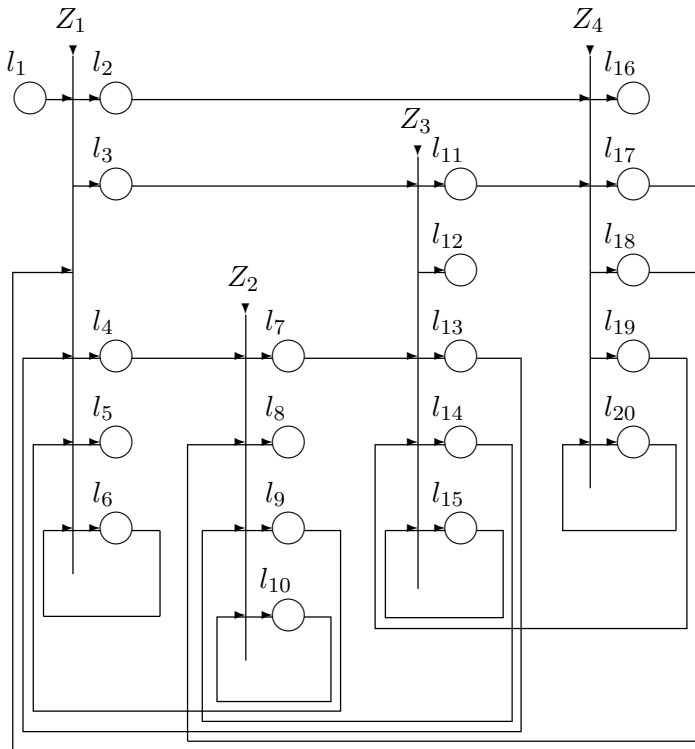
"Management Board",

"Supervisory Board".

Figure 1. The constructed Generalized Net model.

During the GN functioning, tokens $\varepsilon_1, \varepsilon_2, ...$ enter place l_1 wwith initial characteristic "Projects receive additional analysis in Headquarters level, for final approval".

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For brevity, below we mention these tokens without their indices.

$$Z_1 = \langle \{l_1, l_6, l_9, l_{13}, l_{17}\}, \{l_2, l_3, l_4, l_5, l_6\},$$

	l_2	l_3	l_4	l_5	l_6
l_1	$false$	$false$	$false$	$false$	$true$
l_6	$W_{6,2}$	$W_{6,3}$	$W_{6,4}$	$W_{6,5}$	$true$
l_9	$false$	$false$	$false$	$false$	$true$
l_{13}	$false$	$false$	$false$	$false$	$true$
l_{17}	$false$	$false$	$false$	$false$	$true$

$\rangle$,

where:

- $W_{6,2} =$ "Project request is further submitted to Supervisory Board",
- $W_{6,3} =$ "Project request is further submitted to Management Board",
- $W_{6,4} =$ "Project request is further submitted to Credit Council",
- $W_{6,5} =$ "Project request is rejected at Headquarters level due to specific motives".

Tokens ε from each one of the input places of the transition Z_1 enter place l_6 where they unite with token α, that obtains the characteristic "Projects entered in Headquarters data base".

When $W_{6,2} = true$, token α splits to the tokens α and token ε that enters place l_2 with characteristic "Project sent to Supervisory Board from Headquarters for initial comments".

When $W_{6,3} = true$, token α splits to the tokens α and token ε that enters place l_3 with characteristic "Project sent to Management Board from Headquarters for initial comments".

When $W_{6,4} = true$, token α splits to the tokens α and token ε that enters place l_4 with characteristic "Project sent to Credit council for further review".

When $W_{6,5} = true$, token α splits to the tokens α and token ε that enters place l_5 with characteristic "Project rejected at Headquarters level".

$$Z_2 = \langle \{l_4, l_{10}, l_{14}, l_{18}\}, \{l_7, l_8, l_9, l_{10}\},$$

	l_7	l_8	l_9	l_{10}
l_4	$false$	$false$	$false$	$true$
l_{10}	$W_{10,7}$	$W_{10,8}$	$W_{10,9}$	$true$
l_{14}	$false$	$false$	$false$	$true$
l_{18}	$false$	$false$	$false$	$true$

$\rangle$,

where:

- $W_{10,7} = $ "Project application is assessed by Credit Council and submitted to Management Board",
- $W_{10,8} = $ "Project application is rejected by Credit Council",
- $W_{10,9} = $ "Credit Council requests additional information from Headquarters in regards to project".

Tokens ε from each one of the input places of the transition Z_2 enter place l_{10} where they unite with token β, that otains the characteristic "Project enters Credit Council data base.

When $W_{10,7} = true$, token β splits to the tokens β and token ε that enters place l_7 with characteristic "Project approved by Credit Council, sent to Management Board".

When $W_{10,8} = true$, token β splits to the tokens β and token ε that enters place l_8 with characteristic "Project rejected by Credit Council".

When $W_{10,9} = true$, token β splits to the tokens β and token ε that enters place l_9 with characteristic "Additional information requested by Credit Council".

$$Z_3 = \langle \{l_3, l_7, l_{15}, l_{19}\}, \{l_{11}, l_{12}, l_{13}, l_{14}, l_{15}\},$$

	l_{11}	l_{12}	l_{13}	l_{14}	l_{15}
l_3	$false$	$false$	$false$	$false$	$true$
l_7	$false$	$false$	$false$	$false$	$true$
l_{15}	$W_{15,11}$	$W_{15,12}$	$W_{15,13}$	$W_{15,14}$	$true$
l_{19}	$false$	$false$	$false$	$false$	$true$

$\rangle,$

where:

- $W_{15,11} = $ "Project is assessed by Management Board and submitted to Supervisory Board ",
- $W_{15,12} = $ "Project is assessed and rejected by Management Board",
- $W_{15,13} = $ "Management Board requests additional information from Headquarters in regards to project",
- $W_{15,14} = $ "Management Board returns project to Credit Council for additional information and further review".

Tokens ε from each one of the input places of the transition Z_3 enter place l_{15} where they unite with token γ, that otains the characteristic "Project enters Management Board data base".

When $W_{15,11} = true$, token γ splits to the tokens γ and token ε that enters place l_{11} with characteristic "Project approval by Management Board, submission to Supervisory Board".

When $W_{15,12} = true$, token γ splits to the tokens γ and token ε that enters place l_{12} with characteristic "Project rejection by Management Board".

When $W_{15,13} = true$, token γ splits to the tokens γ and token ε that enters place l_{13} with characteristic "Request to Headquarters of additional information by Management Board".

When $W_{15,15} = true$, token γ splits to the tokens γ and token ε that enters place l_{15} with characteristic "Project awaits evaluation".

$$Z_4 = \langle \{l_2, l_{11}, l_{20}\}, \{l_{16}, l_{17}, l_{18}, l_{19}, l_{20}\},$$

	l_{16}	l_{17}	l_{18}	l_{19}	l_{20}
l_2	$false$	$false$	$false$	$false$	$true$
l_{11}	$false$	$false$	$false$	$false$	$true$
l_{20}	$W_{20,16}$	$W_{20,17}$	$W_{20,18}$	$W_{20,19}$	$true$

$\rangle$,

where:

- $W_{20,16} = $ "Project is assessed by Supervisory Board and granted",
- $W_{20,17} = $ "Supervisory Board requests additional information from Headquarters in regards to project",
- $W_{20,18} = $ "Supervisory Board returns project to Credit Council for additional information and further review",
- $W_{20,19} = $ "Supervisory Board returns project to Management Board for further review".

Tokens ε from each one of the input places of the transition Z_4 enter place l_{20} where they unite with token δ, that otains the characteristic "Project to Supervisory Board data base".

When $W_{20,16} = true$, token δ splits to the tokens δ and token ε that enters place l_{16} with characteristic "Project grant by Supervisory Board".

When $W_{20,17} = true$, token δ splits to the tokens δ and token ε that enters place l_{17} with characteristic "Request to Headquarters of additional information by Supervisory Board".

When $W_{20,18} = true$, token δ splits to the tokens δ and token ε that enters place l_{18} with characteristic "Request to Credit Council of additional information, review by Supervisory Board".

When $W_{20,18} = true$, token δ splits to the tokens δ and token ε that enters place l_{19} with characteristic "Further review request to Management Board".

3   Conclusion

The approach with an application of the apparatus of generalized nets is justified due to the high volume of projects received at one particular banks Headquarters office. As usual such aggregation of project requests, results into measure taking action on behalf of Management body of the financial institution. The level approach may by proven to be useful in different situations, when it is necessary to evaluate the effectiveness of the different banks internal financial structural unit as levels of the banks decision making hierarchy.

The obtained in this paper results can be successfully applied for analysis of the work of one structural unit of a financial institution.

In a next step of our research, estimations of the effectiveness of the described process will be made, taking consideration of the aspects of uncertainty. Unertainty is an inherent part of the processes of evaluation of applications for bank support and evaluation of the process itself. For this sake the apparatus of intuitionistic fuzzy sets will be used.

Acknowledgements

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The papers presented in this Volume 2 constitute a collection of contributions, both of a foundational and applied type, by both well-known experts and young researchers in various fields of broadly perceived intelligent systems.

It may be viewed as a result of fruitful discussions held during the Twelfth International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2013) organized in Warsaw on October 11, 2013 by the Systems Research Institute, Polish Academy of Sciences, in Warsaw, Poland, Institute of Biophysics and Biomedical Engineering, Bulgarian Academy of Sciences in Sofia, Bulgaria, and WIT - Warsaw School of Information Technology in Warsaw, Poland, and co-organized by: the Matej Bel University, Banska Bystrica, Slovakia, Universidad Publica de Navarra, Pamplona, Spain, Universidade de Tras-Os-Montes e Alto Douro, Vila Real, Portugal, Prof. Asen Zlatarov University, Burgas, Bulgaria, and the University of Westminster, Harrow, UK:

Http://www.ibspan.waw.pl/ifs2013

The consecutive International Workshops on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGNs) have been meant to provide a forum for the presentation of new results and for scientific discussion on new developments in foundations and applications of intuitionistic fuzzy sets and generalized nets pioneered by Professor Krassimir T. Atanassov. Other topics related to broadly perceived representation and processing of uncertain and imprecise information and intelligent systems have also been included. The Twelfth International Workshop on Intuitionistic Fuzzy Sets and Generalized Nets (IWIFSGN-2013) is a continuation of this undertaking, and provides many new ideas and results in the areas concerned.

We hope that a collection of main contributions presented at the Workshop, completed with many papers by leading experts who have not been able to participate, will provide a source of much needed information on recent trends in the topics considered.