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

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Generalized net model of internal structural unit functionality, focused on SME financing

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Abstract

In this paper is provided an analysis using the Generalized Nets (GN). They are used as a tool for modelling of different processes in industry, medicine, different branches of artificial intelligence, etc. In the present paper is discussed an application of the GN apparatus for assistive technology and the advantages of using such model, for describing the financial support mechanism of the small and medium-sized enterprises (SMEs). It is

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proposed an original GN model of internal structural bank unit functionality. The advantage of this approach is in modelling the inherent aspects of parallelism and concurrency between agents in a situation of competition.

Keywords: Generalized Net (GN) model, Small and medium-sized enterprises (SMEs), Creditworthiness, Credit risk.

1 Introduction

The majority of SME companies in Bulgaria experience difficulties in maintaining a normal life cycle and tend to suffer from early maturity and decline without being able to materialize its full potential. There are many reasons for this, with the most common being - poor management and lack of financing. The Fund will aim in this cases at eliminating these factors with different optimization strategies, so the company converges to its natural development path and then seek expansion opportunities.

More than 80% of the companies in the manufacturing business are managed with outdated structures, based on personal skills and single persons authority. We believe that implementation of modern business processes and process management would increase significantly profitability.

Optimization of the marketing strategy and establishment of adequate financial management will be in most of the investment cases the other substantial driver for successful expansion.

Raising funds via government programs was used by 2.9% of the companies, and access to financing via programs of non-government organizations has a share of 2%. Financing via EU structured funds had an insignificant portion (1.6%) up until few years ago. Nowadays the percentage has increased considerably and 45% of SMEs is making efforts to receive the embedded financing and grant schemes, [3].

One third of all investments made by SMEs are into new equipment and machinery (about 35%), re qualification, training and advertisement is the second investment direction (29%), development of present and design of additional newer products (22%), introduction of systems for intercompany management processes (9%).

In the present paper, we will analyze the process of evaluation of N number of projects, entering one bank facility (branch – first level of competence). The total estimate of project volume shall equal the amount of attracted funds in the form of deposit instruments, accrued at banks branch. The N number of projects is submitted in the branch facility within the spread of L business days. Each project application amount is within granting limits of the Branch manager, voted

to him by Management Board.

In the first visit of the branch by each potential SME borrower, the loan specialist (banks representative) has to perform a preliminary research as he is required to conduct a detailed and exhaustive dialogue with each SME borrowers representative in regards to the aim and purpose of each individual project, the legal status of each entity, the characteristics and perspectives of future development of the business, each main contractors and competitors.

Information concerning financial statements of each legal entity will be required, along with personal economic justification, relationship with financial institutions, credit history statements, and most important the type of collateral available. The above mentioned details are gathered by the branch specialist, in order for him to acquire a general glance of the costumers. The accumulated information will later be used in the preparation process of the loan application, respectively the loan itself. During first meeting the loan officer is required to inform the potential SME borrower of all conditions, sequence of loan review procedures and timing estimate.

Once initial meeting is complete, each potential borrower is given an application form, along with a list of supporting docs and declarations, which needs to be presented at application time. The evaluation process is held in accordance with internal Banks regulation, voted by Management Board. Each application form is evaluated on separate case by case scenario, as a unified scoring system is applied.

As each applicant completes their project application form, they proceed onto in branch submission. All of N number project requests are deposited and registered internally by branch representative as each one receives entry number in the informational system of the Bank. The N numbers of projects applications have entered the administrative IT system of the financial institution within a spread of L business days. Each applicant submits all required by the Bank information, concerning the applicant itself along with third party liable persons or entities in regards to:

- Legal status of the entity/ies, financial statements, audit reports, detailed transcript of all receivables and payables, specified terms of origination and extinction, economic justification of the loan request, along with contractual agreements, declarations, references, ratings, etc. Additional data may be requested by bank officers, in regards to information about market environment, major suppliers, clients and competitors, experience in the sector, professional training of management team, all backed by the necessary documents and materials.

- As completed and fully organized (N number project requests), are dis-

tributed between loan officers to begin analyzing and processing the loan application. Once personnel from branch level (including Branch Manager) have determined that the documents and the data information provided by the borrower are sufficient the official assessment of creditworthiness and credit risk of the borrower begins. The unit (Banks branch officers) has to follow the internal rules of evaluation and come up with a well grounded proposal/decline of the application within L business days.

The N number of project applications are distributed between loan officers for evaluation on the basis of "first come first serve". Following internal evaluation rules the loan officer is able to contact potential borrowers for further clarifications on submitted data. Communication respectively clarification of all details is done according to bank rules (via e-mail, and via written registered and dated documents), and within time frame set by the financial institution at first.

As the evaluation process moves forward each project request receives an individual scoring result, which is based primarily on the purpose of the request, backed by well explained and detailed business plan, characteristics of the existing business (unless an SME startup), perspectives for further development of the business in the future again presented in realistic figures and not so optimistically generated cash flow for the time of the loan, written engagements with contractors and data about major competitors and respective market share.

Major portion in the scoring approach has the financial result of the SME for a period of at least 3 years prior to application (unless an SME startup) and last quarter of present year. Another components bearing value are credit history and financial institutions relationship of each applicant.

Once each loan officer completes the evaluation of the project request according to Banks rules and regulations and within the time frame of L business days, the transactions are moved to Branch management for final decision. In the spread of few business days the Branch manager receives from his staff (loan officers) an N number of evaluated project applications for decision. Each one of the loan requests falls in the scope or in the limits given as an authorization limits (as value) to the Branch Manager by Executive Directors and Management Board of the Bank. As evaluated each project application has an individual score presented in generated points.

Example

Here is an example for the bank unit functionality:

- 60–70 pts. The project request is declined.
- 70–80 pts. The project request is returned for further evaluation and additional data such as need of additional collateral, references from clients, etc.
- 80–90 pts. The project request is returned for minor adjustments in the performed evaluation and few little additional data requested.
- 90–95 pts. The project request has received all adjustments and necessary evaluation, and is sent to the Headquarters of the Bank for final comments and requirement before granting.
- 95–100 pts. The project request receives an automatic approval by the Branch Management and is prepared in internal system for granting.

In the current case, the Branch Manager has N number of evaluated project applications with following scores: P_1 receives 97 pts.; P_2 receives 96 pts.; P_3 receives 94 pts.; P_4 receives 95 pts.; P_x receives 94 pts.; P_y receives 98 pts.

As the evaluation procedures are complete, Branch Manager encounters a complicated situation where out of N number of evaluated project applications, x of them have to receive an automatic approval and be prepared in the informational accounting system for granting on one side, and y number of evaluated project applications have to be sent to the Headquarters for concordance and other requirements.

Having in mind the fact that such accumulation of number of project requests in one particular branch will bring the attention of Executives and Management Board of the Bank, the Branch manager has to proceed with caution and according to internal rules and regulations. Such accumulation could be interpreted as an attempt for fraud activities on the side of the Branch, because similar event is considered add within the financial institution system, where regularity in project requests respectively granting or declining is generally accepted.

As each project is again thoroughly screened by Branch management and loan officers, the following outcome occurred:

- Project requests P_1, P_y and others should receive an automatic OK, due to the fact that total individual score generated is over 96–97 pts. An important fact to mark is that requests P_y through N are submitted by SMEs who are potential customers of the particular bank.

- Projects P_3 and P_x both received around 94 pts., which (following internal rules) would put them in line for additional comments and requirement by the Headquarters of the Bank, prior project financing. At the same time those aplication requests are received from existing costumers of the bank with outstanding credit history, as both have utilized financial instruments in the past and have managed service with no delays and problems.
- The rest of the projects received scores which varied between 93 and 96 pts. As they came from internal costumers of the bank with prior failure of conduct in terms of instrument service, they would receive same treatment as ordinary project applications.

Once the additional screening is complete, the Branch Manager makes his final decision. Considering all facts in connection with each project application, along with and according to internal rules and regulations of the Financial Institution, Branch Management decides on the following. projects P_3 and P_x, which came from internal costumers of the bank with no prior bad history within, regardless of the fact that do not meet the criteria for automatic approval (based on points generated) received the approval and were eligible for granting.

The rest of the project applications where kept divided as initially, but where sent to the Headquarters' Credit Operations and Credit Risk Division for additional opinion and comments.

Again, the following was done, due to the high number of requests which were received at one particular banks location. As mentioned such aggregation of loan requests, could result into irregular sudden inspections from the the Headquarters' divisions, as a motive for fraud prevention. Such checkups would not only distress the working rhythm in the Branch, but will put pressure on Management and Staff as predefined (by Management Board) results have to be reached on monthly and quarterly basis.

2 Proposed Generalized Net Model

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. An original GN model of internal structural unit functionality is described in this paper, which is shown on Figure 1.

The current token α_{cu} (below, we mark is as α, only) enters place l_1 with the initial characteristic "S number of projects submited in the branch, in a spread of L business days".

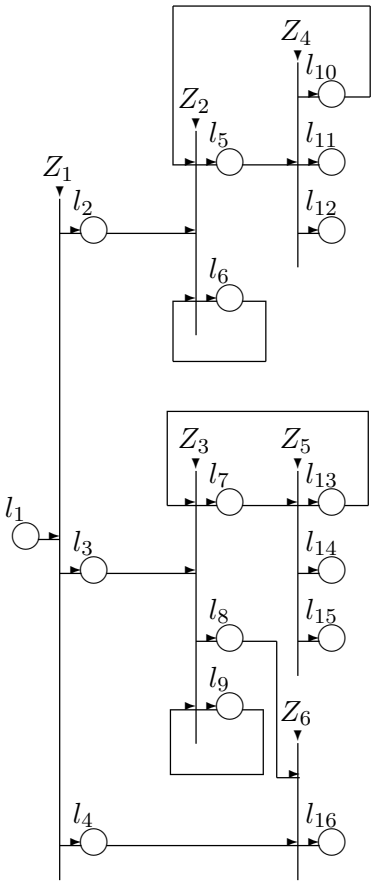

Figure 1. The constructed Generalized Net model.

$$Z_1 = \langle \{l_1\}, \{l_2, l_3, l_4\}, \begin{array}{c|ccc} & l_2 & l_3 & l_4 \\ \hline l_1 & W_{1,2} & W_{1,3} & W_{1,4} \end{array} \rangle,$$

where:

- $W_{1,2}$ = "Project is submited by present clients of the financial institution and in line with grant limit of branch manager",
- $W_{1,3}$ = "Project is submited by external ligal entity in line with grant limit of branch manager",
- $W_{1,4}$ = "Project is submited by internal or external legal entity and is over the grant limit of branch manager".

When $W_{1,2} = true$, token α enters place l_2 with characteristic "Present client with project, which is within the grant limit".

When $W_{1,3} = true$, token α enters place l_3 with characteristic "Potential client with project, which is within the grant limit".

When $W_{1,4} = true$, token α enters place l_4 with characteristic "Present or Potential client with project, which is out of the grant limit of Structural Unit Manager".

$$Z_2 = \langle \{l_2, l_6, l_{10}\}, \{l_5, l_6\}, \begin{array}{c|cc} & l_5 & l_6 \\ \hline l_2 & true & false \\ l_6 & true & false \\ l_{10} & false & true \end{array} \rangle.$$

Token α enters place l_5 with characteristic "Project being discussed", and enters place l_6 with characteristic "Project pending discussions".

$$Z_3 = \langle \{l_3, l_9, l_{13}\}, \{l_7, l_8, l_9\}, \begin{array}{c|ccc} & l_7 & l_8 & l_9 \\ \hline l_3 & true & false & false \\ l_9 & W_{9,7} & W_{9,8} & false \\ l_{13} & false & true & false \end{array} \rangle,$$

where:

- $W_{9,7}$ = "Potential client's project is being sent for discussions",
- $W_{9,8}$ = "Potential client's project is discussed and sent to the Headquarters of the Bank for further analysis".

Token α enters place l_7 with characteristic "Potential client's project receives an ID number and is waiting for assessment" and it enters place l_9 with the characteristic "Potential client's project receives an ID number and stays i database".

When $W_{9,7} = true$, token α enters place l_7 with characteristic "Evaluation of the project".

When $W_{9,8} = true$, token α enters place l_3 with characteristic "Rejection after evaluation of the project".

$$Z_4 = \langle \{l_5\}, \{l_{10}, l_{11}, l_{12}\}, \begin{array}{c|ccc} & l_{10} & l_{11} & l_{12} \\ \hline l_5 & W_{5,10} & W_{5,11} & W_{5,12} \end{array} \rangle,$$

where:

- $W_{5,10}$ = "Project is sent back with further questions",

- $W_{5,11}$ = "Project is evaluated and approved for financing",
- $W_{5,12}$ = "Project is evaluated and rejected at Branch level".

When $W_{5,10} = true$, token α enters place l_{10} with characteristic "Project evaluation, additional information for further review".

When $W_{5,11} = true$, token α enters place l_{11} with characteristic "Project is evaluated, Contract, Grant".

When $W_{5,12} = true$, token α enters place l_{12} with characteristic "Evaluation of the project and rejection at branch level".

$$Z_5 = \langle \{l_7\}, \{l_{13}, l_{14}, l_{15}\}, \begin{array}{c|ccc} & l_{13} & l_{14} & l_{15} \\ \hline l_7 & W_{7,13} & W_{7,14} & W_{7,15} \end{array} \rangle,$$

where:

- $W_{7,13}$ = "Potential client's project is evaluated and generates questions",
- $W_{7,14}$ = "Potential client's project is evaluated and approved for granting",
- $W_{7,15}$ = "Potential client's project is evaluated and proposed for rejection".

When $W_{7,13} = true$, token α enters place l_{10} with characteristic "Project evaluation, request for additional information".

When $W_{7,14} = true$, token α enters place l_{11} with characteristic "Project evaluation, contract and grant".

When $W_{7,15} = true$, token α enters place l_{12} with characteristic "Evaluation of project and rejection under branch level".

$$Z_6 = \langle \{l_4, l_8\}, \{l_{16}\}, \begin{array}{c|c} & l_{16} \\ \hline l_2 & true \\ l_6 & true \end{array} \rangle.$$

Token α enters place l_{16} with characteristic "Evaluation of project sent to the Headquarters for further analysis".

3 Conclusion

In this paper is considered an original Generalized Net model of internal structural unit functionality focused on SME financing mechanism. The paper presents in details the mechanism according to which the first–level of a bank institution operates. The advantages are outlined of the application of the apparatus of generalized nets to the description of this process, featuring both parallel behaviour and

competitiveness. This approach can be beneficially used 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 results, obtained in this paper, can be successfully applied to analyze the work of any structural unit of a financial institution.

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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:

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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.

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