EVALUATION OF THE OPTIMIZATION METHODS IMPACT ON THE DIMENSIONS OF THE SUB-PROCESSES

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Abstract

This research present the methodology, through which quantitative evaluation can be made of the rate of impact of each optimization method on the dimensions of the sub-processes within a business process. To that end, first of all the methods of optimization of the sub-processes, four of the most often used dimensions in the practice, as well as the four aspects of business optimization are presented. A classification scheme has been drafted which reflecting the impact of the optimization methods on the dimensions of the processes. Next, it describes the steps of ascertaining the type of Analytic Hierarchy Process (AHP) method which must be used - traditional AHP, triangular fuzzy AHP, trapezoidal fuzzy AHP or wide-trapezoidal fuzzy AHP, as well as of determining the membership function. Further, the entire methodology is presented through an algorithm built of three main blocks. The steps of performing the traditional and the fuzzified AHP methods are considered. The essence of functioning of the presented methodology is described.

Keywords: business process; sub-process optimization; improvement tools; analysis of influence; methodology; algorithm.

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Evaluation of the Optimization Methods Impact on the Dimensions of the Sub-processes

All business organizations function through carrying out transformation of raw materials into a product/service designated to satisfy the external customer needs (Ангелов, 2008). The very transformation of the inputs is done through the running of various business processes (Harmon, 2007), processes (Deckler, 2003; Haist, 2001; Ould, 2006; Lowenthal, 2003; Süssenguth, 1992) and activities (McDonald, 2010; Portougal & Sundaram, 2006). As a result of the running of all these activities, processes and business processes united in production cycles, value is added (Harrington, 1991). The activities on maintaining high level of competitiveness and market position improvement (Gaitanides & Ackermann, 2004) are in fact a function of the striving of the companies to continuously design, redesign and optimize their business processes. On other hand the organization must be adaptive to tackle with the challenges ensuing from the constantly changing external and internal conditions of the environment. For this purpose the organizations most often resort to modifications of their production and management structure (Grigori, Casati, Umeshwar & Ming-Chien, 2011). This brings forth the necessity of taking measures to reorganize and improve the processes running in the business organizations. It is necessary the optimization itself to be carried out under methods in conformity with the company structure, as well as with the chosen strategy.

In order to perform the optimization of the critical business processes in the organization, it is necessary the overall need of optimization of the entire business process and the necessity and priority of improvement of the sub-processes, which build them, to be identified. One of the options is to identify them by presenting the processes as vectors – real and target ones. Their building can be reviewed as a preparatory stage of the business processes optimization. The real vector represents an aggregate of all activities and sub-processes building the business process (Brüggemann, Heinrich & Sobczak, 1998). Each activity, sub-process or process is presented as a partial vector with the relevant coordinates. The coordinates describe the real (target) values of the parameters characterizing the various aspects of the process effectiveness (Papula, 2001). By summing up the vectors, the common (resultant) vector is obtained. The target vector has been built by marking the coordinates of the target on the coordinate system, which dimensions are determined by the parameters monitored by the early warning system. From the zero point of the coordinate system to the point marking the desired improvement the target vector was constructed. Then it proceeds with performing a comparison between the coordinates of the two vectors. This allows for determination the necessity of improvement of each business process and establishing the need and the priority of improvement of each sub-process building the business process. Finally, the actual reorganization of the existing sub-processes or activities is done. Proceeding from the vector presentation of the processes, the deriving of the optimization methods is based on the following principles: translocation of vectors; change of vectors' lengths/sizes; addition of a vector; elimination of a vector. On the grounds of those principles, ten methods have been elaborated for the performance of improvements in the business processes. Each tool is based on one or a combination of the aforementioned four principles.

- Acceleration – shortening the duration of one or several sub-processes;
- Delay – the running time of a sub-process is prolonged;
- Parallelizing – the critical sub-process is divided and the newly formed sub-processes are performed in parallel;
- Automation – isolated case of the acceleration method;
- Unification – integration of two or more existing sub-processes in one new one;
- Changing the succession – changing the succession of the sub-processes in view of smoother running of the process chain;
- Adding – integration of an entirely new element in the existing process structure;
- Insourcing – adding an element, which by this moment has been outside the company borders;
- Elimination – elimination of one or several sub-processes from the integral business process;
- Outsourcing – assigning a company sub-process for performance by an external organization.

It is necessary to mention that each method may be applied on one or several sub-processes within the business process, as well as that one or several methods of optimization can be applied on one sub-process. This way, the number of possible variants of performing the business process reorganization by the mentioned methods is increased time and again. The number of simulations of process chain running also grows and all that leads to increase of the expenses for the organization. In the conditions of limitedness of resources, in which the companies are functioning, striving exists for continuous reduction of such kind of expenses.

The goal of the present research is to present the methodology of quantitative evaluation of the optimization methods impact on the processes.

Analysis of the influence of the methods for improvement on the sub-processes dimensions

In order to analyze the influence of the improvement methods on the dimensions of the sub-processes, it is necessary a scheme of the influence to be elaborated. To that end it is necessary firstly the dimensions of the processes and the aspects of business processes optimization to be described.

Dimensions of sub-processes

Various characteristics are used as dimensions for the performance of analysis and optimization of the processes (sub-processes) building the business process. They are determined in accordance with the information generated by the early warning system. The characteristics are divided into maximizing and minimizing at the preparatory stage of the optimization. Maximizing are the ones, the values of which should be increased as a result of the improvement, and minimizing are the ones, the values of which should be reduced. In general, the dimensions needed to achieve results from the running of the process can be divided into four categories: “quantity”, “quality” (maximizing dimensions), and “costs”, “time” (minimizing dimensions). The differentiation of the parameters should be in conformity with the strategic goals of the organization. Because of that reason, the characteristics describing each process can be different for the individual business units.

Aspects of business processes improvement

The business processes optimization is most often performed in four main directions – spatial, quantitative, logical and time optimization. They can be presented as summarized categories of criteria, through which one can assess the influence of the methods of optimization over the business processes. The spatial optimization is directed towards improvement of the spatial dislocation of the separate process elements. A basic feature of the quantitative optimization of the business processes is the elimination of their inefficient components. It is expressed as in the physical elimination of sub-processes or activities from the business process structure, as well as spatial configuration of a process outside the company borders – “outsourcing of processes”. The logical optimization is related to the change of the succession of the sub-processes and the activities within the business process (Ангелов, 2008). The essence of the time optimization of the business processes is the shortening or the extension of the running time of one or several sub-processes. It is necessary to mention also that there exist causal relationships between the various aspects (they are presented on Figure 1).

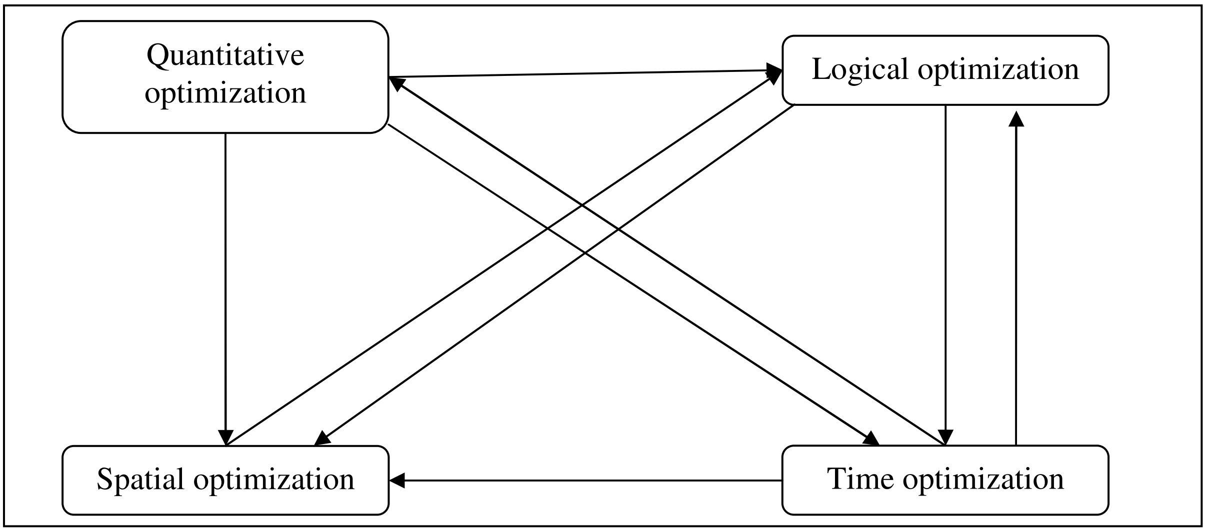

Figure 1. Causal relationship between the aspects of business process improvement

Scheme of the influence of the optimization methods on the dimensions of the sub-processes

As mentioned above, there is possibility of using one or combination of methods for optimization on a sub-process or application of a method on a number of sub-processes. Thus it increases the cost for carrying out the simulation to identify the obtained improvements. The reduction of this type of cost can be achieved by assessing the relations between optimization methods and categories of criteria for evaluating the business processes and between categories of criteria for evaluating the business processes and the dimensions of the individual sub-processes. Besides, in some cases, mentioned most often used in the practice dimensions are dependent from one another. The degree, with which they compensate among them, is specified in a previous stage of the optimization process. The improvement of one may not be achieved by worsening the indexes of the other dimensions. On the other hand, between the categories of criteria for business processes assessment and the exemplary features describing the processes and the sub-processes certain quantitative dependencies also exist. In addition, the proposed methods of optimization in turn affect the achievement of optimum conditions in the four main directions of performing the optimization of the business processes (Appendix B, Figure 2).

Approach for evaluation of the relations between the optimization methods and the dimensions of the sub-processes

Numerous techniques and methods exist, through which it can be value the relationships between the methods, the categories of evaluation criteria and the dimensions of the business processes. In order to identify the quantitative effect of the optimization methods on the dimensions of the processes, it can be used the Multi-criteria Decision Analysis (MCDA). One of the powerful tools used for the performance of MCDA is the Analytic Hierarchy Process (AHP) (Kordi & Brand, 2012). In the literature mainly two approaches of the analytic hierarchy process application are described – traditional and fuzzified AHP. In general the traditional approach of the method is based on the pairwise comparison of the criteria and the alternatives leading to the performance of those criteria. As a consequence of the comparison, the weights of each alternative and each criterion are calculated (Saaty, 2008). Through aggregating the weight of the criterion and the alternatives, a weighed point evaluation is shaped, which describes the effect of each alternative over the achievement of the goal. The fuzzified approach of the method of analytic hierarchy process uses the principles of the fuzzy logic, despite the already set forth fuzzification of the numeric values of the evaluations (Saaty & Tran, 2010). In essence, the evaluations do not show the algebraic dependence between the alternatives, but the interrelations between them. Detailed description of the traditional and the fuzzified AHP methods shall be presented on a later stage of the present research.

A subsequent study of Kordi and Brand (2012) reveals the dependence between the selected level of uncertainty and the output data derived from the traditional and the fuzzified AHP methods. According to him, upon growth of the uncertainty level the fuzzified AHP method with trapezoid and broad-trapezoid membership function gives data closer to the reality. At low level of uncertainty, however, the traditional AHP method and the fuzzified AHP method with triangular membership function show approximately equally accurate results. Whereby it follows that at high certainty level of the experts, correct results could be achieved by the use of the traditional AHP method and there is no need of complication and application of the fuzzified AHP method.

Besides, the selection of the membership function for the fuzzified AHP method is at the root of obtaining maximum close to the real results (Mitaim & Kosko, 1996). The main way of determining the membership function described in the literature is based on evaluation of the uncertainty set forth by an expert (Mladenov & Yordanova, 2006; Voloshyn, Gnatienko & Drobot, 2003) or by the decision maker (Nepal, Yadav & Murat, 2010). It is necessary to mention that mainly two types of uncertainty are known – objective and subjective. The objective one is related to the specifics of the researched objects and to the surrounding reality. The subjective uncertainty is expressed in general in the peculiarity of the human nature and, more specifically, in the different abilities of the individuals of assessing the information (Voloshyn et al., 2003).

On this basis we offer methodology for determination the kind of AHP method through the selected level of uncertainty for the evaluation of the optimization methods influence on the business processes. To that end, we need adaptation of the methodology of the traditional AHP method, which shall be described in detail hereinafter.

Methodology for selection the kind of AHP method

The methodology can be presented in a succession of two steps:

Step 1. Pairwise evaluation of the alternatives. The alternatives are: “very low uncertainty level”; “low uncertainty level”; “average uncertainty level”; “high uncertainty level”; and “very high uncertainty level”. The evaluations are placed in a matrix for pairwise comparison of alternatives (the point evaluations and their verbal expressions are presented in the following Table 1.).

Table 1
Evaluations of the alternatives

Evaluation	Verbal expressions
1	Equally confidence of the expert
3	Little more confidence of the expert
5	More confidence of the expert
7	Much more confidence of the expert
9	Dominant confidence of the expert
2,4,6,8	Intermediate values between two adjacent
1/n	Reciprocal values

Similar to the described below methodological steps of the traditional AHP method, the weighted average point evaluations and the “consistency ratio” coefficient value are calculated.

Step 2. Selection of the kind of AHP method. This is done by juxtaposition between the weights of the alternatives derived on the preceding step. The uncertainty level with the highest weight is selected. According to the alternative with the highest weight, we can define as the kind of AHP method, as well as the kind of membership function to be used. The possible options are four:

- If the alternative "very low uncertainty level" or "low uncertainty level" is with the highest weighed point evaluation, then in order to determine the quantitative influence of the optimization methods towards the four main dimensions of the sub-processes, the traditional AHP shall be used.
- With the highest weight value of the alternative "average uncertainty level" the further juxtapositions shall be made according to the methodology of the fuzzified AHP method with triangular membership function;
- Should it be ascertained that the highest weight is that of the alternative "high uncertainty level", it is necessary to calculate the values of the reorganization methods influence to the dimensions of the processes to be done through the fuzzified AHP method with trapezoid membership function.
- With the last case, the alternative "high uncertainty level" has the highest weight, then the calculations through the fuzzified AHP method with broad-trapezoid membership function are done.

Algorithm of the methodology

The entire methodology of determination of the quantitative influence, which the improvement methods exert on the four basic dimensions through the aspects of business processes optimization, can be presented as an algorithm divided into three blocks (Appendix B, Figure 3).

In block "A" the expert-assessor gets familiar with the optimization methods, the four most often used in the practice dimensions of the sub-processes and the aspects of optimization of the business processes. Also, the process of determining the level of uncertainty is started.

In the next part of the algorithm, it presents schematically the already described logic of the methodology of selecting the kind of AHP method and the membership function of the linguistic rules with its fuzzified variant.

Block "C" presents in summary the performance of the actual calculations according to the selected in Block "B" kind of AHP method and deriving the weighed evaluation of each optimization method's influence on each of the four dimensions of the sub-processes.

After the description of the algorithm of selecting the kind of AHP method, we should present the stages of performance of the traditional AHP method, the fuzzified AHP method with trapezoid and broad-trapezoid membership function, as well as the fuzzified AHP method with triangular membership function.

Traditional AHP method

The methodology of performing the traditional analytic hierarchy process can be presented through a succession of four stages.

Stage 1. Identification of the relationships between the alternatives, the criteria and the goal which should be achieved. For the needs of the present analysis, a modification of the AHP method is needed. As alternatives, the ten methods of business processes optimization are reviewed and the categories of criteria evaluating the improvements are the four aspects of the business processes optimization. The goal is the achievement of improvements in each of the four dimensions.

Stage 2. Evaluation of the improvement methods (alternatives).

Step 1. Creation of a pairwise comparison matrix. Comparison of each two methods by each category of criteria is performed. The alternatives are assessed by an expert for their importance through a special scale (the scale in Appendix A, Table 2).

On the grounds of that comparison, matrixes are formed with binary point evaluations for each of the four criteria.

Strep 2. Calculation of each alternative's weight. Firstly, the geometric mean value of the binary point evaluations of each alternative (method) is calculated. The geometric means of all methods are added up. The weight of each alternative is formed by dividing its geometric mean by the sum of all geometric means.

Step 3. Calculation of the consistency ratio of each matrix. The "consistency ratio" coefficient (*CR*) value reflects the degree of consistency between the evaluations of the alternatives given by the expert-assessor and the actually existing interrelations between them. "*CR*" should not be higher than 0,1. Otherwise, the juxtaposition should be revised. The "consistency ratio" coefficient is calculated under the following formula (1).

$$CR = \frac{CI}{RI} \qquad 1$$

where "*CI*" is the "Consistency Index";
"*RI*" is the "Random Index".

The consistency index is calculated under the formula (formula 2):

$$CI = \frac{L_{\max} - n}{n - 1} \qquad 2$$

where "L_{max}" is determined as the aggregate of the sum of the binary point evaluations of each method (alternative) multiplied by the weight of the relevant alternative (method);
"*n*" is the number of the alternatives reviewed in the matrix.

The random index ("*RI*") is determined by the table (Table 3).

Stage 3. Evaluation of the categories criteria. Matrixes are created for the pairwise comparison of the categories of criteria for each dimension of the sub-process. This way it evaluates the influence of each criterion on the dimensions "quantity", "quality", "costs", or "time" of the sub-processes. The algorithm of calculation of the matrixes and the weights of the criteria are identical with those in stage 2.

Table 3
Random Index

n	1	2	3	4	5	6	7	8	9	10	11	12
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48

Stage 4. Calculation of the weighted point evaluation of the methods (alternatives). It is formed by multiplying the weight of each method by the weight of its corresponding criteria and the derived value is added to the rest of the values obtained in the same way. The weighted point evaluation shows the quantitative value of the influence, which each method (alternative) exerts through the criteria of assessment of the business processes on the improvement of each dimension of the processes.

Fuzzified AHP method

The methodology of performance of the fuzzified AHP analysis is in conformity with the specifics of the present study similar to the presented here above methodology of the traditional AHP analysis. It can be presented as a succession of three main stages:

Stage 1. Similar to the previous methodology, the activities on performance of the analysis start with identification of the hierarchical relations between the objective, the criteria and the alternatives.

Stage 2. Evaluation of the improvement methods (alternatives).

Step 1. Creation of a pairwise comparison matrix. The pairwise comparison of the various alternatives is performed again similar to stages 2 and 3 of the traditional approach, the difference being that the fuzzified methodology the table's evaluations of the linguistic rules, under which the alternatives are assessed, are additionally fuzzified (in Appendix A, Table 4.). This is done according to the selected form of the membership function (μ) of the evaluations.

Step 2. Identification of the membership function. Numerous membership functions have been discussed in the literature, but for this specific study we consider that three of them are most appropriate – trapezoidal, broad-trapezoidal and triangular. The actual form of the membership function is defined on the grounds of the expert assessment depending on the selected uncertainty level of that assessment.

Each trapezoid function is defined by four numerical values $\alpha; \beta; \gamma; \delta$ (Figure 4.), and they are in the following relation: $\alpha \le \beta \le \gamma \le \delta$ (Suresh M.S.V., 2012).

The mathematical expression of the trapezoid membership function is presented by the formula (3).

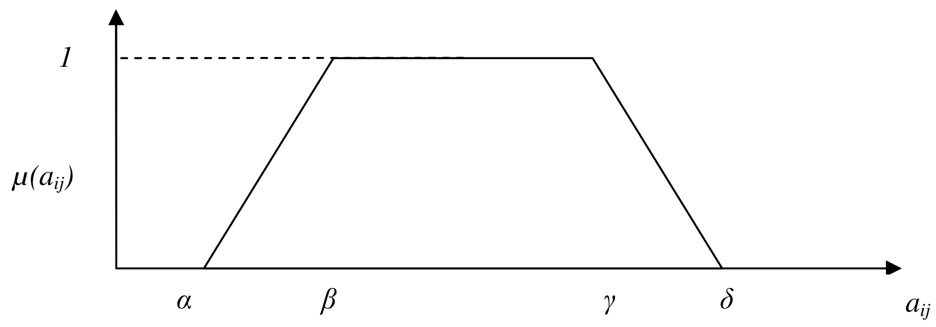

Figure 4. Trapezoidal membership function. This figure is adapted from Kordi et al. (2012)

$$\mu(a_{ij}) = \begin{cases} 0, \ a_{ij} \le \alpha \\ \dfrac{a_{ij} - \alpha}{\beta - \alpha}, \alpha \le a_{ij} \le \beta \\ 1, \beta \le a_{ij} \le \gamma \\ \dfrac{\delta - a_{ij}}{\delta - \gamma}, \gamma \le a_{ij} \le \delta \\ 0, \delta \le a_{ij} \end{cases} \quad 3$$

where a_{ij} is the serial element of the pairwise comparison matrix, „*i*" – the serial number in the row, and „*j*"- the number of the row in the matrix.

The difference between the trapezoidal, broad-trapezoidal and triangular membership functions consists of the value of the difference between *β* and *γ*. This difference represents the uncertainty of the expert upon giving a fuzzified evaluation of the alternatives in the comparison matrix. The bigger the excess "*β*–*γ*", the lower the selected uncertainty level is (Kordi & Brand, 2012). With the trapezoidal membership function the difference is "1", while with the broad-trapezoidal the difference is "1,5". The methodology of selection of the kind of AHP method and the membership function at fuzzified AHP method has been described in the preceding item of the current study.

The triangular membership function can be presented as an isolated case of the trapezoidal function. It is formed at difference of $\beta - \gamma = 0$ or parity of $\beta = \gamma$. The derived that way triangular membership function is often used in the practice, since the calculation is significantly simplified (Figure 5).

The mathematical expression of the triangular membership function is given in formula (4) which is adapted from Chatterjee and Mukherjee (2010).

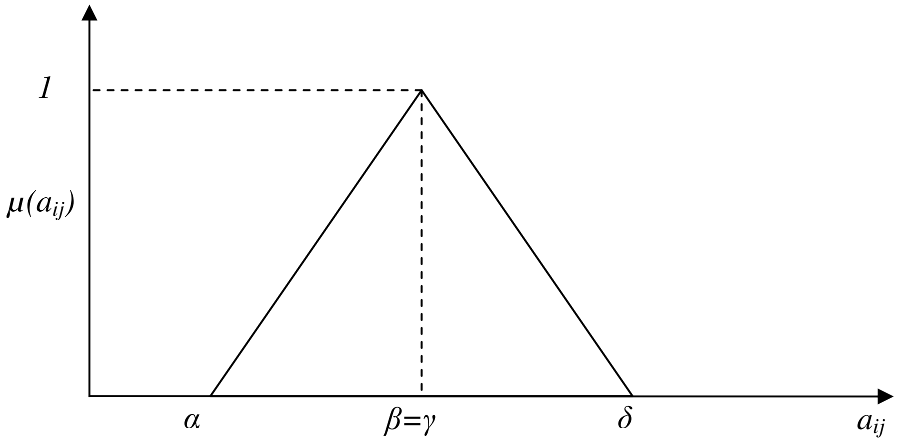

Figure 5. Triangular membership function which is adapted from Nepal et al. (2010)

$$\mu(a_{ij}) = \begin{cases} 0, \ a_{ij} \le \alpha \\ \dfrac{a_{ij} - \alpha}{\beta = \gamma - \alpha}, \alpha \le a_{ij} \le \beta = \gamma \\ 1, \beta \le a_{ij} \le \gamma \\ \dfrac{\delta - a_{ij}}{\delta - \beta = \gamma}, \beta = \gamma \le a_{ij} \le \delta \\ 0, \delta \le a_{ij} \end{cases} \quad 4$$

Step 3. Calculation of weights. The calculation of the weights of the alternatives and the criteria categories with the fuzzified AHP is done under the method of the geometric mean (Buckley, 1985) under formulas (5, 6, 7, and 8).

$$f_i(y) = \left[\prod_{j=1}^{n}\left((\beta_{ij} - \alpha_{ij})y + \alpha_{ij}\right)\right]^{\frac{1}{n}} \quad 5$$

$$g_i(y) = \left[\prod_{j=1}^{n}\left((\gamma_{ij} - \delta_{ij})\gamma + \delta_{ij}\right)\right]^{\frac{1}{n}}, 0 \le \gamma \le 1 \quad 6$$

$$a_i = \left[\prod_{j=1}^{n} \alpha_{ij}\right]^{\frac{1}{n}}, a = \sum_{j=1}^{n} \alpha_i \quad 7$$

$$f(y) = \sum_{j=1}^{n} f_i(y) \;\; g(y) = \sum_{j=1}^{n} g_i(y) \quad 8$$

The final fuzzified weight of the alternatives is calculated under the formula (9).

$$w_i = \left(\frac{\alpha_i}{\delta}; \frac{\beta_i}{\gamma}; \frac{\gamma_i}{\beta}; \frac{\delta_i}{\alpha}\right) \quad 9$$

Step 4. Calculation of the consistency ratio (*CR*) of each matrix. With the fuzzified analytic hierarchy process, the consistency ratio is determined on the grounds of Beckley's theorem (Buckley, 1985). According to the theorem, if matrix $B=[b_{ij}]$, where a_{ij} are evaluations of alternatives is consistent, then the fuzzy-matrix $A=[a_{ij}]$, where $a_{ij} = (\alpha_{ij}; \beta_{ij}; \gamma_{ij}; \delta_{ij})$ and the condition ($\beta_{ij} \le a_{ij} \le \gamma_{ij}$) is met for each *ij* the same is also consistent.

Stage 3. Defuzzification of the weights. Numerous techniques of conversion the fuzzified numbers into "ordinary" numbers are described in the literature (Kordi et al., 2012). According to a number of researches (Liu, 2007), one of the most accurate methods is the "method of the center of gravity", which can be presented by the following formula (10).

$$x_0 = \frac{\int_{x=-\infty}^{+\infty} \mu_x(x).x\,dx}{\int_{x=-\infty}^{+\infty} \mu_x(x)\,dx} \quad 10$$

where $\mu_x(x)$ is the actual membership function of the fuzzified number.

The defuzzified weights of each alternative show its influence on the dimensions of the processes.

Conclusion

In this study a methodology, through which it can determine the rate of influence of each of the ten optimization methods on the four main dimensions of the sub-processes is presented. It has been developed on the grounds of the traditional and the fuzzified AHP methods. The succession of stages and the steps building them for the identification of a concrete variant of the AHP method are presented. The entire methodology of determining the influence of the optimization methods on the dimensions of the sub-processes is presented as an algorithm consisting of three blocks.

The development of a scheme of the influence of the improvement methods on the dimensions of the processes, as well as the application of the methodology of calculating the quantitative evaluation of this influence helps to reduce the number of simulations and the costs related thereto. Thus, on the one hand, the achievement of optimal business processes is guaranteed, and on the other hand, upon availability of data on the exact size of the deviation of each business process dimension from the target, the choice of the kind and number of methods and the number of sub-processes to be applied thereto shall be facilitated. Another positive effect of the presented methodology is related to the simplification of the simulation method itself, the reduction of the simulation procedures number, reducing that way also the alternatives. In such manner, one can gain savings and support to the decision making process at strategic and operating levels.

References

Bedenik, N. O., Rausch, Al., Fafaliou, Ir., & Labaš, D. 2012, ‚Early Warning System – Empirical Evidence', *Tržište*, vol. 24, no. 2, pp. 201-218.

Boroushaki, S., Malczewski, J. 2008, 'Implementing an extension of the analytical hierarchy process using ordered weighted averaging operators with fuzzy quantifiers in ArcGIS', *Computers and Geosciences*, vol. 34, pp. 399–410.

Brüggemann, J., Heinrich, B., Sobczak, R. 1998, *Mathematik. Cornelsen Verlag*: Berlin.

Buckley, JJ 1985, 'Fuzzy Hierarchical Analysis', *Fuzzy sets and systems*, vol. 17, no. 3, pp. 233-247.

Chatterjee, D., Mukherjee, B. 2010, 'Study of Fuzzy-AHP Model to Search the Criterion in the Evaluation of the Best Technical Institutions: A Case Study', *International Journal of Engineering Science and Technology*, vol. 2. no, 7, pp. 2499-2510.

Deckler, G.J. 2003, *Achieving Process Profitability: Building the IT Profit Center*, iUniverse Inc., USA.

Gaitanides, M., Ackermann, Ingm. *2004*, *Die Geschäftsprozessperspektive als Schlüssel zu betriebswirt-sichtlichem Denken und Handeln. bwp@ Spezial, 1. Retrieved from,* viewed 23 January 2013, <http://www.bwpat.de/spezial1/gaitanides-acker.shtml>.

Grigori, D. Casati, F., D., Umeshwar., S., Ming-Chien 2011, Improving Business Process Quality through Exception Understanding, Prediction, and Prevention. *Proceedings of the 27th International Conference on Very Large Data Bases*, Morgan Kaufman Publisher Inc.: San Francisco.

Haist, F. 2001, *Qualität im Unternehmen: Prinzipien, Methoden, Techniken*, Carl Hanser Verlag, München.

Harmon P. 2007, *Business Process Change*, Morgan Kaufmann Publishers, USA.

Harrington, H. 1991, *Business Process Improvement*, McGraw-Hill, New York.

Kordi, M., Brand, S. A. 2012, 'Effects of increasing fuzziness on analytic hierarchy process for spatial multicriteria decision analysis', *Computers, Environment and Urban Systems*, vol. 36, no. 1, pp. 43-53.

Liu, X. 2007, 'Parameterized defuzzication with maximum entropy weighting function - Another view of the weighting function expectation method', *Mathematical and Computer Modelling*, vol. 45, no. 1-2, pp. 177-188.

Lowenthal, J. N. 2003, *Defining and Analyzing a Business Process: A Six Sigma Pocket Guide*, ASQ Quality Press, USA.

McDonald, M. 2010, *Improving Business Process*, Harvard Business School Publishing, USA.

Mitaim, S., Kosko, B. 1996, 'What is the best shape for a fuzzy set in function approximation?', *Proceedings of the Fifth IEEE International Conference on Fuzzy Systems*, vol. 2, pp. 1237-1243.

Mladenov, V., Yordanova, S. 2006, *Fuzzy management and Neural networks*, Technical University Sofia, Bulgaria.

Nepal, B., Yadav, P. O. & Murat, A. 2010, 'A fuzzy-AHP approach to prioritization of CS attributes in target planning for automotive product development', *International Journal "Expert Systems with Applications"*, vol. 37, pp. 6775-6786.

Ould, M. O. 2006, *Business Process Management. A Rigorous Approach*, Antony Rowe Ltd., Chippenham.

Papula, L. 2001, *Mathematk für Ingenieure und Naturwissenschaftler*, Friedrich Vieweg und Sohn Verlagsgesellschaft, Braunschweig.

Portougal, V., Sundaram, D. 2006, *Business Process. Operational Solutions for SAP Implementation*, IRM Press, USA.

Saaty, L.T. 2008, 'Decision making with the Analytic Hierarchy Process', *International Journal of Services Sciences*, vol. 1, no. 1, pp. 83-98.

Saaty, L.T., Tran, T.L. 2010, 'Fuzzy Judgments and Fuzzy Sets', *International Journal of Strategic Decision Sciences*, vol. 1, pp. 23-40.

Suresh, M. S. V. 2012, 'Fuzzy Hierarchical Analysis and Application', *International Journal of Engineering Science and Technology*, vol. 4, no. 9, pp. 4099-4110.

Süssenguth, W. 1992, *Methoden zur Planung und Einführungechnerintegrierter Produktionsprozesse*, dissertation, Berlin, Technische Universität Berlin.

Voloshyn, A., Gnatienko, G. & Drobot, E. 2003, 'Fuzzy Membership Functions in a Fuzzy Decision Making Problem', *International Journal "Information Theories and Applications"*, vol. 10, pp. 243-247.

Angelov, K. 2008 *Reinzhenering na stopanskite protsesi*, Tekhnicheski universitet – Sofiya, Sofiya.

Appendix A

Table 2

Scale for assessment of alternatives

Degree of importance	Verbal expression	Explanation
1	Equal importance	Two alternatives contribute equally to the goal
3	Little more importance	One alternative contribute little more to the goal than another
5	More importance	One alternative contribute more to the goal than another
7	Much more importance	The influence for achieving the goal is strongly expressed
9	Dominate importance	The influence for achieving the goal is very strongly expressed
2,4,6,8	Intermediate values between two adjacent	If the compromise is needed
Reciprocal values	If the value of $a_{i,j}$ shows the importance of *i*-th alternative toward the *j*-th, then the importance of the *j*-th in comparison with the *i*-th is determinate like $1/a_{i,j}$ (Boroushaki & Malczewski, 2008)	

Note: The table is adapted from Saaty (2008, p.86)

Table 4

Scale for assessment of fuzzified alternatives

Degree of importance	Verbal expression	Fuzzified level of importance		
		Triangular function	Trapezoidal function	Broad-trapezoidal function
1	Equal importance	(1;1;1)	(1;1;1;1)	(1;1;1;1)
3	Little more importance	(2;3;4)	(2;2,5;3,5;4)	(1,5;2,25;3,75;4,5)
5	More importance	(4;5;6)	(4;4,5;5,5;6)	(3,5;4,25;5,75;6,5)
7	Much more importance	(6;7;8)	(6;6,5;7,5;8)	(5,5;6,25;7,75;8,5)
9	Dominate importance	(8;9;10)	(8;8,5;9,5;10)	(7,5;8,25;9,75;10,5)
2,4,6,8	Intermediate values between two adjacent	Intermediate values between two adjacent	Intermediate values between two adjacent	Intermediate values between two adjacent
Reciprocal values	If the value of $a_{i,j}$ shows the importance of *i*-th alternative toward the *j*-th, then the importance of the *j*-th in comparison with the *i*-th is determinate like $1/a_{i,j}$ (Boroushaki & Malczewski, 2008)			

Appendix B

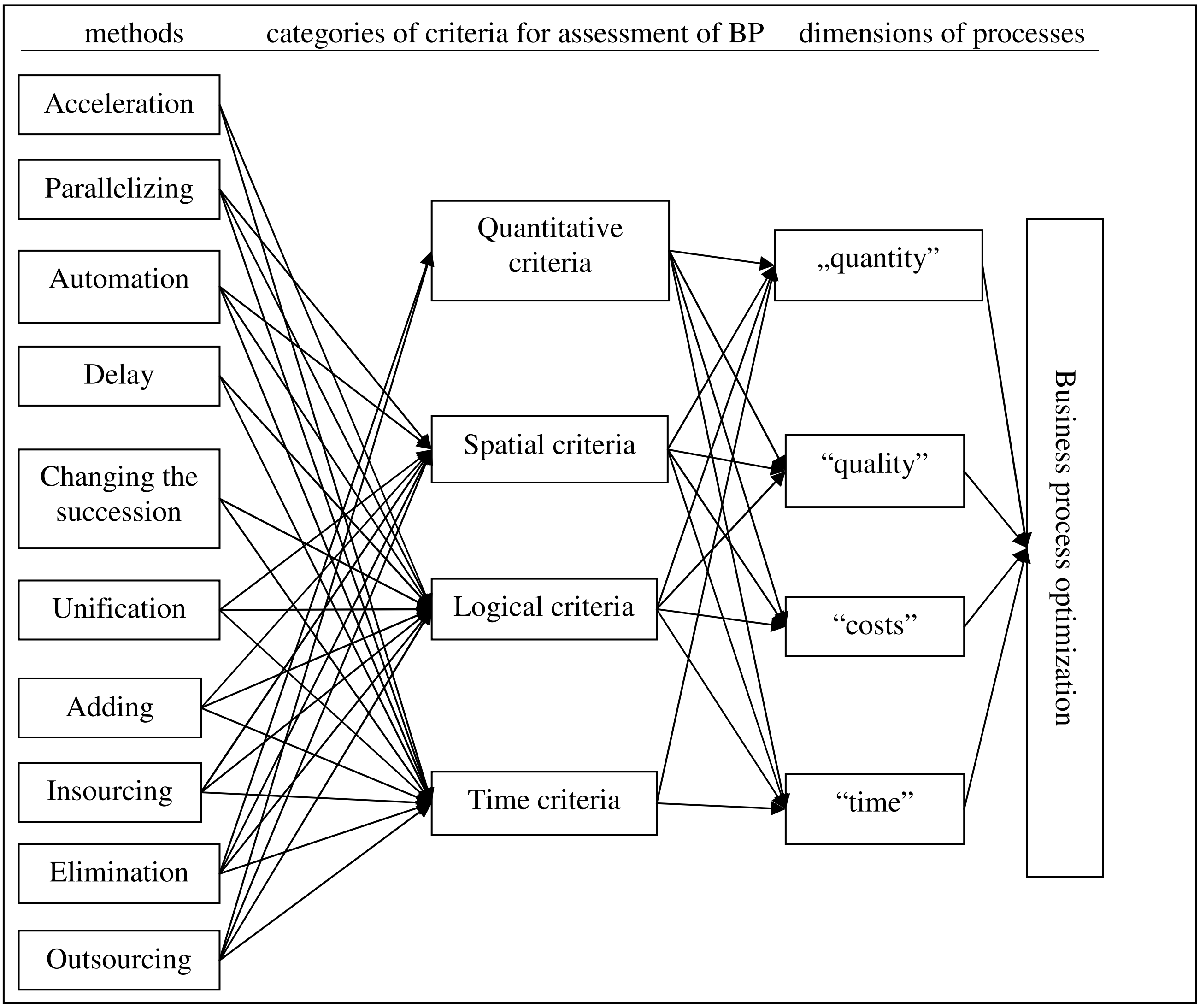

Figure 2. Schematic diagram of influence of methods on the dimensions of processes

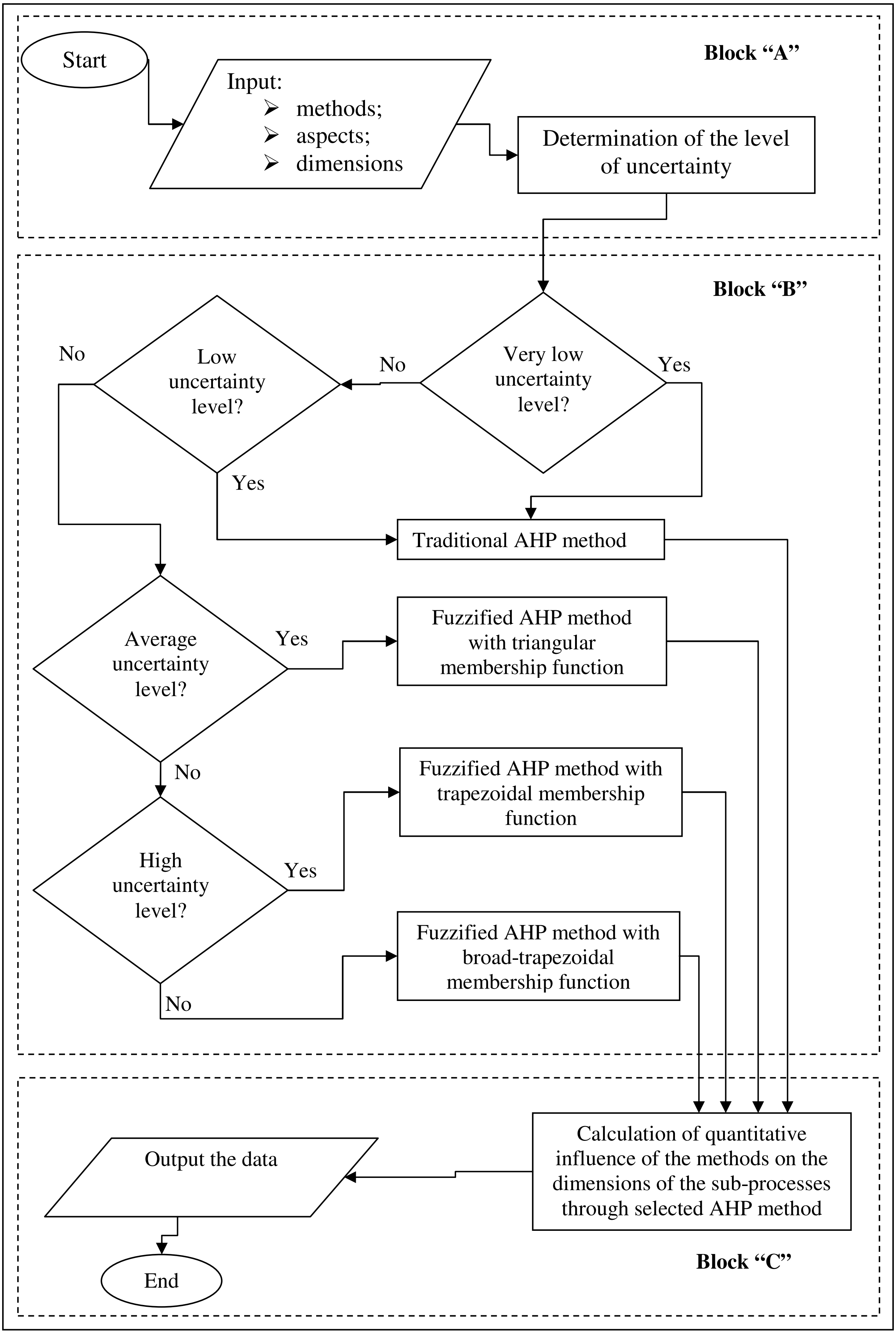

Figure 3. Algorithm of the methodology

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ОЦЕНКА ВОЗДЕЙСТВИЯ ОПТИМИЗАЦИОННЫХ МЕТОДОВ НА РАЗМЕРНОСТЬ СУБ-ПРОЦЕССОВ

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Аннотация. Данное исследование представляет методологию, с помощью которой может быть проведена количественная оценка скорости воздействия каждого метода оптимизации по размерам суб-процессов в рамках бизнес-процесса. С этой целью были представлены, в первую очередь, методы оптимизации отдельных процессов, четыре из наиболее часто используемых размеров на практике, а также четырех аспекта оптимизации бизнеса. Была разработана классификационная схема, которая отражает влияние методов оптимизации на размеры процессов. Далее, описываются этапы установления типа анализа иерархий (МАИ), который должен быть использован - традиционный МАИ, треугольный нечёткий МАИ, трапециевидный нечёткий МАИ или широкий нечёткий трапециевидный МАИ, а также определяется функция принадлежности. Кроме того, вся методика представлена на алгоритме построения трех основных блоков. Рассматриваются этапы выполнения традиционных и нечётких МАИ. Описана сущность функционирования представленной методики.

Ключевые слова: бизнес-процессы; оптимизация суб-процессов; инструментарий улучшения; анализ влияния; методология; алгоритм.