Oct. 31

International Journal of advanced studies in Computer Science and Engineering
IJASCSE, Volume 3, Issue 10, 2014

Expert System Using Multicriteria Decision Making For Enterprise Systems

Gabsi Mounir
Information Technology department
Iset Nabeul
Nabeul,Tunisia

Rekik Ali
Information Technology departement
Iset Sfax
Sfax, Tunisia

***Abstract*—Multiple criteria decision making (MCDM) shows signs of becoming a maturing field. There are four quite distinct families of methods: (i) the outranking, (ii) the value and utility theory based, (iii) the multiple objective programming, and (iv) group decision and negotiation theory based methods. Fuzzy MCDM has basically been developed along the same lines, although with the help of fuzzy set theory a number of innovations have been made possible; the most important methods are reviewed and a novel approach – interdependence in MCDM - is introduced. . In this paper we propose a model of an expert system for MCDM under uncertainty to improve company competitiveness.**

Keywords*—*decision making; fuzzy methods; expert system; uncertainty;

I. INTRODUCTION

Starting business, no one assumes to bring the company into bankruptcy process, but to reach growth/development. So, why companies bankrupt? According to the literature, it is not possible to indicate one reason that would be responsible for bankruptcy of a company [15, 16]. The firms failure is a result of the whole set of factors. These factors very often are overlapping, even with different sources of origin- endogenous and exogenous. Nowadays, in times of uncertainty, risks and incomplete information, the crisis becomes a feature of modern business, not the state of emergency. Multicriteria decision making (MCDM) has emerged as an effective methodology due to its ability to combine quantitative and qualitative criteria for selection of the best alternative [17]. Concurrently, fuzzy logic is gaining importance due to its flexibility in handling imprecise subjective data. In the present study concepts of fuzzy logic and MCDM are integrated and applied to a case study for selecting the best performing of company competence evaluation.

The principle of the mathematical model of decision-making processes was built on the basis of fuzzy logic approach. Main operations of fuzzy logic have been used in the mathematical model for competitivity assessment. Algorithm and software for assessing the impact of various factors on competitivity and formation of the decision-making rules have been worked out. Moreover, the comparative analysis of the calculations, received due to the elaborated program, and the results of calculations using the model based on linguistic relations was done.

The competitiveness of company involves several levels of uncertainty and imprecision [21]. According to Aristotelian logic, for a given proposition or state we only have two logical values: true-false, black-white, 1-0. In real life, things are not either black or white, but most of the times are grey. Thus, in many practical situations, it is convenient to consider intermediate logical values.

Language, dictionaries and the use made of it suggests that uncertainty is the ignorance of future events, and the risk is a direct result of this ignorance, manifested when, once a decision or action taken, the consequences of the latter are unknown. Ultimately, the management control in the approach to uncertainty and risk, has not really developed theories of its own. Most of those adopted this discipline reflect economic references or, more occasionally, social sciences, taken in a broad sense.

Uncertainty is now considered essential to science and fuzzy logic is a way to model and deal with it using natural language. We can say that fuzzy logic is a qualitative computational approach. Fuzzy logic is a method to render precise what is imprecise in the world of management strategies.

This paper is organized as follows; general structure of fuzzy logic system is introduced in section II, design of fuzzy control models is presented in section III , model company competitiveness in section IV in the section V are grouped the factors influencing the formation of the competitiveness, and test system and discussion are presented in section VI.

II. METHODS OF EFFECTIVE DECISION-MAKING BASED ON FUZZY LOGIC RULES

Fuzzy logic is an attractive technique mainly in case where target problems are difficult to model with traditional mathematical methods, but which are easily understood by human expert. Fuzzy logic resembles human like thinking being, due to that efficient decision making operation can easily done and also it is well suited for multidimensional decision problems [4]. The rule base decision making is achieved by fuzzy logic method in an uncertain condition.

Presently great importance is the use of information systems for decision-making for solving volumetric difficult formal problems in different domains. These tasks are characterized by:

- Absence of formal algorithms or complexity of the decision.
- Incomplete and unclear initial information.
- Unclear goals to achieve.

Decision making in task-oriented information and control systems is carried out in conditions of a priori uncertainty. The result may have negative economic, technical and social implications that are generated because of uncertainty leads to increased risk of inefficient decision-making. In particular, it is frequently used methods based on fuzzy logic rules for effective decision-making in cases of uncertainty in terms of the system. These methods are based on fuzzy sets and linguistic variables are used and expression [14] to describe the decision making strategies.

Methods and approaches fuzzy sets theory [12] contribute to overcome conflicting criteria decision-making and help to create logic controls systems. Fuzzy sets allow you to apply linguistic description of complex processes, to establish the relation between fuzzy concepts to predict the behavior of the system, to form a set of alternative actions to perform a formal description of fuzzy decision-making. An important application of fuzzy set theory in management tasks is the fuzzy logic controllers [8, 9], which are used in various control systems. Instead of complex mathematical models describing the system are integrated controllers using knowledge of experts in structure representation is close to verbal communication and described with linguistic variables and fuzzy sets.

III. FUZZY MODEL

Fuzzy modeling is a new modeling paradigm, and fuzzy models are nonlinear dynamic models. Compared with the conventional black- box modeling techniques that can only utilize numerical data, the uniqueness of a fuzzy modeling approach lies in its ability to utilize both qualitative and quantitative information. This advantage is practically important and even crucial in many circumstances. Qualitative information is human modeling expertise and knowledge, which are captured and utilized in the form of fuzzy sets, fuzzy logic and fuzzy rules.

Typically this knowledge is given by linguistic variables, fuzzy sets are described. Linguistic variable is the set of fuzzy variables which are intended to represent (usually verbal) of a fuzzy number. For example, if the linguistic variable X' is defined by some set of dimension m qualitative characteristics A, then there is a representation: $X' = \{A_j\}_{j=\overline{1,m}}$

Where every attribute $X' = \{A_j\}_{j=\overline{1,m}}$ (in the terminology - Term) are fuzzy sets $A = \{\langle \mu_A(x) \rangle \mid x \in X\}$

Where $\mu_A(x) \in [0,1]$ -function of linguistic variable X' domain of X . In this interpretation of linguistic variable X' is fuzzy way. In general, fuzzy variable is a variable which is defined by name, domain definitions and fuzzy set that defines this variable. It is unclear and linguistic variables are used to describe using fuzzy set of objects and processes, and underlying construction of fuzzy logic controllers.

The typical structure of the fuzzy logic controller contains the following blocks: fuzzification, defuzzification, solutions and knowledge base (Fig.1).

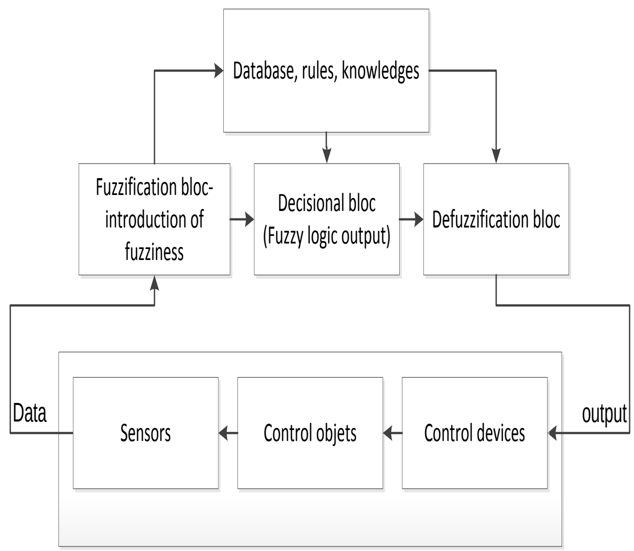

Figure 1. The typical structure of fuzzy model

Each of these units performs its specific task. In particular, the measured output control object value distinct unit fuzzification transforms into fuzzy linguistic variables are defined from the knowledge base. Convert fuzzy input to control actions in general, and fuzzy unit takes decisions by conventional rules, which are incorporated in the knowledge base. Convert fuzzy data block decisions in a clear logic control unit is subject defuzzification [2].

Modern methods of designing control system are based on neuro-fuzzy approach based on the use of fuzzy sets. Modern methods of construction of control systems based on neuro-fuzzy approach based on the use of fuzzy sets. In these sets of values for each output variable degree of membership is a function (not just a point value) - secondary membership function (MF), which is the domain of the (primary affiliation) - is the interval [0,1] and the range of values (secondary measure) may also belong to [0,1].

In practice, there are different types of membership functions. The most common and easiest to use of them is a triangular shape. The vertical model of fuzzy set $X' = (x_1, x_2, x_3)$ with MF triangular shape has the form:

$$\mu(x) = \begin{cases} 0, & \text{when } x < x_1; \\ \dfrac{x - x_1}{x_2 - x_1}, & \text{when } x_1 \le x \le x_2; \\ \dfrac{x_3 - x}{x_3 - x_2}, & \text{when } x_2 \le x \le x_3 \end{cases}$$

Where $x_1 \le x_2 \le x_3$.

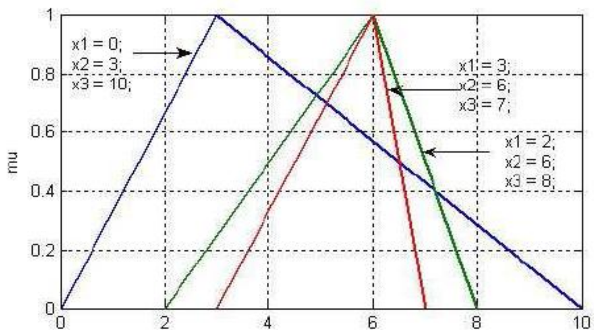

Figure 2. Fuzzy sets with triangular-shaped MF

The purpose of this paper is to simulate the competitiveness of company. Issues of competitiveness are extremely complex and multifaceted. In a competitive business enterprise must learn methods of competition that correspond to the "buyer's market" and the competitiveness of enterprises should serve as a indicator of its economic performance [5, 6].

IV. COMPANY COMPETITIVNESS ASSASSMENT

When modeling the competitiveness of enterprises generally use various modifications of the partial weighted sum method of technical and economic parameters [1, 18, 19]. It is implicitly assumed that the lack of some indicators may be offset by excess of others. Meaningful contribution to the enterprise competitiveness contribute not only to the quality and price of goods, but also a measure of customer awareness, geographic and temporal shopping availability, service level, social, economic, psychological and other factors[24]. Put them through a vector of factors $X' = \{X_i \mid i = 1..N\}$.

When making strategic decisions managers of convenient to use a generic parameter estimation is competitiveness - competitiveness Y. Then using the vector model for evaluating factors competitiveness can be represented in the form of functional mapping: $X' = \{X_i\} \to Y, i = 1..N$.

Where X_i - partial criteria for competitiveness; N - number of criteria taken into account. Criteria X_i describing various aspects of the enterprise are most important to evaluate the competitiveness of enterprises. In Fig.3 is shown a model presented in a hierarchical tree logical deduction, which defines the structure model for the company.

Elements tree logical deduction and quantity in this case is interpreted as follows [7, 10, 13]:

- Tree root - the competitiveness of enterprise Y.
- Terminal vertex - influencing factors Y_1, Y_2, Y_3.
- No terminal vertices - a convolution factors influencing f_{y1}, f_{y2}, f_{y3} partial criteria of competitiveness y_i. Rolls and a convolution y_i, f_{yi} performed using logical deduction by fuzzy knowledge bases.
- Arc graph, out of non terminal nodes - enlarged influencing factors $y_1, \ldots, y_7$ - partial criteria for competitiveness y_i.
- No terminal vertices - a convolution f_{x1}, f_{x2}, …, f_{x7} partial indicators of competitiveness x_{ij}.
- Terminal vertex - partial indicators of competitiveness $\{x_{i,j} \mid i = 1, \ldots, N;\ j = 1, \ldots, M_i\}$
- Where N = 7 - number of sets of indicators; M_i - number of parameters in the i-th group.

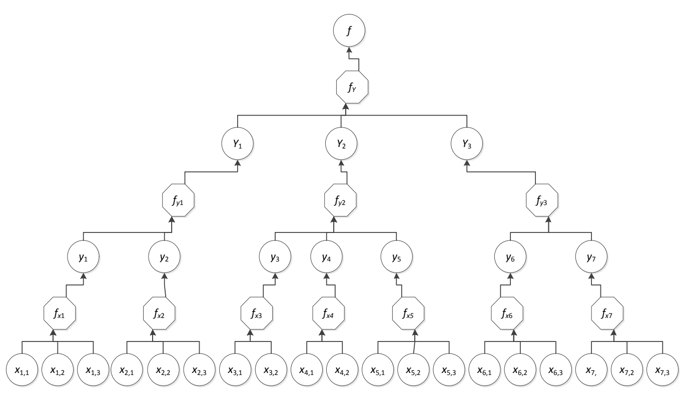

Figure 3. Hierarchical model of decision

Logical deduction in (Fig.3) corresponds to a system of relations: $Y = f_y(Y_1, Y_2, Y_3)$.

$y_1 = f_{x1}(x_{1,1}, x_{1,2}, x_{1,3})$,

$y_2 = f_{x2}(x_{2,1}, x_{2,2}, x_{2,3})$

$y_3 = f_{x3}(x_{3,1}, x_{3,2})$

$$y_4 = f_{x3}(x_{4,1}, x_{4,2})$$
$$y_5 = f_{x1}(x_{5,1}, x_{5,2}, x_{5,3})$$
$$y_6 = f_{x6}(x_{6,1}, x_{6,2}, x_{6,3})$$
$$y_7 = f_{x7}(x_{7,1}, x_{7,2}, x_{7,3})$$
$$Y_1 = f_{y1}(y_1, y_2)$$
$$Y_2 = f_{y2}(y_3, y_4, y_5)$$
$$Y_3 = f_{y3}(y_6, y_7)$$

V. GROUPPING AND RANKING FACTORS INFLUENCING THE FORMATION OF THE COMPETITIVNESS

The theory of fuzzy sets serves as one of the possible ways to formalize expert evaluations of criteria. In this case, the integral criterion is considered as a fuzzy convolution of partial criteria. A disadvantage of this method is associated with the fact that, sometimes, an expert can barely evaluate a certain partial criterion, even on a qualitative level. Note that, in this case, it is easier for an expert to determine the better of two variants, i.e., to perform paired comparisons [11].

Consider the input and output parameters of all the fuzzy subsystems in more detail. To begin with subsystems that determine influencing factors [3].

TABLE I. FIRST SUBSYSTEM

input parameters	*output parameters*
$x_{1,1}$ – quality of design decisions	y_1 – quality
$x_{1,2}$ – Quality production technologies	
$x_{1,3}$ – personnel support	

TABLE II. SECOND SUBSYSTEM

input parameters	*output parameters*
$x_{2,1}$ – rank of producer	y_2 – company image
$x_{2,2}$ – promotional support	
$x_{2,3}$ – level of reclamations	

TABLE III. THIRD SUBSYSTEM

input parameters	*output parameters*
$x_{3,1}$ – flexibility of the company	y_3 – communicability of the company
$x_{3,2}$ – informativeness of the company	

TABLE IV. FOURTH SUBSYSTEM

input parameters	*output parameters*
$x_{4,1}$ – reliability of information	y_4 – informativeness of the company
$x_{4,2}$ – timeliness of information	

TABLE V. FIFTH SUBSYSTEM

input parameters	*output parameters*
$x_{5,1}$ – risk during transportation	y_5 – reliability of delivery
$x_{5,2}$ – Timeliness of delivery	
$x_{5,3}$ – safety of cargo	

These systems belong to the traditional decision support systems in improving competitiveness of the company [20, 21]. It should be noted that the company is not insured against unforeseen situations in times of instability in the country, such as revolution, which is time consuming. Instability in the country creates pressure on the company through additional risks, uncertainty, instability and even interruptions in the work. Since there is a high probability that the security state will not be able to keep the situation under control, the company can also directly in danger, such as property damage.

TABLE VI. SIXTH SUBSYSTEM

input parameters	*output parameters*
$x_{6,1}$ – support workers transport (bus, minibus)	y_6 – security for workers
$x_{6,2}$ – reduction of working hours to workers returning home in a safe time	
$x_{6,3}$ – moral support workers, by taking part in the enterprise revolution	

TABLE VII. SEVENTH SUBSYSTEM

input parameters	*output parameters*
$x_{7,1}$ – increasing the number of guards and watchmens	y_7 – protection of property from arbitrary
$x_{7,2}$ – Financial encouraging neighbors to help in protecting company	

Later given subsystems that define consolidated factors influence.

TABLE VIII. EIGHTH SUBSYSTEM

input parameters	*output parameters*
y_1 – quality	Y_1 – image of the company
y_2 – company image	

TABLE IX. NINTH SUBSYSTEM

input parameters	*output parameters*
y_3 – communicability of the company	Y_2 – seriousness of the company
y_4 – informativeness of the company	
y_5 – reliability of delivery	

TABLE X. TENTH SUBSYSTEM

input parameters	*output parameters*
y_6 – security for workers	Y_3 – related to the instability
y_7 – protection of property from arbitrary	

Subsystem determining competitiveness.

TABLE XI. ELEVENTH SUBSYSTEM

input parameters	*output parameters*
Y_1 – image of the company	*f* – company competitiveness
Y_2 – seriousness of the company	
Y_3 – related to the instability	

VI. CREATION OF FUZZY KNOLEDGE BASES

To simulate consolidated (integrated) factors established expert fuzzy knowledge base of Mamdani type. Antecedent may be joined by OR; AND operators.

- For OR – max.
- For AND – min.

An example is shown in Fig. 4. Elements related parcel fuzzy logical AND operation. The value factors are expressed in deviations (in percent) of the average performance of similar goods competing brands on the market analyzed considering not covered situations in times of instability in the country.

When describing linguistic variables defined range of variation of their values, the number of terms (rules) and shape membership function [22, 23]. Base rules for each subsystem composed under the terms of the interactions input linguistic variables.

Fuzzy logic system makes decisions and generates output values based on knowledge provided by the designer in the form of if- then action rules.

An example of base rules is presented in Table (1.1-8):

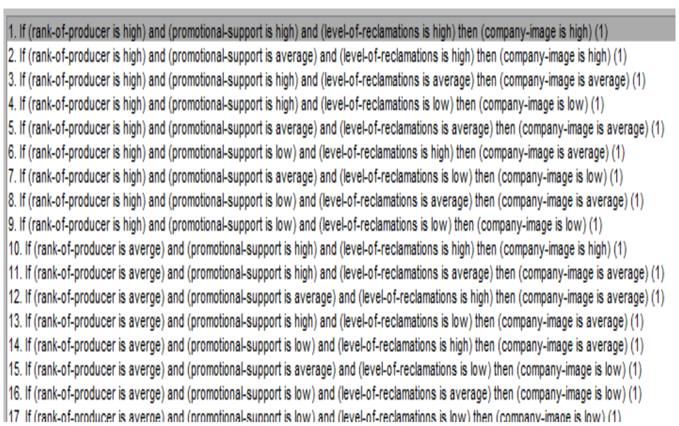
1. If (rank-of-producer is high) and (promotional-support is high) and (level-of-reclamations is high) then (company-image is high) (1)
2. If (rank-of-producer is high) and (promotional-support is average) and (level-of-reclamations is high) then (company-image is high) (1)
3. If (rank-of-producer is high) and (promotional-support is high) and (level-of-reclamations is average) then (company-image is average) (1)
4. If (rank-of-producer is high) and (promotional-support is high) and (level-of-reclamations is low) then (company-image is low) (1)
5. If (rank-of-producer is high) and (promotional-support is average) and (level-of-reclamations is average) then (company-image is average) (1)
6. If (rank-of-producer is high) and (promotional-support is low) and (level-of-reclamations is high) then (company-image is average) (1)
7. If (rank-of-producer is high) and (promotional-support is average) and (level-of-reclamations is low) then (company-image is low) (1)
8. If (rank-of-producer is high) and (promotional-support is low) and (level-of-reclamations is average) then (company-image is average) (1)
9. If (rank-of-producer is high) and (promotional-support is low) and (level-of-reclamations is low) then (company-image is low) (1)
10. If (rank-of-producer is averge) and (promotional-support is high) and (level-of-reclamations is high) then (company-image is high) (1)
11. If (rank-of-producer is averge) and (promotional-support is high) and (level-of-reclamations is average) then (company-image is average) (1)
12. If (rank-of-producer is averge) and (promotional-support is average) and (level-of-reclamations is high) then (company-image is average) (1)
13. If (rank-of-producer is averge) and (promotional-support is high) and (level-of-reclamations is low) then (company-image is average) (1)
14. If (rank-of-producer is averge) and (promotional-support is low) and (level-of-reclamations is high) then (company-image is average) (1)
15. If (rank-of-producer is averge) and (promotional-support is average) and (level-of-reclamations is low) then (company-image is low) (1)
16. If (rank-of-producer is averge) and (promotional-support is low) and (level-of-reclamations is average) then (company-image is low) (1)
17. If (rank-of-producer is averge) and (promotional-support is low) and (level-of-reclamations is low) then (company-image is low) (1)

Figure 4. Base rules for each subsystem composed under the terms of the interactions input linguistic variables

If the values considered in the fuzzy logic sets are in terms of degree variation then in the final output the fuzzy values should be converted in to crisp value by using any Defuzzification method. Defuzzification can be performed by deriving the centre of gravity method with the help of MATLAB.

In Fig.5.and Fig.6. are given sections of the program, particularly in the figures, as an example, are given enlarged factor determining the company image (y_2) for inputs: ($x_{2,1}$) rank of producer, ($x_{2,2}$) promotional support ,($x_{2,3}$) - level of reclamations the data from the database fuzzy knowledge present in the second subsystem.

Thus in figure the value of enlarged factor y_2 = 88.5 for the following values of input factors (rank of producer) $x_{2,1}$ = 78.9, (promotional support) $x_{2,2}$ = 80.1, (reclamation level) $x_{2,3}$ = 88.6. It is found that when the influential factors on the model have considerably high values, the company image is relatively high. Increasing the value of these factors ($x_{2,1}$ = 78.9, $x_{2,2}$ = 12.7, $x_{2,3}$ = 7.83) leads to a fall enlarged factor (y_2 = 13.2, Fig.5.). Therefore, to react on the competitiveness of the company, we just need to change strategies or factors for influencing on the optimal decision. This result indicates adequate model system, which according to selected factors effectively and efficiently responds to their changes.

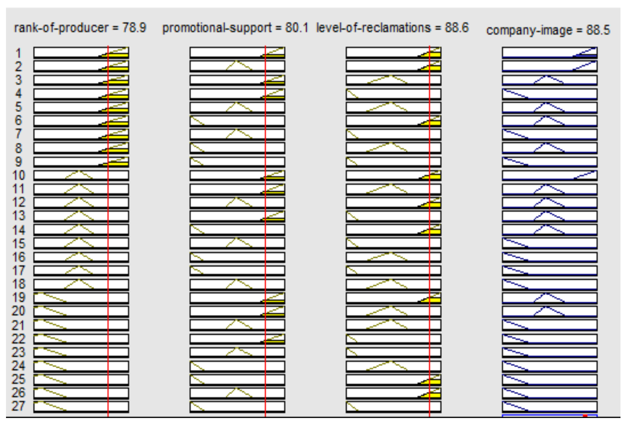

Figure 5. Visualization of fuzzy logic - estimation enlarged factor "Company Image" for given values of input factors

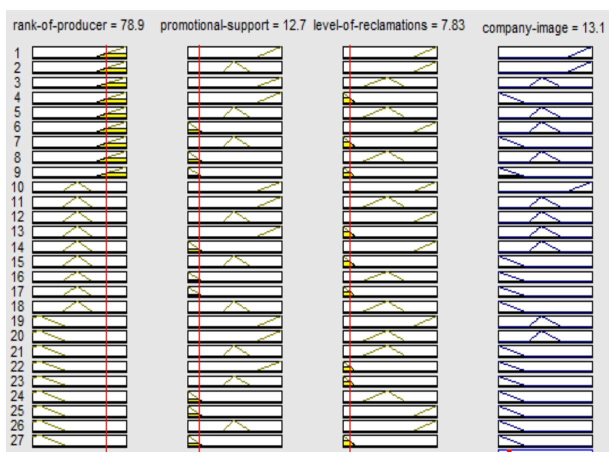

Figure 6. Example Visualization of fuzzy system - result calculating the enlarged factor "Company Image" with altered values of input factors

CONCLUSION

The evaluation of the enterprise competitiveness based on the hierarchical model developed involves not only the calculation of the level of competitiveness, but also determines the effect of this on the evaluation of the different of inputs. This optimizes the values of input factors.

Effective utilization of fuzzy logic in the construction of logico-linguistic models of management requires not only adequate static definition of fuzzy sets for the input factors, rules of inference and aggregation, defuzzification methods but also use the methods of in dynamic mode adaptive improvement compared to the functions of fuzzy variables.

ACKNOWLEDGMENT

I would like to offer my particular thanks to my colleagues in the laboratory SOIE, for their encouragement and support for the completion of this study.

REFERENCES

[1] F. Sahin, Information sharing and coordination in make-to-order supply chains/ F. Sahin, E. Robinson// Operations Managment. – 2005. –No. 23(6). – P. 579-598.

[2] R. K. Mudi, A self-tuning fuzzy PI controller/ R. K. Mudi, N. R. Pal// Int. Jo. Fuzzy sets and systems. – 2000. – No 115 – P. 327 – 378.

[3] A. Kusiak and J. Wang, Decomposition of the design process. Journal of Mechanical Design, Transactions of the ASME, 115(4):687–695, 1993.

[4] R. V. Katwijk, P. V. Koningsbruggen, "Coordination of Traffic Management Instruments Using Agent Technology," Transportation Research Part C: Emerging Technologies, 2002, vol.10, pp.455-471.

[5] H. Wu, B. Ravindran, E. Jensen, and P. Li. Time/utility function decomposition techniques for utility accrual scheduling algorithms in real-time distributed systems. IEEE Transactions on Computers, 54(9):1138–1153, 2005.

[6] F. Chen, Information sharing and supply chain coordination/ F. Chen//Operational Research and Management Science: Supply chain Management. – 2003. – P. 341-421.

[7] M. D. Mesarovic , D. Macko and Y. Takahara Theory of Hierarchical Multilevel Systems, 1970 :Academic

[8] G. E. Fainekos, A. Girard, , & G. J. Pappas, (2007), Hierarchical synthesis of hybrid controllers from temporal logic specification. In LNCS: Vol. 4416. Hybrid systems: computation and control (pp. 203_216). Springer.

[9] M. Sugeno, Industrial applications of fuzzy control/ M. Sugeno. – Amsterdam: North-Holland, 1985. – 269 p.

[10] R. R. Yager, Decision making with fuzzy probability assessments/ R. R. Yager// IEEE Transactions on Fuzzy Systems. – 1999. – Vol. 7. – P. 462-466.

[11] J. Zhou, Analysis and algorithms of bifuzzy systems/ J. Zhou, B. Liu// International Journal of Uncertainty, Fuzziness & Knowledge-Based Systems. – 2004. – Vol. 12. – No. 3. – P. 357-376.

[12] H.J. Zimmerman, Fuzzy Set Theory and Its Applications/ H. J. Zimmerman. – Kluwer, Dordrecht, 1991. – 315p.

[13] H. Tanaka,Possibility distribution of fuzzy decision variables obtained from possibilistic linear programming problems/ H. Tanaka, P. Guo, H. J. Zimmermann// Fuzzy Sets and Systems. – 2000. – Vol. 113. – P. 323-332

[14] R. K. Mudi, A self-tuning fuzzy PI controller/ R. K. Mudi, N. R. Pal// Int. Jo. Fuzzy sets and systems. – 2000. – No 115 – P. 327 – 378.

[15] Sandeep Dahiya, L. Klapper. "Who Survives: A Cross-Country Comparison." Journal of Financial Stability 3.3 (2007): 261-278.

[16] B. Richardson, S.Nwankwo, , & S. Richardson, (1994). Understanding

the causes of business failure crises: Generic failure types. Management Decision. 32 (4), 9-22.

[17] J.Ch. Pomerol, and S.B. Romero,: 2000, Multicriterion decision in Management: principles and practice, Kluwer Academic Publishers, Netherlands.

[18] M. Gabsi, M. Temani, A. Rekik, Informational Logistic Models And Concept of Coordination Strategies Resources Management: Proceedings of the XIth International conference ["The experience of designing and application of CAD system in microelectronics CADSM' 2011"], (Lviv – Polyana, 23 – 25 February 2011)/ Lviv Polytechnik National University. – Lviv: Publishing House Vezha&Co, 2011. – P. 291-293.

[19] Rekik Ali, Models decomposition strategies for managing action plans in hierarchical systems: Proceedings of the VIIth International conference ["Computer science and information technologies: Materials of the VII-th International scientific conference CSIT 2012"], (Lviv, 20-24 November 2012)/ Lviv Polytechnik National University. – Lviv: Lviv Polytechnic, 2012. – P. 7-9.

[20] Gabsi Mounir, Ali Rekik , Moncef Temmani, Coordinated Resource Management Models in Hierarchical Systems, International Journal of Advanced Computer Science and Applications,2013, Vol. 4, Issue 2, pp.105- 109.

[21] Rekik Ali, Temani Moncef, Gabsi Mounir, The formation of action strategies in active hierarchical systems, International Review on Modelling and Simulations (IREMOS), 2013, Vol. 6, Issue 5, pp. 1672- 1679.

[22] Xiaoli Wu, Ruiqing Zhao, Wansheng Tang, Uncertain agency models with multi-dimensional incomplete information based on confidence level, International journal Fuzzy Optimization and Decision Making, 2014, Vol. 13, Issue 2, pp. 231- 258.

[23] Rafik A. Aliev, Witold Pedrycz, Akif V. Alizadeh, Fuzzy optimality based decision making under imperfect information without utility, International journal Fuzzy Optimization and Decision Making, 2013, Vol. 12, Issue 4, pp. 357- 372.

[24] Baoding Liu, A new definition of independence of uncertain sets, International journal Fuzzy Optimization and Decision Making, 2013, Vol. 12, Issue 4, pp. 451- 461.