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ABSTRACT MODELLING OF THE IMPACT OF ACTIVITIES OF ECONOMIC ENTITIES ON THE SOCIAL SYSTEM

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Abstract

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Economic entities as integral parts of the social system have an impact on it. The complexity of structures and uncertainty of behaviour which are also conditioned by incorporating the human factor are the typical characteristics of economic entities and the social system. The lack of precise measurement data as well as precise information is their typical feature. Methods of creating computer models of such systems must therefore be based on uncertain, incomplete or approximate data and hypothetical assumptions. The paper deals with the synthesis of the abstract model of the expert system for determining the level of corporate social responsibility of an enterprise (CSR) with the use of methods of artificial intelligence. The linguistic rule model is built on the basis of the expert determination of the level of CSR based on the level of care for employees, level of supplier-customer relations, level of its ecological behaviour, and compliance with legal obligations. The linguistic modelling method is based on the theoretical approach to fuzzy set mathematics and fuzzy logic. The aim of the paper is the presentation of the system for determining the level of CSR with the use of non-conventional non-numerical methods as well as simulative presentation of the efficiency of its functions. The above-mentioned expert system is a relevant module of the built hierarchical structure aimed at the research of impacts of activities of economic entities on the social system.

Keywords: economic entity, corporate social responsibility, abstract modelling, artificial intelligence, linguistic fuzzy model, fuzzy logic, approximate reasoning, expert system, hierarchical system

INTRODUCTION

Economic entities have an impact on the society. They more or less contribute to the development and growth of the living standard of people. However, it is difficult to make the complete and precise definition of all the activities which have had an impact on the social system. This fact is influenced by two circumstances – the dynamics of the social system and its uncertainty. Nowadays, the social system is constantly changing. Economic entities have to respond to these changes, diversify their activities, and adapt to environmental impacts. The complexity of structures of the social system and strong uncertainty of its behaviour which is also conditioned by incorporating the human factor are the typical characteristics of the social system. The lack of precise measurement data as well as precise information about its behaviour is its typical feature. In order to be able to examine such a system, it is necessary to describe its properties using the abstract descriptions (abstract models). The methods of creating models are often based on uncertain, incomplete or approximate data, and hypothetical assumptions.

The use of the computer technology for formalizing the system of social sciences runs into

the problem of the principles of the strict precision (exactness) of numerical methods (mathematical and logical procedures) which are the basis of precise (exact) computer algorithms. In order to model the real-world systems, it is necessary to choose unconventional (non-numerical) methods which are able to work with uncertainty and ambiguity, and include procedures which allow formalizing and using these properties effectively.

In the paper, we want to show the possibilities of using non-numerical methods for evaluating the behaviour of economic entities. The mission of the paper, therefore, is not a methodical instruction on how to use the presented fuzzy-logic expert system in practice. We present its philosophy, structure, and principles. Its function is presented by computer simulations using appropriately chosen input data. When designing the system for determining the impact of activities of economic entities on the social system, we will lean on the normative scientific approach which uses assessments to determine the different types of microeconomic policies or to prepare and make the adjusted statutory standards. "Normative economics is the investigation assessing the evidence. It deals with the issue from the perspective of what it should be. It assesses the investigated fact based on certain assessment values and criteria. It compares an existing state with an ideal (target) state and gives normative evidence about the differences." (Maaytová, Ochrana *et al.*, 2015). With its help, the goals, interests and motives of economic entities and the entire society will be characterized and so can the changes in their behaviour and thus the behaviour of the entire economic system can be analyzed.

MATERIALS AND METHODS

The hierarchical fuzzy logic/probability system for determining social effects of the activities of economic entities

The aim of the publication is the proposal of the software computer system which comprehensively and objectively evaluates the impact of the activities of economic entities on the social environment, in which they are included, by means of the abstract models.

The determination of the impact of production and non-production activities of economic entities on the social environment is performed using the progressive incorporation of each of the evaluation criteria to evaluation modules for the determination of partial results. Partial results become the criteria for the determination of final results.

This method allows using the hierarchical computing structure, each level of which represents modules for the determination of partial results which become the aggregated criteria (inputs) for the next hierarchical level. This solution brings a number of advantages. In particular, they are the subdivision of the entire system into component subsystems (modules), simplification of the design and tuning of transformational models, openness of the system, and possibility to flexibly add further modules when eventually expanding the task.

The modelled system is not only a complex system which involves a number of difficultly mathematically defined links and functions but, thanks to the significant incorporation of the human factor, it is also a typical uncertain system. The transformation of the input criteria (input module variables) to the output criteria (output module variables) is performed using non-numerical structures which fall under the technology of artificial intelligence. The rule-based linguistic models which use the (natural) uncertainties of input variables for increasing the quality of inferred output variables are the core of these non-numerical structures (expert subsystems). Either fuzzy logic inference mechanisms or inference algorithms which are based on the principles of non-conventional probability are the transformational algorithms (Pokorný a kol., 2014).

Numerical (data) input criteria (input variables) of the module of each hierarchical level can be measured directly or calculated as evaluation criteria y in blocks of the arrangement of data

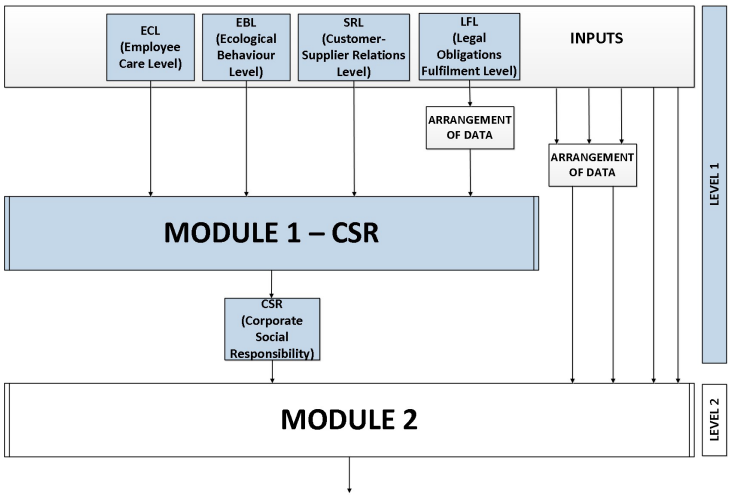
$$y = f(x_1,\ldots,x_m).$$

Linguistic models allow quantifying the (uncertain) input variables either by using linguistic quantifiers such as "not much, moderately, much" (fuzzy logic models), or the expert evaluation of the current numerical input values by probabilistic degrees (probability models). The system contains fuzzy stochastic computing blocks which allow the mutual exchange of information between the two types of models.

Fig. 1 represents the general scheme of the proposed hierarchical system for determining the impact of the activities of economic entities on the society. The colour tinted blocks (see Fig. 1) illustrate the function of the first level of inference. It is the probabilistic module 1 – CSR which is intended to determine the level of the corporate social responsibility of the entity as the first partial result of the impact of economic entities on the social system. The CSR module is described in the following chapter.

The fuzzy logic module for the determination of the CSR

CSR is an internationally used abbreviation of the English name of the Corporate Social Responsibility, from which the Czech name "společenská odpovědnost firmy" was derived. This is the extensively used concept which names the responsive behaviour of economic entities towards the wider social environment (one of the so-called permanent sustainability concepts).



1: *The general scheme of the hierarchical system*
Source: own creation

Both in sources of information and in practice, the CSR is defined differently. The initial thought is that any kind of organization is not an isolated unit but a part of a wider system of relations within the society and, as a result, its prosperity depends on the health of the surrounding society and on its perception by it. In its key document which specifies CSR for the Member countries, the European Union defines the CSR as: "... a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis..." (CoEC, 2001). It particularizes the definition by the statement that the fulfilment of legal obligations is a prerequisite for considering an organization socially responsible which means that "... being socially responsible means not only fulfilling legal expectations, but also going beyond compliance" (CoEC, 2001). The definition of CSR as the behaviour of organizations which respect their legal obligations and do not violate them, and yet set up as socially responsible by their activities beyond the frame are a part of definitions of classics, such as e.g. J. I. Campbell, A. McWilliams, D. Siegel (Pokorná, 2012). Not only the cited source mentions the main characteristic feature of the CSR which is the acceptance of undertakings that, in essence, go beyond the legal obligations of the organization. This is how responsible organizations voluntarily decide to do even what is not directly ordered by law. Members of the platform Business for the Society who are the main authority of both the CSR initiative in Europe and the most numerous platform bringing together responsible entities in the Czech Republic respect the uniform approach "… an ethical approach to the management of entities, respect to the needs of the entity, employees, customers, partners, and thoughtfulness of the environment" (Byznys pro společnost, 2016). The same source expands the explanation of the CSR meaning to the concept in practice. Organizations which have adopted the CSR voluntarily establish high ethical standards, try to minimize negative impacts on the environment, cultivate good relations with employees and the surrounding society, and support the region, in which they operate. Such organizations are bearers of positive trends. They help to change the environment as a whole, differ from the competition, become not only the desired partner to the like-minded organizations but also the attractive employer or business partner. According to the renewed EU strategy in the field of CSR (EC, 2011), corporate social responsibility of enterprises nowadays includes in particular activities in the field of human rights, work and maintaining employment, equality between women and men, activities in the field of the environment, i.e. the climate change, resource efficiency, pollution prevention as well as activities to combat bribery and corruption. It also includes issues such as the participation and development of local communities, integration of disabled people, and interests of consumers, including the protection of privacy.

In addition to the main definitions of CSR, the current issues which focus CSR on other directions are emerging and accented. Among the reasons for CSR of enterprises, the renewed strategy lists the benefits in terms of risk management, cost saving, access to capital, and innovation capacity. Among the benefits for society, the strategy highlights both the private sector operators who provide public services and mitigating the social effects of the current economic crisis, including job losses. (EC, 2011)

On the basis of examples of ways the CSR issue has been defined, the opinion of many cited authors that the CSR has been for the moment still discussed and inaccurately defined can be only confirmed. At the same time, it is possible to admit that the inaccurateness of the definition is in the interest

of organizations which want to keep the space for its widest and the most flexible application.

Despite the above-described inaccuracy, features which describe and homogeneously characterize the general definition of the CSR can be monitored. The CSR has its main characteristics. Within them, we do not deny that, by acting socially responsible, the organization seeks to maximize its profits. By trying to stay in a challenging competitive environment of the market, it needs to comply with the requirements of the society which gives the possibility of its existence. However, the concept of the CSR is used to describe the overall approach to the entrepreneurship and specific activities which benefit the society as a whole. It manifests itself in the approach and method of fulfilling the activities which are connected to the main objectives of organizations, such as the investment in innovation and new technologies, organic waste management, investment in the training and working conditions of employees, customer-supplier relations.

The issue of the CSR is most commonly interpreted by authors of the theory and practice of the CSR in the form of three main areas of responsibility – pillars (International CSR measurement methodologies Global Reporting Initiative – GRI, Down Jones Sustainability Index – DJSI or FTSE4GOOD). The CSR can be defined as the activities and entrepreneurship which have their own economic field of activities and manifestations (often referred to as governance), such as the transparency in the entrepreneurship, rejection of the corruption, loyalty programmes for clients, preference of local suppliers, selection of business partners according to their approach to employees and environs, etc. The social field of activities focuses on the respect of equal opportunities, human rights, creation of conditions for the development of health and safety, development and training of employees, philanthropy, dialogue with stakeholders, "work-life balance", involvement of employees in social activities. The environmental part of the responsibility, i.e. the area of the environmental policy of organizations, deals with the reduction of the impact of activities of economic entities on the environment and protection of natural resources.

The fuzzy logic modelling and inference

Our fuzzy logic module for detecting activities in the area of the CSR assesses the behaviour of economic entities from four points of view. We consider three major responsibilities of the entity – pillars (the social pillar, the economic pillar, and the environmental pillar), to which we assigned the legal responsibility. We consider fulfilment of legal obligations the basic monitored parameter of the organization, since we work on the assumption that the organization which does not obey valid laws is not socially responsible (within the meaning of CoEC: GREEN PAPER and opinions of classics of CSR).

Those areas are expressed in the module using four input variables – ECL (the employee care level) – SRL (the customer-supplier relations level), – EBL (the ecological behaviour level) – LFL (the fulfilment of legal obligations level). The output of the fuzzy logic module is the CSR (the corporate social responsibility) value.

The fuzzy logic module simulates the decision-making activities of the expert in the area of the CSR in determining the level of the social responsibility of the entity. It uses knowledge which was adopted from the expert. This knowledge is the basis of linguistic models and is represented in the form of rules. The experience shows that any human knowledge can be expressed using the linguistic rules of IF-THEN type. These rules have the form (Novák, Perfilieva, Dvořák, 2016).

IF *(assumption 1), and (assumption 2) and ... and (assumption n)* THEN *(inference)*

Assumptions and the resulting inference are expressed using words of the natural language. The rule of the CSR fuzzy model is the example

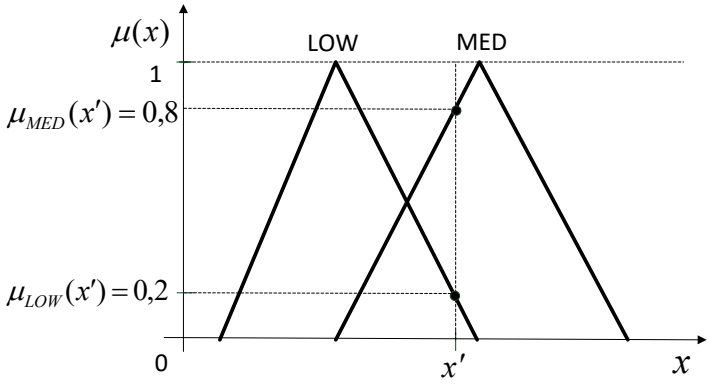
IF (ECL is LOW) and (SRL is LOW) and (EBL is LOW) and (LFL is LOW)

THEN (CSR is LOW) (1)

Linguistic quantifiers (verbal, non-numerical) LOW, MEDIUM, and HIGH are uncertain and vague. The important thing is that the software system has to use this uncertainty as effectively as the human expert.

The first problem is connected to the computer representation of the value of vague linguistic quantifiers. Fuzzy logic approaches use fuzzy sets (Novák, Perfilieva, Dvořák, 2016) for this representation. In the ordinary set theory, the element x either belongs to the set A absolutely (the degree of its membership to the set) or absolutely not ($\mu_A(x)=0$). However, the fuzzy set theory admits the partial membership, when $\mu_A(x)\in\langle 0,1\rangle$. So, the element of the universe can simultaneously belong to more fuzzy sets. This way, it is possible to formalize the fact that, for example, the value of ECL marked with (x') is neither LOW, nor MEDIUM but rather MEDIUM. If the linguistic values of LOW and MEDIUM are formalized by fuzzy sets, then the value (x′) belongs to both of them. However, it belongs to the MEDIUM fuzzy set with a greater degree of the membership ($\mu_{LOW}(x')=0{,}20$ a $\mu_{MED}(x')=0{,}80$). This situation is shown in Fig. 2. Membership functions of the linguistic values LOW and MEDIUM are approximated by the triangular polygonal chain.

The second problem of the computational formalization of the mental model of the expert is the issue of the algorithm which, after operating with the linguistic model (the knowledge base) and



2: *The membership of the element x′ in two fuzzy sets LOW and MED* (linguistic values LOW and MEDIUM)
Source: own creation

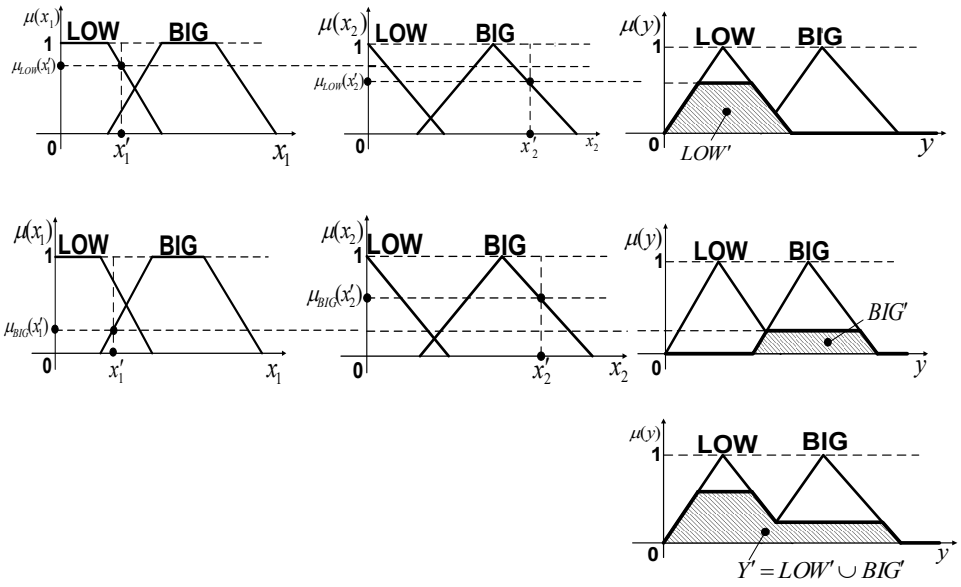
taking into account the data for a particular case (the data base), will make the same inference as the expert. The multi-valued fuzzy logic (Novák, Perfilieva, Dvořák, 2016) is the theoretical basis for such algorithms (inference mechanisms). In the system of the CSR expert module, the Mamdani inference mechanism, the function of which is shown graphically in Fig. 2, is used. The following example considers the simple fuzzy model with two rules

R_1: IF(x_1 is LOW) and (x_2 is BIG) THEN (y is LOW)

R_2: IF(x_1 is BIG) and (x_2 is BIG) THEN (y is BIG)

Fuzzy assertions about the size of the input variables x_1 and x_2 are registered in the left part of rules (the antecedent). Fuzzy assertions about the corresponding size of the output variable y are registered in the right part of rules. After assigning the current values x'_1 and x'_2, the algorithm will determine the degree of their membership to the fuzzy set in the rule, for example, the values $\mu_{LOW}(x'_1)$ and $\mu_{BIG}(x'_2)$ for the rule R_1 (the procedure of fuzzification of input values). The smallest of them limits the corresponding fuzzy set in the right part of the rule (the consequent), i.e. the fuzzy set LOW. So, the fuzzy set LOW′ is the result of the evaluation of the rule R_1. Similarly, the fuzzy set BIG′ is the result of the evaluation of the rule R_2. The fuzzy set which membership function Y′ is determined by the sum of the sets LOW′ and BIG′, i.e. $Y' = LOW' \cup BIG'$ is the global result of the evaluation of the two rules.

The verbal interpretation of results can be written in the form: Y is neither LOW (small), nor BIG (large) but rather LOW (small). The numeric form of the result is the coordinate of the plane centre under the Y′ function (the procedure of defuzzification of the output fuzzy set), (Pokorný, Krišová, 2011).



3: *The graphical form of the Mamdani inference*
Source: own creation

Practical inferences of the CSR model are listed in the simulation description.

The Interpretation of the rule creation approach

Individual rules are formulated by the expert on the basis of their mental model. As far as the CSR model rules are concerned, the following principles are taken into consideration.

- The organization is legally responsible if it fulfils legal obligations connected to activities of the particular legal entity. Among these legal obligations belong organization activities such as the due publishing of information about the organization given by law, incorruptible behaviour, due fulfilment of tax obligations, complying with the Labour Code, complying with legal obligations in the field of ecology. Fulfilling legal obligations (the LFL variable) is considered a fundamental monitored parameter of the organization, as we assume from the prerequisite that if the organization does not obey valid laws (LFL = 0), it is not socially responsible and the CSR value is preconfigured to CSR = 0. This procedure will be realized outside the linguistic model in the DATA ARRANGEMENT block.
- The organization is socially responsible if it follows legal regulations (the LFL variable) and apart from this, above the duties, it takes care of its employees, invests in their education and above-standard working conditions, evaluates the compliance with equal opportunities and human rights in general, is interested in the work-life balance of employees, enables the employees to take part in social activities and that is how it reinforces the mutual solidarity of people in the region where it resides and advocates the so-called Good Corporate Citizenship policy (the ECL variable).
- The organization is ecologically responsible if it follows legal regulations concerning the environment protection (the LFL variable) and also behaves in an ecological manner even above the standard legal obligations in order to lower the impacts of its activity on the environment. Furthermore, it invests in ecological activities and also in technologies which provably save energy and natural resources (the EBL variable).
- The organization is economically responsible if it follows legal regulations (the LFL variable), and besides this, above the obligatory standard, it for example actively proves its incorruptible behaviour and publishes more information than the law requires. Furthermore, it builds fair customer-supplier relations (the SRL variable), i.e. the quality product for the customer, maximum service in favour of the customer, fair attitude to competitors, preferring local suppliers, choosing business partners according to their attitude to employees and environs, caring for customer life quality, etc.

The linguistic fuzzy logic model of the CSR expert module

The fuzzy model determining the corporate social responsibility includes four input linguistic variables

Employee Care Level	*ECL*
Ecological Behaviour Level	*EBL*
Customer-Supplier Relations Level	*SRL*
Legal Obligations Fulfilment Level	*LFL*

with identical linguistic values

Low – LOW, Medium – MED, High – HGH

The fuzzy model output variable

Corporate Social Responsibility	*CSR*

with linguistic values

Very Low – VLO, Low – LOW, Satisfactory – SAT, Good – GOD, Increased – INC, High – HGH

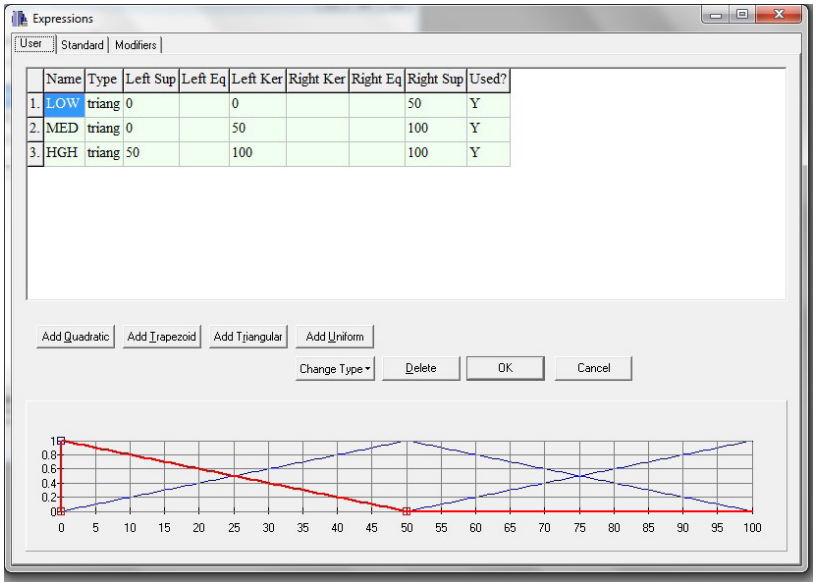
The linguistic model is represented by a collection of 81 rules of the IF-THEN type. The fragment of its five rules is described in Tab. I.

The computational formalization of the linguistic fuzzy model is realized in the development environment of a shell expert system and is described in the following chapter.

I: *The fragment of rules of the linguistic model's SR knowledge base*

IF (ECL is LOW) and (EBL is LOW) and (SRL is LOW) and (UPR is LOW) THEN (CSR is VLO)
or
IF (ECL is LOW) and (EBL is LOW) and (SRL is LOW) and (UPR is MED) THEN (CSR is VLO)
or
IF (ECL is LOW) and (EBL is LOW) and (SRL is LOW) and (UPR is HGH) THEN (CSR is LOW)
or
IF (ECL is LOW) and (EBL is LOW) and (SRL is MED) and (UPR is LOW) THEN (CSR is VLO
or
IF (ECL is LOW) and (EBL is LOW) and (SRL is MED) and (UPR is MED) THEN (CSR is LOW)

Source: own creation



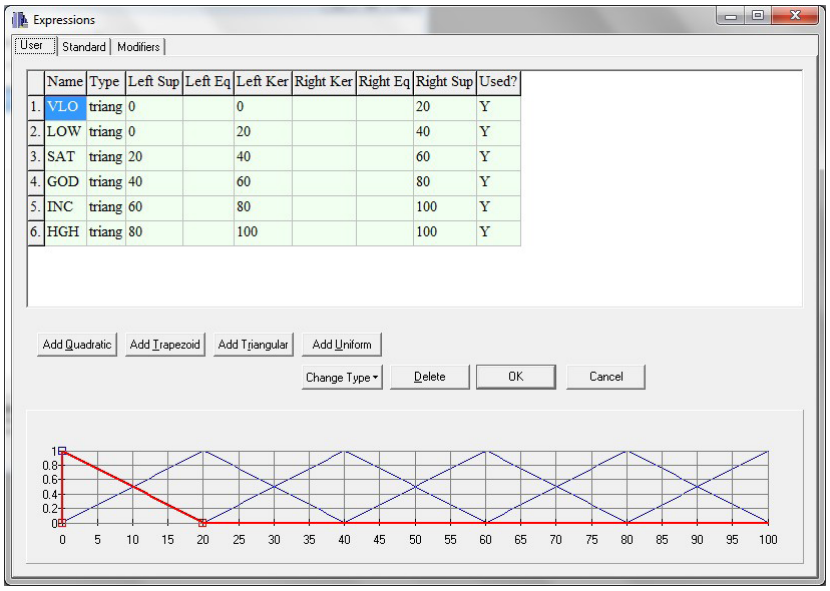
4: *The window for editing linguistic values of input variables*
Source: own creation

RESULTS

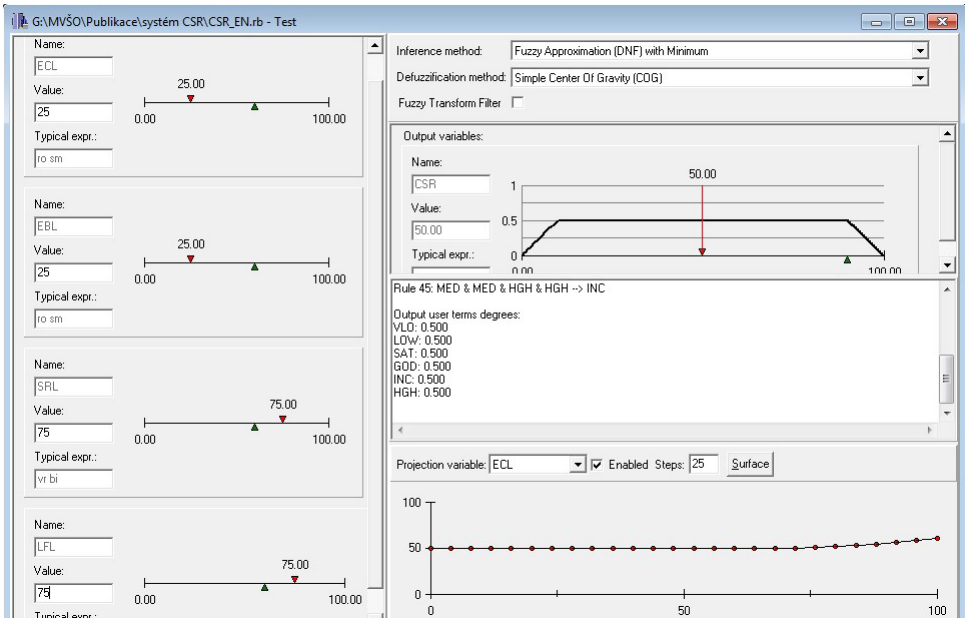
The implementation and simulation of the function of the CSR expert fuzzy module

The fuzzy logic module determining the level of the social responsibility of the economic entity is implemented in the LFLC program development environment v. 2000 (the Linguistic Fuzzy Logic Controller), (Dvořák, Habiballa, Novák, Pavliska, 2004). This shell expert system enables editing, tuning and testing of the IF-THEN type rule-based linguistic models and includes the possibility to choose the inferential and defuzzification algorithm type.

Fuzzy sets of linguistic values of input variables are edited in an interactive window, see Fig. 4. The names of three linguistic values as well as breaking points of their three triangular fuzzy sets are edited. In the bottom part of the window, there are membership functions of these fuzzy sets illustrated graphically. Linguistic values are defined in a normed scope of the universe 0–100. Their initiation distribution is equidistant. The names of linguistic values and their fuzzy representation are identical for all five input variables.



5: *The window for editing linguistic values of the output variable*
Source: own creation

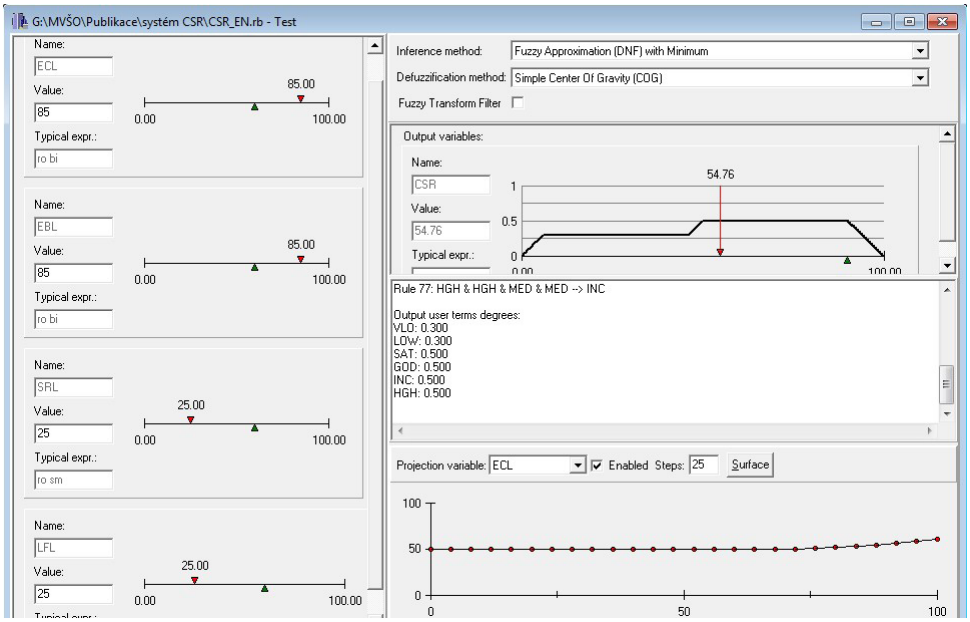


6: *The simulation of the entity with the average CSR value, CSR = 50*
Source: own creation

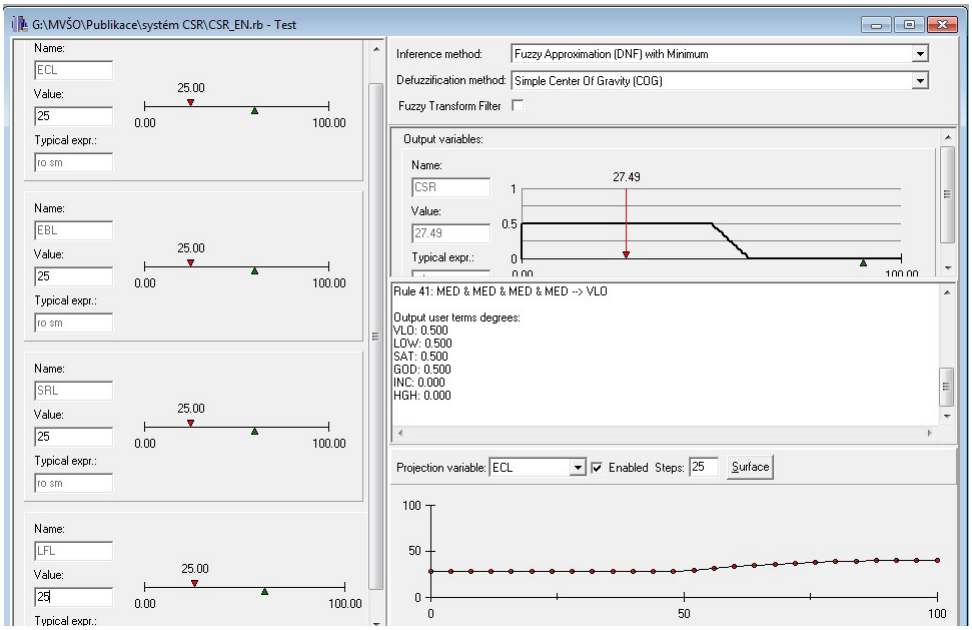
The window for editing the output linguistic variable CSR is shown in Fig. 5. The triangular membership functions of linguistic values of these six variables are defined in the normed universe 0–100. Their initiation distribution is again equidistant.

Simulation verifications of the correctness of the decision-making module function have been performed in simulation windows in Fig. 6 to Fig. 9. On the left, there are tools for entering current values of input variables – numerically or graphically by dragging the cursor. The right top part gives information about the shape of the elicited function of the output variable membership and its defuzzified value. The middle part includes information about the process and result of elicitation, the right bottom part introduces the graphical dependency of the output CSR variable value on the chosen input variable.

In Fig. 8, there is the evaluation of the average entity with the following input values: ECL = 25, EBL = 25, SRL = 75, and LFL = 75. The defuzzified value of CSR = 50.



7: *The simulation of the entity with the above-average CSR value, CSR = 55*
Source: own creation

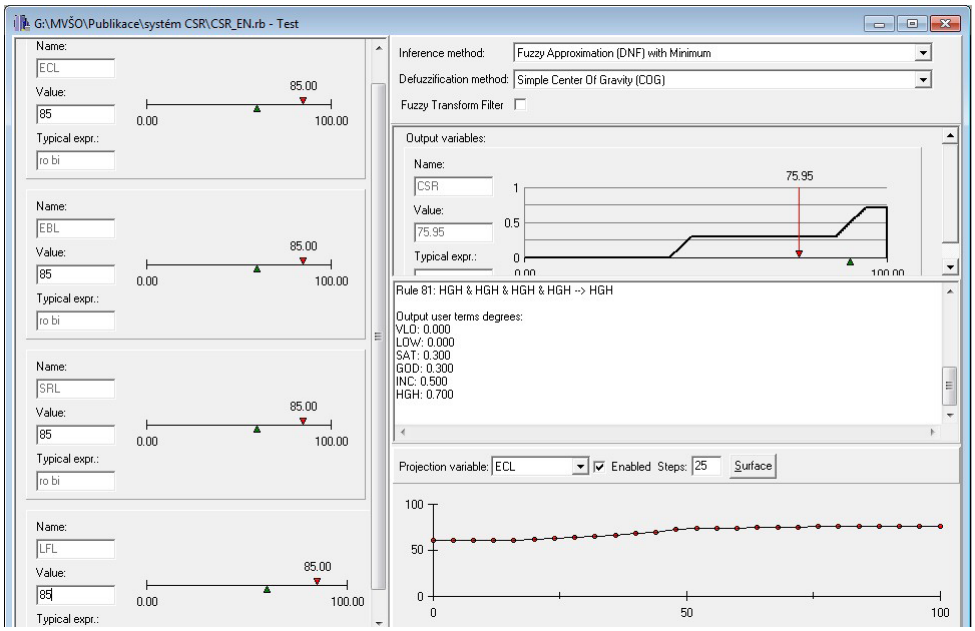


8: *The simulation of the entity with the low CSR value, CSR = 27*
Source: own creation

In Fig. 7, there is the evaluation of the slightly above-average entity with the following input values: ECL = 85, EBL = 85, SRL = 25, and LFL = 25. The defuzzified value of CSR = 55. The shift to higher output values becomes evident also in the shape of the membership function of the CSR output fuzzy set.

In Fig. 8, there is the evaluation of the entity with the low-level social responsibility with the following input values: ECL = 25, EBL = 25, SRL = 25, and LFL = 25. The defuzzified value of CSR = 27. The shift to lower output values is evident also in the shape of the membership function of the CSR output fuzzy set.

In Fig. 9, there is the evaluation of the entity with the high-level social responsibility with the following input values: ECL = 85, EBL = 85, SRL = 85, and LFL = 85. The defuzzified value of CSR = 76. The shift to higher output values is evident also in the shape of the membership function of the CSR output fuzzy set.



9: *The simulation of the entity with the high CSR value, CSR = 76*
Source: own creation

The explanatory mechanism of the system is realized by a list of active rules in the middle part of the right hand-side of the window in Fig. 7 and Fig. 9 (the fragment is visible). In Fig. 6 and Fig. 8, this part of the window is set to present trimming levels of particular membership functions of linguistic values of the output variable.

Simulation calculations have proven the qualitative correctness of the function of the model and its ability to determine the social responsibility level of the entity on the basis of relevant criteria as its input variables.

DISCUSSION

The paper introduces the proposal of the hierarchical expert system which evaluates the impact of economic entities on the social environment. The system core was described in detail – the concept of the corporate social responsibility (level one – see Fig. 1). Four main fields were mentioned – the pillars of the corporate social responsibility; they undoubtedly have an influence on their surrounding environment and the life standard of the society. Individual economic entities fulfil their social activities just within the frame of these pillars, even though they very often do not realize the positive impacts of their behaviour on the society or do not know about them. But if we want to achieve positive changes in the society, it is necessary to begin with every individual, every particular entity in harmony with the idea „think globally, act locally". We all realize that we are a part of the global world and that acts of each individual can have a worldwide dimension. That is why it is necessary that economic entities (small and medium-sized enterprises of a local character) realize the same thing and, at the same time, do not get distant from local current events. They should also be solidary and helpful in their activities, more responsible and frugal towards human resources and nature in general. However, turning the attention to local markets does not mean establishing protectionism or cutting off from the world production. Economic entities of small and medium size have a huge power to contribute to rising basic economic indicators, the local employment and economic growth in particular.

Economic entities can then even create and change business atmosphere of the particular region by their socially responsible behaviour, they can embody a mentor or lecturer for the future economic entities, bring new inspiration and push others to a positive change. Apart from the above-mentioned benefits, we can also mention some others, such as the spontaneity of growth of the small economic entities sector or their function of the "built-in economic stabilizer".

According to the stated facts, the CSR issue has been quickly evolving in the world. This fact, however, does not give any information about how elaborated, transparent or understandable to all its users has the CSR issue been. The practical usage in the CR shows a number of distorted and mostly narrowed opinions on the CSR concept including the unfamiliarity with the concept. The result of the practical reality is that organizations in the Czech Republic create a heterogeneous spectrum in their attitude to the social responsibility. On the one hand, there are organizations which perform CSR at the level of current worldwide standards, they have their own detached CSR manager, the mutual relations between profit and non-profit organizations are elaborated, by means of which the profit organizations exercise all their donations. They also introduce solutions of the most topical problems of the current society (some organizations only schematically memorize phrases and models taken over from abroad without deeper knowledge of the issue). On the other side, there are organizations, the owners and managers of which have not met the CSR concept yet, neither have they any interest in getting to know it and yet they act beneficially to their environs since it arises from their natural feeling of solidarity. However, there exist organizations which act on the borderline of legality, they make use of gaps in law or rely on the difficulty of proving and holding them liable for some illegal procedures. Other organizations calculatedly spread a positive image of themselves in public via CSR activities and reports which represent an appropriate PR. There exist organizations with the high level of social responsibility that do not provide any information about themselves, even though they could be examples for others. The difference of attitudes to CSR and CSR awareness is not always determined by whether they are big multinational institutions, corporations with the international participation in management, or if they are locally operating institutions and small and medium-sized organizations (see the current membership base of the Business for the society platform). The proposed hierarchical expert system based on linguistic models formulable/definable by the CSR expert can be a suitable evaluative tool for various economic entities in such a reality which is hard to predict.

Scientific efforts to express all phenomena, processes, and even feelings by a number, mathematical equation or mathematical model displace the so-called "soft" incalculable values. Highly sophisticated scientific models based entirely on hard data often do not work in practice. That is why including the CSR in the macroeconomic theory is a matter of development, it concerns more the philosophical and verbal side of economics rather than exercising the mathematical evidence, because it includes the moral evaluation. As it has been proven, the proposed model elicits correct results and gives a chance to process incalculable facts and phenomena. This model reviews the behaviour of economic entities from four points of view. However, these fields are not comprehensive and their number is not final. We have considered

this fact as well, since the proposed model has a developing character, input variables and rules can be broadened and changed on the basis of using the expert's knowledge, verbal description of these variables, and their linguistic valuation by scales, measures or levels of fulfilling the given criterion.

It can be assumed that using the fuzzy logic model in practice will bring the possibility to visualize the economic reality and its uncertainty in the form of an output or effect which is easier to understand and, at the same time, is applicable at the macroeconomic level. Macroeconomics as a whole behaves in such a way in which its individual elements act, and its economic power is in fact a sum of the behaviour and performance of economic entities. The output of the linguistic fuzzy logic model is not only the membership function of the output variable fuzzy set (suitable for a verbal interpretation of the result) but also a proper numerical representation as a result of its defuzzification. Such numerical information is suitable not only for the mutual objective comparison of entities among each other but also mainly as an appropriate entrance to another level of evaluating the macroeconomic impacts in the subsequent hierarchical models.

The fuzzy logic model enables to differentiate, know and anticipate the behaviour and performance in the form of the precise (numerical) degree of membership of individual economic entities in various fields (that we have set, chosen). The correct determination of the values of its input variables is an important prerequisite for the accuracy of the functions of the model. Methods of preparing input data are absolutely dependent on the specific operational technologies of the specific economic entity. We assume that the typical case is entering the input values in their numeric form. The system user then has two options. If the input variable can be defined as a numeric value with a specific dimension (CZK, absolute or relative numbers for a specific period, etc.), then the results of statistical analyses can be used. The dimensions of universals of input variables then must correspond to such a solution. In cases when a quantity with a dimension is unavailable, a specific value of input depends on the expert assessment of the user. The form of standardized inputs (e.g., interval 0–100, as in our case) then can be used, and the numeric value in this range can be estimated in a qualified way. The output of the system – the determined value of CSR – is, in our case, solved by a standardized way. The described model of such combination of input variables is currently a part of the solution of the innovation voucher "Index of socially responsible behaviour" CZ.01.1.02/0:0/0.0/16_045/0007362 which is focused on the formation of the self-assessing tool for determining the index of CSR which will combine the data gained from an expert on CSR in an organization with data collected online in verbal and numeric form which are expressed in the assigned values (the source document for the creation of the tool).

On the basis of model computer simulations, it is possible to anticipate to a certain level the behaviour of the whole economy and take notice of the so far unseizable and incalculable values and include them in the macroeconomic development. Macroeconomic predictions based on the ascertained results could be much more reliable than those which have so far stemmed from the so-called "hard" indicators.

Furthermore, any attempts to improve macroeconomic and social environments by the "top-down" approach often fail and do not influence the microeconomic level in the desirable manner. The realization of changes at a local or municipal level has seemed to be both more useful and efficient. The qualitative output (the fuzzy set) or quantitative output (the defuzzified proper numerical value) of the expert CSR module gives the chance to assess the potential of possibly increasing the social responsibility of the particular examined entity (organization, region) at the local level. This is how the participating entities will realize both the importance and impacts of their behaviour in relation to the whole economy and society much faster and to a larger extent. Simultaneously, we can anticipate positive changes in the performance and state of the entire macroeconomic environment, in which the microeconomic entities perform their activities. The importance and benefit of (verbal) mapping the level of the behaviour of economic entities via the model we have proposed seems absolutely unquestionable and useful in this sense.

CONCLUSION

The proposed fuzzy logic model has been applied to the field of the CSR, it is open and can be easily modified. In the described CSR fields, the number and depth of input variables can be broadened and each of them can be valuated by the measurements of the subjective probability. That enables to constantly make the model more precise, to express more specifically the peculiarities of the individual types of economic entities as well as to process newly emerging activities in the CSR field.

In the paper, we focused only on the CSR model which represents the first level – module 1 in the proposed hierarchical system which determines the impacts of activities of economic entities on the society (see Fig. 1) In other models, it is important to focus on the fields of the behaviour of economic entities such as their business model, innovative approach, or company culture.

The hierarchical system determining the impacts of the activities of economic entities on the society further includes the level of the impacts on the society. This level of the system also has to be determined by further development. The model we have proposed enables this, since various levels of individual modules can be included. They intervene in many fields of the whole social system in mutual interaction and consecutiveness.

The CSR model is the base of the whole hierarchical system, the development of which is the aim of our further scientific work.

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