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PROJECT PRIORITIZING IN A MANUFACTURING – SERVICE ENTERPRISE WITH APPLICATION OF THE FUZZY LOGIC

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Abstract
The article includes presentation of fuzzy numbers application in projects prioritizing at manufacturing and service providing enterprises. The following criteria have been applied as a basis for projects prioritizing analysis in enterprise: NPV index, linked with the enterprise strategic aims, project execution cost, project time, project scope and risk. As the criteria selected were of measurable and non-measurable character in projects prioritizing evaluation, the fuzzy decision making system has been developed, in which a linguistic value has been defined for each criterion of projects prioritizing. Knowledge base has been developed afterwards, presenting cause-effect dependencies in projects prioritizing. Knowledge base consisted of conditional rules. Fuzzy system of decision making in project prioritizing has been developed in MATLAB application.
The decision making fuzzy system established, constitutes an efficient tool for projects prioritizing, on the basis of criteria given and concluding system developed. The obtained analysis results provide basis for the decision making parties to set the projects execution sequences.

Keywords
Priority assignment, project selection, fuzzy systems, fuzzy logic, decision theory, decision support systems.

Introduction

Variability of solutions proposed contemporarily in management as well as an intense economic globalisation, particularly the revolutionary changes in IT issues and technique as such, cause, that production company management in 21st century must be directed towards external environment of business. It should first of all be based on defining the enterprise goals in view of the market and customer requirements. Such situation is most frequently related with execution of complex production and service projects or with simultaneous execution of multiple projects [1, 2]. As may be inferred from research published in the paper by A. Lova, C. Maroto, P. Tormos: *"A multicriteria heuristic method to improve resource allocation in multiproject scheduling"*, over 80% of enterprises execute multi-project ventures. Over 84% of projects performed in enterprises consist of at most fifty activities, and about 95% of projects consist of nearly one hundred ones [3]. Management of such projects is a long lasting and work consuming process. According to K. B. Hass the more complex a project the more difficult it is to be managed [4]. Particularly if a company is to perform several of such orders simultaneously. Then, not only proper approach to project management but also determining their sequence, i.e. prioritizing is significant. Priorities determining in project constitutes an important stage of planning a company activities, as the decision influences efficiency of all projects execution and obtaining profits, both by the enterprise and the customer. The purpose of projects execution sequence is to determine the project ranks according to criteria set by the enterprise. The criteria include mainly: conformity with the company strategy, risk, project complexity, business profits, execution cost, profit and return on investment [5, 6]. Due to the fact that the criteria are very different, it is necessary to select such project prioritization technique which will facilitate determining an optimum project execution sequence. Related to the above place to get the game in the Research Store: What method of prioritization will make it possible to effectively prioritize projects in a multi-project environment. In order to analyze the research problem, the literature analysis was first carried out and then it was assumed that the fuzzy set method, a carefully fuzzy inference system can increase the effectiveness of prioritizing projects in a multi-project environment. This assumption made it necessary to answer the following research question in this article: Can a fuzzy inference system effectively prioritize projects for the adopted criteria?

Literature review

Literature on the subject, includes numerous different methods applied in projects prioritizing. We have included here a group of ad hoc methods, including [7]: forced ranking, voting methods, Delphi method, nominal group technique. These methods are most frequently applied, if a company has no adopted decision making model, regarding prioritizing of projects, and project managers determine projects ranking on the basis of their experience. Another approach in projects priority setting represent comparative methods. They are used for alternative projects comparing. The methods may be very simple, when comparing one project parameter only, or more complex, if several criteria or criteria weighs are compared simultaneously. We should include in them [7–16]: paired comparison, Q-sorts, Analytic Hierarchy Process (AHP) Analytic Network Process (ANP). Financial methods constitute further methods group, very frequently applied in projects prioritizing. In this case, the projects are prioritized on the basis of classical financial indices, such as [5, 17–19]: Net Present Value (NPV), Internal Rate of Return (IRR), Return on Investment (ROI) or payback period. Another project prioritizing method is the method named: weighted sum model. Projects prioritizing takes place by determined criteria and weighs assigned to them [21, 22]. We may also use optimization methods in projects prioritizing, which determine a project priority at certain assumed resource constraints. These methods include: linear programming, non-linear programming, integer programming [21, 23, 24]. Table 1 shows the advantages and disadvantages of the above-mentioned methods.

The methods of projects prioritizing and selection described, constitute less or more complex ones. Selection of a proper prioritizing projects method constitutes one of the key decisions to be made by a company management board. It depends on the information of a decision maker, and the strategic targets of a company. If an enterprise activities are based exclusively on financial results, we may apply financial methods, where financial indices only will be subject to analysis. However, if for a company, apart from the financial aspect, also other criteria are significant, e.g. relating a project with the company strategy, scope of a project, we should apply, multicriteria methods.

The article includes presentation of projects prioritizing method, using multi-criterion approach, as it was recognized that prioritizing projects on the basis of one criterion only may be less effective. The following criteria have been selected for projects priorities evaluation: NPV index, linked with the enterprise strategic aims, project execution cost, project time, project scope and risk. As the criteria selected were of measurable and non-measurable character in projects prioritizing evaluation, the fuzzy decision making system has been developed, in which a linguistic value has been defined for each criterion of projects prioritizing. Knowledge base has been developed afterwards, presenting cause-effect dependencies in projects prioritizing. Fuzzy system of decision making in project prioritizing has been developed in MATLAB application.

Adopting such an approach to prioritization seems right, because taking into account several criteria when determining the order of projects that are financial and non-financial, a multi-criteria method should be chosen. As we know, AHP-type methods have disadvantages (see Table 1), in particular regarding the necessity to perform multiple comparisons of criteria, which makes the method laborious. Therefore, a fuzzy system of prioritizing projects built in MATLAB was proposed, because after determining the appropriate weights for the criteria and the value of the criteria by the entrepreneur, it is possible to quickly determine the order of project implementation. Moreover, the above assumptions may contribute to a positive answer to the research question.

Table 1
Summary of advantages and disadvantages of selected methods of prioritizing projects.

Methods of prioritizing projects	Advantages of the methods	Disadvantages of the methods
Ad hoc methods	• prioritizing projects is based on independent opinions and knowledge of specialists/expert, • the order of projects is established on the basis of the sum of opinions of specialists/expert, • no input required to make a decision.	• prioritizing projects takes place in several stages, which makes the process laborious, • necessity to involve highly qualified and experienced specialists/experts, • prioritizing projects is based solely on the experience and knowledge of experts.
Comparative and multi-criteria methods	• priority of projects is made on the basis of data and adopted criteria, • possibility to take into account qualitative and quantitative criteria, • possibility to include criteria and sub-criteria.	• reactively small number of estimation methods, • lack of possibility to use own preference matrices and the consistency index, • the method is time-consuming as many criteria have to be compared.
Financial methods	• prioritizing projects is based on a selected financial indicator, e.g. NPV, ROI, etc. • the order of projects depends only on one criterion.	• the method is labor-intensive because it requires forecasting the elements that are needed to calculate the indicators, • the method requires a lot of data, • project prioritization is made on the basis of one criterion.
Weighted sum model methods	• the methods are simple to apply, • prioritizing projects is made on the basis of many criteria to which appropriate points and weights are assigned.	• difficulties with selecting appropriate weights for individual criteria, • need to convert priority conditions.
Optimization methods	• prioritizing projects is based on the adopted mathematical model, • the order of projects depends on the adopted optimization criterion.	• data must be numerically, • limiting the use of the method only for quantitative criteria.

Methods

Literature analysis indicates, that multi-criterion approach, used in projects prioritizing, constitutes one of the most accurate methods. In particular, if we extend it, application of fuzzy logic [25]. An attempt has therefore been made, to construct a fuzzy system in MATLAB, which facilitates determining of a given project priority in multi-project environment.

Fuzzy logic theory

Fuzzy logic, is applied in reality description, in a manner imitating human reasoning. The fuzziness purpose is to overcome defects of traditional computer algorithms, which fail in particular in situations when humans are capable to solve a problem without major difficulties [26]. In real world, numerous phenomena are described in an imprecise manner. It is expressed by statements such as e.g. 'high, 'average', 'low' etc. People are capable of interpreting such assertions, to apply the such formulated knowledge in solving problems facing them. Linguistic statements are very difficult to be defined, and their imprecise character is a cause of difficulty in providing accurate determining of all variables values. The problem is based on determining, what the expression 'low' or 'very low' mean. The kind of such lack of precision is called 'fuzziness'. Fuzzy set is defined by a function, with the value of zero or one. The definition of a fuzzy set constitutes a generalization of sharp set, based on adopting a set characteristic function (assignment), obtained apart from extreme values of 0 and 1, also intermediate values [27–30]. Contrary to sharp sets, which constitute only a certain approximation of actual phenomena in the world, fuzzy sets model provide more measurable and accurate modelling of phenomena. Classical theory of sets involve inter alia two laws: non contradictory and off centre law. Each element is included either in a set or in its complementing. It cannot be included in both at the same time. Theory of fuzzy sets assumes, that the element may be included partially in a set and in its complementing. Applying the linguistic variables approach defined as a pattern [31]:

$$\langle x_{\text{name}}, L(x), X, M_x \rangle, \tag{1}$$

where x_{name} – linguistic variable name, $L(x)$ – set of linguistic values of x, i.e. words in natural language (e.g. high, average, low), X – consideration field (e.g.

NPV index for the range 0–40 thousand PLN), M_x – semantic function, assigning to each linguistic value of the set $(L(x))$ a fuzzy set devined over X.

Then, the fuzzy set marked by A in certain X space, may be defined [31, 32]:

$$A = \{(x, \mu_A(x)), x \in X\}, \tag{2}$$

where $\mu_A(x)$ refers to assignment function defined as such X, that $\forall x \in X : \mu_A(x) \to [0, 1]$.

The function constitutes the described semantic function, which reflects ordered considerations at space objects and introduced by linking a certain property with a set [31]. The assignment function results in practice from situation context and is defined by an expert in a subjective manner. The most frequently applied dependencies include section-linear functions (triangular, trapezoid, rectangular functions), in such situation the decision requires low amount of information. As mathematic representation of intuitive assignment functions, more complex functions are applied, i.e. symmetric and non-symmetric Gauss functions, i.e. the bell functions. Fuzzy sets function is applied in many phenomena, both in information technology and economic ones [28, 31–48]. The article includes a presentation of a non-technical example of fuzzy sets application in prioritizing projects in multi-project environment. Application of fuzzy numbers is deliberate, as some of the criteria applied in projects prioritizing are characterized by a subjective evaluation by experts (in this case the Company Management Board). Which increases difficulty of measurable and non-measurable values comparison. The phenomenon under analysis included the following measurable criteria (NPV index, time, cost, scope), which are expressed by numbers and non-measurable ondx (relation with the company strategy, risk), which are evaluated by experts in a subjective manner.

Projects fuzzy prioritizing system in multi-project environment

The decision making fuzzy system based on approximate conclusions consists of four basic components: fuzzy block, rule knowledge base with linguistic values data base, fuzzy concluding block, and sharpening block. The system structure with relations between its elements has been presented in Fig. 1.

Fuzzy block constitutes the first stage of decision mechanism. Input data are replaced at this stage from quantity field, which constitute evaluation parameters values, to quality ones, represented by fuzzy sets. Fuzziness is obtained by assignment functions defined in database. The values calculated at the output, inform about the level of assignment of inputs to individual fuzzy sets. Knowledge base consists of two main elements: linguistic data base, and rules base, which include field knowledge, significant for a given problem. In case of management problems, we most frequently encounter difficulty in digital experiment information collection, on the basis of which a knowledge base might be formed. In view of that, it is necessary to model using expert knowledge and rules governing a given phenomenon. The first element deals with determining of linguistic variables by an expert and the values representing the variables. The values provide basis for linguistic data base. Cause and effect interdependencies of inputs and outputs, which lead to concluding on the system responses are recorded as rules. In case of Mamdani-Assilan systems, single rule in the rule base may be as follows [30]:

$$\text{If (NPV is LOW) and (WEIGHT NPV is LOW)} \\ \text{then PROJECT PRIORITY is LOW.} \tag{3}$$

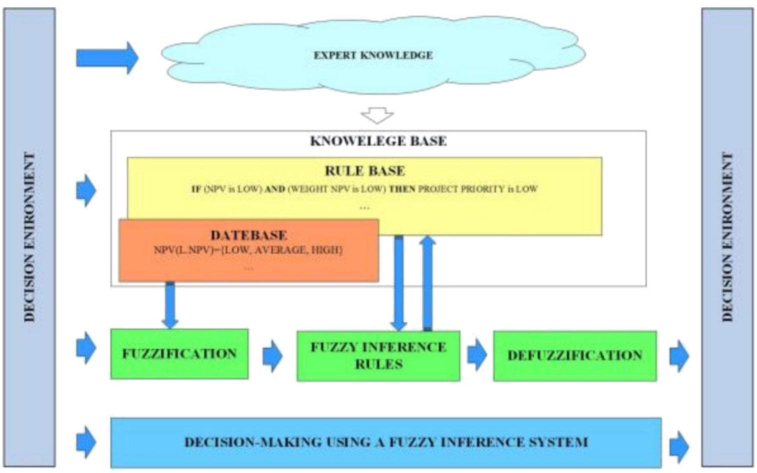

Fig. 1. Structure of concluding fuzzy system. Source: compiled on the basis of [49].

Inference block uses knowledge base and the methods implemented, to solve the problem posed. In case of higher number of rules in knowledge base, the assignment result functions for all rules are aggregated, to obtain the final assignment function.

Defuzzification block on the basis of result assignment function, calculates sharp (non-fuzzy) ultimate model value, which provides a response to advisory system. There are numerous methods of sharpening [26, 46–48] with the most frequently applied method of centre of gravity (COG). This method was used in a fuzzy project prioritization system in a multi-project environment. The results for the discrete space of variables were determined on the basis of the relationship:

$$y^* = \frac{\sum_{i=1}^{m} y_i \cdot \mu_i}{\sum_{i=1}^{m} \mu_i}, \tag{4}$$

where y_i – constitutes i-th project priority value (value of the output variable), μ_i – output value of assignment function for the i-th variable value, m – number of discreet values of output variable value.

In addition, several assumptions were made in the fuzzy system of prioritizing projects in a multi-project environment. The first assumption concerns the adopted criteria for determining the order of projects. In the presented system, it was assumed that the project priority depends on the following criteria: NPV ratio, implementation costs, project duration, project risk, project scope and connection with the company's strategy. The next assumptions concerned the expected values of the adopted criteria for project prioritization. It was assumed that the enterprise aims to maximize profits, i.e. to maximize the NPV value, minimize costs and project implementation time. In addition, the company wants to implement projects that are burdened with the lowest possible risk. At the same time, enterprises want to complete the project as soon as possible, so they will first consider implementing projects with a low degree of complexity, i.e. a smaller scope for implementation. Moreover, it was assumed that each criterion may have a different meaning when prioritizing projects. Therefore, the linguistic variables for each criterion and criterion weights are presented below. In Table 2 presents the knowledge base on the basis of which 54 inference rules in MATLAB were built.

Table 2
Projects prioritizing system knowledge base.

Assessment of the project priority				
Weight of NPV		*LOW*	*AVERAGE*	*HIGH*
Value of the NPV indicator	*LOW*	LOW	LOW	AVERAGE
	AVERAGE	LOW	AVERAGE	HIGH
	HIGH	LOW	HIGH	HIGH
Weight of costs		*LOW*	*AVERAGE*	*HIGH*
Value of project costs	*LOW*	AVERAGE	HIGH	HIGH
	AVERAGE	AVERAGE	AVERAGE	HIGH
	HIGH	AVERAGE	LOW	LOW
Weight of time		*LOW*	*AVERAGE*	*HIGH*
The duration of the project	*SHORT*	AVERAGE	HIGH	HIGH
	AVERAGE	AVERAGE	AVERAGE	LOW
	LONG	AVERAGE	LOW	LOW
Weight of risk		*LOW*	*AVERAGE*	*HIGH*
Project risk assessment	*LOW*	AVERAGE	HIGH	HIGH
	AVERAGE	AVERAGE	AVERAGE	LOW
	HIGH	AVERAGE	LOW	LOW
Weight of scope		*LOW*	*AVERAGE*	*HIGH*
The complexity of the project	*LOW*	AVERAGE	HIGH	HIGH
	AVERAGE	AVERAGE	AVERAGE	LOW
	HIGH	AVERAGE	LOW	LOW
Weight of linking the project with the strategy		*LOW*	*AVERAGE*	*HIGH*
Relationship with the strategy	*LOW*	LOW	LOW	AVERAGE
	AVERAGE	AVERAGE	AVERAGE	HIGH
	HIGH	AVERAGE	HIGH	HIGH

During fuzzy system construction, for prioritizing of projects in multi project environment, the following linguistic input variables have been determined:

1) Selected projects prioritizing criteria:
   - NPV index with values [0–40000 PLN], with linguistic variables: 'low' is a trapezoidal number and takes values such as [−5000, 5000, 10000, 15000], 'average' is a triangular number and takes values of [12000, 17000, 23000], 'high' is a trapezoidal number with values such as [20000, 25000, 30000, 400000],
   - project execution cost in PLN [0–45000], with linguistic variables: 'low' is a trapezoidal number and takes values such as [10000, 15000, 20000, 25000], 'average' is a triangular number and takes values of [22000, 28000 32000], 'high' is a trapezoidal number with values such as [30000, 35000, 40000, 450000],
   - project time in days [0–600], where linguistic variables: 'short' is a trapezoidal number and takes values such as [10, 50, 50, 100], 'average' is a triangular number and takes values of [75, 150, 300], 'long' is a trapezoidal number with values such as [250, 400 500, 600],
   - project risk, determined according to the experts experience (Management Board), with values [0–1], where linguistic variables are triangular numbers, with the following values: 'low' [0.1, 0.2, 0.4], 'average' [0.3, 0.5, 0.7] and 'high' [0.6, 0.8, 1],
   - scope of project (project complexity) with values for project tasks [0–100], where the linguistic values are as follows: 'low' is a trapezoidal number and takes values such as [5, 10, 20, 30], 'average' is a triangular number and takes values of [25, 50, 60], 'high' is a trapezoidal number with values such as [55, 80 90, 100],
   - project linking with the enterprise strategy, the criterion is described by the experts, and gets the value [0–1], where the linguistic variables are triangular numbers with the following values: 'low' [0, 0.2, 0.4], 'average' [0.3, 0.5, 0.7] and 'high' [0.6, 0.8, 1],
2) Weights parameters: NPV index, cost, time, risk, scope and linking the project with company strategy. The parameters constitute evaluation of the projects prioritizing criterion, determined by the evaluation expert as [0–1], where linguistic values constitute triangular values as follows: 'low' [0, 0.2, 0.4], 'average' [0.3, 0.5, 0.7] and 'high' [0.6, 0.8, 1].

Pointwise project priority evaluation of [0–1], constitutes the input linguistic value of evaluation system. The projects prioritizing in multi-project environment, applied the triangular functions for determining the linguistic values: 'low' [0.1, 0.2, 0.4], 'average' [0.3, 0.5, 0.7] and 'high' [0.6, 0.8, 1]. Cause and effect relations in projects prioritizing in multi-project environment, have been based on criteria pairs and weighs (Table 1). Such knowledge base selection is determined by the availability of intuitive determining of fuzzy logic results.

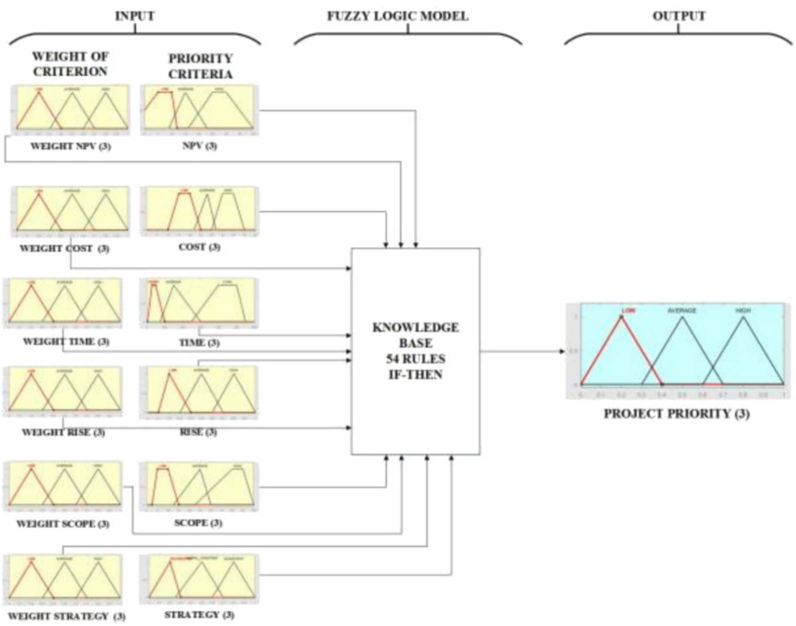

Fig. 2. Structure of concluding system for projects prioritizing in multi-project environment.

The system adopts the assumptions of the MAMDANI model, which is the most natural inference model and the most frequently used in practice. Therefore, it was assumed that:

- the operator at the connectors "AND" in the premises of the rules and as a conjunctive interpretation of these rules is the minimum value,
- the operator of aggregating the results of inference obtained on the basis of individual rules is the maximum value,
- application of the center of gravity method to sharpen the resulting fuzzy set the center of gravity method was adopted.

Results

The developed inference system has been applied for prioritization projects in an enterprise operating in Poland, and which since 1997 has been executing industry automation orders. The company provides services in design and implementing of automation systems and industrial electrical installations for technological installations, production halls and office buildings, machinery, manufacturing and processing equipment, power supply structures and water treatment plants as well as environment protection installations.

The company provides automation systems with applied modern controllers by SIEMENS, GE Fanuc or other manufacturers as indicated by the customer. The company moreover use complex apparatuses and devices, on the basis of products of renowned manufacturers and suppliers. Additionally, apart from automation systems the company workshops produce boxes for control of drives and for distribution of electrical power as well as buildings pneumatic systems. Electrical installations are designed and executed by the company, using modern technologies and equipment of the most known manufacturers.

The enterprise most frequently performs several orders at a time, which causes that persons directly responsible for their execution, deal with problems of orders execution sequence determining. Recently, the company must consider execution of three projects: (1) electrical installation execution in an industrial building (2) execution of a lighting system of buildings and production areas (3) and execution of electrical installation in a water treatment plant.

The first project concerned the installation of an electrical installation in a water treatment plant. It included the implementation of ten main tasks: (1) installation of internal power supply, control and measurement in the building, (2) assembly of the power supply and control switchgear of the technological system, (3) assembly of the RTOO power supply and control switchgear, (4) the internal power supply, control and measurement installation in the field, (5) installation of internal power supply, control and measurement in the filter building, (6) lighting installation in the ozonation room, (7) assembly of a power supply and control switchgear in an ozone station, (8) electrical installation of internal power supply and controller, (9) assembly of supply lines for all switchboards, (10) equalizing installations.

The second project, on the other hand, included the electrical installation in an industrial building. The project consisted of the following tasks to be carried out: (1) power installation, (2) driver installation, (3) lighting installation and (4) ACP and A installations.

The third project is the lighting of buildings and production areas. The project includes the implementation of: (1) underground cable ducting, (2) delivery and assembly of a lighting tower, (3) delivery and assembly of electrical switchboards for industrial facilities and (4) assembly of the entire electrical installation.

To set projects priorities, the concluding system developed in MATLAB has been applied. The Management has set criteria weighs first. It was assumed that the highest weigh will refer to NPV index criterion of weigh (0.4), the half lower (0.2) will refer to project risk, and the remaining criteria weighs which refer to cost, time, scope and relation with strategy will amount to 0.1. The criteria weighs for individual projects have been determined consequently (Table 3).

Table 3
The criteria weighs for individual projects.

Criteria	Project 1	Project 2	Project 3
Value of the NPV indicator [PLN]	30000	20000	25000
Value of project costs [PLN]	35000	20000	30000
The duration of the project [Day]	400	250	300
Project risk assessment	0.5	0.3	0.4
The complexity of the project	50	40	40
Relationship with the strategy	0.5	0.4	0.4

Project priority evaluation simulation has been performed for each project in the concluding system developed in MATLAB.

The first project of electrical installation execution in an industrial building obtained the result 0.628, which indicates, that the project priority is between average and high. As the project NPV gets the linguistic value 'high' in the case under analysis, it becomes advantageous for the company. Cost and time have also the linguistic value 'high', which is however not advantageous for the enterprise, but the criteria are of much lower weigh (0.1), as compared with NPV (0.4). Other criteria are of linguistic value 'average'.

The second project of structures and production systems lighting system execution obtained evaluation of 0.5, which means, that the project is of lower priority than the first one. Due to the fact the company should first execute the first project and then the second one.

The third project of electrical installation execution in the water treatment plant received the best result of 0.65, i.e. it is of the highest priority according to the criteria Fig. 3 presents evaluation of the project on the basis of concluding base, developed in MATLAB.

The project of electrical system execution in water treatment plant is of the highest priority, as the NPV linguistic value, similarly as in case of the first project is 'high'. The project, simultaneously, in comparison with the first one is one at lower cost and execution time and the project risk.

The projects prioritizing research, in the developed fuzzy concluding system, provided The company should first execute the electrical installation execution project in the water treatment plant, second the electrical installation execution project in the industrial building and then the lighting execution project in buildings and manufacturing zones.

The use of the developed fuzzy inference system in the MATLAB program, as it results from the research carried out, allows to determine the optimal order of project implementation in a multi-project environment according to the adopted criteria and their weights. Therefore, a positive answer can be given to the question: Can a fuzzy inference system effectively prioritize projects for the adopted criteria? Moreover, the research problem has been solved as it has been proved that the fuzzy inference system is an effective tool. As the results of the study show, the use of this approach is simple when we have access to the developed system in MATLAB, because it is enough for the company's management board to define the weighting of the criteria and the values of individual criteria. In addition, there is no organic regarding the types of projects to which we can apply a fuzzy inference system, which confirms the correctness of using this solution in practice. However, it should be pointed out that the fuzzy inference system has a limitation in terms of criteria. The following criteria were adopted in the developed system: NPV indicator, implementation costs, project duration, project risk, project scope and connection with the company's strategy. If the company wants to arrange the project according to other criteria, it will be necessary to modify the system.

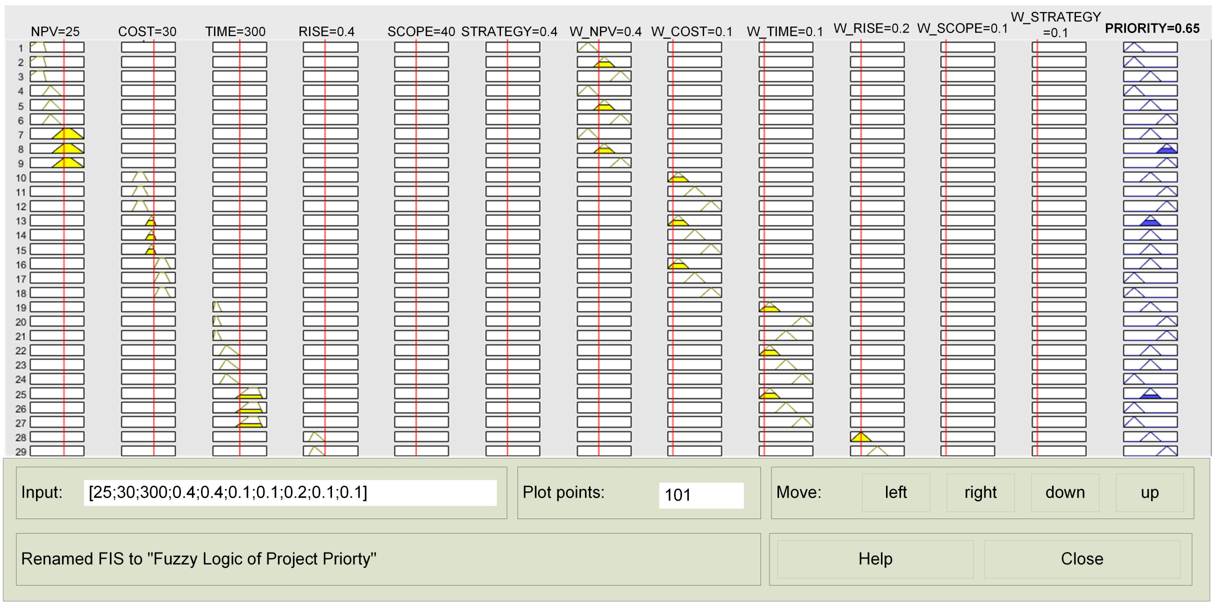

Fig. 3. Evaluation of electrical installation system priority at the water treatment plant in concluding system.

Conclusions

Enterprises performing several single orders should determine the sequence of their execution. Orders prioritizing in manufacturing and service providing enterprises is a very important issue, as resources availability constraints appear frequently. At the decision making on the project execution sequence, financial and beyond financial factors should be considered, such as NPV, cost, project execution time, scope risk and the project linking with the company strategy. In view of the above, it is necessary to apply a problem analysis method which facilitates analysis of quality and quantity value of a criterion. One of such methods may involve application of fuzzy concluding system, facilitating transformation of all values to linguistic values.

The tool developed in MATLAB, for projects prioritizing in multi-project environment, facilitates a fast and efficient method of project priority evaluation based on given criteria and concluding system. Fuzzy concluding system is based on 54 rules, activated during concluding process. The fuzzy concluding system is an efficient tool supporting the project priority evaluation process. The obtained analysis results provide basis for the decision making parties to set the projects execution sequences.

The paper has presented an example of fuzzy concluding system for determining the execution sequence for three projects in a manufacturing – service providing company. The tool performed its designed target, and it has been inferred, that the company should first execute the electrical installation execution project in the water treatment plant, second the electrical installation execution project in the industrial building and then the lighting execution project in buildings and manufacturing zones.

The above facts allow us to conclude that the fuzzy inference system is an effective tool supporting decision making when prioritizing projects for the adopted criteria. Therefore, a positive answer to the research question was obtained: Can a fuzzy inference system effectively prioritize projects for the adopted criteria?

The developed fuzzy project prioritization system can be applied to all types of projects, regardless of the industries in which they are implemented.

Therefore, it is planned to develop soon the concluding system to obtain additional criteria of projects prioritizing and extension of input data of criteria determined, so that the tool developed becomes an universal system supporting decision making process for projects prioritizing in multi project environment.

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