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FUZZY APPROACH TO BUSINESS IMPROVEMENT OF HOLDING EQUIPMENT IN THE CONDITIONS OF DECREASED PRODUCTION RANGE

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Abstract: In recent years, manufacturing industry has been characterised by a decreased production range and a demand for a rapid change of production programs. In such conditions holding equipment costs are considerably larger. In this paper, we review and analyze possible ways of business improvement concerning holding equipment in specific production conditions characterized by the decreased production range and lack of financial sources for applying systems of assembled and disassembled equipment. Classification of elements and group of elements of those systems is performed by applying a new fuzzy ABC method presented in this paper. Selected optimization criteria describe the performance measures of elements and group of elements of assembled and disassembled equipment whereas their relative weights are not the same. It is assumed that the values of imprecise optimization criteria and their relative weights are described by discrete fuzzy numbers. The developed procedure is illustrated by an example with real input data.

Keywords: Assembled and disassembled equipment, fuzzy ABC method, fuzzy data.

1. INTRODUCTION

One of the most important problems in manufacturing is concerned with the use of special holding equipment [10]. The importance of this problem is explained in the following: geometrical accuracy of machining and quality of machined surface depend on holding equipment. Secondly, costs and launching time for new products and production program also depend upon costs, design time and manufacturing time for holding equipment. They are applied in high repetition and mass production. However, even in those conditions, there are many problems of design and manufacturing of the holding equipment.

In conditions of decreased production range, using of special holding equipment is not economically justified because the unit price of a product is increased. In these cases, as well as, in repetition and piece production, applying of assembled and disassembled-modular system of equipment (in further ADMSE) is economically justified. ADMSE are known as BAUCASTEN, UMA (Universal Assemble Tools) and other systems in industry. These ADMSE are characterised by high flexibility and short assembling time. Many problems exist in applying of these ADMSE: (1) lack of financial resources needed for initial investment in this equipment, (2) majority of developed systems of assembling and disassembling equipment are not stable enough; degree of mechanization and automation is not sufficient, (3) assembling of ADMES is complex, specially in cases of complex equipment, which consists of several thousands of standard elements.

Not taking into consideration the analyzed problems in applying of ADMSE, these ADMSE are widely used in industrially developed countries ([15], [16], [17], [18]).

Business problems concerning the holding equipment in manufacturing a decreased production range are significant [11]. Introduction of expensive assembling and disassembling equipment systems is almost impossible, considering the level of the required initial financial investment. The authors suggest gradual introduction of ADMSE into production.

If this approach is adopted, ADMSE should be developed gradually in the firms. Design of ADMSE is based on: (1) maximum use of standard and typical elements and (2) minimum of special- dressed elements. In each construction, participation of special-dressed elements should be smaller. In this way, element base would be gradually filled and in period of several years it would become flexible assembling and disassembling equipment system. The question is which elements and group of elements are the most important with respect to unit prices, flexibility and quantity in flexible systems.

In decreased range industries, which are characteristic for less developed countries, improvement in holding business is attained through gradual replacement of special holding equipment by ADMSE. In the observed business environment, the authors claim that it is necessary to determine the importance of ADMSE, first, and then the supply are carried out by giving priorities to the most important elements. This way of supplying is important from the aspect of the needed financial investments and from the aspect concerning dynamics of transition from special to flexible equipment.

In this paper, ranking problem of elements and group of elements of ADMSE by applying fuzzy ABC method is considered. In the classical ABC method based on Pareto analyses, classification is carried out by respecting one optimization criterion. The values of optimization criterion are deterministic. Also, management judgements have to describe more realistically: by random numbers, fuzzy sets, rough sets, etc. In this paper, modelling of uncertainties is based on the fuzzy set theory. Fuzzy approach is used in the cases where sources of uncertainties and impreciseness of any kind exist.

In literature papers may be found describing the ABC with uncertain data ([4], [7], [12]). In paper [7] management values, unit prices and demand are described by triangular fuzzy numbers. In paper [4], unit prices and volume demand are described by continuous fuzzy numbers whose membership functions are in the shape of parabola and logistic curve, respectively. In both papers ([4], [7]), the single criterion used for making classification is "annual value" and its defuzzification is done in the first step of ABC method. In paper [12] the procedure for classification of different kinds of gasoline is developed by using a fuzzy ABC method.

In this paper we suppose the following:

(1) We consider the problem of classification of elements and group of elements (further called items) from which in the process of assembling different kinds of ADMSE is produced;
(2) The number of items is defined according to expert judgments;
(3) Optimization criteria have different relative importance;
(4) The optimization criteria for each item have imprecise values. The values of uncertain optimization criteria can be described by fuzzy numbers.

This paper is organized in the following way: in Section 2, the problem statement of ranking items is presented. In Section 3, the optimization criteria are defined and values of imprecise optimization criteria are described by discrete fuzzy numbers. Calculation of optimization criteria weights is based on a concept of equal possibilities and it is presented in Section 3. In Section 4, a new approach in ABC classification method is presented. The proposed procedure is illustrated by an example given in Section 5.

2. PROBLEM STATEMENT

The mathematical model for ranking elements of ADMSE is developed under the following assumptions:

1. Generally, we consider different items from which in the process of assembling ADMSE is produced. They are presented by $\text{set} = \{a_1, ..., a_i, ..., a_I\}$, whereas $a_i\ (i = 1, ..., I)$ is the considered item. Total number of considered items is I. Number value I is determined by engineers according to the kind and complexity of the ADMSE.
2. Each item is described by attributes. They are denoted by a set $K = \{1, ..., k, ..., K\}$, of indices of the criteria. Total number of optimization criteria is K. Their values can be either crisp or imprecise. In this paper, three optimization criteria are associated: unit price, flexibility and demand.
3. As it is known, the optimization criteria can be either of the benefit or of the cost type. According to classification, which is given in [13], unit price is a cost criterion. Flexibility and demand are the benefit criteria.
4. In general, the relative importance of each criterion $k \in K$ $w_k \left(k = \overline{1, K}\right)$ is different. There are a number of techniques to assess the weights of optimization criteria [8]. This paper illustrates the use of comparison pair matrix of relative criteria importance. It is assumed that elements of this matrix are discrete fuzzy numbers. The procedure for calculating the optimization criteria weighted vector is presented in Section 3.

The problem of elements' estimate can be represented in a matrix form:

$$
\begin{array}{ccccccc}
 & 1 & \dots & k & \dots & K \\
1 & f_{11} & \dots & f_{1k} & \dots & f_{1K} \\
\dots & \dots & \dots & \dots & \dots & \dots \\
i & f_{i1} & \dots & f_{ik} & \dots & f_{iK} \\
\dots & \dots & \dots & \dots & \dots & \dots \\
I & f_{I1} & \dots & f_{Ik} & \dots & f_{IK} \\
 & \max/\min & \dots & \max/\min & \dots & \max/\min \\
 & \tilde{w}_1 & \dots & \tilde{w}_k & \dots & \tilde{w}_K
\end{array}
$$

where:

The values $f_{ik}\ (i=1,...,I; k=1,...,K)$ for each column k ($k \in K$) are cardinal,

The values $\tilde{f}_{ik}\ (i=1,...,I; k=1,...,K)$ for each column k ($k \in K$) are linguistic and are modelled by discrete fuzzy numbers.

The problem is to rank all elements of ADMSE with respect to all criteria, simultaneously, taking into account the type of each criterion and its relative importance.

3. MODELLING OF UNCERTAINTIES

In this Section, the following uncertainties are treated: optimization criteria values and optimization criteria weights. Modelling of these uncertainties is based on fuzzy the set theory. All the uncertainties that appear in the considered problem are described by the discrete fuzzy numbers. Why we opted for discrete fuzzy numbers? We used discrete membership function in order to avoid analytic considerations and to apply "digital way of thinking" [6].

3.1. Modelling of optimization criteria values

The following optimization criteria are associated to each element of ADMSE: unit price, flexibility and demand. Unit price and demand are the crisp values.

1. Flexibility

The term flexibility denotes the ability to adapt. In this paper, flexibility of considered item denotes the possibility of installing the item into different ADMSE.

It is supposed that the flexibility can be described by the three linguistic descriptors: "small", "medium" and "large" which are modelled by discrete fuzzy numbers $\tilde{F}_1, \tilde{F}_2, \tilde{F}_3$, respectively. Values of domains of fuzzy numbers $\tilde{F}_1, \tilde{F}_2, \tilde{F}_3$ are defined in the set of integers which belongs to interval [1, 9], so that number 1 denotes the smallest and number 9 denotes the largest flexibility. The membership functions of these discrete fuzzy numbers are determined by applying the individual estimation by experts.

In this paper, the flexibility as discrete fuzzy numbers are:

"small"= $\tilde{F}_1 = \{(1,1),(2.5,0.75),(4,0.5),(5.5,0.25),(6,0)\}$

"medium"= $\tilde{F}_2 = \begin{Bmatrix}(1,0),(2,0.25),(3,0.5),(4,0.75),(5,1), \\ (6,0.75),(7,0.5),(8,0.25),(9,0)\end{Bmatrix}$

"large"= $\tilde{F}_3 = \{(9,1),(7.5,0.75),(6,0.5),(4.5,0.25),(3,0)\}$

3.2. Calculation of optimization criteria weights

It is assumed that the relative importance of a pair of optimization criteria (k, $k^{'} \in K$) is defined by three linguistic descriptors: "less important" (k is less important than $k^{'}$), "important" (k is not as important as $k^{'}$) and "very important" (k is much more important than $k^{'}$) which is modelled by discrete fuzzy numbers $\tilde{X}_1, \tilde{X}_2, \tilde{X}_3$, respectively. The domain of each discrete fuzzy number $\tilde{X}_1, \tilde{X}_2, \tilde{X}_3$ is an integer, which belongs to the interval [1, 9]. The scale $\{1,...,9\}$ is defined in the prototype Saaty scale measurement [9]. Value 1 denotes that the relative importance of criterion k ($k \in K$) versus $k^{'}$ ($k^{'} \in K$) is the smallest while number 9 denotes the highest importance of criterion k ($k \in K$) versus $k^{'}$ ($k^{'} \in K$). The membership functions of each discrete fuzzy number $\tilde{X}_1, \tilde{X}_2, \tilde{X}_3$ are given by the subjective judgement of experts. In general, the values of the membership functions of each treated discrete fuzzy number are different.

In this paper, each discrete fuzzy number considered has the discreet step $\Delta = 0.25$. The values of membership functions are equal and are: $\alpha_1 = 0.25, \alpha_3 = 0.5, \alpha_3 = 0.75, \alpha_4 = 1$.

According to these assumptions, it means that:

"less important" = $\tilde{X}_1 = \{(1,1),(1.5,0.75),(2,0.5),(2.5,0.25)\}$

"important" = $\tilde{X}_2 = \begin{Bmatrix}(3.5,0.5),(4,0.5),(4.5,0.75),(5,1), \\ (5.5,0.75),(6,0.5),(6.5,0.25)\end{Bmatrix}$

"very important" = $\tilde{X}_3 = \{(9,1),(8.5,0.75),(8,0.5),(7.5,0.25)\}$

Calculation of the optimization criteria weight vector is based on the concept of equal possibilities [3]. For each level of membership function of treated discrete fuzzy numbers $\tilde{X}_1, \tilde{X}_2, \tilde{X}_3$ the comparison pair matrix of relative optimization criteria importance is formed.

The optimization criteria weighted vector for level α are calculated by applying the eigenvector method [9] and it is denoted as $w^{\alpha} = \left(w_1^{\alpha},..., w_k^{\alpha},..., w_K^{\alpha}\right)$. In this way, we obtain the fuzzy value of optimization criteria weighted vector, $\tilde{w} = \left\{\tilde{w}_k\right\}, k = 1,..., K.$

4. NEW FUZZY ABC METHOD

A new algorithm for multi criteria estimation and ranking of elements of ADMSE is proposed. In this Section, we consider the following sub problems:

1. The problem of normalization of all the cardinal criteria values f_{ik} $(i = 1,..., I; k = 1,..., K)$ into $r_{ik\,(i=1,..,I;\,k=1,...,K)}$ defined a common scale [0, 1] by applying linear transformation [8]:

   a) For a benefit- type criterion k∈ *K*:

   $$\left(f_{ik}\right)' = \frac{f_{ik}}{f_{ik}^{max}}$$

   b) For a cost-type criterion k∈ *K*:

   $$\left(f_{ik}\right)' = 1 - \frac{f_{ik} - f_{ik}^{min}}{f_{ik}^{max}}$$

where: $f_{ik}^{max} = \max_i f_{ik}$, $f_{ik}^{min} = \min_i f_{ik}$ and (i∈ *I*)

2. Transform all the linguistic criteria values, which are modelled by the discrete fuzzy numbers $\tilde{f}_{ik}$ $(i = 1,..., I; k = 1,..., K)$, into degrees of belief b_{ik} $\left(i = 1,..., I; k = 1,..., K\right)$ expressed on a common scale [0, 1] by applying a fuzzy set comparison method [8]:

   a) For a benefit type criterion k∈ *K*, find the degree of belief b_{ik} $\left(i = 1,..., I; k = 1,..., K\right)$ that $\tilde{f}_{ik}$ $(i = 1,..., I; k = 1,..., K)$ is greater or equal to all other $\tilde{f}_{i'k}$ $(i = 1,..., I; k = 1,..., K); i \neq i'$,

   b) For a cost type criterion k∈ *K*, find the degree of belief b_{ik} $\left(i = 1,..., I; k = 1,..., K\right)$ that $\tilde{f}_{ik}$ $(i = 1,..., I; k = 1,..., K)$ is less or equal to all other $\tilde{f}_{i'k}$ $(i = 1,..., I; k = 1,..., K); i \neq i'$.

3. Considering the weights, values of the optimization criteria are being calculated according to expressions:

   a) $\tilde{d}_{ik} = \left(f_{ik}\right)' \cdot \tilde{w}_k$ for all columns $k \in K$ which correspond to the cardinal criteria,

   b) $\tilde{d}_{ik} = b_{ik} \cdot \tilde{w}_k$ for all columns $k \in K$ which correspond to the linguistic criteria.

Values $\tilde{d}_{ik}$ $(i = 1,..., I; k = 1,..., K)$ are modelled by the discrete fuzzy numbers on the rules of fuzzy algebra.

4. Applying ABC method with uncertain data. ABC method with uncertain data is performed in three steps like the classical ABC method.

Step 4.1. In this step the criterion value, based on which we perform the ranking is $\tilde{G}_i$ (i=1,..,I) for each considered item. The value is obtained according to the following expression [2]:

$$\tilde{G}_i = 1 - \sum_{k=1}^{K} \tilde{d}_{ik} \tag{4.1}$$

Step 4.2. We first calculate the relative value of the ranking criterion for each considered item, $\tilde{g}_i \ (i = 1,..,I)$ as:

$$\tilde{g}_i = \frac{\tilde{G}_i}{\sum_{i=1}^{I} \tilde{G}_i} \, . \tag{4.2}$$

Then we crank items according to the calculated values $\tilde{g}_i \ (i = 1,..,I)$, in such a way that the first place belongs to an item that has the highest value $\tilde{g}_i \ (i = 1,..,I)$, while at the last place one can find the item to which the lowest value of $\tilde{g}_i \ (i = 1,..,I)$ is associated. The items ranking is based on determination of the

measure of belief that the fuzzy number $\tilde{g}_i \ (i = 1,..,I)$ is better than all other fuzzy numbers [8]. Also, in this step we calculate the cumulative values of the ranking criteria, $\tilde{cf}_i \ (i = 1,..,I)$ which are also described by the fuzzy numbers based on the fuzzy algebra rules, [14].

By defuzzification of the discrete fuzzy numbers $\tilde{cf}_i \ (i = 1,..,I)$, representative scalars are obtained, $cf_i \ (i = 1,...,I)$ which represent the cumulative values of the ranking criterion.

Step 4.3. This step is identical as in the classical ABC method. For $cf_i \ (i = 1,...,I)$, it gives items that are of the highest importance for treated problem and they are the A group items. These items need to have strict attention of management. Items that have "mean" value for assembling of flexible equipment are the B group items and are calculated from condition $0.8 \le cf_i \le 0.95 \ (i = 1,..,I)$. Item management is based on the use of already developed models. The remaining items from the set of considered items are of the least importance for treated problem regarding the considered criteria and respecting their weights. These are the C group items.

5. ILLUSTRATIVE EXAMPLE

Consider an example where all the elements of ADMSE can be divided into seven groups: floor places, body equipment, base elements, elements for conducting of cutting tools, holding elements, special dressed elements and standard elements. These elements are denoted by a set A=$\{a_1,...,a_7\}$. One of the most important tasks in the management of ADMSE in the conditions of the decreased production range is to determine the optimal supply strategy, so the limited financial sources could be used in the best way. On the other hand, rapid dynamics of replacement of special equipment by ADMSE can be fulfilled if the supply strategy is determined as: priority of supplying the ADMSE groups is determined according to their importance.
Further is presented the classification procedure of the flexible devices groups by applying a new fuzzy ABC method.

Data entry

- The optimization criteria values for each element of ADMSE are:

Elements	*Unit price (monetary units)*	*Flexibility*	*Demand (in pieces)*
a_1	520	$\tilde{F}_3 = \{(3,,0),(4.5,0.25),(6,0.5),(7.5,0.75),(9,1)\}$	100
a_2	280	$\tilde{F}_2 = \left\{\begin{matrix}(1,,0),(2,0.25),(3,0.5),(4,0.75),(5,1),\\(6,0.75),(7,0.5),(8,0.25),(9,0)\end{matrix}\right\}$	80
a_3	10	$\tilde{F}_1 = \{(6,0),(5.5,0.25),(4,0.5),(2.5,0.75),(3,1),(1,1)\}$	500
a_4	10	$\tilde{F}_1 = \{(6,0),(5.5,0.25),(4,0.5),(2.5,0.75),(3,1),(1,1)\}$	320
a_5	10	$\tilde{F}_2 = \left\{\begin{matrix}(1,,0),(2,0.25),(3,0.5),(4,0.75),(5,1),\\(6,0.75),(7,0.5),(8,0.25),(9,0)\end{matrix}\right\}$	310
a_3	26	$\tilde{F}_1 = \{(6,0),(5.5,0.25),(4,0.5),(2.5,0.75),(3,1),(1,1)\}$	200
a_7	2.5	$\tilde{F}_1 = \{(6,0),(5.5,0.25),(4,0.5),(2.5,0.75),(3,1),(1,1)\}$	1000

- In this paper, the optimization criteria are: unit price, flexibility and demand. The relative importance of each pair criteria is defined by 1:2="less important", 1:3="very important" and 2:3="important". It should be mentioned that 1:2 means the relative importance of unit price to flexibility, up to 2:3, which means the relative importance flexibility to demand. The comparison pair matrix of relative importance of the criteria is presented:
-

$$\begin{bmatrix} - & "less\ impor\tan t" & "very\ impor\tan t" \\ & - & "impor\tan t" \\ & & - \end{bmatrix}$$

5.1. Determining the values of data entry

The procedure of determining the optimization criteria weights is described in Section 3.2. The comparison pair matrix of relative optimization criteria importance for each level of membership function $\alpha_1 = 0.25$, $\alpha_3 = 0.5, \alpha_4 = 0.75, \alpha_4 = 1$ is shown. The optimization criteria weighted vector for each considered level of membership function is determined by applying the eigenvector method [3].

Values of membership functions	The optimization criteria weighted vector	The optimization criteria weighted vector
0.25	$w_1^{0.25} = 0.646$, $w_2^{0.25} = 0.272$, $w_3^{0.25} = 0.082$	$w_1^{0.25} = 0.617$, $w_2^{0.25} = 0.319$, $w_3^{0.25} = 0.064$
0.5	$w_1^{0.5} = 0.615$, $w_2^{0.5} = 0.308$, $w_3^{0.5} = 0.077$	$w_1^{0} = 0.595$, $w_2^{0} = 0.34$, $w_3^{0} = 0.065$
0.75	$w_1^{0.75} = 0.573$, $w_2^{0.75} = 0.354$, $w_3^{0.75} = 0.073$	$w_1^{0} = 0.562$, $w_2^{0} = 0.371$, $w_3^{0} = 0.067$
1	$w_1^{1} = 0.511$, $w_2^{1} = 0.313$, $w_3^{1} = 0.068$	

5.2. Classification of items by fuzzy ABC methods

Ranking of elements and group elements of ADMSE is performed by applying the new fuzzy ABC method presented in this paper.

Step 1. Value $\tilde{G}_i$ for each considered item is:

$$\tilde{G}_1 = \begin{Bmatrix} (0.727,0.25),(0.687,0.5),(0.642,0.75),(0.671,1), \\ (0.626,0.75,1),(0.656,0.5),(0.677,0.25) \end{Bmatrix}$$

$$\tilde{G}_2 = \begin{Bmatrix} (0.606,0.25),(0.609,0.5),(0.533,0.75),(0.472,1), \\ (0.613,0.75,1),(0.608,0.5),(0.605,0.25) \end{Bmatrix}$$

$$\tilde{G}_3 = \begin{Bmatrix} (0.281,0.25),(0.31,0.5),(0.346,0.75),(0.361,1), \\ (0.357,0.75,1),(0.33,0.5),(0.312,0.25) \end{Bmatrix}$$

$$\tilde{G}_4 = \begin{Bmatrix} (0.296,0.25),(0.323,0.5),(0.359,0.75),(0.393,1), \\ (0.369,0.75,1),(0.341,0.5),(0.323,0.25) \end{Bmatrix}$$

$$\tilde{G}_5 = \begin{Bmatrix} (0.247,0.25),(0.267,0.5),(0.213,0.75),(0.166,1), \\ (0.35,0.75,1),(0.279,0.5),(0.265,0.25) \end{Bmatrix}$$

$$\tilde{G}_6 = \begin{Bmatrix} (0.326,0.25),(0.352,0.5),(0.385,0.75),(0.289,1), \\ (0.394,0.75,1),(0.368,0.5),(0.35,0.25) \end{Bmatrix}$$

$$\tilde{G}_7 = \begin{Bmatrix} (0.231,0.25),(0.262,0.5),(0.301,0.75),(0.424,1), \\ (0.315,0.75,1),(0.289,0.5),(0.271,0.25) \end{Bmatrix}$$

Step 2. Relative importance of the ranking criteria, for each considered item is obtained according to expression (4.2) and they amount to:

$$\tilde{G} = \sum_{i=1}^{7} \tilde{G}_i = \begin{Bmatrix} (2.714,0.25),(2.811,0.5),(2.779,0.75),(2.776,1), \\ (2.974,0.75),(2.892,0.5),(2.803,0.25) \end{Bmatrix}$$

$$\tilde{g}_1 = \begin{Bmatrix} (0.259,0.25),(0.238,0.5),(0.216,0.75),(0.242,1), \\ (0.225,0.75,1),(0.233,0.5),(0.249,0.25) \end{Bmatrix}$$

$$\tilde{g}_2 = \begin{Bmatrix} (0.216,0.25),(0.211,0.5),(0.179,0.75),(0.171,1), \\ (0.221,0.75,1),(0.216,0.5),(0.223,0.25) \end{Bmatrix}$$

$$\tilde{g}_3 = \begin{Bmatrix} (0.1,0.25),(0.107,0.5),(0.116,0.75),(0.13,1), \\ (0.128,0.75,1),(0.117,0.5),(0.115,0.25) \end{Bmatrix}$$

$$\tilde{g}_4 = \begin{Bmatrix} (0.106,0.25),(0.112,0.5),(0.121,0.75),(0.142,1), \\ (0.133,0.75,1),(0.121,0.5),(0.119,0.25) \end{Bmatrix}$$

$$\tilde{g}_5 = \begin{Bmatrix} (0.088,0.25),(0.092,0.5),(0.072,0.75),(0.06,1), \\ (0.108,0.75,1),(0.099,0.5),(0.098,0.25) \end{Bmatrix}$$

$$\tilde{g}_6 = \begin{Bmatrix} (0.116,0.25),(0.122,0.5),(0.129,0.75),(0.104,1), \\ (0.142,0.75,1),(0.131,0.5),(0.129,0.25) \end{Bmatrix}$$

$$\tilde{g}_7 = \begin{Bmatrix} (0.08,0.25),(0.091,0.5),(0.101,0.75),(0.153,1), \\ (0.113,0.75,1),(0.103,0.5),(0.099,0.25) \end{Bmatrix}$$

Comparing of discrete fuzzy numbers $\tilde{g}_i$ $(i = 1,..,7)$ the following rank is obtained: $a_1, a_2, a_4, a_6, a_3, a_7$ and a_5.

Table 5.1: Fuzzy and crisp cumulative value of optimization criterion for each item

Items	$\tilde{cf}_j$	cf_j
a_1	$\left\{\begin{matrix}(0.259,0.25),(0.238,0.5),(0.216,0.75),(0.242,1),\\(0.225,0.75,1),(0.233,0.5),(0.249,0.25)\end{matrix}\right\}$	0.234
a_2	$\left\{\begin{matrix}(0.475,0.25),(0.449,0.5),(0.395,0.75),(0.413,1),\\(0.446,0.75,1),(0.449,0.5),(0.472,0.25)\end{matrix}\right\}$	0.432
a_4	$\left\{\begin{matrix}(0.581,0.25),(0.561,0.5),(0.516,0.75),(0555,1),\\(0.579,0.75,1),(0.57,0.5),(0.591,0.25)\end{matrix}\right\}$	0.559
a_6	$\left\{\begin{matrix}(0.697,0.25),(0.683,0.5),(0.645,0.75),(0.659,1),\\(0.721,0.75,1),(0.701,0.5),(0.72,0.25)\end{matrix}\right\}$	0.682
a_3	$\left\{\begin{matrix}(0.707,0.25),(0.79,0.5),(0.761,0.75),(0.789,1),\\(0.849,0.75,1),(0.818,0.5),(0.835,0.25)\end{matrix}\right\}$	0.796
a_7	$\left\{\begin{matrix}(0.787,0.25),(0.881,0.5),(0.862,0.75),(0.942,1),\\(0.962,0.75,1),(0.921,0.5),(0.934,0.25)\end{matrix}\right\}$	0.91
a_5	$\left\{\begin{matrix}(0.875,0.25),(0.973,0.5),(0.934,0.75),(1,1),\\(1.07,0.75,1),(1.02,0.5),(1.03,0.25)\end{matrix}\right\}$	1

Step 3. Items which belong to group A are: a_1, a_2, a_4, a_6, a_3. Items a_7, a_5 belong to group B.

The obtained result show that the elements a_1, a_2, a_4, a_6, a_3 of ADMSE belong to group A, which means that these items of ADMSE are the most important concerning the unit price, flexibility and demand volume respecting their importance. This means that available financial means should be engaged in order that the supply group A elements is to be even.

6. CONCLUSION

It is known that applying of special holding equipment in condition of decreased level of production volume has the influence on unit prices of products. The use of ADMSE in less developed countries is not possible because of the lack of financial resources. In this paper we suggest different ways of increasing business efficiency of holding equipment within some limits:

- Gradual development of smaller owned ADMSE,
- The use of inexpensive standard elements of ADMSE which are developed,
- Partial applying of special dressed elements.

In this paper, ranking of elements and element groups of ADMSE is done by applying a new fuzzy ABC method. In this way, importance of elements of ADMSE is obtained. It is shown that:

(i) Criteria used for the ranking of items are functions of several variables modelled in relation to the problem being considered

(ii) The uncertainties which exist in the model can be described by the discrete fuzzy numbers.
(iii) Changing values of optimization criteria, as well as, changing of their relative importance are created as a consequence of environmental changes. All the changes can be incorporated into the model, so in this way, the exactness of input data increases as well as the correctness of the decision.
(iv) The developed methodology of classification is illustrated by an example in which the realistic data appear. Obtained results show that almost all elements of the ADMSE have a great importance; i.e. they belong to group A; what completely responds to theoretical knowledge and experience of leading world ADMSE manufacturers.

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