Development of the fuzzy logic module to determine the expediency of event selection

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To ensure personal success it is important to maintain balance between professional achievements, health, family wellbeing, etc. It is never an easy task. But that is where the essence of effectiveness lies, balance is the key to efficiency of the short term plans and long term goals. An approach is offered to find balance between the wish to see a child clean, and the building of relationship with said child in which he or she maintains own hygiene without the need for reminders. Unfortunately such an approach may cause an issue of overload, when the desire of accomplishing everything negatively affects the ability to focus, and causes burnout. To avoid the issue of overload it is recommended to use the software that will give advice on even selection based on the rules of balance and the matrix of Eisenhower. To automate the process of decision making in terms of the expediency of even selection and their inclusion in the long term plans on the basis of the matrix of Eisenhower it is suggested to use Mamdani fuzzy model. Representation of the individual interests of the users, their preferences and expectations by use of linguistic variables, allows the opportunity to build the most effective route to success. The linguistic variables for the indicator of expediency of event selection such as urgency, importance, overload, rest, motivation are reviewed. Examples of rules for determining the task expediency indicator and the part of the knowledge base of the fuzzy system are presented. An example of the application of fuzzy logic to the event of employee training is given and it is shown that the event corresponds to a sufficient level of expediency of the event selection.

Keywords — fuzzy logic; linguistic variable; matrix of Eisenhower, bell-shaped function, priority, knowledge database.

I. INTRODUCTION

It is difficult to call the rhythm of life of a modern person measured and carefree. Everyday drive, workload, many urgent tasks, that keep stockpiling, deadlines, the crazy schedule turns into a habit. The constant state of "I don't know what to do first" does not help to solve any issues, that piled up, and the inability to magian personal time can cost a pretty price: stress, apathy, fatigue, failure to perform and prioritize tasks, emotional burnout. Being used to the chronic lack of time is a concerning signal about the urgent need of time management.

The overload is a large and important issue today. It causes burnout, nervous meltdowns and as a consequence the loss of productivity and in extreme cases even the loss of ability to work. It is possible to counteract human overload on the way to achieving one's goal by cutting off many unimportant and non-urgent events. Powerful tools such as the rules of life balance [1] and the Eisenhower matrix [2] can help.

The aim of this study is to develop Mamdani model, the fuzzy rules of which, based on the rules of life balance and the Eisenhower matrix, will be provide to the user with a choice the optimal events in the process of achieving his or her goal. Despite the growing popularity of fuzzy logic, there is very little research on the use of fuzzy modeling in psychology [3]. The novelty of this article is that it offers a new model of time planning, based on fuzzy rules for selecting optimal events on the way to the goal, based on individual interests, wishes and expectations of a particular person. Chapter II of the article provides a brief overview of research on fuzzy modeling of the decision-making process in various problem areas. Chapter III is devoted to substantiating the feasibility of using fuzzy logic, determining the main parameters of the problem of choosing optimal events, describing fuzzy rules and determining the form of membership functions. In Chapter IV, the basic parameters of the problem are presented by linguistic variables and the membership functions of their terms are determined. Chapter V presents a matrix base of fuzzy knowledge and examples of fuzzy rules. Chapter VI on a specific experiment demonstrates the main steps of the Mamdani fuzzy inference algorithm, and Chapter VII demonstrates the main limitations of the research and further steps in the development of the information technology

II. LITERATURE OVERVIEW

A brief overview of similar studies using fuzzy logic:

- In his article [4], Adame-Sanchez explores ways to achieve this goal, using qualitative comparative analysis with fuzzy data sets. His research also draws attention to the fact that the financial problems are key to achieving a balance of life.

- In [5], Per Hilletofth investigates the application of fuzzy logic to the problems of choosing production solutions. Conclusions are provided using 16 rules and obtained with the help of experts from a Swedish manufacturing company. Accuracy is investigated using various rule bases.

- The article [6] studies the monitoring of the efficiency of material supply with the use of fuzzy logic. Analysis and monitoring allowed to develop the structure of logistics, and fuzzy logic provides recommendations for the number of purchases of materials.

- Article [7] is devoted to the study of the moment of entering the market for new products. Key to the study are the performance indicators as a basis for decision making. A number of data sources are used to predict the time to market, such as process maps and market analysis of similar products.

- Devin DePalmer [8] explores the prioritization of corporate strategic goals through strategic planning. Budget and resource constraints create the need to modernize the decision-making process. Fuzzy logic allows you to gain an advantage over the classic methods based on the risk matrix.

- The article [9] studies time management in the context of waiting for transport using fuzzy logic. Constant congestion, problems of increasing traffic, pollution, downtime create the need to create modeling algorithms to optimize processes and upgrade infrastructure. Using fuzzy logic in the research allowed to calculate the optimal time of switching traffic lights and create a "green wave".

- M.Saleem Khan's book [10] is devoted to the processes of industrial automation due to use of fuzzy logic. Improving productivity without losing efficiency is the main goal of the book. The multi-agent system allows to develop a strategy taking into account the external factors and the internal features under the conditions of uncertainty.

- O. Hernandez's article [11] investigates use of fuzzy logic in management and administration. Much attention is paid to the document management and accounting. In order to reduce costs and increase profits, global companies will be interested in using fuzzy logic to plan and develop logistics.

III. JUSTIFICATION FOR THE USE OF FUZZY LOGIC

Solving the problem of successful placement of events, rejection of not actua tasks, enabling the rational formation of further action strategy can be done by creating a recommendation system for ordering events based on the Eisenhower matrix. The developed fuzzy recommendation system of event planning should determine the strategy of user development, provide them with confidence that they are successfully moving towards the greate goal.

Modern conditions of extraordinary acceleration of society have shown that the main problem in establishing indicators of the selection of events in the interests of the user is the lack of completeness and adequacy of information to perform research, as well as incorrect input of information by the user.

Characteristics of the user's attitude to events, his condition, interests are often impossible to quantify. For example, the attractiveness of a job is usually described by characteristics such as likes, dislikes, doubts, preferences, and so on. Therefore, there is a need for expert evaluation of parameters. However, expert assessments can also be characterized by incomplete information, inaccurate wording, and fuzzyness .

Uncertainty of the system leads to increased risks of adopting ineffective recommendations which can in negative result. In order to simplify the process of recommendations in cases of high multidimensionality of the initial data, if you need to take into account a large number of poorly formalized factors, it is advisable to create models based on fuzzy modeling and fuzzy logic [12,13]. Such methods are based on fuzzy sets and use linguistic variables and statements to describe the strategy. Fuzzy set methods are especially useful in the absence of an accurate mathematical model of system operation. The theory of fuzzy sets makes it possible to apply inaccurate and subjective expert knowledge of the subject area without formalizing it in the form of traditional mathematical models [14]. The presence of mathematical means of displaying the vagueness of the source information makes it possible to build a model adequate to reality [15].

The main tasks to be solved by the developed fuzzy recommendation system of event planning are:

1) processing of input data, which are the characteristics of the user and his wishes, which determine the choice of a recommendation;

2) determining the correspondence indicators of the squares of the Eisenhower matrix.

Experts believe that when planning events one should take into account the presence of psychological characteristics, motivation, emotional load, as well as understand what psychological difficulties need to be corrected to prevent their further development [3].

Of course, it is not possible to clearly define which universal plan or schedule of tasks suits each person. Many factors play a role in this choice. Let us consider that the most important of them is individual interest. A job or everyday life must bring joy and satisfaction. Of course, life doesn’t exist without difficulties, but they are what hardens the character. In order to achieve something, one must work hard. Another important criteria for choosing events is health restrictions. Their presence immediately cuts off certain activities that are strictly contraindicated for one reason or another.

To design fuzzy recommendatory information technology, it is necessary to identify parameters that will be the key to defining the strategy. Since the main purpose of the study is to provide personal advice regarding the choice of the events, the main characteristics will be urgency and importance. Because events cannot exist without context, it is also necessary to consider the characteristics of the decision-maker. Namely, their workload, normalization of rest and motivation.

If these factors are denoted as a set of linguistic variables x_1, x_2,… x_n, then the indicators for the selection of events can be given as a vector Y:

$$Y = (x_1, x_2, \dots x_n) \rightarrow Q \in [0,100],$$

where Y is the vector of factors influencing the values, Q is the indicator of importance.

We will provide expert information on the indicators of providing recommendations for the event and the task in the form of a fuzzy production model of statements "IF - THEN", which associates the input variables x1 - xw with one of the types of solutions:

$$\text{IF } (x_1 = a_1^{11}) \text{AND } (x_2 = a_2^{11}) \text{AND } \dots \text{ AND } (x_w = a_w^{11}),$$
$$\text{OR } (x_1 = a_1^{12}) \text{AND } (x_2 = a_2^{12}) \text{AND } \dots \text{ AND } (x_w = a_w^{12}),$$
$$\text{OR } \dots \left(x_1 = a_1^{1\delta_1}\right) \text{AND } \left(x_2 = a_2^{1\delta_1}\right) \text{AND } \dots \text{ AND } \left(x_w = a_w^{1\delta_1}\right),$$
$$\text{THEN } y = d_1 \text{ etc.},$$

where x is the input variable, a with coefficients is the linguistic estimate of the input variable, δ_q is the number of rules that determine the value of the output variable y.

As terms of the set of initial variables we use linguistic values corresponding to the indicators "low", "medium", “high". Thus, the obtained data on the importance of the parameters will be translated into linguistic indicators to provide a recommendation as to which event is most suitable for the user.

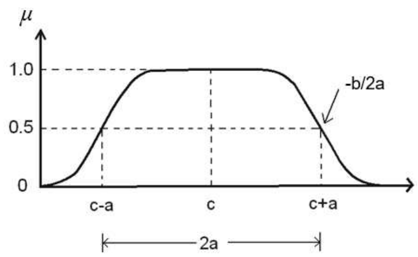

Fig. 1 - Graphical representation of the bell-shaped function

Let us define the membership functions $\mu_A(x)$ of fuzzy sets of the indicators of individual interests of the user, his wishes, expectations and opportunities. The degree to which $\mu_A(x)$ belongs to the fuzzy set $\tilde{A}$ is interpreted as a subjective measure of the extent to which the element $x \in X$ corresponds to a concept whose meaning is formalized by the fuzzy set $\tilde{A}$. To describe fuzzy quantities, it is advisable to use bell-shaped membership functions [10, 18], described by the formula:

$$f(x) = \frac{1}{1+\left|\frac{x-c}{a}\right|^{2b}},$$

where c is the coordinate of the maximum of the function, $\mu T(c) = 1$; a - the coefficient of concentration-stretching function [10]. In fact, the number c represents the most pragmatic value of the variable x for a fuzzy term.

IV. DEFINITION OF LINGUISTIC VARIABLES

As the basic scales of linguistic variables of all membership functions we define the range [0… 100], which corresponds to the percentage of user responses to each group of characteristics.

To construct the membership functions of linguistic variables, we consider the main characteristics of events and the state of the user.

Urgency (Ur). How quickly you need to complete a task depends on this indicator, as it is a very important parameter for event planning. The transition from the basic scale to the term set of the linguistic variable takes into account the ratio of the need to complete the selected task as soon as possible to the average of the tasks performed in the same category. The set of values of the parameter "Urgency" is defined as: $Ur = \{Ur_1, Ur_2\}$, where Ur_1 = small; Ur_2 = large. For example, if you need to start the event immediately, the urgency is high, if the indicators of the need for immediate performance of the task is less than half, the urgency is low. The membership function for the Urgency parameter is shown in Figure 2.

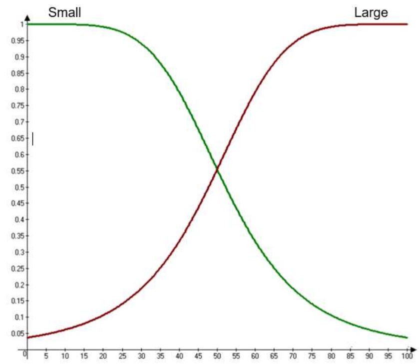

Fig. 2 – Membership function for the parameter Ur,«Urgency»

Importance (Im). The consequences of failure to perform the task depend on this indicator, which in turn increases or decreases the amount of responsibility. The higher the importance of the task, the greater the need to focus on it as much as possible, which in turn increases the indicator of expediency of the task. The transition from the base scale to the term set takes into account the ratio of consequences relative to the average of the same category on a scale from 0 to 100. The set of values of the parameter "Importance" is defined as: $Im = \{Im_1, Im_2\}$, where Im_1 = does not matter; Im_2 = important. The membership function for the Importance parameter is shown in Figure 3.

Workload (Wl). This indicator determines a person's ability to perform the maximum number of tasks in a short period of time. It is important in determining the appropriateness of the choice of event, because ordinary people often pay attention to it and will not plan new events, if they are too busy with important tasks. The transition from the base scale to the term set takes into account the ratio of user workload indicators for a short period of time to the normalized workload indicators. This indicator is individual and is determined on the basis of psychological and physical parameters of the user and taking into account the expert opinion of specialized specialists.

An important indicator for maintaining the mental and physical health of the user. The set of values for the parameter "Workload" is defined as: $Wl = \{Wl_1, Wl_2, Wl_3\}$, where Wl_1 = low; Wl_2 = average; Wl_3 = high. The membership function for the workload parameter is shown in Figure 4.

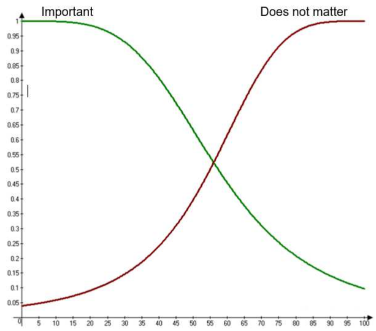

Fig. 3 – Membership function for the parameter *Im*,«Importance»

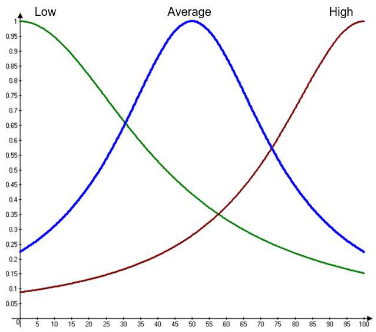

Fig. 4 – Membership function for the parameter *Wl*, «Workload»

Rest Normalization (*RN*). This parameter affects the level of fatigue, the desire to continue working, shows the level of internal energy and strength. The appropriateness of the choice of event depends on the characteristics that the user pays attention to, which help him to act more effectively and prevent fatigue while maintaining health. The transition from the basic scale to the term set is taking into account previous studies of individual user parameters, during which the level of user fatigue at different intervals is determined. The set of values for the parameter “Rest Normalization" is defined as: $RN = \{RN_1, RN_2, RN_3\}$, where RN_1 = low; RN_2 = average; RN_3 = high. The membership function for the parameter “Rest Normalization" is shown in Figure 5.

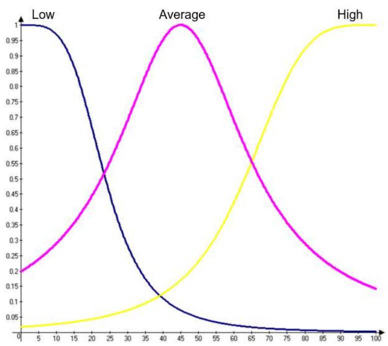

Fig. 5 – Membership function for the parameter *RN*, «Rest Normalization»

Motivation (*Mo*). This indicator is related to such user characteristics as inspiration, mood; indicator of emotional state. And the indicator of the expediency of choosing an event directly depends on motivation, because it makes no sense to choose an event that you do not want to do, despite all the benefits. The transition from the basic scale to the term set takes into account previous studies of individual user parameters, during which the level of motivation of the user to perform different categories of tasks is determined. The set of values for the parameter "Motivation" is defined as: $Mo = \{Mo_1, Mo_2, Mo_3\}$, where Mo_1 = small, Mo_2 = medium, Mo_3 = large. The membership function for the Motivation parameter is shown in Figure 6.

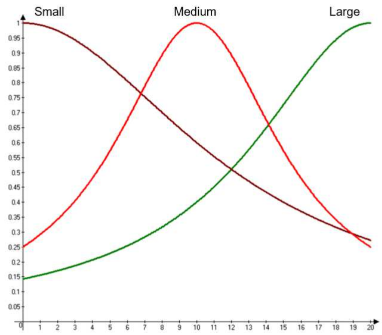

Fig. 6 – Membership function for the parameter *Mo*, «Motivation»

The result of the developed fuzzy decision support system should be an indicator of the appropriateness of the selection of the event for its further implementation. We present the linguistic variables of this indicator *EA* Event Advisability values: $EA = \{EA_1, EA_2, EA_3\}$, where EA_1 = low; EA_2 = sufficient; EA_3 = high. The values of the base scale of this parameter are defined in the range from 0 to 100%. The membership function of the output parameter EA is shown in Figure 7.

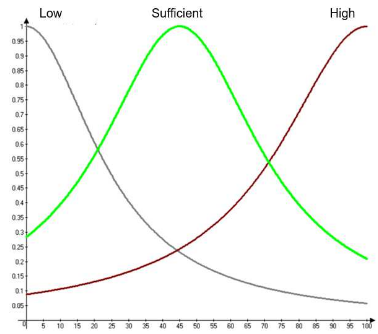

Fig. 7 – Membership function for the parameter *EA* “Event Advisability”

V. BUILDING A FUZZY KNOWLEDGE DATABASE FOR THE EVENT SELECTION PROCESS

Based on the individual characteristics of the person that affect an indicator of the advisability of event implementation, and their membership functions, we will conduct experimental studies to build a matrix-like knowledge database of fuzzy decision support system in time management (table 1).

The indicator of the expediency of performing events is the output value *EA* = {low, sufficient, high} for it further inclusion in the schedule of tasks.

On the basis of expert knowledge and the received experimental data of indicators of individual characteristics of researched persons, we will form rules of definition of an indicator of expediency of performance of the task which we will reduce to a matrix database of knowledge.

TABLE I. INPUT DATA FRAGMENT FOR BUILDING A KNOWLEDGE DATABASE OF FUZZY DECISION SUPPORT SYSTEM FOR EVENT SELECTION

№	*Ur,* Urgency	*Im,* Importance	*Wl,* Load	*RN,* Rest Normalization	*Mo,* Motivation	*EA,* Event Advisability
1	16	20	84	17	3	*EA1*
2	30	33	78	20	5	*EA1*
3	27	45	95	23	7	*EA1*
4	48	50	72	26	8	*EA1*
5	52	45	70	60	6	*EA2*
6	50	58	56	45	7	*EA2*
7	65	50	29	58	8	*EA2*
8	77	34	55	85	11	*EA2*
9	60	69	75	35	18	*EA2*
10	67	65	53	77	6	*EA3*
11	78	56	64	64	16	*EA3*
12	85	71	72	83	19	*EA3*
13	95	95	24	99	13	*EA3*

Here are the examples of such rules [3]:

R1: IF $Ur = Ur_1$ AND $Im = Im_1$ AND $Wl = Wl_3$ AND $RN = RN_1$ AND $Mo = Mo_1$ THEN $EA = EA_1$;
R2: IF $Ur = Ur_1$ AND $Im = Im_1$ AND $Wl = Wl_2$ AND $RN = RN_2$ AND $Mo = Mo_1$ THEN $EA = EA_2$;
R3: IF $Ur = Ur_2$ AND $Im = Im_2$ AND $Wl = Wl_2$ AND $RN = RN_3$ AND $Mo = Mo_1$ THEN $EA = EA_3$.

The obtained fuzzy knowledge database is given in Table II.

TABLE II. FRAGMENT OF THE MATRIX KNOWLEDGE DATABASE OF THE FUZZY DECISION SUPPORT SYSTEM FOR EVENT SELECTION.

№	*Ur,* Urgency	*Im,* Importance	*Wl,* Load	*RN,* Rest Normalization	*Mo,* Motivation	*EA,* Event Advisability
1	Low	Unimportant	High	Low	Low	Low
2	Low	Unimportant	High	Low	Low	
3	Low	Unimportant	High	Low	Medium	
4	Low	Unimportant	Medium	Medium	Medium	
5	Low	Unimportant	Medium	Medium	Low	Sufficient
6	High	Important	Medium	Medium	Medium	
7	High	Unimportant	Low	Medium	Medium	
8	High	Unimportant	Medium	High	Medium	
9	High	Important	High	Medium	High	
10	High	Important	Medium	High	Low	High
11	High	Important	Medium	Medium	High	
12	High	Important	Medium	High	High	
13	High	Important	Low	High	Medium	

VI. EXPERIMENT RESULTS

Consider a specific example of the process of logical derivation of a fuzzy decision support system for event selection.

Suppose the following data on the characteristics of the event, which consists in training lower-level employees: urgency - 60%, importance - 70%, workload - 8%, normalization of rest - 78%, motivation - 40% (Table 3).

TABLE III. EXAMPLE OF A INPUT DATA WITH SPECIFIC VALUES

№	*Ur,* Urgency, %	*Im,* Importance, %	*Wl,* Load, %	*RN,* Rest Normalization, %	*Mo,* Motivation, %	*EA,* Event Advisability
1	60	70	8	78	40	*EA1*
1	High	Important	Low	High	Medium	High

Let's fuzzification the input parameters using the appropriate membership functions (Figures 2-6). We write down the formulas for calculating the membership the indicator of the expediency of performing the of event each of the fuzzy sets.

Then the above rules R1 - R3 will be represented by the formulas:

$$EA_1 = \max(\min(Ur_1, Im_1, Wl_3, RN_1, Mo_1), \min(Ur_1, Im_1, Wl_3, RN_1, Mo_2), \min(Ur_1, Im_1, Wl_2, RN_2, Mo_2));$$

$$EA_2 = \max(\min(Ur_1, Im_1, Wl_2, RN_2, Mo_1), \min(Ur_2, Im_2, Wl_2, RN_2, Mo_2), \min(Ur_2, Im_1, Wl_1, RN_2, Mo_2), \min(Ur_2, Im_1, Wl_2, RN_3, Mo_2), \min(Ur_2, Im_2, Wl_3, RN_2, Mo_3));$$

$$EA_3 = \max(\min(Ur_2, Im_2, Wl_2, RN_3, Mo_1), \min(Ur_2, Im_2, Wl_2, RN_2, Mo_3), \min(Ur_2, Im_2, Wl_2, RN_3, Mo_3), \min(Ur_2, Im_2, Wl_1, RN_3, Mo_2)).$$

Let us define the membership functions of each of the characteristics of the event "training of lower-level employees":

Urgency = {0.33 / small, 0.79 / large};
Importance = {0.31 / not important, 0.83 / important};
Load = {0.97 / low, 0.29 / medium, 0.1 / high};
Rest Normalization = {0.01 / low, 0.31 / medium, 0.89 / high};
Motivation = {0.7 / low, 0.87 / medium, 0.31 / high}.

$$EA_1 = \max(\min(0.33, 0.31, 0.1, 0.01, 0.31), \min(0.33, 0.31, 0.1, 0.01, 0.87), \min(0.33, 0.31, 0.29, 0.31, 0.87)) = \max(\min(0.01), \min(0.01), \min(0.29)) = 0.29;$$

$$EA_2 = \max(\min(0.33, 0.31, 0.29, 0.31, 0.7), \min(0.79, 0.83, 0.29, 0.31, 0.87),$$

$$\min(0.79, 0.31, 0.97, 0.31, 0.87),$$
$$\min(0.79, 0.31, 0.29, 0.89, 0.87),$$
$$\min(0.79, 0.83, 0.1, 0.31, 0.31)) =$$
$$= \max(\min(0.29), \min(0.29), \min(0.31),$$
$$\min(0.29), \min(0.1)) = 0.31;$$

$$EA_3 = \max(\min(0.79, 0.83, 0.29, 0.89, 0.7),$$
$$\min(0.79, 0.83, 0.29, 0.31, 0.31),$$
$$\min(0.79, 0.83, 0.29, 0.89, 0.31),$$
$$\min(0.79, 0.83, 0.97, 0.89, 0.87) =$$
$$= \max(\min(0.29), \min(0.29), \min(0.29),$$
$$\min(0.79) = 0.79.$$

Then we calculate the membership function values: $EA_1 = 0.29$, $EA_2 = 0.31$, $EA_3 = 0.79$.

Based on the obtained data, we will carry out dephasification by the method of the center of mass (Figure 8).

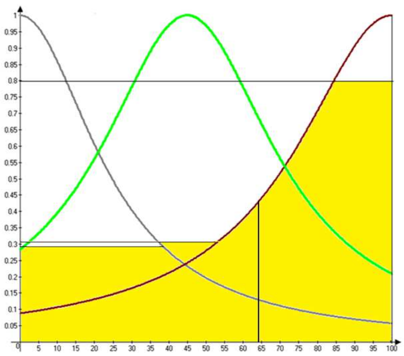

Fig 8 – Example of dephasification for the problem of determining the expediency of the event

Let's calculate the dephasification result:

$$EA = \frac{\sum_{i=1}^{n} \mu(EA_i) \times EA_i}{\sum_{i=1}^{n} \mu(EA_i)}$$

$$EA = \frac{5 * 0.29 + 10 * 0.29 + 15 * 0.29 + 20 * 0.29 +}{0.29 + 0.29 + 0.29 + 0.29 +}$$
$$\frac{+25 * 0.29 + 30 * 0.29 + 35 * 0.29 + 40 * 0.31 +}{+0.29 + 0.29 + 0.29 + 0.31 +}$$
$$\frac{+45 * 0.31 + 50 * 0.31 + 55 * 0.33 + 60 * 0.38 +}{+0.31 + 0.31 + 0.33 + 0.38 +}$$
$$\frac{+65 * 0.44 + 70 * 0.52 + 75 * 0.6 + 80 * 0.71 +}{+0.44 + 0.52 + 0.6 + 0.71 +}$$
$$\frac{+85 * 0.79 + 90 * 0.79 + 95 * 0.79 + 100 * 0.79}{+0.79 + 0.79 + 0.79 + 0.79} =$$
$$= \frac{1.45 + 2.9 + 4.35 + 5.8 + 7.25 + 8.7 + 10.15 +}{2.03 +}$$
$$\frac{+12.4 + 13.95 + 15.5 + 18.15 + 22.8 + 28.6 + 36.4 +}{+ 2.6 +}$$
$$\frac{+ 45 + 56.8 + 67.15 + 71.1 + 75.05 + 79}{+ 4.47} =$$
$$= \frac{40.6 + 147.8 + 394.1}{2.03 + 2.6 + 4.47} = \frac{582.5}{9.1} = 64.01$$

Thus, the indicator of expediency of the choice of the event is equal to 64.01 which corresponds to the level - sufficient. The obtained indicators provide accurate recommendations, which increases personal efficiency. They prevent a long stay in the square of "unimportant - urgent" and the square of "unimportant - not urgent" events of the Eisenhower matrix. Indicators provide a formalized basis for shifting the main activity to the square of "important - not urgent events". This square includes activities such as relationship building, personal goal determination, long-term planning, exercise, issue prevention, training, learning.

Testing of information technology based on the fuzzy logic module to determine the appropriateness of the event selection was conducted on a training sample of 10 people for two weeks. The average number of events was 7 business and 3 personal events per day. The training sample was entered into the database of the developed new software and systems with similarly functional. Software applications that are most similar in functionality: Todoist, Nirvana, TimeMaster.

The test results are presented in Table 4. The overall accuracy of the recommendations for prioritization is 89.12%, the accuracy of error detection is 82.75%. However, it should be noted that as the rules in the knowledge base increase, which will happen every day, the accuracy will increase. The applications have a large number of functionalities not listed in the table, in this case the functionality was available in all applications.

To design fuzzy recommendatory information technology, it is necessary to identify parameters that will be the key to defining the strategy. Since the main purpose of the study is to provide personal advice regarding the choice of the events, the main characteristics will be urgency and importance. Because events cannot exist without context, it is also necessary to consider the characteristics of the decision-maker. Namely, their workload, normalization of rest and motivation.

TABLE IV. TESTING OF INFORMATION TECHNOLOGY BASED ON THE MODULE OF FUZZY LOGIC TO DETERMINE THE APPROPRIATENESS OF THE EVENT SELECTION

Functionality	Todoist	Nirvana	Time Master	Developing IT
Recommendations about priorities	82,9 %	75,8 %	81,5 %	89,1 %
Accuracy of error detection	78,8 %	-	74,5 %	82,7 %
Sorting of events (hashtags and tags)	+	-	-	+
Correspondence with global goals / events	-	-	+	+
Delegation of tasks	-	-	-	-
Notes to events	+	-	-	+
Synchronization with email	+	+	-	-
Reminders	+	+	+	+
Reports	+	+	-	+
Ukrainian language	-	-	-	+

VII. LIMITATIONS AND FUTURE RESEARCH

112 participants tested information technology with a fuzzy logic module. The participants are experienced people, mostly with higher education. The major number of participants were specialists in engineering and managers. Participation was voluntary among potential users of the service and was not encouraged in any way. Given these factors, it follows that the results of the study can not be generalized to the entire population of the region. Expanding the sample of users will increase the accuracy of providing recommendations in the future.

Information technology is designed to provide individual results, so the system can not provide the full range of recommendations at once, namely the system needs the user to pass psychological tests, specify global goals, define their key roles and more. It takes an average of 2 weeks to fill all the "gaps" in knowledge. The user is warned about this restriction at the beginning of the work with the application.

Research does not take into account the possibility of team performance of some events. Expanding research in these areas will provide more accurate recommendations for accelerating the implementation of tasks with the calculation of the resources and the technological features. With the help of other persons, one can increase overall efficiency and productivity.

CONCLUSIONS

The research allowed to formulate recommendations on time management and justify the use of fuzzy logic as a method of solving the problem of determining the advisability of the selection of events, based on the rules of balance and the Eisenhower matrix.

Research of the balance of events allowed to exclude problems with burnout and overload of the user by means of personal recommendations. An evenly distributed workload will preserve the user's health, ensure professional growth and strong relationships. Using information technology for time planning will help to overcome uncertainty and bad habits.

The developed mechanism of event selection based on fuzzy logic allows to operate with linguistic variables instead of exact values of indicators and recommendations, to carry out estimation of quality of input and output results by means of reliability degree, and also essentially to reduce the derivation rules base, without reducing accuracy of recommendations. The results of testing software developed using fuzzy logic correspond to the data obtained from the results of research, which indicates the effectiveness of the developed system, the accuracy of which was up to 90%.

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