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DECISION SUPPORT SYSTEM FOR PERSONNEL SELECTION BASED ON FUZZY SETS

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In the context of rapid digitalization of human resource management processes and growing competition for talent, not only attracting qualified specialists but also retaining them is becoming a strategic priority for companies. Statistical data indicate that a significant share of staff turnover occurs precisely during the adaptation period (the first 3–6 months of work), which leads to substantial financial losses associated with recruiting, onboarding, and training costs, as well as a decrease in overall team productivity [1].

Existing personnel selection methods traditionally focus on assessing professional and "soft" skills, which allows determining a candidate's ability to perform the work but does not guarantee their long-term loyalty to the company. Subjective assessment by recruiters often fails to account for hidden behavioral patterns and the set of factors correlating with an employee's tenure [2].

The lack of reliable tools for preliminary assessment of resignation risks necessitates the implementation of automated decision support systems. The application of fuzzy logic apparatus for modeling Retention Rate allows operating with linguistic variables and fuzzy criteria within the framework of a decision support system. This ensures a qualitative transformation of the hiring process into a predictive model, significantly reducing the percentage of erroneous personnel decisions (false positives) at the very start of the selection funnel [3-4].

The purpose of the work is to increase the term of employee retention in the company by developing a decision support system for personnel selection based on fuzzy sets.

We formalize the candidate assessment task as a mapping of the space of their characteristics into the space of retention risks. Let

$$C = \{c_1, c_2, \ldots, c_n\}, \quad (1)$$

where each candidate c_i is described by a vector of input variables

$$X = \{x_1, x_2, \ldots, x_m\}. \quad (2)$$

Due to the heterogeneity and uncertainty of the criteria (quantitative and qualitative), they are represented as linguistic variables in terms of fuzzy sets. The target variable is the retention indicator *R* (Retention Score), which reflects the probability of the candidate working for more than one year.

Three key factors were selected for the model that correlate most with staff turnover:

- job change history (Stability Index) - x_1

$$T_1 = \{\text{“}Jumper\text{”}, \text{“}Stable\text{”}, \text{“}Loyal\text{”}\}; \quad (3)$$

- expectation match (Expectation Match) - x_2

$$T_2 = \{\text{“}Below\text{”}, \text{“}Match\text{”}, \text{“}Exceeds\text{”}\}; \quad (4)$$

- logistical comfort (Commute Effort) - x_3

$$T_3 = \{\text{“}Comfortable\text{”}, \text{“}Moderate\text{”}, \text{“}Hard\text{”}\}. \quad (5)$$

Crisp values are transformed into degrees of membership

$$\mu(x) \in [0,1].$$

Trapezoidal and Gaussian functions are used for the terms. For example, for the term “Stable” of the variable x_1:

$$\mu_{Stable}(x) = exp(-\frac{(x-c)^2}{2\sigma^2}). \quad (6)$$

The system is built based on the Mamdani model. A typical rule takes the form:

$$IF\ x_1 is\ A_i\ AND\ x_2 is\ B_i\ THEN\ y is\ C_i\ . \quad (7)$$

The aggregated fuzzy output is transformed into a crisp Retention Score value using the center of gravity method:

$$y_{out} = \frac{\int \mu_{agg}(y) y dy}{\int \mu_{agg}(y) dy}. \quad (8)$$

The obtained value is used as an integral assessment of the risk of resignation.

The proposed retention risk assessment model based on fuzzy logic provides a formalized and interpretable approach to decision support in the personnel selection process. The use of linguistic variables enables considering the uncertainty and subjectivity of HR criteria, while the rule base allows integrating the expert experience of recruiters. The application of the Mamdani method and center of gravity defuzzification allows obtaining a balanced, quantitatively measurable Retention Score. The model can be integrated into existing hiring systems, contributing to improved accuracy of turnover prediction and optimization of personnel decisions.

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