Issues of Creating an Intelligent Automated Business Process Management System

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Abstract: This article to the creation of intelligent automated systems of business process management is devoted. Model of intelligent management of business processes based on a comparative analysis of fuzzy models is proposed. And also architecture and algorithm of intelligent automated systems of business process management are presented.

Keywords: business process, algorithm, architecture, intelligent system, statistical evaluation.

In recent years, the development of systems based on intelligent control has been noted. The main direction of development of these systems is the use of fuzzy logic: fuzzy sets, fuzzy modeling, etc. Development and implementation of intelligent automated business process management system (IABPMS), is an innovative process, in order to improve its efficiency and effectiveness.

The basis of fuzzy models of automated control systems are fuzzy logic regulators (FLR), used to create various IABPMS, control systems of complex dynamic systems, etc. At the heart of FLR are models of fuzzy logic: models of fuzzy logical connectivity and inference rules. The following scheme of linguistic description is common for NLR based on fuzzy production processor: translation into fuzzy values (fuzzifier), fuzzy logic bundle, compositional inference rules and conversion operators into clear values (defuzzifiers). The main stage of designing an intelligent fuzzy regulator is to create a "knowledge base", using the methods of representations and knowledge retrieval.

Since the purpose of this dissertation work is to investigate the features, justification and development of the methodology of IASBP of the enterprise in Uzbekistan in the digital economy, it is necessary to develop a system for automating the management of BP enterprise. For this purpose, it is necessary to justify the model of the control system and to study its manageability.

In contrast to the above computer systems for collecting and analyzing data on the quality of enterprise processes on the basis of the study proposed the following methodology for automated management system quality BP on the basis of intelligent automated system, which includes three modules.

1) Calculation of assessed indicators of quantitative assessment of the performance of BP enterprise, allowing automating the process of making management decisions for the next stage of monitoring;

2) Monitoring and visualization of enterprise BP manageability on the basis of its graphical representation in relation to its average, lower and upper limits, which allows to ensure statistically manageability and stability of the enterprise

3) On the basis of the obtained information, fuzzy-multiple models of intelligent

management of production processes, representing the dependence of process quality on their characteristics using the productive form of their representation are built.

Proposed in accordance with the above methodology of IABPMS of enterprise architecture IABPMS includes 3 modules (Fig.1):

1) "BPEC software" - to enter and calculate the estimated indicators of quantitative assessment of the performance of business processes of the enterprise;

2) "IMPP software" - for intelligent management of production processes;

3) "Statistical evaluation software" - for continuous monitoring and visualization of business process performance.
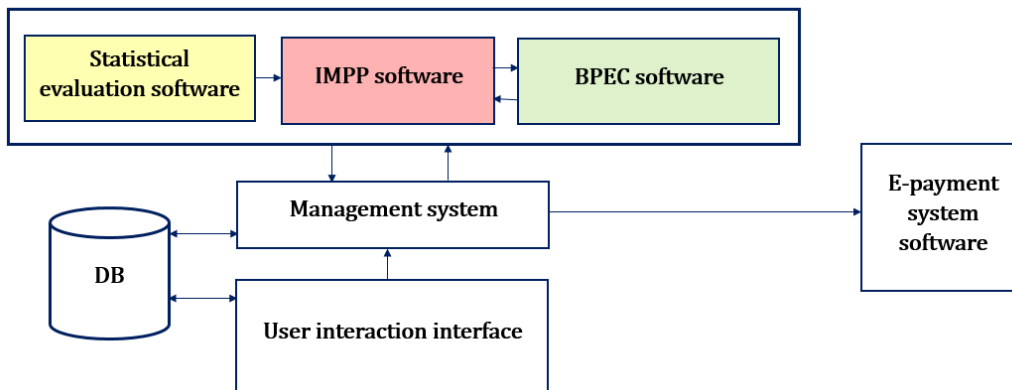

Fig. 1. IABPMS enterprise architecture

Below is the algorithm of the IABPMS of the enterprise
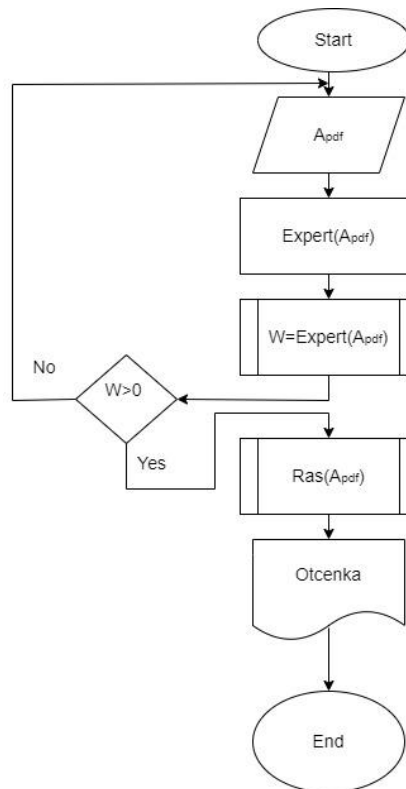

Fig.2. IABPMS algorithm

Model for BPEC: according to the "Quality Plan" the management of the enterprise should conduct periodic monitoring and analysis of business processes according to the organizational structure heads of departments act as experts, the number of experts - is determined according to the regulations.

To conduct the analysis to improve enterprise business processes and assess the effectiveness of enterprise business processes, quantitative metrics are required. Given the peculiarities of the object of automation as an organizational system, as such a tool you can choose and adapt the well-known methodology of "Weighted average value" (Weighted average).

This model, as applied to the evaluation of the effectiveness of BP consists of the following steps:

— Finding the Level II indicator;

— Finding the 1st level indicators;

— Finding the CBPSM indicator;

— Determining the value of the CPBMS indicator.

In addition, the presence of such metrics makes it possible to assess the impact of each Level II indicator on the performance of quality management for the period under study.

The artificial neural networks based on the learning and generalization algorithms allow in a number of cases to successfully forecast time series, to reduce the requirements to mathematical training of subject matter experts, but the neural network models can not be formally presented, and it is impossible to provide the results of the analysis of time series.

The most widespread methods are: Mamdani, Tsukamoto, Larsen, Takagi-Sugeno, of which the Mamdani model is the most optimal. The model can be defined as follows:

➢ Definition of a fuzzy rule base;

➢ Pacification of input variables;

➢ Aggregation of sub conditions;

➢ For each rule, the calculation of degree of affiliation values is performed. Rules where the values of the degrees of affiliation of the preconditions are non-zero are used for the calculations;

➢ Activation of sub conclusions in fuzzy rules is calculated using a formula, considering only active rules;

➢ Accumulation of the conclusions of fuzzy product rules, where the union of fuzzy sets is performed and the final set of fuzzy for the output linguistic variables (LPs) is obtained;

➢ In defuzzification, the result is reduced to a clear representation using the center of gravity method.

Application of fuzzy logic theory for the analysis of enterprise business process management systems gives an opportunity to get fundamentally new models and methods of analysis of these systems.

Thus, the model of intelligent management of business processes of production using the apparatus of fuzzy logic Mamdani is justified, the possibilities of obtaining quantitative estimates in the fuzzy model of FIBPMS are substantiated (Fig. 3.).
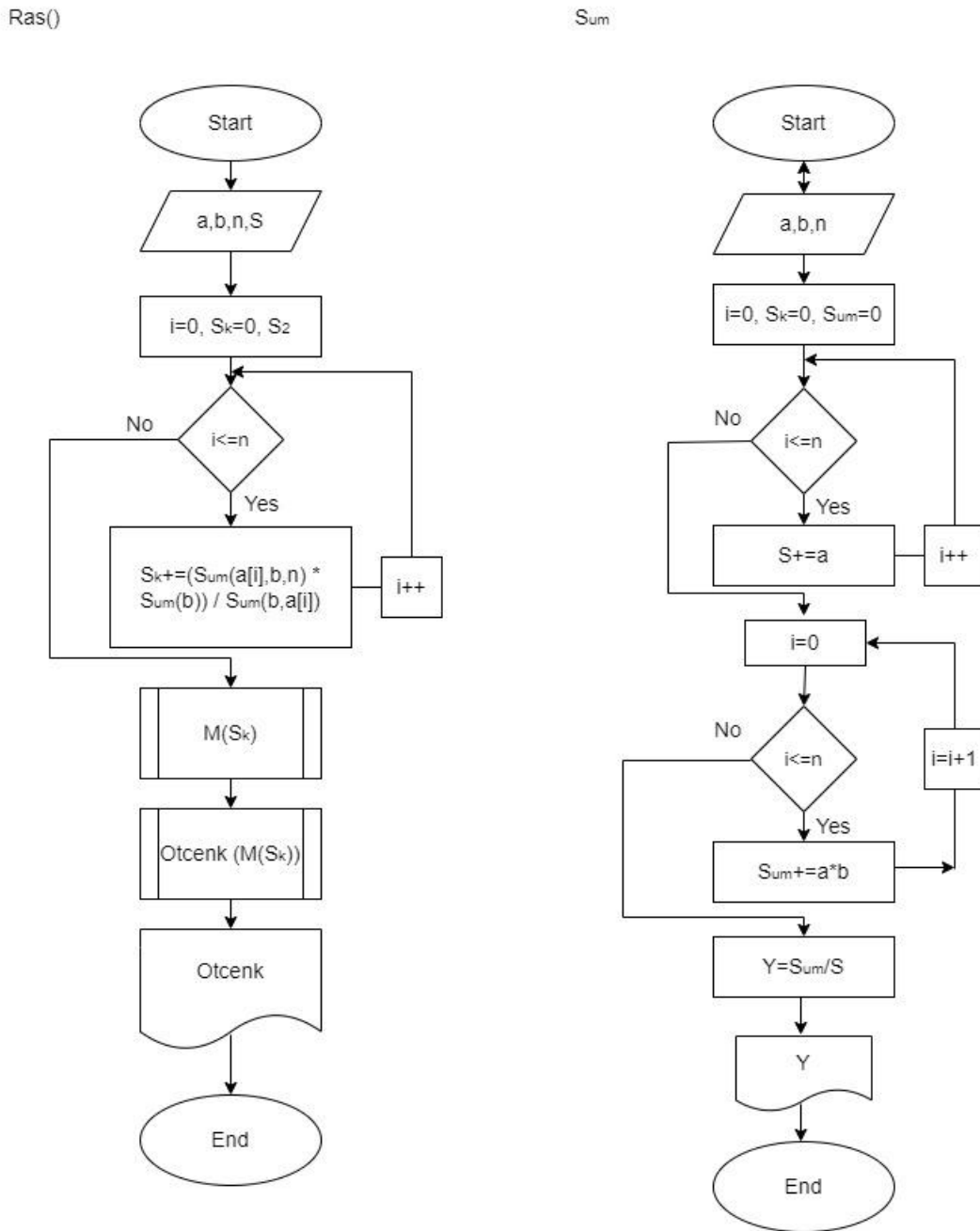
Fig. 3. IMPP algorithm

Algorithm of Monitoring and visualization of controllability of BP of the enterprise on the basis of its graphic representation in relation to its average, lower and upper limits, allowing to provide statistically manageability and stability of the enterprise and on the basis of the received information the fuzzy-multiple models of intelligent management of production processes, representing dependence of quality of processes from their characteristics with use of product form of their representation (the algorithm is presented on fig. 4) are constructed.

Model of assessment of statistical controllability of BP: statistical controllability of processes SPC (statistical controllability of enterprise processes) is widely used for prediction of performance of processes, analysis of behavior and monitoring of enterprise processes.

Control charts are graphical representation of the process flow, average, lower and upper

limits, if the process variations are within the upper and lower limits, then the process is statistically controllable and stable. If the points are outside the lower and upper limits, the process is considered to be uncontrollable and unstable, which characterizes its unpredictability.

Application within the proposed model of enterprise business processes based on intelligent automated system of continuous monitoring with visualization of controllability of the process flow of enterprise on the basis of its graphical representation, will ensure controllability and stability of enterprise business processes.
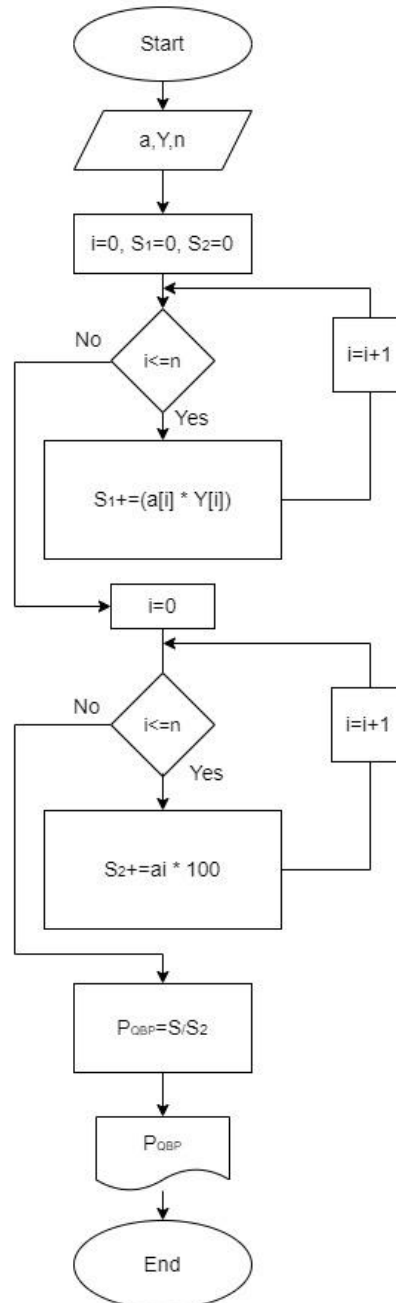

Fig. 4. BPEC algorithm

Methods for assessing the qulality of business process management and carried out their systematization in terms of methods of collecting information and the main evaluation criteria. Analysis of various methods applicable to FIBPMS shows the effectiveness of the

use of integrated statistical methods for data processing and fuzzy logic for assessing business processes of the enterprise. Without the use of statistical methods, it is impossible to implement the process approach at the desired level, to achieve results in improving the quality of products and reducing costs for it. Such methods as Kaizen, TQM (Total Quality Management) and Six Sigma are based on statistical methods. The task of statistical process management is to ensure and maintain processes at an acceptable and stable level, while ensuring that products and services meet established requirements. The main statistical tool used in this is control charts. Control charts are a paradigm for continuously monitoring processes based on numerical data through the use of Statistical Process Control or SPC (Statistical Process Control). SPC was formalized by Dr. Walter Schuchart. The principle of statistical methods is: "Reducing process variation (variability)." The lower the variation, the better the process; the better the process, the more stable the quality, the more stable the quality, the higher the controllability.

Monitoring allows you to determine qualitative characteristics, measurement, in turn, allows you to establish quantitative indicators.

The algorithm for calculating the evaluated indicators of quantitative assessment of the effectiveness of BP of the enterprise, allowing to automate the process of making management decisions for the next stage of monitoring is shown in Fig. 4.

Table 1. Performance indicators of business processes of the enterprise

Classification of business process indicators	
Qualitative parameters of the business process	- effectiveness - effectiveness - adaptability - productivity - duration - cost
Product performance	- performance measures - cost indicators - time performance - quality indicators - Fragmentation indicators (organizational complexity of the business process, determined by the number of business units and employees involved in it)
Processes indicators	- process values - process product indicators - process customer satisfaction indicators - cost indicators - time indicators - technical indicators
Quantitative indicators of business processes	- complexity - process ability - controllability - resource-intensiveness - controllability

The analysis of existing classifications of performance indicators of business processes of the enterprise allowed distinguishing two directions of their formation. The first direction is associated with the allocation of groups of indicators in accordance with the characteristics of the process (cost indicators, time indicators, etc.). The second direction is associated with the

definition of groups of indicators to assess various elements of business process (process indicators, product indicators, resource indicators, process satisfaction indicators, etc.) (Table 1.). The system of enterprise business process indicators should be built in such a way as to ensure the adequacy of their assessment. In our opinion, it should combine both quantitative and qualitative approach to evaluation.

For statistical management of business processes, an effective tool is control charts, which for the enterprise's IABPMS as part of a corporate or information system have not yet found application in Uzbekistan. Based on the analysis as the main method of fuzzy inference for constructing an optimal model of intelligent control it is proposed to apply the algorithm of fuzzy logic apparatus. The analysis and justification of the model of intelligent management of business processes using the apparatus of fuzzy logic is performed.

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