Journal of Theoretical and Applied Information Technology
31st January 2023. Vol.101. No 2

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

EVALUATION OF THE EFFICIENCY OF BUSINESS PROCESS MANAGEMENT AS AN ELEMENT OF AN AUTOMATED QUALITY MANAGEMENT SYSTEM FOR AN ENTERPRISE OF THE REPUBLIC OF KAZAKHSTAN

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ABSTRACT

This research is devoted to the development of innovative technology for automation of the quality management system of enterprise in Kazakhstan and its adaptation to the management system of enterprise. This paper deals with quality, as an important strategic tool in business. System effectiveness evaluation of quality management enterprises is of a great importance connected with the formation of rational decisions in the management of quality management systems including specificity of quality indicators, multi-level system, necessity to choose the optimal number of performance indicators and system status evaluation.

The objective and relevance of this research is connected with the need to: 1) solve the problems of quality management in the digital economy, following from the relevant National programs of the Government of the Republic of Kazakhstan, which are important at this step of in-depth scientific research; 2) guarantee the competitiveness of domestic enterprises with high quality requirements for products and services; 3) improve the efficiency of automated quality management systems; 4) saving resources (human and timing) in data processing.

The method and model of automated enterprise quality management and intelligent automated system of quality management of enterprise integrated with ruling MICS subsystems (Management Information and Control System) are offered allowing to automate QMS implementation and support processes and increasing the validity, efficiency and effectiveness of management decisions by automated a number of functions of decision makers and personnel.

This project was supported by a grant from the Ministry of Education and Science of the Republic of Kazakhstan (Zhas Galym project No. AR 13268939 Research and development of digital technology to provide consistency in the media of normative documents of the quality management system).

Keywords: *Quality Management System, Automated Business Processes, Quality Management, Efficiency Evaluation, Fuzzy Logic.*

1. INTRODUCTION

Quality is an important strategic tools in business [1]. Goal of business process improvement is the transformation of the enterprise so as to meet the requirements of modern IT and management ideology in the aspect of process approach. Problems of evaluating the effectiveness of the company's QMS are of great importance connected with the formation of rational decisions in the management of quality management systems including specificity of quality indicators, multi-level system, necessity to choose the optimal number of performance indicators and system status evaluation [2,3].

Information technology helps to change the relationship between consumption and production, and their interaction requires the exchange of information in order to organize and manage both manufacturers and consumers [4].

A monograph by B.S. Kubekov [5,6] has been studied as part of the ontological modeling of knowledge representation and management in the quality management system, where the methodology of modeling knowledge components

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

based on ontological engineering is presented, and new definitions are introduced. And as to this project, we introduced a methodology for modeling business processes from the detailed engineering of architecture to the marketing of business logic [7,8].

V.N. Burkov in management theory of organizational systems [9] discusses management models of organizational systems, as well as methods of solving management problems. The project [10] provides the basic mechanisms to manage organizational systems, provides samples for the design of integrated management mechanisms, as well as mathematical models of the theory to manage organizational systems and their applications. We also devote attention to the complexity of computing the solution of problems of optimal management in the models of functioning of active systems, study effective methods of decision-making, put management problems, using «parallelization» solution algorithms [11, 12]. Conceptual and methodological research in management systems are presented in [13].

The main objective for effective management is the stages of formation, implementation and use of an automated quality management system. The management system should provide access to the documentation of the enterprise, qualitative conclusion of the requested information for receiving managerial operations to solve the problems of the enterprise as of a certain moment.

As to analysis reports of the literature over the past 20 years, we can say that today in the world, especially in Kazakhstan, a scientific direction is developing related to the problems of implementation and automation of quality management systems, technology analysis of business processes of various organizations.

The reviewed works on the topic of research are of great theoretical and practical importance, the review of works showed that not all aspects of the studied area are covered. For example, there is no generally accepted standardized methodology for assessing the effectiveness and efficiency of the QMS, and many problems in this area of automation have not been solved. There are few products on the Kazakhstan software market that facilitate the systematic maintenance of the QMS of an enterprise. Therefore, there is a need for research and adaptation of automated quality management systems to improve enterprise operations and reduce labour and system operation costs.

In this article, having analyzed the theoretical foundations, models and methods, information technology automated enterprise quality management systems, we propose a methodology for automated enterprise quality management system based on statistical management and intelligent information system. The main contributions of this article are as follows. Firstly, the proposed methodology is based on one of the effective methods in modern management theory fuzzy logic, which is based on fuzzy sets. Secondly, the software of the information system for automated management of enterprise quality management developed by the authors, oriented for use in QMS and made in the form of a web-application, is proposed.

2. THE MAIN PART

It is necessary to solve the problems of introducing and maintaining up-to-date modern management systems in an industrially developed country, where competition, knowledge-intensive, innovative and technologically sophisticated production is developed.

The government has approved a Concept for the Development of Small and Medium-Sized Enterprises in Kazakhstan until 2030 [14]. One of the points of achievement of the goals and objectives of the concept is the automation and digitalisation of business reporting, as well as the reduction of permitting documents

Currently, entering the digital age and the advancement of human life in every field affect the development of TQM through the diversification of Industry 4.0 techniques and applications [15,16].

Quality management systems (QMS) are key to maintaining desired product quality and providing first-class services. QMS systems automate a wide range of business processes including product design, SOP development (standard operating procedures), management analysis, audits, training, claims management, corrective and preventive actions (CAPA – Corrective Action Preventive Action), etc. QMS users deal with huge amounts of data and various documents in their daily work. Handling such heterogeneous information manually can lead to human error and endanger products and consumers.

The automation of enterprises requires a lot of time and investment. Even if the system is designed and compliant with ISO standards, it will not provide assessment and prompt processing of a large amount of information related to the

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functioning of the organization. The information required is not communicated to a process on time for all intents and purposes, as a result, the decisions approved will largely not be fully adequate and are only addressed in an automated system [17].

The fact is critical important that quality management not only requires the use of automation tools, but is also as well adapted as possible for their application. The provisions of the ISO 9000 series are based on the modification of the information flows of the enterprise [18], which makes possible the development and application of a running, in a way standard software.

Kazakhstan enterprises certify quality in their organizations as an important business strategy. And as information technology has developed, a problem arose in obsolescence of traditional methods of data management on conformity of quality management [19,20].

Today, intelligent methods based on neural network technologies and fuzzy logic are used to solve management problems. [21-24].

Artificial neural networks, based on learning and generalization algorithms, allow in some cases to successfully predict time series, reduce the requirements for mathematical training of subject experts, but neural network models cannot be formally imagined, and it is not possible to provide the results of time series analysis.

3. DISCUSSION

Intelligent management systems have developed over the past few years [25]. The main direction of development of these systems is the use of fuzzy logic apparatus: fuzzy set, fuzzy modeling, etc.

The fuzzy models of automated management systems are based on fuzzy logic controllers (FLC) used to develop various APCS (automated process control systems), control systems for complex dynamic systems, etc. The FLC is based on fuzzy logic models: fuzzy link models and inference rules. The following system of linguistic description is popular for the FLC based on a fuzzy production processor: translation into fuzzy values (fuzzy value), fuzzy logical link, composite inference rules and conversion operators into plain values (defuzzy value). The main step in designing an intelligent fuzzy controller is to create a "knowledge base" using representation methods and knowledge search.

Business processes of an enterprise are divided into several subgroups according to the ST RK ISO 9001 standard: Main processes, Management (or managerial), Supporting (or otherwise auxiliary), and the number of processes depends on the specifics of the enterprise, as the standard does not define the exact number of processes, but is only a recommendatory (Figure 1).

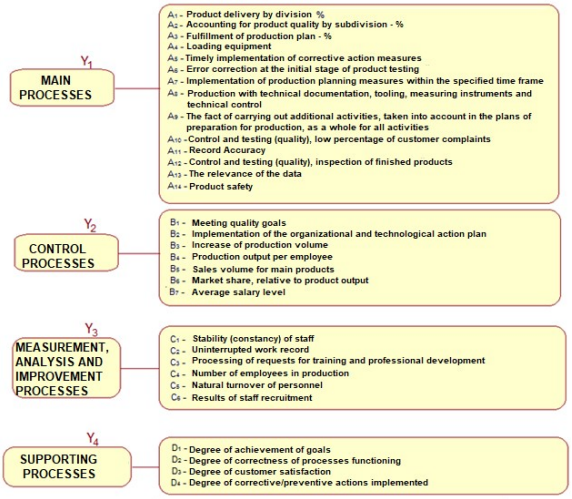

Figure 1 – Business processes of the enterprise

The offered fuzzy model of production quality management gives an opportunity to predict indicators of quality of services provided by the enterprise using "Supporting processes" for further use and introduction into the model.

Input and output variables of the two-level model are presented in Figure 2, where the output of the first level will be one of the inputs for the second level.

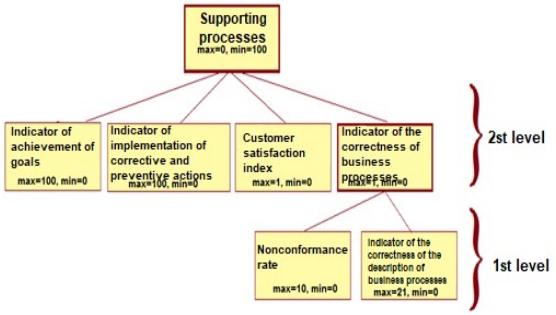

Figure 2 – Two-level QMS assessment model

Figure 3 shows the fuzzy inference algorithm using the first level.

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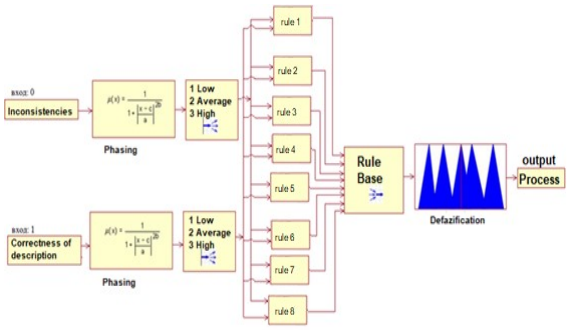

Figure 3 – Fuzzy inference algorithm using the first level

A level I output is an index of the correctness of business processes, the inputs are the variables i.e. the Index of inconsistencies (Inconsistencies) and the Index of the correctness of the description of business processes (Figure 3). Sector is divided into 3 areas for variables, these are Low, Average and High, defining their interval and membership functions.

So let's make a rule database (Table 1).

Table 1 – I Rule database of the evaluation model Quality Management System Manual

№	Inconsistencies	Correctness of description	The Process
1	High	High	Low
2	Average	Average	Average
3	Low	Low	High
4	High	Low	Average
5	High	Average	Low
6	Low	Average	High
7	Average	Low	Average
8	Average	High	Low

We can use the fuzzy model surface viewer shown in Figure 4 to find out the adequacy of the model, and as input variables affect the output one.

The test results of the created fuzzy inference model are presented in the Table (Table 2). As the systemic error δ,% is not more than 5% to the original expert data, the developed model is considered adequate [p. 2.8, 118].

Table 2 – Test result of the Fuzzy Output Model Level 1

№	Inconsistencies	Correctness of description	The Process	δ, %
1	1	1	0.85	4,1
2	5	10.5	0.5	0,0
3	9	20	0.090	0,1
4	2	19	0.40	5,0
5	8	2	0.44	2,9
6	7	7	0.45	1,9
7	4	15	0.35	1,7
8	3	14	0.53	1,4

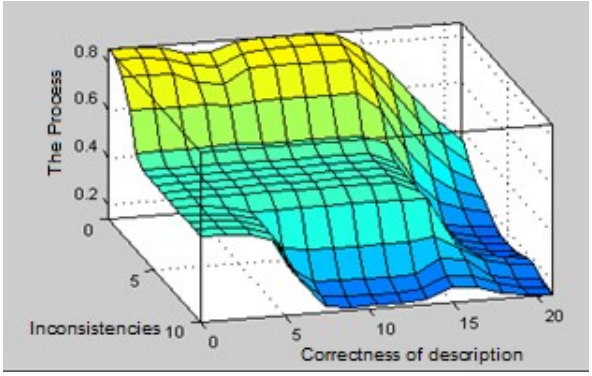

Figure 4 – Matlab Fuzzy Model Surface View Window

The rule database (a number of rules $T^{input\ variable} = 3^4 = 81$, after optimization = 30) is shown in Table 3.

Table 3 – II Rule database of the evaluation model Quality Management System Manual

№	Achieving goals	Degree of proper functioning of processes	Customer satisfaction level	Degree of implementation of corrective/preventive actions	Performance Assessment
1	2	3	4	5	6
1	Bad	Low	Not satisfactory	Low	1
2	Well (Medium)	Low	Not satisfactory	Low	1
3	Perfect	Low	Not satisfactory	Low	2
4	Bad	Average	Average	Average	2

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

			satisfactory		
5	Well (Medium)	Average	Average satisfactory	Average	3
6	Perfect	Average	Average satisfactory	Average	4
7	Bad	High	Satisfactory	High	3
8	Well (Medium)	High	Satisfactory	High	5
9	Perfect	High	Satisfactory	High	5
10	Bad	Average	Not satisfactory	Low	1
11	Bad	High	Not satisfactory	Low	2
12	Well (Medium)	Low	Average satisfactory	Average	2
13	Well (Medium)	High	Average satisfactory	Average	4
14	Perfect	Low	Satisfactory	High	3
15	Perfect	Average	Satisfactory	High	5
16	Bad	Low	Average satisfactory	Low	1
17	Bad	Low	Satisfactory	Low	1
18	Well (Medium)	Average	Not satisfactory	Average	3
19	Well (Medium)	Average	Satisfactory	Average	4
20	Perfect	High	Not satisfactory	High	4
21	Perfect	High	Average satisfactory	High	5
22	Bad	Low	Not satisfactory	Average	1
23	Bad	Low	Not satisfactory	High	1
24	Well (Medium)	Average	Average satisfactory	Low	3
25	Well (Medium)	Average	Average satisfactory	High	4
26	Perfect	High	Satisfactory	Low	4
27	Perfect	High	Satisfactory	Average	5
28	Bad	High	Not satisfactory	High	2
29	Bad	High	Average satisfactory	High	2
30	Bad	High	Satisfactory	Average	3

We can use the Level II fuzzy model surface viewer, shown in Figure 5, and determine the adequacy of the model, as input variables of Level II affect the output variable Score (Figure 6).

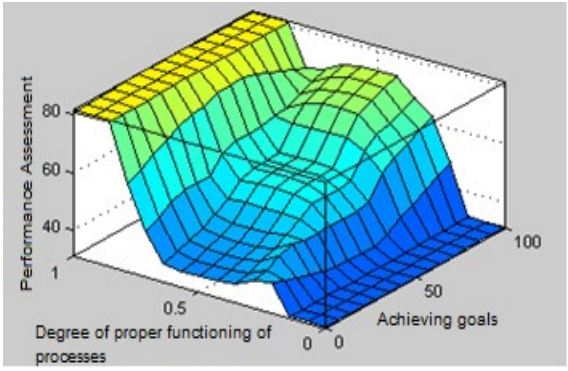

Figure 5 – II-Level Fuzzy Model Surface View Window

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ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

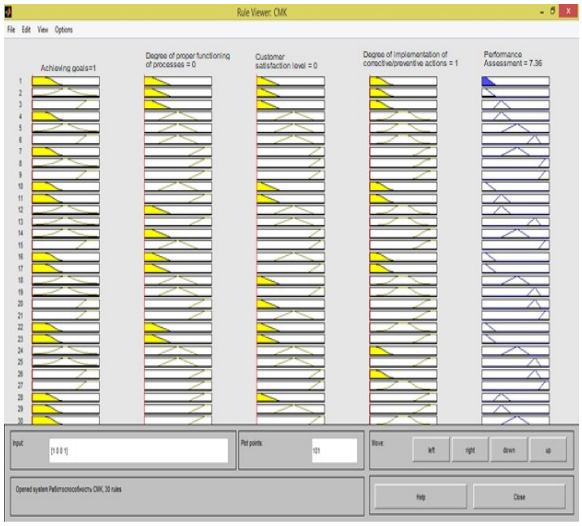

Figure 6 – II-Level Fuzzy Inference Rules View Window

Table 3.14 shows the model test results showing the positive effects of II-level input variables on the output variable Score.

The analysis of software for the automation of enterprise quality management systems, their advantages and disadvantages has established that they mainly automate document management. Among them we can single out Business Studio, which has some functionality for QMS. However, this software cannot be used because of its tight connection to the server and integration only with Microsoft Visio and Word.

Several problems can be highlighted which quality management professionals encounter when using such static management systems:

1) Unproductive use of working time. Managers have to enter the same data several times, collect information from different sources and combine it into single reports.

2) Lack of up-to-date information in real time. It takes time to distribute and update information across the organisation. Data is updated slowly in the system and the most recent changes in compliance data must be processed in order to give an accurate assessment of the situation.

3) Limited access to accurate analysis. Enterprise management relies on managers to monitor what is going on in the enterprise. Since the managers themselves are not quality managers, they rely on the latter to analyse and present data that they can understand and read. It takes a lot of time to generate reports, thereby slowing down the feedback process.

4) Preparing monthly reports for most businesses is a duplication of data. It takes time for managers to submit reports to managers when calculating the data.

5) Communication with employees is inefficient. Creating communication with employees and training people is time consuming. Quality managers spend a lot of time on compliance issues without paying attention to other activities.

6) Lack of databases of documented information and the resulting lack of an automated decision support system. Lack of prompt notification and response to deviations from targets.

The proposed enterprise quality management system includes: the management entity (enterprise), personnel, production and business processes, auditors and enterprise performance indicators. QMS influences the performance indicators of the enterprise through the improvement of production and business processes and can be included in the indicators in the form of evaluated QMS performance indicators of the enterprise. The QMS process is carried out by the staff through documented information and periodic assessment of staff commitments, corrective and preventive actions, and their follow-up. This process is time-consuming and distracts the staff of the enterprise from their main work (Figure 7).

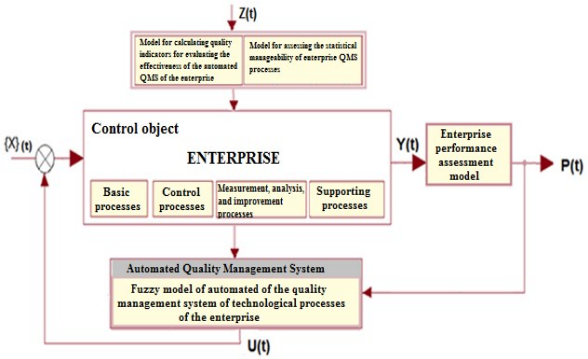

Figure 7 – The Structural Diagram Of A Company's Automated Quality Management System

Let's consider possible methods of enterprise QMS management automation and development of enterprise quality management automation system.

1) Input data {X}(t) goes into a control object available for viewing by decision makers;

2) The control object "Enterprise" has the following processes: Main processes, management processes, measurement and improvement processes, as well as auxiliary processes. Each of

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ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

the processes contains indicators to quantify the performance of the enterprise quality management.

3) Here Z(t) is positive perturbation, which provides for the use of models "Calculation of assessed quality indicators of enterprise QMS" for the ranking of significant process indicators and calculation of enterprise QMS performance, and "Statistical manageability of enterprise QMS processes" for statistical manageability of the enterprise. Quantitative indicators obtained as a result of primary expert evaluations are used for further processing in computational models.

Y(t) - determines the quality assessment parameters. Information about current values comes into , Control System by means of fuzzy-multiple model of intelligent management of production processes, Control System makes controlling influence U(t) on Control System, output result P(t) is an enterprise activity estimation.

The algorithm for an automated quality management system is shown in figure 8.

In contrast to the studied computer systems for collection and analysis of data on the quality of enterprise processes, on the basis of the study the following methodology for automated management of enterprise quality management system based on an intelligent automated system, which includes three modules (Figure 8), is proposed.

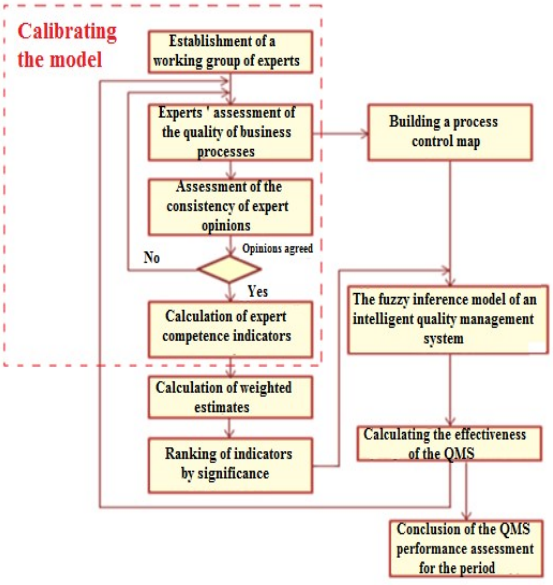

Figure 8 - Algorithm of the automated quality management system

1) Calculation of evaluation indicators of quantitative assessment of enterprise QM performance, which allows automating the process of making management decisions for the next stage of monitoring;

2) Monitoring and visualization of manageability of the management process of an enterprise, based on its graphical representation in relation to its average, lower and upper limits, which allows statistically ensuring the manageability and stability of the enterprise;

3) On the basis of the received information, fuzzy-multiple models of intelligent control of production processes are constructed, representing dependence of quality of processes from their characteristics using productive form of their representation.

In recent years, the development of systems based on intelligent control has been observed. The main direction of development of these systems is the use of fuzzy logic: fuzzy sets, fuzzy modelling, etc.

Figure 8 shows the window of the automated quality management software developed by the authors of the enterprise QMS "Progress Analysis".

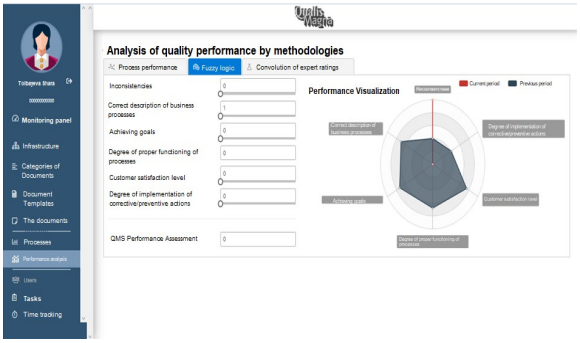

Figure 9 – QMS Progress Analysis Window

Figure 7 shows the window view to fill in the assessments of the company's QMS indices developed by the intelligent automated quality management system of the enterprise.

4. CONCLUSIONS AND FOLLOW-UP

Effective data analysis is critical for upgrading and progressive improvement. Quality management technology provides data presentation in one place and facilitates data exchange and analysis. This can help to identify wasteful processes, quality defects or inefficient equipment in less time.

Companies can improve quality processes in less time and take corrective actions with production management software. Overall result is better products and fewer customer complaints.

Using fuzzy logic theory for the analysis of quality management systems provides an opportunity to get fundamentally new models and methods for analyzing these systems.[26]

It is reasonable to use the production form of knowledge stored in QMS effectiveness assessment, which was confirmed in the development of a model of intelligent quality management of production processes using fuzzy logic apparatus [27].

The follow-up will focus on the development of the Implementing Models and Algorithms for Digital Transformation of Documentation Support for Quality Management System to detect Contradictions and Inconsistencies in Documentation Support of Quality Management System (QMS) of Kazakhstan Economy. This solution will eliminate the problems of processing high volumes of regulatory documents of the enterprise when accompanied in the automated QMS management system. The solution should be based on a reality model and be accompanied by the development of a formal language with approaches similar to the creation of well-known declarative programming languages.

Objectives of subsequent research:

1) analysis of theoretical foundations, models, methods and algorithms for detecting contradictions and inconsistencies in the arrays of normative documents and developing a methodological framework for ensuring the consistency and coherence of documents in the information space of the quality management system;

2) creation of methodology of formalized description of quality management system normative documents on the basis of physical structure and object model of QMS documents;

3) development of an architecture of integrated automated system for development, adoption and application of normative documents of the quality management system;

4) development of algorithmic modeling apparatus with application of formalized record of QMS documents;

5) development of a module to ensure consistency and coherence of documents of the integrated automated system of development, adoption and application of normative documents of the quality management system.

The following scientific and practical results have been implemented and obtained in the course of the research carried out:

1) Methodology of automated enterprise quality management based on intelligent information system, including a model for selecting and calculating the assessed indicators of quantitative assessment of enterprise QMS performance, continuous monitoring and visualization of QMS process manageability and building of fuzzy-multiple models of intelligent management of production processes is developed.

2) Developed a rule base and model for intelligent automated quality management of production and business processes of the enterprise of Kazakhstan using the apparatus of fuzzy logic Mamdani.

3) An automated enterprise quality management system has been developed, with a cloud-based version of the system increasing scalability, simplifying management and access to the software and data center.

REFRENCES:

[1] Bolatana G., Gozlub S., Alpkanb L., Zaim S. “The Impact of Technology Transfer Performance on Total Quality Management and Quality Performance” *Procedia «Social and Behavioral Sciences»*, 2016, V.235, - P. 746-755

[2] Khlevnaya Ye.A., Garnov A.P. “Modernizatsiya biznes-protsessov organizatsii. MIR (Modernizatsiya. Innovatsii. Razvitiye)”, 2011. №6// https://cyberleninka.ru/article/n/modernizatsiya-biznes-protsessov-organizatsii 29.10.2018.

[3] Mossalam A., Arafa M. “Governance model for integrating organizational project management (OPM) with corporate practices” *HBRC Journal*, V. 13, I. 3, 2017, P. 302-314

[4] Kubekov B.S. “Organizatsiya i predstavleniye znaniy planiruyemogo obucheniya na osnove ontologiy”. Monografiya. - *Almaty: IP «LP Zhasulan»*, 2019. - 336 c.

[5] Waldemar W., Kubekov B, Naumenko V., Narynov S, Toibaeva S., Utegenova A, “A.Project - Competency based approach and the ontological model of knowledge representation of the planned learning INTL” *Journal of electronics and telecommunications*, 2018. V.65, № 1, - P. 45-49.

[6] Barros O. “Enterprise and Process Architecture Patterns” *Business Process Management Journal*, 2010. - 17(4). - P.598-618

[7] Lychagin N.I., Vershinina V.P., Dmitriyev V.P. “Upravleniye znaniyami v sisteme menedzhmenta kachestva predpriyatiya - razrabotchika programmnogo obespecheniya” *Nauch.-tekhn.*

vedom. SPbPU «Informatika. Telekommunikatsii. Upravleniye», 2012. №4(152), - S.61-66.

[8] Burkov V.N., Korgin N.A., Novikov D.A. "Vvedeniye v teoriyu upravleniya organizatsionnymi sistemami" *M.: Librokom*, 2009. - 264 s.

[9] Burkov V.N., Burkova I.V. "Mekhanizmy upravleniya" Mul'tifunktsional'noye uchebnoye posobiye. - *M.: Lenand*, 2011. - 192 s.

[10] Barkalov S.A., Burkov V.N., Poryadina V.L. "Models of the competitive mechanism at the organization of mechanical engineering production" *IOP Conf. Series: Materials Science and Engineering*, 2019. 537. 042049. 10.1088/1757-899X/537/4/042049.

[11] Burkov V.N., Burkova I.V., Barkhi R., Berlinov M. "Qualitative Risk Assessments in Project Management in Construction Industry" *Journal MATEC Web of Conferences*, Vol. 251, 06027 (2018). DOI: https://doi.org/ 10.1051/ matecconf/201825106027

[12] Günthera L., Colangeloa E., Wiendahla H., Bauer Ch. "Data quality assessment for improved decision-making: a methodology for small and medium-sized enterprises" *18th International Conference on Sheet Metal*, SHEMET, 2019. -P. 583-591

[13] "Sayt kompanii TOO «Natsional'nyy tsentr akkreditatsii» 2017 // http://www.nca.kz/ 02.02.2017

[14] Ob utverzhdenii Kontseptsii razvitiya malogo i srednego predprinimatel'stva v Respublike Kazakhstan do 2030 goda // https://adilet.zan.kz/rus/docs/P2200000250// 05.01.2023

[15] M. Akhmatova, A. Deniskinaa, D. Akhmatova, L. Prykina "Integrating quality management systems (TQM) in the digital age of intelligent transportation systems industry 4.0" *Transportation Research Procedia*, Vol. 63, 2022, P. 1512-1520

[16] Kasenov K.R., Baysengirova A.J. "Development of management systems in Kazakhstan" Almaty: *Vestnik KazNPU*, 2017. - No. 1. - S. 26-33.

[17] Priede J. "Implementation of Quality Management System ISO 9001 in the World and Its" *Strategic Necessity Procedia «Social and Behavioral Sciences»*, 2012, V. 58, - P. 1466-1475

[18] Prokof'yeva N.P. "Razrabotka i vnedreniye sistemy menedzhmenta kachestva" *Standarty i kachestvo*, 2014 - № 2. - S. 25 - 29.

[19] Tsifrovoy Kazakhstan»: umnyye goroda, sovremennaya ekonomika// https://yvision.kz/post/815122: 24.09.2018.

[20] Utepbergenov I.T., Toybayeva SH.D., Muslimova A.K., Isabekova L.S. "Nechetkaya model' menedzhmenta kachestva tekhnologicheskikh protsessov pishchevogo proizvodstva" *Mezhdunarodnaya nauchnaya konferentsiya «Informatika i prikladnaya matematika»*, Almaty, 2017. CH.II. - S.374-388.

[21] PingWanga Hua Bu "Enterprise hierarchical management based on neural network model" *Optik*, Vol. 272, 2023

[22] Y. Zhao, S.Wenab, T. Zhou, W.Liu, "Development and innovation of enterprise knowledge management strategies using big data neural networks technology", *Journal of Innovation & Knowledge*, Vol. 7, Issue 4, 2022, 100273

[23] D. Zhu, Z. Li, A.R. Mishra "Evaluation of the critical success factors of dynamic enterprise risk management in manufacturing SMEs using an integrated fuzzy decision-making model", *Technological Forecasting and Social Change*, Vol. 186, Part A, 2023

[24] Bobrov L.K., Medyankina I.P., Toybayeva SH.D., Isabekova L.S. "Innovatsionnoye kachestvo s novymi innovatsionnymi instrumentami" *Materialy III mezhdunarodnoy nauchnoy konferentsii «Informatika i prikladnaya matematika»*, Almaty, 2018. - S.213-220.

[25] Toybayeva SH.D. "Kompleksnaya metodika avtomatizirovannogo upravleniya menedzhmentom kachestva predpriyatiya Kazakhstana", *Mezhdunarodnyy nauchnyy zhurnal SCITECHNOLOGY, Latviya*, 2019. №21. -C.23-27

[26] Utepbergenov I.T., Kalimoldaev M.N., Skliarova I.V., Toibayeva Sh. D., Muslimova A.K., Issabekova L.S. "Intelligent management system of production and quality products for the small and medium business enterprises" *Przeglad Elektrotechniczny* (Poland), 2018. №1. - P. 152-156.

[27] Utepbergenov I.T., Toybayeva SH.D., Muslimova A.K., Isabekova L.S. "Nechetkaya model' menedzhmenta kachestva tekhnologicheskikh protsessov pishchevogo proizvodstva" *Mezhdunarodnaya nauchnaya konferentsiya «Informatika i prikladnaya matematika»*, Almaty, 2017. CH.II. - S.374-388.