

ISMGE 2020**II International Scientific and Practical Conference "Individual and Society in the Modern Geopolitical Environment"****DEVELOPMENT OF AN INFORMATION EXPERT SYSTEM FOR ASSESSING THE EMPLOYEE'S QUALIFICATION LEVEL**

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Abstract

This article describes the main elements of the information expert system conceptual model that assesses the qualification level of employees in the enterprise. This system will provide decision support in determining the qualification level of employees, diagnostics of their professional deformation, as well as in the choice of methods and modes of training. Decision support is implemented through the gain of knowledge and experience of experts, which subsequently undergo the approval and processing procedure. The systematic approach and the methods of expert analysis used for qualification assessment procedures were chosen as the methodology for solving this problem. Methods of expert knowledge convolution, methods of experts' opinions reconciling allow removing a high uncertainty level of information as employee's qualification in most cases has qualitative characteristics which demand transfer to quantitative categories for carrying out an assessment procedure. In this regard, the system provides for the possibility for experts to introduce their own rating scales, in categories that will allow them to express their opinions most accurately and, through scales, bring judgments to a single rating system. Thus, the projected expert system for assessing the qualification level will make it possible to more effectively improve the professional skills of employees and more effectively organize the training process.

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1. Introduction

In the transition to the innovative stage of development in Russia, all previously existing directions of economic development are also changing. Nowadays, any innovative activity is directly related to the human factor. At the present stage of economic development, the key role in all processes is played by the person, instead of resourcing, material and technical equipment. Russia has a sufficiently high level of intellectual potential as well as scientific and technical resources, but it is not provided with the necessarily qualified workforce that supports the normal pace of the innovation strategy development. If earlier the main element of the economic potential was the material base, the production apparatus, that is, the provision of the enterprise with fixed assets, the level of their workload and their utilization efficiency, now the most important factor is the employees (Skiter et al., 2019).

2. Problem Statement

Russia's transition to a market economy model imposes requirements on enterprises – growth and development are possible only in case of conditions conducive to free competition. It creates such economic conditions that require the progressive system of staff development according to changing conditions of economic management activity.

Staff development plays a special role in the achievement of strategic goals, as changes occur in the activities and structure of the organization, constant changes in the qualification and professional orientation of personnel are required (Zade, 1976). Such changes are directly related to changes in the mechanisms of staff training and development as well as the development of the enterprise as a whole, which forms an objective need to develop a conceptual model of the expert system for assessing the qualification level of employees in the enterprise, which makes it possible to optimize the interaction of its elements and effective decision procedures support regarding the goals of the enterprise.

3. Research Questions

One of the main problems of many enterprises is the historical professional and personal degradation of labor resources in Russia. A well-developed system of professional retraining and training of employees, which ensures constant professional growth, can fundamentally change the situation. Any work activity will be economically feasible only if each employee has regard to the tasks of saving resources and time. To achieve such an organization of hired labor is possible due to high staff competence, to obtain such a result is possible through constant staff training and retraining. Therefore, only the constant striving of employees for professional growth can lead to cost-effective activities of the enterprise.

As it is known from the experience of developed countries, one of the most important social problems of the market economy is unemployment, since one of its main differences from the administrative-command system is the lack of stable work and, consequently, stable wages guarantees. Moreover, the unemployment rate always depends on the quality of employment duties performed by employees, very often this is due to the nature of the economy, like any other system which, as it is

scientifically proven, cyclically develops, that is why job loss is also associated with the onset of a particular phase of the economic cycle and the negative effects of any types of crises.

4. Purpose of the Study

Thus, the need to develop an information expert system for assessing the qualification level of employees at the enterprise, based on the system of decision procedures support is associated with the following reasons (Trahtengerts, 1998):

- The requirements imposed by a market economy where competition is the basis of progress. The main competitive strength of the enterprise is its personnel, and well-designed training programs help to organize employees effectively (Spandagos & Ng, 2018; Stock & Mark, 2013).
- The negative consequence of the transition from the administrative-command economic system to the market economy is the currently developing labour passivity, which leads to the professional degradation of labour resources. The effects of the reforms can be overcome by the development of activities encouraging employees to improve their professional level and aim at continuing training.
- The cyclical nature of economic development necessitates overcoming the negative consequences of the crisis, which are most strongly reflected in the labour resources. The use of flexible teaching methods will help preserve workforce capacity by reorienting it to promising activities.
- The development of flexible systems for monitoring the level of personnel qualifications is a prerequisite for the transition of Russia to a post-industrial society. This is dictated by the characteristic feature of this stage, namely the replacement of oil, as the main strategic resource with information, and information acquires value only when a person uses it.
- Russia has uncharacteristic features of development, as it is located between the West and the East and the consciousness of workers contains both Western and Eastern features, their symbiosis. Therefore, the training process of Russian workers is quite complicated and contradictory.
- The potential and ability of the labour resources in Russia are not lower than the level of foreign personnel potential, even higher, however, the main problem is that employees do not seek to unveil and use them in their working process.

Currently, professional degradation is an urgent problem of many Russian enterprises, for its effective solution it is necessary to clearly define the goals and objectives of the enterprise (Malushko et al., 2016).

For a manager, one of the important tasks is the need to determine the level of employees' qualification with a high degree of reliability and the ability to competently manage them in order to identify reserves for improving productivity and labour quality.

From this perspective, it becomes relevant to create a system assessing the level of employees' qualification in the enterprise, based on the concept of personnel training management, corresponding to current economic conditions and existing requirements.

5. Research Methods

Application of methods using numerical data to staff qualifications assesses and managerial decision support is limited by the fact that qualifications cannot always be quantified.

In this regard, the following requirements were formulated for the processing methods of the subject area, included in the algorithm for qualification level assessing of personnel, implemented in the program (Ketko et al., 2019):

- must take into account many criteria, that is, meet the conditions of multi-criteria;
- use expert knowledge as input data;
- be economically advantageous (Spertsyan et al., 2018);
- provide support for decision-making procedures, which provides real assistance in making managerial decisions.

For the purposes of the assessment, it is proposed to use the expert assessment methods with a fuzzy conclusion, belonging to the class of decision support methods. The choice is conditioned by the following advantages that meet the criteria for the qualification level assessing: Firstly, the fuzzy sets theories were developed as a tool for analysis and modeling of systems that are associated with a person and his life. Secondly, the mathematical apparatus of methods with fuzzy conclusion is configured to evaluate the thinking process of a person who thinks not in numerical categories, but in elements representing fuzzy sets, characterised by the continuity of the transition from the category of "belonging" to the category of "non-belonging". Thirdly, the features of the decision-making process, which requires methods that allow generating not one but several feasible solutions, and these solutions must satisfy the specified restrictions. Fourth, methods should be able to represent restrictions in the form of criteria, the significance of which is assessed by assigning each criterion a value, corresponding to the significance of its impact. Fifth, the solution must meet several contradictory criteria, which is currently becoming particularly relevant in connection with the acquisition of spontaneous crisis phenomena. Sixth, since the qualification level assessment is a quite difficult task (Ergunova et al., 2017), especially if it is solved individually by the manager since he does not have the opportunity to have profound knowledge of quality and nature of each employee work, the assessment is usually carried out by taking a collective decision involving the immediate supervisor of each department or site, and the collective decision-making process requires coordination of conflicting requirements to employees, their criteria and ratings. Seventh, the method should be intuitive to use in continuous mode. Eighth, should not require permanent financial costs for training. A necessary condition is simultaneous training of experts and decision-makers, enable them later to use it independently. In this regard, to support decision-making procedures in assessing the qualification level of employees in the enterprise, coordination of resource capabilities and monitoring the effectiveness of training activities, in the methodology of assessing and support of

decision-making procedures included the method of fuzzy preference, the method of hierarchical synthesis, the method of analytical strategic planning (ASP).

A group of methods is used to carry out the procedure for coordinating expert opinions, the choice of a particular method will depend on the task, the number of experts, alternatives and criteria, namely: discussion resulted in a consensus; arithmetic mean; weighted average analysis and ideal point method.

6. Findings

6.1. Description

The high level of dynamism of training processes puts forward requirements for constant monitoring of implemented activities effectiveness.

Based on the established requirements, the qualification level assessment and decision-making procedures support as part of the management process in the information expert system provides:

- coordination of goals, objectives and main development directions of the enterprise with the existing level of employees' qualification;
- regularity of qualification assessment;
- importance assessment of the activities that affect the qualification level of employees;
- coordination of internal and external restrictions and measures system necessary to maintain the required level of employees' qualification (Gusyatnikov & Sokolova, 2008);
- effectiveness control of implemented measures to improve the qualification level of employees in the enterprise.

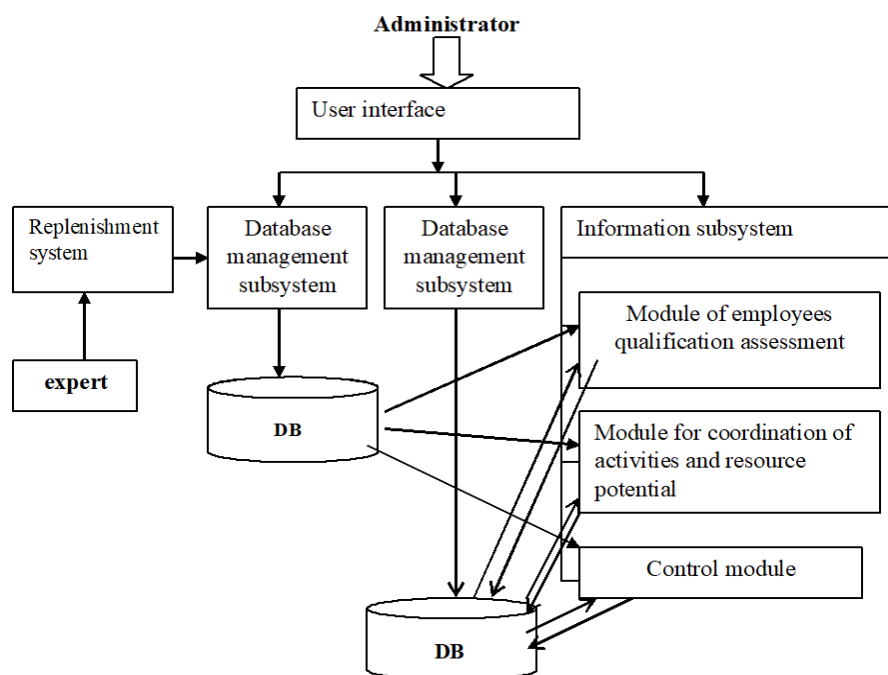


Figure 01. Architecture of an information expert system for assessing the qualification level of employees

Source: compiled by the author

In accordance with the established requirements for the expert system, the main elements of its components are defined: database containing input data; database containing information about intermediate calculations and output data; calculation module for evaluating and coordinating motives; calculation module for coordination of motivating and stimulating impacts with the resource potential of the enterprise; module for monitoring the effectiveness of implemented impacts.

Design of two databases is dictated by the need to optimize data storage and processing. The first database stores only the data entered from the keyboard, and the second database stores the data which entering does not depend from the experts, it is either intermediate calculations or the final results of the assessment and approval processes. Also, the expert system contains three separate assessment modules, their combination is an assessment of the full managing cycle by the qualification level of employees in the enterprise. Since a group of experts who can be far apart from each other takes part in the decision-making process, it is necessary to provide network support for the persons participating in the study. In this case, obtaining data from experts can be realized mainly through remote access via the Internet, or using an e-mail system.

To control and coordinate the process of collecting, processing, storing information, as well as to display the results of the study, an administrator is appointed. The system should also support individual decision making (Erokhina, 2006). If experts find it difficult to independently enter data into the system, in this case the survey is conducted on paper, and the administrator collects disparate data, enters into the system, conducts data reconciliation procedure, if the coordination is violated, the experts are tasked with the re-evaluation or a secondary survey of the expert group is conducted, the decision-maker processes the data and transmits the results of the study.

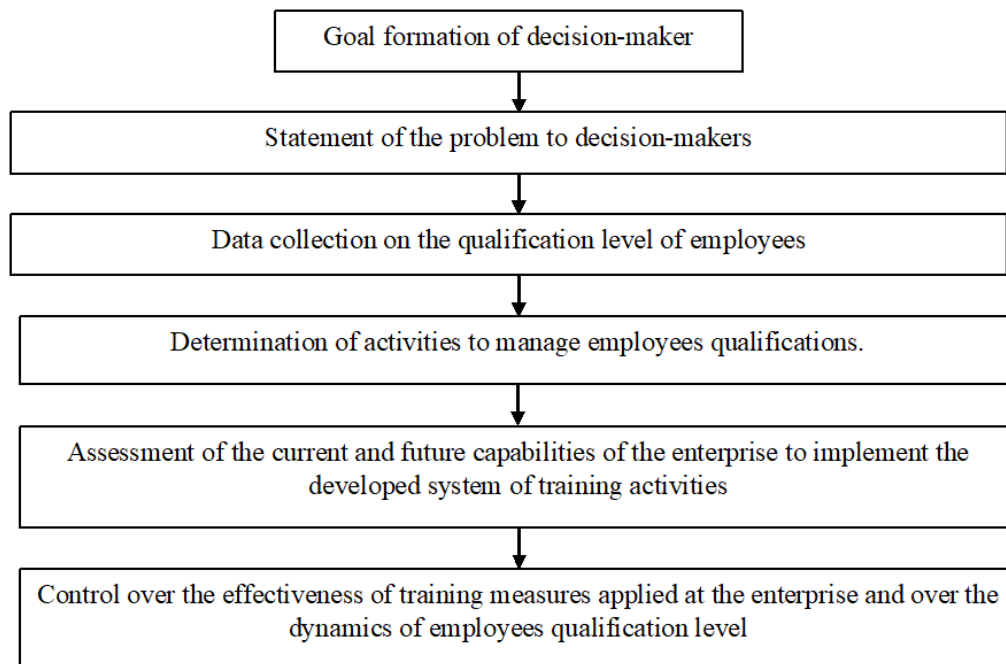


Figure 02. Algorithm of conceptual model of information expert system
Source: Compiled by the author

A person who is directly in contact with personnel management - Human Resources Officer, Head of HR, or a system administrator in state bodies - an information department inspector, may act as an enterprise administrator. However, job restrictions for the administrator are not provided –this position can be taken by any trained employee, and the training is of a one-time nature.

The subsystem of measures is influenced by the subsystem of restrictions, which includes the conditions imposed by the external and internal environment, which do not allow the company to implement an unlimited set of training activities, that depend on its potential resource and other capabilities and on the existing business environment. A characteristic feature of the training is variability, which makes it necessary to introduce a function of constant monitoring of implemented training activities effectiveness. The effectiveness monitoring of such activities is achieved through the subsystem of indicators, which elements reflect the effectiveness level of the impact on the professional qualification of personnel.

6.2. Results

The developed conceptual model of an information expert system for assessing the qualification level of employees at an enterprise meets the conditions of a market economy and knowledge-based economy and is aimed at levelling the negative and enhancing the positive interaction of system elements (Figure 1).

The developed expert information system is implemented through the decision-making procedures support, by performing the sequence of actions, shown in Figure 2. Support for the process of managing the personnel potential qualification is as follows: managers, based on their own experience and observations, determine the main qualification problems of employees, which are ranked by importance afterwards.

When a set of problems is structured, they are coordinated with the main goals and development directions of the enterprise. To improve the perception of the assessment results and, accordingly, decision-making support in determining the training activities, the agreed problems will be built in the form of a structural-hierarchical model in accordance with their rank obtained during the ranking procedure. Then, based on the obtained structural and hierarchical model, experts (managers) select activities that will improve the qualification level of employees in the enterprise. However, since the resource provision is limited, it is necessary to determine the ability of the enterprise to implement the developed measures. At this stage, the information flow from the subsystem of restrictions is transferred to the subsystem of impacts, clearly forming the area of impacts that the enterprise can implement within this economic state under these external economic conditions. After the measures are coordinated with the resource capabilities of the enterprise, the enterprise approves the system of personnel training. In order to determine the effectiveness of the implemented training activities, the concept is provided with a control procedure, according to which experts rank indicators, reflecting the results of already conducted training activities. Thus, through constant decision-making support, a complete cycle of managing the qualification level of employees in the enterprise is formed.

6.3. Discussion

The current business environment has formulated certain requirements for the information expert system at the enterprise:

- modern economic conditions and the new economic system do not allow assessing qualifications only from the perspective of usefulness in the production process, effective decision-making support can be carried out by coordinating the training programs with the goals and development directions of the enterprise;
- a notion qualification is an object by its nature, its development is associated with a high level of uncertainty, this involves not only the development acceleration of all processes but also the rather high complexity of its assessment, through accurate quantitative calculations. The qualification level does not have direct quantitative assessment indicators by which it can be determined, that is, the data processing methods in the information expert system should provide work with qualitative parameters;
- issues related to determining the qualification level of employees are directly interrelated to the decision-making process since it is the managers who have to decide whether to accept or dismiss the employee, what advanced training methods to apply, and since a person by his nature cannot predict all possible events in the future, then the decision-making process itself has a high level of uncertainty. In this regard, the information expert system should contain a mathematical apparatus that allows working in conditions associated with a high level of uncertainty.

The manager or decision-maker in choosing the “best” solution relies on their subjective ideas about the effectiveness of possible solutions and the importance of the influence exerted by various factors (Lgova, 2010). If earlier decision-making process was based on one or two factors, since the intensity of the change rate in the environment was small, and events occurred sequentially one after the other, now the set of tasks solved by a person has changed greatly, the rapid pace of development has caused new complex problems that have to be solved, considering many factors of simultaneous influence. In such circumstances, the manager has to make decisions, while assessing many forces and consequences that characterize them. Meeting the objective depends on the adequate choice of a solution from a variety of alternatives. The existence of several options for assessing the situation, mistakes in prioritizing creates difficulties in decision-making and increases the level of uncertainty.

Accounting for uncertainty is an important issue in the current stage of development. Whereas previously a high level of uncertainty existed only in processes that cannot be quantified, now uncertainty is present in almost all processes of human activity. This is due to the acceleration of scientific and technological development and, accordingly, development of all systems of human activity.

Nowadays the closest attention should be paid to the problems of uncertainty related to natural phenomena and human behaviour (Anisimova et al., 2019). It is important for the manager to take into account the uncertainty of human behaviour. Many different ways of describing uncertainties have been created for this purpose: probabilistic models, fuzzy set theory, interval mathematics, game theory.

Studies aimed at finding methods to reduce uncertainty in decision-making processes provided their classification: uncertainty arising from inadequate information about the issue under consideration; uncertainty caused by the inability to account for the response to the effects; the uncertainty created by the decision-maker (DM) due to an inaccurate understanding of his goals.

Decision-making in the field of managing the qualification level of employees can be complicated by the uncertainty related to internal factors: uncertainty may arise due to the actions of partners and competitors related to their business activity, financial situation and other factors; uncertainties associated with the inability to predict and take into account the reaction of employees to certain training activities.

Uncertainties arising from changes in external factors have a great influence on decision-making in managing the qualification level of employees: uncertainty of the future market situation in the country; uncertainties associated with cyclic fluctuations of systems; uncertainties associated with events taking place in foreign countries and international organizations. Thus, the manager, making any decision, faces uncertainty of one kind or another, since they are an integral part of this process (Tarakanov et al., 2019). Modern mathematical tools allow formalizing each of the listed types of uncertainty.

It is impossible to present tasks with uncertainties in the form of tasks with precisely defined goals since it is necessary to reduce the level of uncertainty or what is commonly called “to clear up uncertainty”. The most popular method to clear up uncertainty is the subjective opinion of an expert, which determines his preference in the problem being solved. A decision-maker, based on the examination results and their subjective ideas about the importance of possible alternatives and criteria, makes a decision.

In the process of life, each person makes decisions, our life is inextricably linked with this process, it is the basis of the management process. The simplest method of making management decisions is voting. This simple method allows you to identify difficulties that adversely affect the relative objectivity of the result.

7. Conclusion

Since the assessment of the qualification level is associated with the following problems: the presence of qualitative, difficult to formalize assessment parameters; multi-criteria nature of tasks; high level of uncertainty, it becomes necessary to organize the interaction of experts and decision-makers. To solve this problem, a conceptual model of the information expert system was developed, which allows assessing the level of the employees' qualification, as well as assessing and coordinating the complex formalized the knowledge of experts.

The main purpose of the information expert system is to help in the main areas:

- determination of the qualification level of employees in the enterprise;
- optimization of training activities selection (Suzdalova et al., 2017);
- control of the implemented training activities effectiveness.

The proposed information expert system meets the following requirements:

- processes the initial data in the form of qualitative characteristics and estimates, that is, operates with linguistic variables;

- assessment of the qualification level is associated with a high level of uncertainty, where the methods of information processing contain an algorithm to clear up uncertainty;
- the decision-support system provides not only a ranking procedure for training activities ranking by importance for employees but also a procedure for matching them with the goals and development directions of the enterprise;
- limited resources necessitate coordination of developed training activities and resource capabilities of the enterprise.

In general, the information expert system allows:

- visualizing the assessment results by hierarchical classification, namely, to build various structural and hierarchical models of staff development activities at the enterprise, which will take into account the main goals and objectives of the enterprise;
- based on the developed structural and hierarchical models, a subsystem of impacts will be formed: a system of professional development at the enterprise;
- coordination of potential resource capabilities of the enterprise in the implementation of the proposed system of professional development;
- forecasting the possibility of obtaining the desired results when implementing and using the developed system of training;
- assessing the effectiveness of the training activities used in the strategy and policy of the enterprise, with a view to timely correct them in case of changes in the environment, as well as changing the significance of the activities of the enterprise.

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