Advances in Economics, Business and Management Research, volume 105
1st International Scientific and Practical Conference on Digital Economy (ISCDE 2019)

Integration of foresight methods in the educational process aimed at improving the economic efficiency of master's and PhD theses on the basis of increasing the communication connectivity of the scientific and educational space

Sagintayeva S.S.
Almaty University of Power Engineering and Telecommunications
Almaty, Republic of Kazakhstan
sagintayeva@mail.ru

Zhanbayev R.A.
Almaty University of Power Engineering and Telecommunications
Almaty, Republic of Kazakhstan
zhanbayev@mail.ru

Abildina A.Sh.
Almaty University of Power Engineering and Telecommunications
Almaty, Republic of Kazakhstan
aalimbaeva@mail.ru

***Abstract* — There are a large number of educational technologies, which for the most part do not take into account that learning should be directed to the future, should be taught to predict and be ahead of modern advances in science and technology. In our opinion, a foresight can act as a tool for its assessment, which will help determine strategic directions of research and new technologies. The purpose of this article is to consider the possibility of using foresight, as a technology, in the educational process in order to increase the communication connectivity of the scientific and educational space. This article will consider the possibilities of improving the existing foresight technologies intended for the most promising scientific and technical measures aimed at ensuring the correction of the progress in the implementation of master's and doctoral theses in order to increase their economic efficiency**

Keywords — foresight, scientific and technical activity, educational process, dissertation, scientific and educational space

I. Introduction

It is obvious that the main goal of educational activity is the formation of a personality that expresses the potential of a person to the maximum. This leads to an increase in the importance of the paradigm of higher education, which treats students as active, responsible and full-fledged subjects of educational activity, along with faculty and employers [1].

Conceptually, this paradigm aims at creating educational space in universities that actively supports students' intellectual and creative potential, develops competencies that contribute to the acquisition of skills and abilities to determine promising vectors for the development of their personal and professional sphere in the context of dynamically changing conditions of social life and the needs of the country's innovative development.

In this regard, the foresight tool will serve as a tool for assessing the long-term perspective of science, technology, economics, and society, which will help determine strategic research directions and new technologies that contribute to the greatest socio-economic effect.

II. Research Methodology

The concept of foresight has been studied deeply enough not only in developed countries, but also in Kazakhstan. The theoretical achievements of Kazakhstan scientists in revealing the essence of the foresight, as a mechanism for determining priorities in the formation of a knowledge society, were the scientific achievements of R.S. Karenov, G. Schweizer, E.M. Mercer, B.D. Imanberdiev, S.Sagintayeva [2-5].

As noted earlier, the foresight technology has a difference, it is open absolutely for everyone and does not impose restrictions on the participants creating the image of the future. This implies that the outcome of the work should be a certain concept of development, i.e. a vector that defines the direction of work in the long term, involving participants in the discussion of ideas in groups. These features allow to seamlessly integrate the foresight technology into the educational process.

III. Results

The research results showed that the labor and time spent on the preparation of master's and doctoral (PhD) theses represent a definite resource that can be used for the innovative development of Kazakhstan. At present, this resource is mainly spent only on the fulfillment of formal requirements for dissertations; their results in the overwhelming majority of cases do not find real practical application and do not contribute to the development of public-private partnership in terms of commercialization of the results of scientific and technical activities [6,7].

To solve this problem, it is necessary to provide a steady systemic link between specific sectors of the economy and higher education. Scientific and technical problems, the solution of which the higher school directs its efforts, should be determined, first of all, by the demands of the economy and society, and not by the factor of inertia, when the same scientific or technical problem has been exploited by a particular department for decades, without reference to the possibility (or lack of opportunity) of commercializing the results of scientific and technical activities. This problem is essentially systemic. According to the tradition that has developed in the post-Soviet space, the planning of scientific activity comes from the scientific interests of a particular department or a particular scientist, i.e. first, the development is created, and only then the possibilities are found to promote it to the market. In modern conditions, it is necessary to switch to a different scheme, when the choice of the direction of scientific and technical activity is preceded by marketing and economic study of the question of the feasibility of carrying out relevant research [8, 9].

In this regard, there is a need to create an effective tool for the exchange of information between the business community, production organizations and other domestic structures that are able to select and adequately formulate real tasks that need to be solved for the innovative development of Kazakhstan.

For this purpose, the resource mentioned above can also be used - master's and doctoral theses. Foresight-oriented techniques used to assess the potential commercial attractiveness of dissertations will reveal the points of growth that the business environment will be oriented towards. To do this, first of all, it is necessary to change the current practice, when the choice of the dissertation topic is entirely determined by the personal scientific interests of the supervisor. It is necessary to create effective information technologies that will allow correcting the progress of work on master's and doctoral theses in order to commercialize the results of scientific and technical activities [10-12].

We consider the possibilities of modernizing existing foresight technologies designed to identify the most promising areas of scientific and technical activity, aimed at ensuring the correction of the progress of master's and PhD dissertations in order to increase their economic efficiency, including in terms of commercializing the results of scientific and technical activities.

The first step in the implementation of this goal is to create the foundations for increasing the communication connectivity of the scientific and educational space. There is a classic problem of selection and motivation of experts. Foresight methods are aimed at solving this problem through the use of statistical methods and a wide base of expert assessments. In this case, partly eliminates the need to attract highly qualified experts (and verification of this qualification) through the use of large teams of experts. However, in the existing form, foresight methods solve the problem of assessing the quality of such scientific materials as master's theses only partially, since the question remains about attracting a significant number of experts whose task, moreover, is to work with a large data array. The question of the motivation of experts and the assessment of the quality of the examination itself remains open in this case (there are no guarantees that a particular expert will not score points on the basis of a superficial review of work or on the basis of certain subjective considerations).

This paper shows that there is the possibility of obtaining expert assessments in the mode of self-organization (at least, if we talk about the assessment of doctoral and master's theses). Namely, the defense of the thesis requires the participation of two actors - the actual dissertator and his supervisor.

Historically, it was from the team of scientific leaders (more precisely, from the faculty of a particular university) that the most authoritative specialists stood out who formed the scientific councils, which developed (in modern terms) expert assessments. In other words, until recently, the receipt of relevant expert assessments took place precisely in the mode of self-organization of the scientific and pedagogical team, which distinguished the most reputable experts from its midst [13-16].

If we talk about improving methods for assessing and monitoring the results of scientific and technical activities (including dissertations), a fundamentally important question arises - should we try to restore the mechanisms of self-assessment of the activities of the above-mentioned community or is the use of third-party resources (albeit in combination with internal) mandatory?

Another factor needs to be considered when developing adequate approaches to the development of expert assessments. Namely, the system of expert assessments at the same time is both a control tool and a management tool.

Indeed, as current practice in Kazakhstan shows, the introduction of formal indicators designed to quantitatively reflect the effectiveness of scientific and technical activities immediately led to a change in the goal-setting of the majority of the scientific and technical community. Namely, after the Hirsch index, which reflects the performance of a particular research worker, was officially used (for example, there is a threshold value for the Hirsch index, which a project manager applying for budgetary funding should have), the publication activity of Kazakhstani scientists immediately increased.

Considering that the quality of master's and doctoral dissertations defended at Kazakhstan universities is currently extremely low (moreover, the factors considered in [17, 18] will remain, at least in the medium term), then the procedures for assessing their quality appear appropriate to consider, first of all, as a management tool. In other words, when developing appropriate quality assessment methodologies, the emphasis should be shifted to ensuring the improvement of the level of dissertations, their scientific and applied value.

Otherwise, the task is not so much to assess the real state of affairs as to create the prerequisites for a qualitative leap, which is quite possible due to the availability of the necessary intellectual resources and political will, expressed in the

Message of the President of the Republic of Kazakhstan to the people of Kazakhstan which explicitly states the need to modernize the education sector in order to bring it into line with the challenges of the digital age [19].

This thesis also allows answer the question about the need to attract external intellectual resources (third-party experts). Namely, if the emphasis is shifted to management, then the grading procedure itself can be viewed as one of the tools for information management of the faculty activities. This approach is fully consistent with modern ideas about the macroscopic control of complex systems in which self-organization processes take place [20]. In accordance with these ideas, the most effective approach to management is that which uses natural processes of self-organization, reducing regulation to their direction in the right direction. A little running ahead, we note that the proposed algorithm is essentially a prototype of an artificial intelligence system that ensures the management of the faculty community of a particular university through the mechanisms of forming a rating scale. Here it is necessary to emphasize that modern approaches to the development of artificial intelligence (AI) systems [21] operate with ideas about man-machine systems. (In accordance with these ideas, AI is integrated into a specific community, which is considered as integrity.) Therefore, we can really talk about restoring the self-assessment mechanisms of the scientific and teaching community, but on a new basis that best meets the ideology of the digital age.

With a simple example is can be shown that it is possible to use the procedure for grading students by university teachers to evaluate their own business and professional qualities.

Suppose that it is possible to get “true” grades (the scale is not yet concretely specified) of a certain array of scientific and technical works (further for definiteness, master's theses will be considered). In this case, it is immediately possible to assess the competence / objectivity of the expert himself; to do this, it is enough to compare the marks he gave with the “true” ones. Obviously, a certain ambiguity arises here, due to the fact that possible deviations will be due to several factors acting simultaneously:

- the expert in good faith is mistaken (factor of insufficient competence);
- the judgments of the expert are influenced by subjective factors (for example, an underestimation of the assessment of the work, the author of which is unpleasant to the expert);
- The expert treats this work in bad faith (the factor of insufficient motivation, for example, estimates are made on the basis of superficial judgments).

The purpose of the algorithm being developed, therefore, should be including the selection of the results for the indicated factors, as well as obtaining estimates as close as possible to the true ones, based on data in which the subjectivity factor is obviously present. In this case, it is possible to provide not only high-quality expertise without the involvement of third-party resources, but also to use the very fact of its conduct in order to increase the level of scientific and technical activity.

Initial Data Collection Technique. The assessment is carried out on the basis of data on the implementation of N scientific works of the same type (for definiteness, the master theses will be considered below). It is assumed that for the convenience of expert assessments, the most significant information relating to the thesis will be converted into a compact form. (The development of such forms is an integral part of the project "Development and implementation of the foresight-oriented teaching methods of doctoral students and undergraduates in the educational process"). It is also assumed that these forms will provide for the possibility of grading by teachers who are not specialists in a particular narrow field. (This provides an expansion of the expert base and the possibility of using AI methods or statistical methods.)

In accordance with the proposed methodology, the leaders of master's theses themselves act as experts.

The principal difference from the existing approaches (used, for example, by the National Scientific Councils of the Republic of Kazakhstan when conducting international examination) is that respondents do not put out absolute scores, but compare several dissertations with each other. Specifically, materials reflecting the results of work on 5 master's theses are provided to each of the scientific leaders. (The choice of this number is justified below). The respondent is asked to rank these dissertations by assigning each of them a number from 1 to 5 (1 is the best of this set, 5 is the worst, assigning the same value to all works is not allowed), the nature of the data is illustrated in Table 1.

TABLE I. AN EXAMPLE OF A TABLE CONTAINING RAW DATA

	1	2	3		N	n+1	n+2	n+3	n+4
Name 1		3			1		2		
Name 2	1		5	…				4	
…									
Name N		5				2			3

For additional control, the respondent is also asked to assign one of the numbers from 1 to 5 to the work of his undergraduate.

The ranking is carried out according to one or several comparison criteria, the nature of which should be established by the implementation of other sections of the funded R & D "Development and implementation of the foresight-oriented methods of educational work of doctoral students and graduate students"

The advantages of the comparison are obvious. First, if teachers are offered to give points according to a method similar to the one currently used by the NNS, then, most likely, significantly overestimated points will be given (in order to avoid conflicts with colleagues). Secondly, in this case, the procedure for applying the evaluation criteria is simplified, since this is a comparison of works.

The main arguments, on the basis of which it is proposed to go to the comparison procedure, are as follows. To improve the quality of education at this stage, the factor of competition will be the most effective, not only between students, but also between academic leaders. In existing conditions, the processes of self-organization in the teaching environment have led to the fact that it provides passive collective resistance to innovation. Attempts to use nanotechnology as a driver for a technological breakthrough will fail precisely because of the existence of pronounced resistance to innovation [22].

For this reason, the condition of ranking is obligatory when evaluating, and according to the conditions of the assessment procedure, respondents should be announced in advance that a conclusion will be made on its basis, including regarding their own competence and integrity. This will serve as an additional incentive for making an objective conclusion. At the same time, it is the factor of mandatory ranking that excludes the possibility of forming a conclusion like "we are all competent and highly qualified specialists".

Basic algorithm

In the first (basic) approximation, the procedure for parallel assessment of the level of master's theses and the integrity / competence of scientific leaders acting as experts is based on the following counting method.

Each of the N survey participants actually gives 5 ratings, ranking the 5 materials received, that is, 5N ratings are given in total. Provided that the materials are distributed evenly, this means that each of the participants receives 5 ratings, i.e. the score varies from a minimum of 5 to a maximum of 25.

The number 5 is chosen from psychological considerations. A smaller number gives insufficient statistics, but its further increase creates significant difficulties with ranking. Indeed, psychologically, of the five works, it is fairly easy to select the best and the worst, and then repeat the procedure with respect to the two remaining works (two stages of ranking). The implementation of such a ranking in three stages can already lead to difficulties due to the necessity of parallel accounting of a sufficiently large amount of material.

So, in the first approximation, the estimation procedure is expressed by the formula

$$I_n = \sum_{k=1}^{s} w_{nk} \tag{1}$$

where w_{nk}– is one of the numbers of the natural series from 1 to s (for the above reasons, it is advisable to choose this number to be five), which the expert assigns to the nth job in the ranking process, $I_n$is the estimate corresponding to the first approximation.

At the next stage, the mapping K is constructed using the standard method of fuzzy logic.

$$\{I_n\} \xrightarrow{K} \{Q_m\} \tag{2}$$

which translates the resulting estimate into a ball scale [23].

In the simplest case, this mapping corresponds to splitting the entire possible interval of change in the $I_n$estimates into several subintervals, each of which corresponds to a certain administrative action. Simplifying, assessments should be transferred to a coarser scale, for example, "excellent", "good", "satisfactory", "bad", in order to eliminate the influence of errors. In addition, it is this mapping that corresponds to the procedure for using neural networks to solve the problem, as will be clear from the sequel.

The disadvantage of formula (1) is the inability to take into account the good faith / competence of a particular expert. We rewrite formula (1) in the form with a different upper limit of summation, corresponding to the total number of participants in the mutual evaluation procedure.

$$I_{n0} = \sum_{k=1}^{N} w_{nk} \tag{3}$$

Formally, formula (2) looks the same as (1), but it contains elements of the N × (N-1) matrix, which assume a zero value if work with number k is not evaluated by an expert with number n. This type of evaluation formula allows you to directly enter the weights S_k, reflecting the good faith / competence of a particular expert. Here

$$I_n = \sum_{k=1}^{N} S_k w_{nk} \tag{4}$$

Thus, the task is reduced to the determination of coefficients reflecting the characteristics of a specific expert. Its solution allows, on the one hand, to characterize a specific supervisor (if we are talking about master's theses), on the other hand, it allows to obtain relevant assessments of the quality of work performed.

The simplest method for determining weights is based on a direct comparison of the judgment made by a particular expert with a collective opinion. Such a comparison is as follows.

Obtaining a set of estimates $\{I_{n0}\}_{i=1}^{i=N}$, obviously, allows to sort the N estimated works according to the first approximation rating, getting a sequence of integers $\{q_{n0}\}_{i=1}^{i=N}$. Every 5 jobs, ranked by each of the experts, in this sequence occupy certain positions: deleting from the entire sequence $\{q_{n0}\}_{i=1}^{i=N}$the numbers of those jobs that are not included in the set of papers, ranked by an individual expert, it gives the ranking required for comparison (a special case when in the ranking $\{q_{n0}\}_{i=1}^{i=N}$two or more jobs occupy the same position, is considered separately below). The result of such a ranking will be denoted by the sequence $\{r_{mk}\}_{i=1}^{i=5}$, respectively, by $\{r_{mk0}\}_{i=1}^{i=5}$denote the ranking formed by a separate expert.

The result of the procedure just described can be represented as a substitution (5)

$$\begin{matrix} 1 & 2 & 3 & 4 & 5 \\ \underbrace{3 \quad 2 \quad 1} & & & 5 & 4 \end{matrix} \tag{5}$$

The top line of the substitution is the ranking obtained on the basis of a collective opinion, the bottom one is based on the judgments of the individual expert. The numerical distance between the rankings is defined as the sum of the squares of the differences between the positions, which is occupied by the specific work in the top and bottom line (5). In example (5), the distance corresponding to the work with the number "3" is 2, which is shown by a curly bracket. In general, the distance is given by

$$Q_k = \sqrt{\sum_{m=1}^{5}(r_{mk0} - r_{mk})^2} \quad (6)$$

Or, for the case of ordering the form (5)

$$Q_k = \sqrt{\sum_{m=1}^{5}(m - r_{mk})^2} \quad (7)$$

The weights S_k, respectively, are given by the formula:

$$S_k = \frac{Q_k}{\sum_{i=1}^{N} Q_i} \quad (8)$$

Formula (8) provides the ability to implement an iterative procedure that allows to calculate the final values of the weights. At the i-th step of this procedure, the search for ranking {I_n^i }, is carried out, for which the values of the weighting factors {S_n^(i-1) }, are used, obtained at the (i-1) -th step. By ranking {I_n^i }, the coefficients {S_n^i },are determined, the procedure is repeated until the required accuracy is achieved.

The self-assessment of experts is used to further check the integrity and the adequacy of the proposed procedure itself. Initially, it is sufficient to implement it by means of a qualitative comparison of an expert's conscientiousness assessment, carried out through the procedure of calculating the coefficients {S_n^i }, described above, with data obtained by comparing the expert's self-assessment and ranking {I_n^i}.

IV. THE DISCUSSION OF THE RESULTS

Algorithmic basis for the transition to an artificial intelligence system. A description of the algorithm for constructing an artificial intelligence system designed to obtain expert assessments using modernized foresight methods is given below using an example when the mapping (2), built on the principles of fuzzy logic, is binary.

Binary mapping is also of direct practical interest for Kazakhstani universities in terms of improving the quality of education in the magistracy. Namely, as even a cursory review of master's theses in technical disciplines shows that the overwhelming majority of them are hopelessly outdated and have no practical significance. It is obvious that attempts to force the undergraduate to work on a dissertation, a topic that cannot be interesting, lead to the fact that work on the dissertation will be reduced only to the fulfillment of formal requirements, which cannot but affect quality.

Consequently, the problem arises on the selection of topics of dissertation papers on the criterion of relevance, which implies the possibility of using a binary assessment (“relevant - irrelevant”). This task is also of interest from the point of view of improving the economic efficiency of universities, by blocking further work on topics that do not promise a clear economic return. In addition, this example is very convenient for working out the proposed assessment methodology, since it significantly expands many experts, since it is possible to make an adequate judgment about the commercial relevance of a particular work without being a narrow specialist in a particular field.

It can be seen that, for binary splitting, the sequential application of formulas (4) and (2) actually leads to a formula describing the functioning of a separate neuron of the network with a stepwise activation function

$$I_n = \theta\left(\sum_{k=1}^{N} S_k w_{nk} - s_0\right) \quad (9)$$

where θ(x)={■(1,x≥0@0,x<0)┤ - step activation function, s_0 - activation threshold experimentally selected during system setup.

This conclusion suggests that the described method is in fact a numerical implementation of an analogue of a Hopfield-type neural network with a matrix of weight coefficients w_nk. The analogy is not direct, since the specified matrix is not symmetric, but this suggests that the corresponding method can be transformed to the prototype of the AI system, and for the case when the partition corresponding to certain administrative actions is not binary. In general, the output is preserved, with the difference that it is necessary to proceed to the use of K-valued logic.

Expert system setup method. Configuring the expert system is carried out on the example of establishing the relevance of the topics of master's theses. Setup is carried out in three stages. At all three stages, the main instrument is the questionnaire-substantiation of the relevance of the topic of the thesis, which is filled by the scientific leaders of the set selected by administrative methods. The same persons act as experts.

However, in three stages, three different types of questionnaires are used, containing a minimized and most vivid amount of information, allowing the expert to make all the conclusions, spending no more than 10 minutes.

First step:

The questionnaire is developed according to a standard sample, it is assumed that experts score points from 0 to 9 according to several criteria (a similar technique is currently used by the NSC). It is expected that experts will mark overestimated points for all positions, except for individual cases related to personal antipathies. The purpose of the survey at this stage is to conduct a comparative analysis with the proposed methodology in order to substantively prove the existing advantages. In addition, the identification of obvious antipathies allows a comparison with the results of the survey at subsequent stages in order to demonstrate that the proposed method allows you to automatically make corrections that take into account such subjective factors as dishonesty and expert bias.

Second phase:

The questionnaire states that the processing will be carried out in order to train an expert system built on the use of neural networks. The purpose of the questionnaire is also a classification of topics of dissertations by criterion of relevance. The questionnaire is designed so that the time to fill it out was minimal; the nature of the information provided implies the possibility of assessing the receipt of economic benefits by the university (commercialization of the results of scientific and technical activities). The focus on commercialization is to ensure that the assessment can make the widest possible range of specialists. At this stage, the proposed methodology based on the ranking principle is used for evaluation.

The third stage:

The questionnaire is developed on the same principles as for the second stage. The nature of the questions asked provides for obtaining the same information as in the second stage, the only difference is in the formulations. The purpose of the stage is to re-test the system, as well as a clear demonstration of the possibility of automatic detection of subjective judgments. This is achieved, among other things, due to the fact that the same expert at the second and third stages of setting up the system are provided with different sets of jobs, which provides an opportunity for a comparison.

V. Conclusion

In conclusion, it can be noted that this method, after passing the test on the example of master theses assessment, can be applied more widely, in particular, in the distribution of grant funding. The advantage in this case is significant financial savings, since the participants of the competition can be involved as experts.

References

[1] Filosofiya sotsial'nykh i gumanitarnykh nauk. The philosophy of the social science sand humanities: uchebnoe posobie / Lebedev S. A. idr. Pod obshch.red. S. A. Lebedeva. Moskva: Akademicheskiy proekt, 2008. -733 s.

[2] R.S. Karenov. Novaya metodologiya predvideniya budushchego razvitiya nano-tekhnologiy s primeneniem nauchnogo instrumenta «Forsayt» // Vestnik Karagandinskogo universiteta. Seriya «Ekonomika». № 1(85)/2017.-S.77-83.

[3] Shvaytser, E. M. Merser. Nauka i tekhnologii v Kazakhstane – sostoyanie i perspektivy. Forsayt // Izdatel'stvo «NIU «Vysshaya shkola ekonomiki». Moskva, 2007. Tom 1. №2.-S. 60-66

[4] G. Revalder. S.Sagintayeva. Contribution of higher education in regional competiveness and development: case of Kazakhstan. Economic science for rural development, 2018. №49. –C. 402-411. http://www.esaf.llu.lv/sites/esaf/files/files/lapas/Krajums_Nr_49_01.05.2018.pdf

[5] B.D. Imanberdiev, S.M. Kasymov. Forsayt-prognoz razvitiya Kazakhstana na period do 2050 goda// Almaty, Vestnik KazNPU, 2013.-№3 (37). –S. 16-35.

[6] Sagintaeva S. S. Nauka i obrazovanie v Kazakhstane: zarisovki na fone mirovoy turbulentnosti // Nauchno-tekhnicheskiy zhurnal «VESTNIK Almatinskogo universiteta energetiki i svyazi», 2018. Spetsial'nyy vypusk. - S.7-12.

[7] Zhanbaev R. A.«Rol' lichnosti v istorii s tochki zreniya teorii neyronnykh setey: stremlenie k individual'nomu bessmertiyu kak mekhanizm obespecheniya ustoychivogo razvitiya // Nauchno-tekhnicheskiy zhurnal «VESTNIK Almatinskogo universiteta energetiki i svyazi», 2018. Spetsial'nyy vypusk. -S. 35-47 (soavtory Kalimoldaev M. N., Shaltykova D. B., Pak I. T., Bakirov A. S.)

[8] Vereshchagina A. V., Samygin S. I., Imgrunt S. I. Intellektual'naya bezopasnost' Rossii v usloviyakh krizisa nauchno-obrazovatel'noy sfery i rosta sotsial'nogo neravenstva //Gumanitariy Yuga Rossii. – 2016. – T. 18. – №. 2

[9] Gulyaev G. Yu. Rossiyskiy krizis: tendentsii i perspektivy //International scientific review. – 2016. – №. 1. – S. 46-49

[10] Danova M. A. Metodika vybora prioritetov pri prognozirovanii nauchno-tekhnicheskogo razvitiya krupnomasshtabnykh ob"ektov na osnove tekhnologii Forsayt // Aviatsionno-kosmicheskaya tekhnika i tekhnologiya. – 2013. – №. 7. – S. 227–231-227–231.

[11] Ptuha A. R. Forsajt-tekhnologii marketinga–cennostnaya i strategicheskaya paradigma predprinimatel'stva // Problemy sovremennoj ekonomiki. – 2016. – №. 2 (58).

[12] Sidunova G. I., Sidunov A. A. Gejmifikaciya v sisteme forsajt menedzhmenta //Teoreticheskie i prikladnye aspekty sovremennoj nauki. – 2014. – T. 5. – №. 5. – S. 181-186.

[13] Innovatsionnye stsenarii v postindustrial'nom obshchestve / I. Suleĭmenov, O. Gabrielyan, I. Pak, S. Panchenko, G. Mun. — Almaty–Simferopol':PrintExpress, 2016. — S. 218.

[14] Nekotorye voprosy sovremennoǐ teorii innovatsiĭ / I. Suleĭmenov, O. Gabrielyan, G. Mun, I. Pak, D. Shaltykova, S. Panchenko, E. Vitulëva. — Almaty–Simferopol': PrintExpress, 2016. — S. 197.

[15] Suleimenov, I., Shaltykova, D., Obukhova, P., Stentsova, A., &Suleymenova, K. (2014). Quantitative theory of effectiveness of highest education: role of interpersonal communications. European Journal of Educational Sciences (EJES), 171.

[16] Zhanbaev R. A. Fantomnye boli mirovoy nauki // Nauchno-tekhnicheskiy zhurnal «VESTNIK Almatinskogo universiteta energetiki i svyazi», 2018. Spetsial'nyy vypusk. -S. 24-34 (soavtor Mun G. A.)

[17] Obukhova, P. V., Guichard, J. P., Baikenov, A. S., &Suleimenov, I. E. (2015). Influence of Mass Consciousness on Quality of the Higher Education in Kazakhstan. Procedia-Social and Behavioral Sciences, 185, 172-178.

[18] Suleimenov, I., Guichard, J. P., Baikenov, A., Obukhova, P., &Suleimenova, K. (2015). Degradation of Higher Education in Kazakhstan as an example of post-transitional crisis. International Letters of Socialand Humanistic Sciences, 54, 26-33.

[19] Poslanie Prezidenta Respubliki Kazakhstan N. Nazarbaeva narodu Kazakhstana ot 10 yanvarya 2018 goda «Novye vozmozhnosti razvitiya v usloviyakh chetvertoy promyshlennoy revolyutsii» http://www.adilet.gov.kz

[20] Sulejmenov I. E. Byurokratiya s tochki zreniya teorii samoorganizacii //Obrazovatel'nye resursy i tekhnologii. – 2017. – №. 2 (19). –S. 36-44. DOI.10.21777/2500-2112-2017-2-36-44

[21] Bostrom N. Iskusstvennyj intellekt: Etapy. Ugrozy. Strategii. – \" Mann, Ivanov i Ferber\", 2015.-656s.

[22] Ergozhin E.E., Aryn E.M., Sulejmenov I.E., Belenko N.M., Gabrielyan O.A., Sulejmenova K.I., Mun G.A. Nanotekhnologiya. Ekonomika. Geopolitika. / Biblioteka nanotekhnologii. Almaty – Moskva-Sofiya-Antipolis – Simferopol': Izd-vo TOO «Print-S», 2010, 227 s.

[23] Semenenko M. G., Chernyaev S. I. Funkcii pol'zovatelya v Excel 2013: razrabotka prilozhenij nechetkoj logiki //Uspekhi sovremennogo estestvoznaniya. – 2014. – №. 3.–S. 114-117