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ITERATIVE SIGNAL PROCESSING IN ANTICIPATORY MANAGEMENT OF INDUSTRIAL ENTERPRISE DEVELOPMENT

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Abstract. The article proposes the use of an iterative approach in anticipatory management that is based on a two-stage iteration of the noise correction of the detected signal and the establishment of a signal response base, which ensures obtaining the most accurate original content of the signal and the scope of the industrial enterprise by the intensity of its manifestation. It is expedient to establish a maximum and a minimum threshold value of the force of the detected and devoid of noise original signal in the established field of activity of the industrial enterprise (review base). Setting the maximum and minimum threshold values is a necessary task, both in the case of forecasting the onset of crisis events, and in the case of identifying favorable conditions for development. It is proved that the principle of iterative signal processing is universal for controlling signals, which indicate the approach of critical events and opportunities for development. The developed approach can be applied in the anticipatory management in the internal and external environment of the industrial enterprise.

Keywords: management, development, signal, enterprise, iteration, filter, noise, correction, management decision.

JEL Classification: C600, M110, M210

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1. Introduction

Receiving signals about changing the state of the external and internal environment of an industrial enterprise prior to the occurrence of the events related to the change of this state in the future is the first step in anticipatory management if this type of management is applied to the enterprise. Ignoring signals or delaying their interpretation leads to significant consequences, especially if the company implements a development program that is usually associated with an orientation towards the market, competitors, consumers, financial and credit institutions (Berry et al., 2007).

Therefore, the monitoring of such signals, their identification, detection in a particular area of the enterprise is an urgent task, the solution of which requires the development of an appropriate approach, which in its properties ensures the accuracy of the recognition of the signals of the approaching crisis or changes in the conditions of development and operation of industrial enterprises. This approach is an iterative one (Cockburn, 2008; Larman & Basili, 2003), unlike classical approaches: systemic, process, functional, and others. This approach to management is most often used in cases where it is necessary to carry out work in parallel with the continuous analysis of the results obtained and adjusting the previous stages of work.

2. Literature review

The feasibility of using the iterative approach has been proven in a number of scientific studies and publications.

In the work (Voloshchuk, 2014) it is proposed to use the iterative approach as one of the analytical tools for managing the economic security of an industrial enterprise, where the criteria of classification are the steps (iterations) of the procedures for assessing the economic security of the enterprise and their respective task of formation of analytical tools.. The author developed a two-stage iterative cycle for assessing the economic security of an industrial enterprise, where, at the first stage, individual blocks are evaluated; and the second stage is an integral estimation of the data array defined at the previous iteration stage.

R. R. Tan et al. grounded the necessity of using an iterative approach in modeling the optimal production program of an industrial enterprise (Tan et al., 2016). Thus, the author developed economic-mathematical models that are used in various iterations and differ both in the composition of restrictions and in the form of criteria indicators. In this case, individual iterations are carried out at different stages of the formation of the production program. The advantage of using the principles of an iterative approach is the increase in the efficiency of optimization calculations when forming an enterprise's production program and reducing the cost of analyzing the market demand.

The need to use an iterative approach in the process of developing and adopting managerial decisions is emphasized (Pamučar et al., 2017; Kuzylyak et al., 2016; Pająk et al., 2016, 2017; Kwilinski, 2018). To streamline the process of making managerial decisions as a set of formal

and informal procedures, the authors are encouraged to use the technology of decision-making, which will allow to analyze the decisions made earlier and to make optimal managerial decisions. This process is presented in the form of several iterations:

1. Setting a task.
2. Preparation of managerial decisions.
3. Adoption of managerial decisions.
4. Implementation of the approved managerial decisions (Kuzylyak et al., 2016).

Using the proposed approach will provide an improved quality assessment of probable managerial decisions that involves the collection and processing of operational data from the uncertain and risk area and the development of managerial decisions using iterative cycles (repetitions).

Using an iterative approach in management, due to the use of an unlimited number of stages of iteration (repetition) of input data processing, will improve the quality of managerial decisions.

In the anticipatory management, such input data to be processed are the signals coming from the internal and external environment of the industrial enterprise and inform about the approach of the crisis, threats to the industrial enterprise or the creation of potential opportunities for the development of the organization, favorable conditions for the implementation of strategic development activities (Ashley & Morrison, 1997). Therefore, despite the sufficient number of scientific papers on the methodology of the iterative approach, the spectrum of its action in the anticipatory management remains insufficiently studied.

3. Methodology

The main tools for such monitoring include:

3.1. Concurrent analysis

The purpose of this type of environmental monitoring tools is to determine the economic state of the industry, the main directions of its development, the level of competition and competitive positions of the main players of the market, to analyse the closest competitors to the investigated enterprise, to analyse the prospects of the industry, etc.

In the general form of competitive analysis, the identification of weak and strong environmental signals is reduced to the following stages:

1. Definition of the time period within which an analytical assessment will be carried out.
2. Definition of product market boundaries.
3. Definition of geographical boundaries of the market.
4. Identification of the economic entities on the market.

5. Calculation of the volume of the commodity market and the share held by the business entity.
6. Determination of the degree of market saturation.
7. Identification of barriers to entry.
8. Assessment of the competitive environment (Norik, 2005*).*

When using this tool as the main one during monitoring, the main attention is paid to the competitors, as a factor of direct influence on the state of the enterprise, therefore, the analysis of the internal environment is secondary.

3.2. Comparative industry analysis

This type of analysis is carried out on the basis of comparison of the main indicators of production and economic activity of enterprises operating in one industry:
- profit;
- sales;
- cost of manufactured goods;
- profitability;
- wage fund;
- investments;
- volume of produced products, etc.

Comparison of the data of the enterprise and other enterprises-competitors is made on the same indicators with the average industry values. The advantage of using this tool as the main one in monitoring is the ability to identify weak and strong signals regarding the use of insufficient production capacity, marketing policy effectiveness, etc.

3.3. Resource analysis

It consists of describing and evaluating financial, organizational and technological resources (creating a resource profile), comparing the profile created according to the market requirements (identifying the strengths and weaknesses of the rated entity), and identifying specific competencies (the strengths and weaknesses of the rated entity are compared with the strengths and weaknesses of the underlying asset of a competitor). Only the internal environment of the enterprise is analyzed and evaluated. The influence of environmental factors is completely excluded. The basis for further development of the strategy is the comparison with the activities of the main competitor (Ognev & Chernyshenko, 2013).

3.4. Competitive analysis on the model of "Five Forces" by M. Porter

The use of this type of analysis as a tool for environmental monitoring involves analyzing the main external forces:
- market power of suppliers;
- market power of consumers;

- market power of competitors;
- the threat of the emergence of new competitors on the market;
- the threat of the appearance of analogue products on the market.

4. Results and discussion

The scheme of application of the iterative approach in the processing of signals in anticipatory management is presented in Figure 1 (part 1a and 2b).

Receipt of signals for the first stage of the iteration cycle is based on the results of continuous monitoring of the internal and external environments of the industrial enterprise (Guselbaeva & Pachkova, 2015).

The analysis involves two steps:

1. Assignment of quantitative indicators to determinants of five forces by expert assessment.
2. Analysis of the strengths and weaknesses of the current competitive situation, as well as possible compensatory measures.
3. SNW analysis. The purpose of this analysis is to characterize and assess the internal environment of the enterprise in three positions:
   - strong (advantages of the enterprise activity);
   - weak (restrictions in the activity of the enterprise);
   - neutral.

When applying this type of evaluation analysis exclusively for the internal environment of the enterprise as a resource, as a result you can see signals for expansion of activity or vice versa collapse.

4. STEP (PEST) analysis. It is carried out by means of a detailed description and evaluation of social, technological, economic and political factors affecting the organization's activities.

The factors of direct and indirect impacts of the organization's external environment are described and analyzed in details. The estimation of the factors of the internal environment is completely excluded (Hedouri et al., 2007). According to the results of this type of analysis, it is possible to draw conclusions on the identification of signals for the implementation of measures related to the development of the industrial enterprise or the introduction of preventive measures to ensure the production and economic performance of current activities.

5. SWOT analysis. This type of analysis is the most common among the main tools for monitoring the threats and opportunities for enterprise development, which involves identifying strengths and weaknesses in the company's activities, identifying development potential and evaluating opportunities for implementing strategic measures.

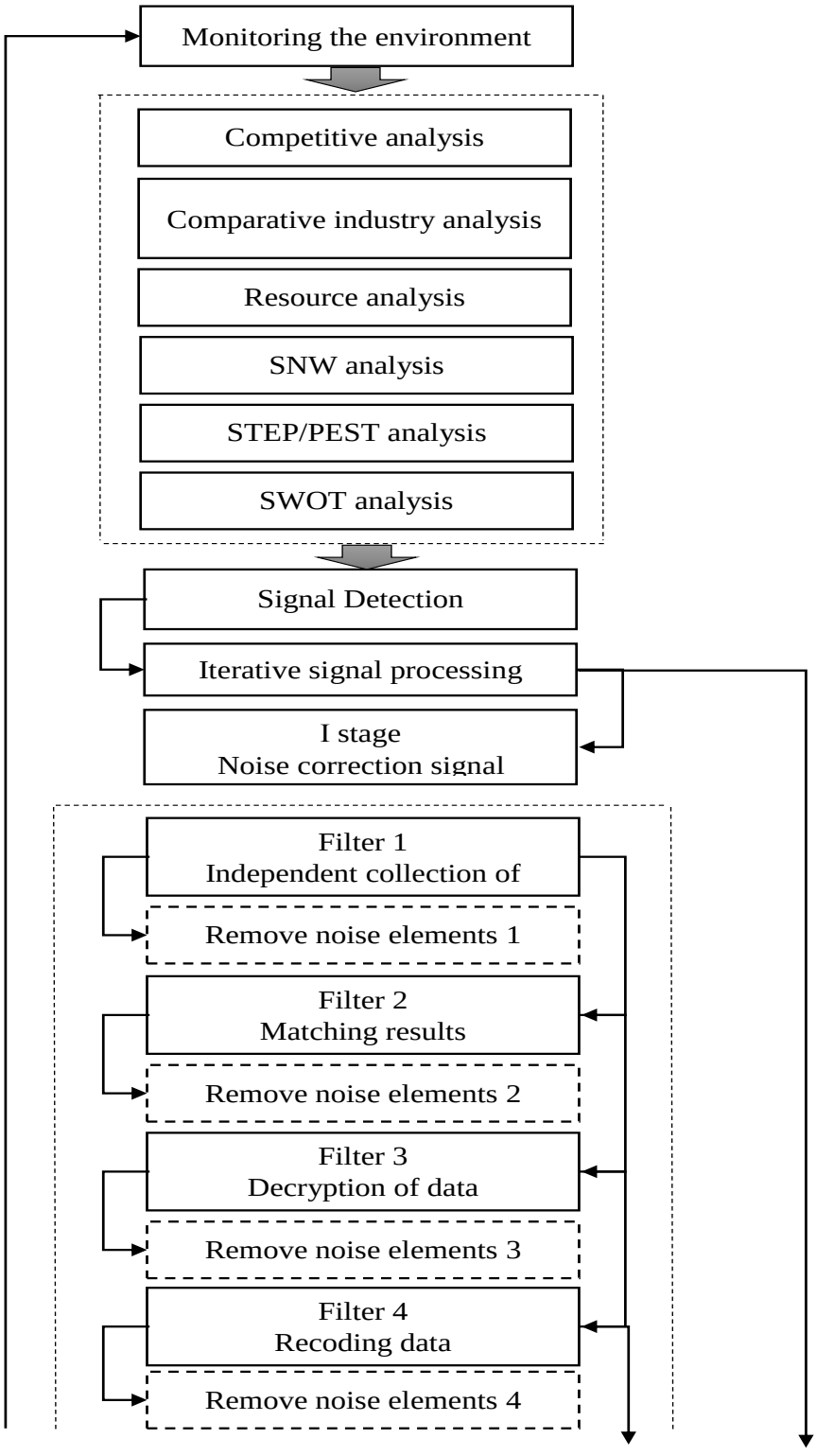

Figure 1a. An iterative approach in anticipatory management of the development of an industrial enterprise (part 1)
Source: own research.

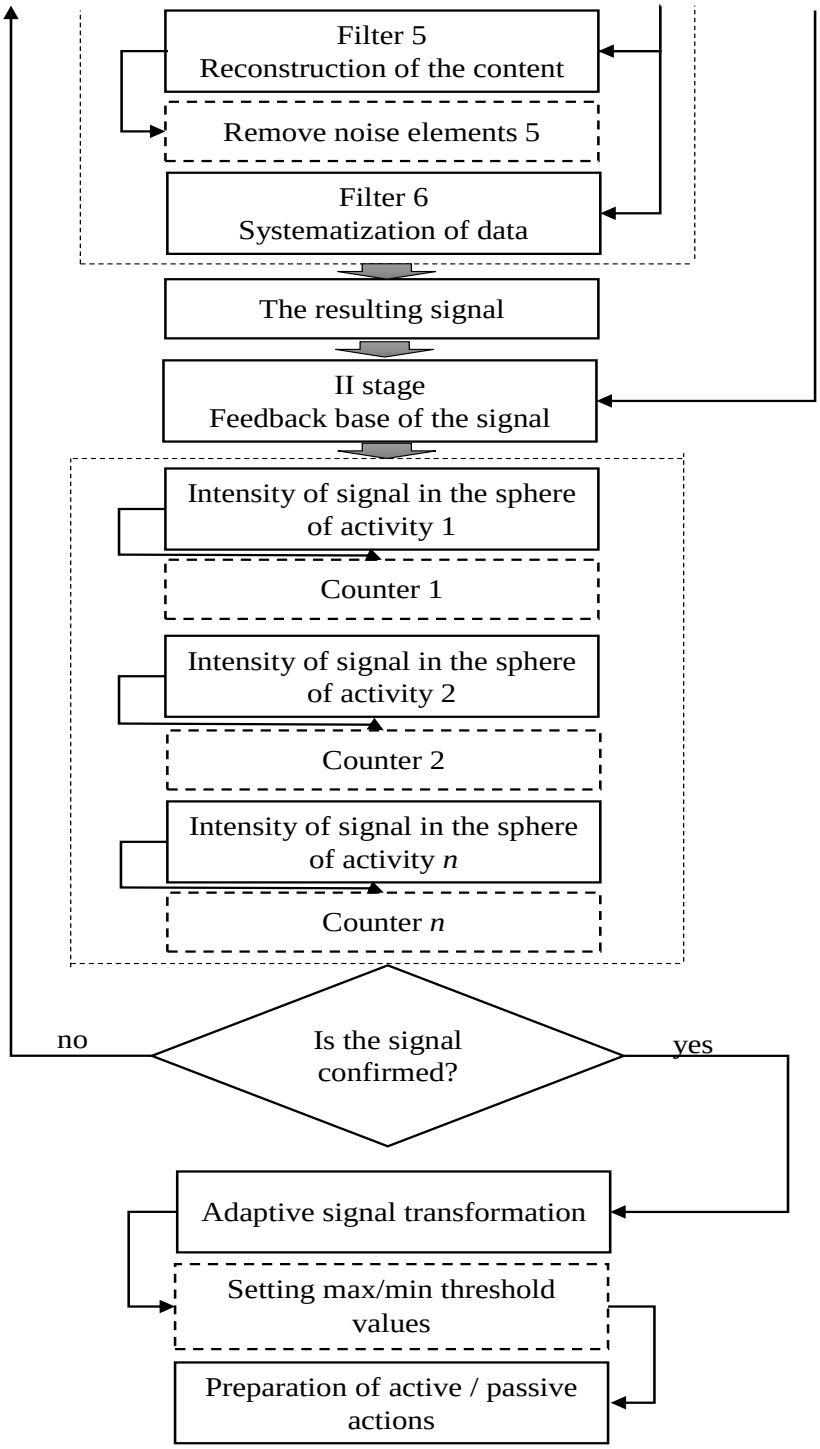

Figure 1b. An iterative approach in anticipatory management of the development of an industrial enterprise (part 2)
Source: own research.

There are different interpretations of SWOT analysis, but the main stages are reduced to the following:

Stage 1 - Definition of goal. SWOT-analysis is always carried out for a certain purpose, it is not abstract. Strengths and weaknesses, opportunities and threats - concepts are relative and depend on time, place, character of actions of subjects.

Stage 2 - Definition of the object of research. The analysis can be subjected to the company as a whole, separate units (branches, etc.) or a business unit.

Stage 3 - Identify the strengths and weaknesses in terms of the goal.

Stage 4 - Identify market opportunities and threats in terms of the goal (Barinov & Kharchenko, 2006; Milova & Chernyshenko, 2015).

According to the results of using one of the presented (or several) tools for monitoring the state of the industrial enterprise environment for the purpose of detecting impulse messages about a crisis or favorable development opportunities, a weak signal can be set, which is then transferred to the iterative processing unit (Figure 1).

In the block of iterative processing, the received signal passes through the first stage of the iterations - the stage of noise correction of the signal. This stage can be characterized as a procedure for setting up an outgoing message that was detected during a monitoring process that was distorted by external noise.Noise in this context should be understood as random variances of various kinds of information distorting the output signal data. Also, noise can be called the difference between the content of the input signal and the content of the resulting signal after the noise correction.

To perform the noise correction of the signal in the first stage of the iterative signal processing, which was discovered by means of monitoring the internal and external environment of the industrial enterprise, it is proposed to use appropriate filters, through which the passage through which gradually eliminates the noise distorting the original content of the signal. Each installed noise correction filter in the first stage of iterative processing as a result of its work must process the content of the signal for a minimum time interval, the longer the time is spent on noise processing, the higher the noise concentration increases (over time, the received signals acquire new content, which is explained by the dynamics of the external environment, the influx of distorted information in the media, using of technologies of reflexive attacks of rival enterprises, etc.).

The criteria for the effectiveness of filters are as follows:
- minimum processing time of the signal;
- the optimum amount of computing resources;
- the quality of the result.

Each filter of the first stage of the iterative signal processing has a certain purpose and tasks, where at the output (from switching from one to another filter) a "purified" signal from a certain amount of noise must be transmitted. If, as a result of one or more filters, a signal was transmitted without sufficient noise reduction, the iterative loop will return to the required filter, where the number of repetitions that is necessary to clear the signal occurs.

Thus, by varying the number of processing iterations in the first stage and the degree of noisiness detected during the monitoring signal, it becomes possible to control such indicators as the quality of the formation of the resulting signals and the speed of the iteration cycle.

The first stage of the noise processing of the signal is proposed to be carried out through the passage of six filters, where after each there is removal of noise.

So, the purpose of the first filter is to conduct an independent self-scanning environment for determining the authenticity of the signal entering the block of iterative processing. The following methods can be used in the first filter operation:

- polls;
- interviews;
- scanning;
- focus groups and others.

According to the results of the first noise correction filter, the second filter receives a signal with a cellular difference in the amount of noise.

The second filter compares the results obtained by its own independent collection of materials on the topic of the detected signal with the content of the signal received from the internal or external environment. By the results of the second filter, the noise is removed again. On the third filter of the first stage of the iterative signal processing information is obtained from the adjacent topics that distort the original content of the signal (for example: according to the monitoring results, a signal has been received that changes the expectations of consumers about the output of a new type of product manufactured by an industrial enterprise, the removal of noise in the second filter in this An example will be the appearance of analogue products on the market, purchasing power of consumers, etc.).

The purpose of the third filter is to decode the signal data, which is already presented with the noise difference that occurred through the passage of the first and second filters. Turning to the example of the signal about changing the expectations of consumers, here the decoding will be a rough approximation to the original content of the signal (Is there a change in consumer expectations regarding the technical or economic characteristics of the product? or qualitative characteristics?). Approximate focusing on the original content of a signal deprived of noise on previous filters of noise correction will allow to define a coarse description of the coordinates of the field of useful information that was inserted into the signal before its distortion in time.

The purpose of the fourth filter is to adapt the decoded signal in the conditions of the operation of the industrial enterprise. If the content of the signal after passing through the previous filters and the loss of noise will not be related to the activities of the industrial enterprise, the end of the iterative cycle can be considered without going to the fourth filter. If, based on the results of the transcoding of the content of the signal, it is concluded that this signal carries information about the approaching threat or the creation of favorable opportunities for the implementation of development measures, such a signal with the adapted (recoded) content in relation to the industrial-economic activity of the industrial enterprise passes to the fifth filter.

The purpose of the fifth filter is the final reconstruction of the original content that was inserted into the signal to distort it in time before it is detected in the process of monitoring the internal and external environment. Through the passage of this filter, the signal that was pre-processed from the noise component on the first, second, third, and fourth filters of the first stage of the iterative processing into the last is removed the remnants of noise, or the so-called "zero information", which does not contain information about the original content of the signal, but only increases the width of its spectrum due to noise. If the result of the work of the previous filters is qualitative and corresponds to the previously established criteria for the effectiveness of the filters, enterprise managers will be able to obtain the original content ("body") of the signal, the correct interpretation of which will provide the basis for the preparation and adoption of management decisions on the development of the industrial enterprise, however, these solutions will be conditional, more detailed specification will be possible after passing the second stage of the iterative signal processing and confirmation or refutation signal.

On the sixth and final filter of the first stage of the iterative signal processing there is a systematization of data, the purpose and tasks of which are:

- data generation for noise correction at subsequent iterative cycles;
- compilation of calculations to determine the difference between the signal (original content and the presence of noise, zero information) that was detected during the monitoring and reconstructed content of the signal received as a result of passage through filters;
- generalization of data about distorted information, grouping it on a basis for use as a tool for iterative processing of analog signals.

Systematizing the data on the sixth filter and inserting it into a database for future work on noise processing will allow more efficient removal of noise at subsequent iterations, obtaining a better resultant signal and losing less time for its processing.

After passing the first stage of the iterative signal processing, the resulting signal falls on the second stage of the iterative processing - the establishment of the signal response base at the industrial plant. At this stage, the scope of activity of an industrial enterprise is divided into blocks, where by means of the meter the highest frequency of the intensity of the manifestation of the resulting signal is established. As the base blocks for the activities of the enterprise can be distinguished:

1. Production.
2. Staff.
3. Material security.
4. Finance.
5. Investments.
6. Marketing.
7. Administrative and management personnel.
8. Security service of the industrial enterprise.
9. Accounting.
10. Quality and standardization service.
11. Design and development department.
12. Planning department.

Counter the frequency of the resulting signal in a given area of the industrial enterprises (or a few at a time) reflects the severity of the signal by which to draw conclusions about the confirmation or refutation of the detected signal.

If the signal is refuted, that the counter displays zero or very low frequency intensity of display signal in a given area of the industrial enterprises actions of returning to the initial phase - monitoring of the environment (a priori this stage is to carry continuous nature) to signal detection of the occurrence of critical events or identifying potential for developing.

If, after passing the second stage of the iterative processing of the establishment of the base of the response of the signal, the sphere of activity of the enterprise was detected, where the average (high) frequency of the intensity of the resultant signal is recorded, an adaptive signal transformation occurs, that is, conditional management decisions prepared during the passage of the fifth filter of the first stage iterative signal processing will be practical in nature, corrected for possible changes that occurred in time, which was spent on the second stage of the iterative signal processing.

It is expedient to establish a maximum and a minimum threshold value of the force of the detected and devoid of noise of the original signal in the established field of activity of the industrial enterprise (review base). Setting the maximum and minimum threshold values is a necessary task, both in the case of forecasting the onset of crisis events, and in the case of identifying favorable conditions for developing.

Depending on the thresholds obtained, active or passive manual actions are set.

Active actions include:
- jerk;
- overtaking competitors;
- conquest of new markets;
- production of a new type of product;
- development of investment projects;

- expansion of the park of production equipment;
- introduction of new technological lines;
- modernization of the park of production equipment;
- acquisition of assets;
- diversification;
- expansion of the range of products;
- opening of new directions of activity;
- rebranding;
- absorption of competitors;
- increase in the number of staff, etc.

Passive actions include:

- preservation of current values of indicators of production and economic activity;
- preservation of the existing market share;
- partial reduction of staff;
- saving of share capital;
- partial preservation of production;
- release of investment funds from development projects;
- reduction of development programs, etc.

Depending on the set maximum and minimum threshold values of the strength of the detected signal in a given area of the enterprise, a combination of several types of active and passive actions of the management to respond to the state of the internal and external environment is allowed.

Thus, the proposed use of the iterative approach anticipatory management, which is based on two-step iteration correction of signal noise and installation base response signal, providing a maximum precision of the original signal content and scope of industrial enterprises for the intensity of its manifestation. The developed approach can be applied in anticipatory management both in the internal and external environment of an industrial enterprise. The principle of iterative signal processing is versatile to control signals indicating the approach of critical events and opportunities for development.

References

Ashley, W.C., & Morrison, J.L. (1997). Anticipatory management: tools for better decision making. *The Futurist, 31*(5), 47–50.

Barinov, V. A., & Kharchenko, V. L. (2006). SWOT-analiz: vzaimosvyazi vnutrennej i vneshnej sredy [SWOT-analysis: interconnections between the internal and external environment]. *Strategicheskij menedzhment - Strategic management* (pp. 138-143). Moskva: INFRA-M (in Russian).

Berry, A., Sweeting, R., & Holt, R. (2007). Constructing risk management: framing and reflexivity of small firm owner-managers. *Proceedings of the 1st European Risk Management Conference, University of Münster, 5–7 September,* 1–23.

Cockburn, A. (2008). Using both incremental and iterative development. *STSC CrossTalk USAF Software Technology Support Center, 21*(5), 27–30.

Guselbaeva, G., & Pachkova, O. (2015). The Estimation of Property and Business in the Anti-Crisis Measures. *Procedia Economics and Finance,* 27, 501-506. https://doi.org/10.1016/S2212-5671(15)01027-8

Hedouri, F., Albert, M., & Meskon, M. (2007). *Osnovy menedzhmenta [Fundamentals of Management].* Moskva: Viliams (in Russian).

Kuzylyak, V., Yakovchuk, R., Samilo, A., Povstyn, O., & Shyshko, V. (2016). Pidkhody do rozroblennia ta pryiniattia upravlinskykh rishen v umovakh nevyznachenosti ta ryzyku [Approaches to the development and adoption of managerial decisions under conditions of uncertainty and risk]. *Bulletin of the National University Lviv Polytechnic*, 4, 218-224 (in Ukrainian).

Kwilinski, A. (2018). Mechanism of modernization of industrial sphere of industrial enterprise in accordance with requirements of the information economy. *Marketing and Management of Innovations,* 4, 116-128. http://doi.org/10.21272/mmi.2018.4-11

Larman, C., & Basili V. (2003). Iterative and Incremental Development: *A Brief History (PDF). IEEE Computer. IEEE Computer Society, 36(*6), 47–56.

Milova, Y.Y., & Chernyshenko, M.S. (2015). Sravnitel'nyj analiz instrumentov kompleksnoj ocenki vneshnej i vnutrennej sredy predpriyatiya [Comparative analysis of integrated assessment tools of enterprise external and internal environment]. *Vestnik Irkutskogo gosudarstvennogo tekhnicheskogo universiteta - Herald of the Irkutsk State University, 11*(106), 245-251 (in Russian).

Norik, L.O. (2005). Konkurentnyi status pidpryiemstva vyznachennia i formalizatsiia [Competitive status of the enterprise: definition and formalization]. *Komunalne hospodarstvo mist*, 61, 99-105 (in Ukrainian). Retrieved from https://khg.kname.edu.ua/index.php/khg/article/view/2402/2387

Ognev, D. V., & Chernyshenko, M. S. (2013). Ocenka vneshnej i vnutrennej sredy malyh innovacionnyh predpriyatij na baze uchebnyh organizacij [Evaluation of external and internal environment of the small innovative enterprises based on educational organizations]. *Vestnik ekonomicheskoj integracii - Herald of Economic Integration, 11*(68), 73-80 (in Russian).

Pająk, K. Kamińska, B., & Kvilinskyi, O. (2016). Modern trends of financial sector development under the virtual regionalization conditions*. Financial and Credit Activity: Problems of Theory and Practice 2*(21), 204-217. https://doi.org/10.18371/fcaptp.v2i21.91052

Pająk, K., Kvilinskyi, O., Fasiecka, O., & Miśkiewicz, R. (2017). Energy security in regional policy in Wielkopolska region of Poland. *Economics and Environment, 2*(61), 122-138.

Pamučar, D. S., Božanić, D., & Ranđelović, A. (2017). Multi-criteria decision making: an example of sensitivity analysis. *Serbian Journal of Management, 12*(1), 1-27. https://doi.org/10.5937/sjm12-9464

Tan, R.R., Aviso, K.B., Cayamanda, C.D., Chiu, A.S.F., Promentilla, M.A.B., Ubando, A.T., & Yu, K.D.S. (2016). A fuzzy linear programming enterprise input–output model for optimal crisis operations in industrial complexes, *International Journal of Production Economics, 181,* Part B, 410-418. https://doi.org/10.1016/j.ijpe.2015.10.012

Voloshchuk, L. O. (2014). Klasyfikatsiia pidkhodiv ta metodiv formuvannia analitychnykh instrumentiv otsiniuvannia ekonomichnoi bezpeky promyslovoho pidpryiemstva [Classification of approaches and methods of analytical tools for assessing the economic safety of an industrial enterprise]. *Economics: Time Realities, 5*(15), 224-231 (in Ukrainian).