Innovative Assessment for Forecasting the Competitiveness of An Enterprise Based on The Elliott Wave Principle

Abdumurotov Shokhrukh Shavkat Ugli
Researcher at Tashkent State University of Economics,
Tashkent, Uzbekistan

Abstract. **The purpose of this work is the theoretical and practical substantiation of methodological tools for forecasting the competitiveness of an enterprise based on the Elliott wave principle, as well as developing a model for assessing the forecast of competitiveness of enterprises based on the Elliott wave principle and using the Fibonacci spiral.In this paper have been elaborated an innovative method for predicting the competitiveness of enterprises based on the Elliott wave principle and the use of the Fibonacci spiral. The developed model shows a high accuracy of the competitiveness forecast, it reflects the optimistic and pessimistic forecasts for the development of an industrial enterprise, which indicates that both under one scenario for the development of an enterprise and under another one, it is possible to introduce various measures to optimize the process of functioning of an enterprise in the future. At each stage of the forecast, profitability indicators were calculated, all indicators of the enterprise's work for previous periods were taken into account. As a result, the author came to the conclusion that the developed model is effective, it takes into account all options for the development of events in the market.**

Keywords: Competition, finance, Elliott wave principle, Fibonacci spiral, production, competitiveness of enterprises, indicators.

1. INTRODUCTION

Under market conditions, the efficiency of enterprises is largely due to their financial and economic prospects, profitability and competitiveness. It is competitiveness that determines the ability of an enterprise to sell such goods or services, the consumer attractiveness of which is higher than similar ones offered by competitors. Consequently, the strategy for the continued existence and development of the enterprise should be focused on reducing individual costs and increasing the volume of production of quality products. Only high quality products will be in demand, which ultimately will lead to an increase in profitability and form the competitiveness of the enterprise. Strategic planning as a factor in improving competitiveness reflects an organized mechanism for managing changes in the organization of production and labor. And also, the formation of a single common vision of its economic future and development, a harmonious process of identifying problems and agreeing on realistic goals and objectives for solving them. It is the powerful tool that has a positive effect on the production and organizational microclimate of the enterprise, its competitive position in the market.Determining the economic opportunities and problems of an enterprise in achieving its long-term goals, increasing its competitiveness on the basis of the chosen strategy determines the relevance of the problem of skillful use of the provisions and principles of strategic planning. [15]

2. LITERATURE REVIEW

At present, the basis for the growth of the competitiveness of industrial enterprises is the development and implementation of competitive strategies that ensure their transition to a qualitatively new level of development of the industrial complex, corresponding to the world's leading counterparts in terms of competitiveness. The formation and development of competitive strategies should be based on a scientifically based approach that organically combines all kinds of directions and methods that determine the competitiveness of industrial enterprises in their constant comparison with the characteristics of the external environment (competitors). It should be noted that today in the scientific literature there is no single methodological approach to assessing and forecasting the competitiveness of industrial enterprises, existing methods allow us to evaluate only a limited number of areas of activity of industrial enterprises, while a number of indicators characterizing the efficiency of the functioning of industrial enterprises as a system with synergistic effect due to production and technological relations between enterprises within the enterprise, remain behind the scenes. In this regard, the development of methodological tools for forecasting the competitiveness of an enterprise based on the Elliott wave principle becomes especially relevant.

The works of Russian and foreign scientists, authors, such as: Smirnova N.A., Suslova G.V. are devoted to the research of methodological tools for forecasting the competitiveness of an enterprise. Berezina A.A., Finogeeva A.G., Volkova S.N., Sivak E.E., Shleenko A.V., Kabitsky D.A., Myachkoav A.S., Kuts V.I., Tretyakova V. D., Matias Marañon, Mustafa Kumral., P. Arthuis, T. Duguet, A. Tichai, R.-D. Lasseri, J.-P. Ebran and others.

The technique of N.A. Smirnova and G.V. Suslov, based on the Elliott wave principle, which is expressed in three relative features: models (figures), time and relation. Moreover, all these features obey the Fibonacci summation series. "The task is to interpret the waves, to understand their nature and patterns" [10].

The model of A.A. Berezina, A.G. Finogeeva "Modeling methodology, competitiveness forecasting algorithm, scenario analysis methodology and criteria for evaluating the results of predictive modeling are components of the competitiveness management method" [1].

To assess competitiveness, the authors have developed a modified mathematical model associated with the Van der Pol equation with a delay, which is introduced for stabilization under random exposure to external and internal fluctuations. The model is based on the following terms of factors: "a set of mathematical models of competitive interaction adapted for enterprises of various types of activity; methodology for mathematical modeling of the benchmarking process; algorithm for predicting indicators of competitiveness and financial position of companies in a competitive environment; typical scenarios of enterprise behavior for market situations (optimistic, pessimistic, critical, optimal); scenario analysis methodology for modeling competitive interactions; criteria for evaluating simulation results for choosing a competitive strategy; recommendations for improving competitive advantages; procedures for monitoring the activities of the enterprise to assess the effectiveness of the implemented recommendations. This model is used in financial institutions.

A very interesting model is A.A. Voronov, N.A. Ovcharenko "... a mathematical model of competitive processes in the competitive environment of industrial enterprises." This model is based on the ratio of the net present value criteria proposed by H. Fashiev and O. Sitnikova in order to model the competitiveness of a car at the design stage. The developed model of the authors can be used not only in calculating the competitiveness of a car at the design stage, but also in "simulating the current market conditions for industrial products; situations of entering the market of a new enterprise; modeling the situation of bringing an innovative product to the market" [4].

Considering the analysis of the competitiveness of microeconomic systems by the authors Shuvalov I.A., Semenchin E.A., we see that the authors used the apparatus of the theory of discrete Markov processes when developing a competitiveness forecasting model, which also allows predicting the competitiveness of enterprises in the market. When developing the model, the authors took into account the characteristic criteria of the market, namely the intensity of transitions from one state of market functioning to another, which is associated with the passage of time, when "analogues of products with new properties demanded by consumers always appear on the market, and, as a rule, they remain on the market competing with the company's products. But these intensities cannot be completely neglected, since there is always the possibility that the competitor's products will not be in demand, and therefore he will have to leave the market." The advantage of this model of the authors is its simplicity of calculation. The disadvantage is the low informative base, a number of factors for the development of the competitiveness of the enterprise are not taken into account, the mechanism of the functioning of the enterprise has not been identified [12].

Y. Kabitsky used certain groups of algorithms to develop a model of enterprise competitiveness: "The first group of heuristic algorithms uses some heuristic rules for the priority of operations in the event of a conflict situation associated with limited resources. The second group of heuristic algorithms uses the idea of local optimization, that is, the improvement of some initial solution. The second approach is based on the idea of aggregation, that is, reducing the number of project operations by replacing several operations (subprojects) with one operation. The resulting aggregated project, as a rule, allows more efficient solution methods (due to the smaller dimension). The resulting aggregated solution is then disaggregated into the original project schedule." On the basis of the considered factors of the functioning of the enterprise and the methods of pricing using the econometric approach, he formulated a mathematical model for determining the price, which, after transforming the model, the author obtains a model for predicting the competitiveness of enterprises. The strength of the model is that it describes the proposed dependence; this model proposes a calculation using the regression analysis method, which allows "to establish a functional relationship between the dependent variable (response) and independent variables (factors) in each of the equations presented in the mathematical model. The resulting mathematical model can be used to determine the estimated price of the product based on domestic market factors." The disadvantage of this model is that there is no testing of the model on the example of an enterprise [5].

You can also consider the developed model of "assessing the effectiveness and managing the competitiveness of the financial activity of an enterprise based on the formation of the optimal structure of its total capital, taking into account the market prices of its constituent elements." A.S. Myachkov. The author has developed an approach and a numerical procedure for managing the competitiveness of the production activities of an industrial enterprise based on the formation of an optimal variant of the production program according to the criterion of total marginal income, taking into account market restrictions on demand, sales costs and calculated levels of specific marginal income of individual products. The advantage of this model is the consideration of all factors of production, their impact on the competitiveness of an industrial enterprise.

I would also like to note the research work of V.I. Kuts, who, when developing a model for predicting the competitiveness of enterprises, took into account the national scale of industrial production. The author substantiated the developed model as follows: "The developed model for the implementation of competitiveness factors of the national industry as its sectoral structure is modernized in the context of structuring the basic conditions necessary for this, efficiency factors, innovation activity priorities at the micro level and taking into account the assessment of the contribution of each of these parameters to increasing the competitiveness of the real sector of the economy as a whole" [8].

A model for "evaluating the competitive advantages of Russian enterprises in the science-intensive sector of industry in the practice of realizing their scientific and technical potential depending on prices, product quality, organizational and commercial conditions, brand image, as well as economic, financial, scientific, technical and stock factors."

Thus, we present the studies of authors, scientists who, using mathematical tools, developed models for predicting the competitiveness of enterprises. The models were based on such mathematical tools as: the apparatus of the theory of discrete Markov processes, which also allows predicting the competitiveness of enterprises in the market, the Elliott wave principle, the apparatus of Fibonacci relations for the purpose of predicting economic dynamics, a modified mathematical model associated with the Van der Pol equation with delay, automated generating BMBPT diagrams of order p by generating all oriented adjacency matrices of size $(p + 1) \times (p + 1)$, etc. All models for predicting the competitiveness of enterprises have their strengths and weaknesses, but nevertheless they are unique and show predictive criteria for the competitiveness of enterprises, and the uniqueness of these models lies in the fact that each of them uses mathematical tools, and transformations of the basic models are carried out.

3. RESEARCH METHODS

Analysis and synthesis, induction and deduction, systematic approach, systematic analysis, abstract-logical thinking, monographic observation, comparison, statistics, economic analysis and economic-mathematical methods were used in the research paper.

4. ANALYSIS AND RESULTS

In this paper, we will present some models for assessing the forecast of the competitiveness of an enterprise based on mathematical modeling by researchers and authors in the field of economic and mathematical sciences. Let us pay attention to the "development of a mechanism for searching for the zone of waiting for a bifurcation of the "rise-fall" type based on the Elliott wave principle. The presented analytical model is used to predict the Fibonacci spiral" presented by N.A. Smirnov and G.V. Suslov. This model is based on the dynamics of real economic processes, in which there are cycles, within which three phases can be distinguished: inception, saturation and decline. At the same time, the phase of origin is always accompanied by growth, and the decline is accompanied by the emergence of a new one, which provokes new demand. Such cycles are short in time and make it possible to predict the economic activity of enterprises [10].

According to the authors, "when interacting with the external environment of a large number of economic entities, the cyclic oscillatory regime of individual entities leads to the cyclicity of the system itself. Cycles add up and are accompanied by a synergy effect with possible resonances. Proceeding from this, the possibility of predicting the state of socio-economic systems can be based on the following provisions: the only form of existence of socio-economic systems is an oscillatory regime; socio-economic systems are hierarchical; the behavior of a socio-economic system of any level is determined by the impact of a system of a higher level". In his developed model, N.A. Smirnov and G.V. Suslov uses the Elliott wave principle and Fibonacci trend channels. The authors take as a basis two groups into which, according to Elliott, the stock market is divided into "bull market" and "bear market". "Bull market" according to Elliott "is a market that has a fairly stable growth dynamics, however, with partial failures, "bear market" - with similar features - on the contrary" [10]. "The bull market is divided into five "main" waves, and the "bear" - stagnating - into three main waves. The main waves 1, 3 and 5 of the bull (growing) market are divided, in turn, into five "medium" waves. In turn, each of the medium waves 1, 3 and 5 is divided into five small waves. In fact, there is a repetition of the same structure on a smaller and smaller scale. Such "replication", cyclical repetition of the same fragment with certain variations is called "fractal structure", and the basic repeating element itself is called "fractal". We show the ideal Elliott cycle in Fig.1.
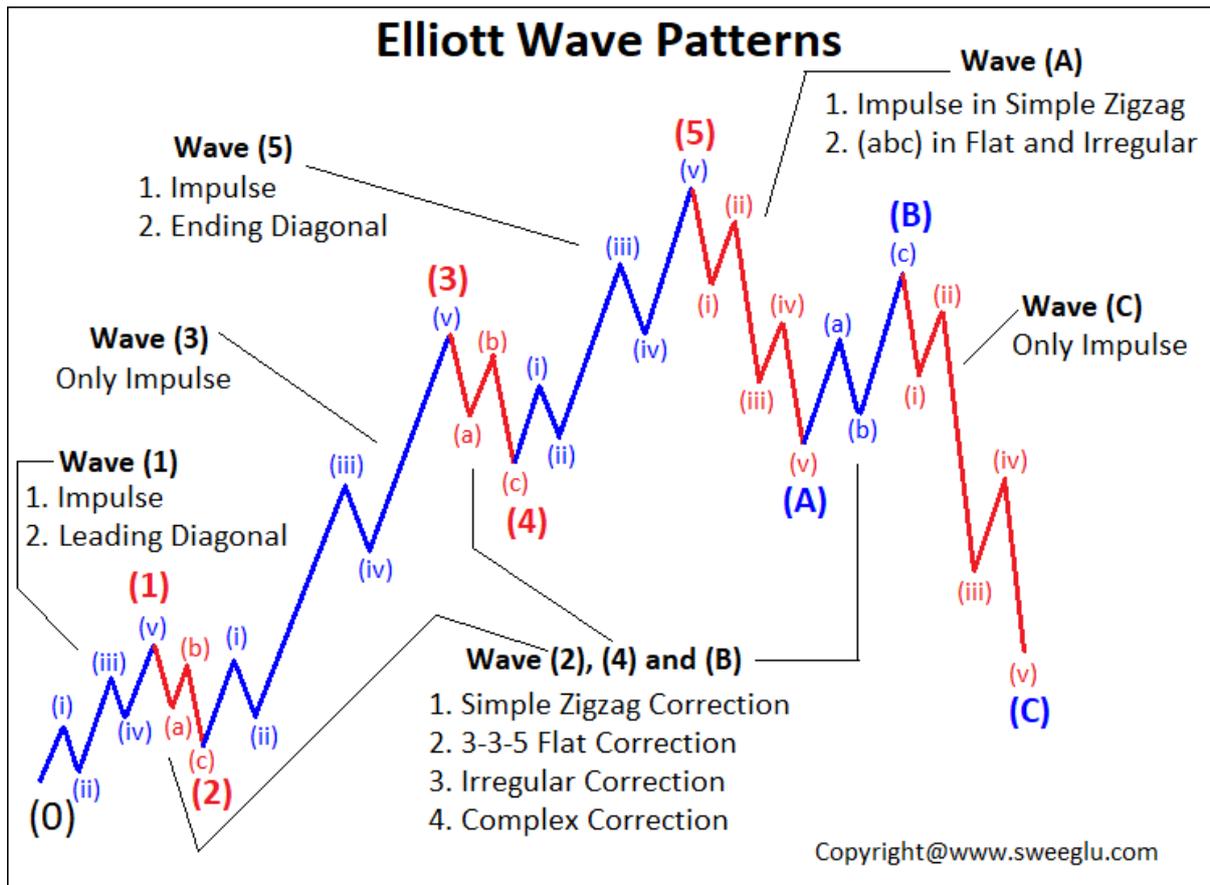
Fig. 1. Elliott Ideal Cycle [16]

In further research, Elliott noted that such ideal cycles do not exist, he further introduced a set of rules that are used for most market situations. "According to these rules, wave 2 will not form until the start of wave 1, and wave 4 will not subside (correct) below the top of wave 1. Each of the two corrective waves 2 and 4 can be subdivided into three waves of a lower category. As part of a fractal, corrective waves 2 and 4 alternate, that is, Elliott called such cycles "alternating". "If wave 2 is simple, wave 4 will be complex, and vice versa (Figure 2).

Waves of this nature are called complex, in contrast to simple ones in the structure of the basic fractal.
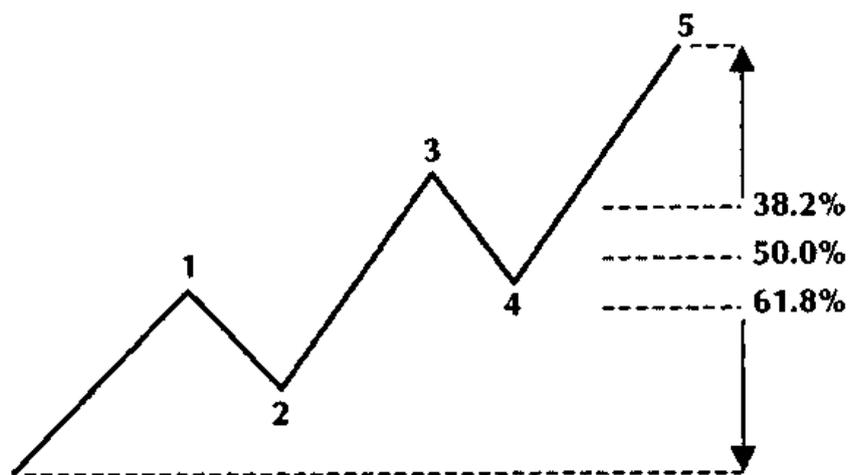

Fig. 2. Correction after a five-wave move [1]

To this development, the authors N.A. Smirnov and G.V. Suslov took the numerical ratios of the Fibonacci series, which were applied directly to corrections and extensions of the above Elliott wave cycle. The authors formed a sequence according to the coordinates of the PHI-spiral points: "38.2% is the result of dividing 0.618 by 1.618; 50.0% - converted ratio 1.000; 61.8% is the result of a direct ratio of 1.000÷1.618." The main task was to

predict the size of the correction. "Using this ratio as an analysis scheme, it was possible to catch market movements, predict its future dynamics and be quite confident in the future" [10].

The authors set a goal to expand the scope of the FI method for predicting the dynamics of an enterprise operating in the real sector of the economy. The research proceeded in stages. At the first stage, the authors identified in the retrospective reporting available for analysis the presence of a typical fractal according to the following criteria: "the second wave never reaches the initial level of the first wave; waves 2 and 4 should never overlap; the third wave is never the shortest of waves 1, 3 and 5 and always exceeds the final level of the first wave; the third wave does not have to be the largest of the three waves, it can be the second largest; the fifth wave, as a rule, overcomes the final level of the third wave. At the second stage, the PHI-channel was constructed for both the ascending and descending branches of the dynamics; a family of lines was formed, which stand apart from each other at distances described by the PHI-family of numbers. The third stage was limited to identifying the beginning of the fractal and building a PHI-spiral on this geometric base. At the fourth stage, the area of intersection of the PHI-spiral with PHI-channels was identified and a hypothetical zone of bifurcation (sign change) of economic dynamics was identified.

In this case, the analytical Finabocci equation was used. This equation looked like this (1).

$$\left.\begin{array}{l} x(t) = \frac{1+\delta}{1+\delta^2}\left(1 - \delta^t * cos\frac{\pi t}{2}\right) - \frac{1-\delta}{1+\delta^2} sin\frac{\pi t}{2} \\ y(t) = \frac{1-\delta}{1+\delta^2}\left(1 - \delta^t * cos\frac{\pi t}{2}\right) - \frac{1+\delta}{1+\delta^2} sin\frac{\pi t}{2} \end{array}\right\}, \qquad (1)$$
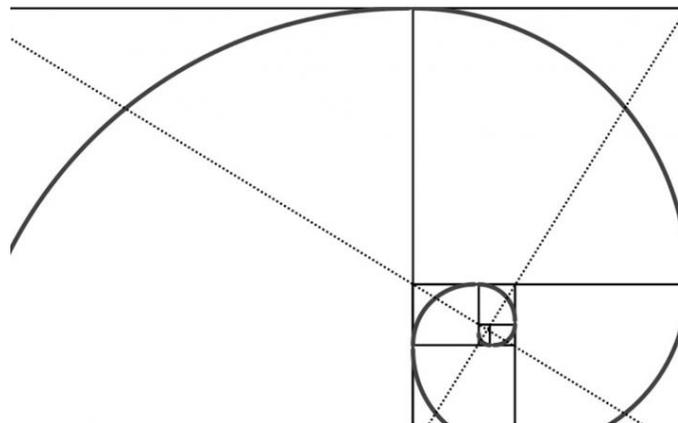

Fig. 3. Nodal points of the Fibonacci spiral [1]

The Elliott wave principle was based on such provisions as "the only form of existence of socio-economic systems is an oscillatory regime; socio-economic systems are hierarchical; the behavior of a socio-economic system of any level is determined by the impact of a system of a higher level".

Thus, having studied the development of N.A. Smirnova and G.V. Suslova noted the advantages and disadvantages of this model. The advantage of the model is that it "confirms the possibility of using this method not only for predicting fast-moving (stock) processes, but also for relatively slowly changing economic dynamics", the model also shows the level of wave cycles, in a market situation, when the market is born, saturated and recession. The most important feature of this model is that it shows the accuracy of measuring the forecast for the onset of the crisis period from "+" to "-", which is 1–3 months (quarter) [10].

The disadvantage of this development is that a large amount of data is needed to identify the role and place of FI tools for the purposes of economic forecasting, and the disadvantage of the model is that it requires a large set of numerical observation points in the past.

As a methodological tool for assessing the forecast of the competitiveness of an enterprise, it is proposed to consider the model Berezin A.A., Finogeev A.G. "Development of a model of competitiveness dynamics based on the Van Der Pol equation" [1]. The development of this model was based on the research of Van der Pol, who proposed a nonlinear model of two pairs of coupled equations, that is, a pairwise comparison model, which looks like this (5):

$$\frac{d^2 M_1}{dt^2} - a_1(1 - Y_1)\frac{dM_1}{dt} + \omega_3^2(1 + \alpha_1 M_2 + \alpha_2 M_3 + \alpha_3 M_4)M_3$$
$$= c_1\frac{d^2 M_2}{dt^2} + c_2\frac{d^2 M_3}{dt^2} + c_3\frac{d^2 M_4}{dt^2} + d_1 F_1 + d_2 F_2 - d_3 F_3;$$
$$b_1 Y_1 + T_1\frac{dY_1}{dt} = M_1^2$$

$$\frac{d^2M_2}{dt^2} - a_2(1 - Y_1)\frac{dM_2}{dt} + \omega_2^2(1 + \alpha_4M_1 + \alpha_3M_3 + \alpha_6M_4)M_2$$
$$= c_4\frac{d^2M_3}{dt^2} + c_3\frac{d^2M_3}{dt^2} + c_6\frac{d^2M_4}{dt^2} + d_1F_1 + d_2F_2 - d_3F_3;$$
$$b_2Y_2 + T_2\frac{dY_2}{dt} = M_2^2$$

$$\frac{d^2M_3}{dt^2} - a_3(1 - Y_3)\frac{dM_3}{dt} + \omega_3^2(1 + \alpha_2M_1 + \alpha_3M_2 + \alpha_3M_4)M_3$$
$$= c_7\frac{d^2M_1}{dt^2} + c_3\frac{d^2M_2}{dt^2} + c_9\frac{d^2M_4}{dt^2} + d_1F_1 + d_2F_2 - d_3F_3;$$
$$b_3Y_3 + T_3\frac{dY_3}{dt} = M_3^2$$

$$\frac{d^2M_4}{dt^2} - a_4(1 - Y_4)\frac{dM_4}{dt} + \omega_4^2(1 + \alpha_{10}M_3 + \alpha_{11}M_2 + \alpha_{12}M_1)M_4$$
$$= c_{10}\frac{d^2M_1}{dt^2} + c_{11}\frac{d^2M_2}{dt^2} + c_{12}\frac{d^2M_3}{dt^2} + d_1F_1 + d_2F_2 - d_3F_3;$$
$$b_4Y_4 + T_4\frac{dY_4}{dt} = M_4^2, \qquad\qquad (5)$$

In this model, we see the application of differential equations, here the indicators M1, M2, M3, M4 represent market shares, approximately 4 enterprises, proportional to the number of sales; a1,a2,a3,a4 reflect the coefficients that show the level of rhythm of the companies' work (from 0.1 to 2); α1, α2, α3, α4, α5, α6, α7, α8, α9, α10, α11, α12 are indicators that reflect the level of ownership of strategic information data of one company about another (from 0 to 100%); c1,c2,c3,c4,c5,c6,c7,c8,c9,c10,c11,c12 are coefficients that show the degree of possession of ordinary information of one company about another; F1,F2 are random functions that reflect the impact on the company's market share of monthly and annual fluctuations in market criteria; F3 is a random function that reflects the impact on the trading process of "force majeure circumstances from the external environment of a man-made, natural and anthropogenic nature"; T1, T2, T3, T4 show the delay time of the product in the warehouses of companies; b1,b2,b3,b4 show the speed of products exit from the company's warehouses for sale; ω1, ω2, ω3, ω4 are indicators that are inverse to the time of production cycles by companies.

In this model, there is no ever-increasing dependence of the number of sales on the possession of insider information by an industrial enterprise. An increase in market share can be only with 50% of confidential information, in the future we will increase the receipt of this information. In this variant, it is noted that upon receipt of insider information, negative trends begin to intensify. Note that this model is suitable for applying competitive intelligence, but this model shows that insider facts can have less and less impact on the competitiveness of an industrial enterprise due to other indicators of other enterprises.

5. RESULTS & DISCUSSION

Thus, the use of this model shows the application of competitive intelligence methods, that is, for the growth of the competitiveness of industrial enterprises, mutual exchange of information between them, both publicly available and confidential, is necessary. If the same initial conditions arise that interact (information-related), then industrial enterprises have a pronounced competitive advantage in terms of the possibility of obtaining the largest market share than single enterprises that operate without cooperation with other industrial enterprises. The advantage of the model is its relative stabilization of the dynamics of market shares for industrial enterprises while reducing the factor of irregular work. The disadvantage of the model is its low information content; the model does not take into account many factors of the work of industrial enterprises.

Above, we considered the opinions of authors, scientists who developed models for assessing the forecast of the competitiveness of enterprises using mathematical modeling. As we have already noted, the main criterion for increasing the competitiveness of industrial enterprises is its factor-forming terms, which show the level of financial and economic activity of enterprises, their level of competitiveness. It should be noted that the financial, economic, competitive criteria for the development of an enterprise are influenced by the macroeconomic level, which reflects all economic processes in the state. Taking into account this factor, we will develop an innovative method for forecasting the competitiveness of enterprises based on the Elliott wave principle and the use of the Fibonacci spiral [10].

Developing an innovative method for assessing the forecast of the competitiveness of an industrial enterprise based on the Elliott wave principle and the use of the Fibonacci spiral, we note the main criteria that are inherent in this principle. The Elliott wave principle shows its effectiveness for a general understanding of the market: the current trend point, momentum or rollback (correction) of the value. In our situation, it is necessary to correctly determine the momentum and correction on a certain timeframe - annual. Since this principle will be applied on the example of industrial enterprises, then we will build an annual forecast.

Next, we introduce the level of assessment of the competitiveness of industrial enterprises using a new model based on the Elliott principle (Table 1).

Table 1: The scale of the level of assessment of the competitiveness of industrial enterprises using a new model based on the Elliott principle

National brand value assessment levels	Criterias	
Low level	From 0,300 to 0,450	
Average level	From 0,450 to 0,700	
High level	From 0,700 to 3,000	

Source: author`s ellaboration

On this scale, we mark the levels of assessment of the competitiveness of industrial enterprises using a new model based on the Elliott principle. A low level indicates that the enterprise is little known in the market, low awareness of the population, as a result, competition among other enterprises is low. The average level indicates that the company is competitive, but there are negative aspects, in this situation it is better to use competitive intelligence tools, which will give the necessary level of development. A high level indicates that the company is competitive, it is successful, and it occupies a high position in the markets.

Thus, this model according to the Elliott principle can be used when calculating the assessment of the competitiveness of industrial enterprises. This model has its advantages and disadvantages. The disadvantage is that before calculating this model, it is necessary to calculate all the previous levels of the enterprise's functioning. The advantage of the model is the high accuracy of the competitiveness forecast, the model shows an optimistic development forecast and a pessimistic forecast, such a forecast indicates that both under one scenario for the development of an enterprise, and under another, various measures can be implemented to optimize the functioning of the enterprise in the future.

6. CONCLUSIONS

This paper provides a theoretical analysis of research by foreign and domestic authors of methodological tools for forecasting the competitiveness of enterprises. In the work, the main task was to develop a (new) method for forecasting the competitiveness of enterprises based on the Elliott wave principle and the use of the Fibonacci spiral, which as a result was fulfilled. We reviewed and studied a large number of scientific articles and studies on this topic, presented the opinions of many authors who have studied this area of science. We also present the developments of the authors in the paper: we considered the model of "development of a mechanism for searching for a waiting zone for a rise-fall bifurcation based on the Elliott wave principle. The presented analytical model is used to predict the Fibonacci spiral" presented by N.A. Smirnov and G.V. Suslov. The model of V.D. Tretyakova, which is based on R. Bellman's equation. This model shows "dynamic programming, which is a kind of methods for step-by-step optimization of the functionality (in our case, maximizing the competitiveness index) by making optimal management decisions at each stage." As a methodological tool for assessing the forecast of the competitiveness of an enterprise, we considered the model of Berezin A.A., Finogeeva A.G. "Development of a model of competitiveness dynamics based on the Van Der Pol equation". The development of this model was based on the research of Van der Pol, who proposed a nonlinear model of two pairs of coupled equations. The model of V.I. Kuts was also considered. "Models for assessing the competitiveness of the national industry". The model shows the level of heterogeneity of the resources of industrial enterprises, which is not a deviation from the norm, but acts as a certain criterion for the transition to the new highest state of the technological paradigm. As a result, taking into account the research of many authors, we have developed an innovative method for forecasting the competitiveness of enterprises based on the Elliott wave principle and the use of the Fibonacci spiral. In this model, we presented our advantages and disadvantages. The disadvantage was that before making the calculation according to this model, it is necessary to calculate all the previous levels of the enterprise functioning. The advantage of the model is the high accuracy of the competitiveness forecast, the model shows an optimistic development forecast and a pessimistic forecast, such a forecast indicates that both under one scenario for the development of an enterprise, and under another, various measures can be implemented to optimize the functioning of the enterprise in the future.

7. LIMITATIONS OF RESEARCH

In addition, when forecasting the competitiveness of basic innovations, so called innovations of the highest degrees must lead to the development of new forecasting methods and, above all, methods of qualitative character that will supplement the methods and approaches that now exist

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