

Industrial Enterprise Stability Management in a Globalized Economy

S Chuprov¹

¹Baikal State University, Irkutsk, 664003, Russia

E-mail: ChuprovSV@yandex.ru

Abstract. Solving a problem of maintaining the efficiency and stability of the developing industry subject to quick and sudden changes in the globalizing business environment has been of priority in the economic research for the last time. Against the dynamic background of institutional and innovative transformations being executed in Russia the activities of industrial enterprises are subject to risks of resource deterioration, competitive ability loss and sliding towards bankruptcy. On this account it is an important challenge to develop and improve the control technologies for stability of enterprises.

For this purpose, it is proposed to provide theoretical, methodological and applied support for the technology being designed, including the use of both well-known system analysis tools, cybernetics, etc., and modern knowledge in the field of nonlinear dynamics and self-organization, which forms the basis for an interdisciplinary synergistic paradigm.. The results of research obtained in the theory of nonlinear fluctuations are apply able to analysis of stability properties in developing economic systems.

In order to provide application for the concept and tools of management of industrial enterprise stability, including the use of heuristic algorithm (on the basis of fuzzy sets) there has been developed technology for monitoring their stability that fulfills the functions of operational processing, visualization and understanding of trends of change with regard to indicators observed.

1. Introduction

Among the main directions of the latest economic research, theoretical and applied importance is acquired by solving the problem of developing an adaptive system for ensuring the stability of the developing industry. In the flow of energetic changes in the business environment, domestic industrial enterprises are now experiencing increasing "overloads" of both the tension of economic interactions and the innovative transformations of economic entities.

Expansion of foreign trade cooperation of Russian industrial enterprises with foreign partners in conditions of the global systemic crisis gives rise to escalation of threats caused by extensive sanctions and export restrictions imposed by countries of the European Union. As a result, the activities of domestic enterprises are inherent risks that can weaken the business activity and the stability of their work, worsen the competitiveness and viability of industrial enterprises.

2. Relevance, scientific importance and review of references

The task demanded by the economy, aimed at analyzing modern challenges and threats, dictates the need to reveal the possible negative consequences of the impact of crisis factors, to develop the con-

cept of the stability (in the sense of Lyapunov [1]) management system of industrial enterprises and the structure of adaptive management technology [2] that provides sustainable operation of the enterprise with a high perturbation of the environment and a lack of available information. Grounds are given for application of heuristic models built by means of the fuzzy sets theory algorithms that enable entering and processing both quantitative and poorly formalizable qualitative information [3-5]. Thereby, it is manageable to moderate chaotic processes in activity of an industrial enterprise which arise due to flow of disturbances and to remedy the lack of management information in order to ensure the enterprise operation in a mode of effective development [6]. Therefore, the task of studying the stability of an industrial enterprise, whose mode of operation becomes nonlinear with intricate metamorphoses and phases of slow and rapid, smooth and abrupt changes, acquires relevance and scientific significance.

3. Statement of the problem

Deep integration into the world's economic space and growing economic interaction between countries, being the powerful dictates of the present time, along with the benefits of inter-country cooperation and mutually beneficial partnership also carries heightened risks for a developing national economy and for stability of its industrial enterprises.

With the influence of world and national factors, the disturbing nature of future interaction and competition between countries is replaced by the expectation of perceptible losses and confusion when a planetary systemic crisis puts a powerful pressure on the process of their natural integration, affecting the socio-economic sphere not so much powerful states as poorly adapted to it. overtaking "countries. Such a negative scenario is peculiar to the states having their market institution under formation, in particular, to the ex-USSR, for which the loss of foreign partners, deterioration of cooperation conditions, and decline in enterprises' output may turn into a long-term depression and significantly slow down their progress, while the state itself may be thrown back even further to the category of outsiders.

Due to the powerful impact of global and national institutional and innovative factors, the activities of enterprises become indignant, as a result of which their functioning regime is disrupted. In particular, the risk of chaotizing and weakening the stability and adaptability of their activities increases, the competitiveness and degradation of industrial enterprises are decreasing.

4. Risks and threats of the Russian industry against the backdrop of the globalization of economic interactions

What risks can manifest themselves in the activities of industrial enterprises and cause threats in equivalent interaction with competitive transnational companies and thereby undermine the effective activity of commodity producers involved in world economic relations? Here we mention just the most obvious of them in terms of impairment of resources reproduction and industrial enterprises stability.

Firstly, strong fluctuations in the rouble exchange rate and tightening of money-and-credit conditions aimed at control of inflation hold back crediting of Russian enterprises and undermine their ability to upgrade their resources and maintain business stability.

Secondly, increase in energy prices in the domestic market, dictated by their developed global level, will lead to sharp rise in product prices, aggravate the financial and economic situation and hit stability of industrial enterprises.

Third, massive "invasion" of imported goods (not always of the best quality, but at a lower price) will put competitive pressure on our enterprises' products in the market, which will result in extinction of economic activity, increase of insolvency and bankruptcy of industrial enterprises.

Fourth, predominance of energy producing materials demanded abroad in the total exports postpones opportunity of shifting the resource-oriented approach of the industry to development of technologies of higher processing levels, which causes weakening of manufacturing industry enterprises

and their stability as a consequence of decrease in the share of advanced technologies and products manufactured with the use of these technologies in the country's economy.

Fifth, the resource-based economy points to a dead end of de-industrialization and dependence of budget revenues on fluctuations in global demand for raw materials being extracted, and thereby reduces the industry to a primitive level of a "borehole" trade, with consequent loss by the country of its economic security.

Sixth, the manufacture development slowdown related thereto deprives the industry of incentives and motives for implementing innovations and scientific and technological achievements in production of modern equipment and means degradation of enterprises (including those of military industrial complex) and their exit from the market of competitive science-intensive products, which minimizes the enterprises' chances to maintain stable activity in future.

Seventh, reduction in need for research activities and for acquisition of knowledge and skills in the high-tech area is fraught with not only the country's engineering and technical lag behind the Western economy leaders, but also with suppression of intellectualization of the country's labour resources.

And finally, conservative structure of the national economy denies it in the opportunity of big investments, without which the prospects of innovative development of the Russian industry are unlikely to be optimistic.

In short, lack of balanced and competent approach to evaluation and analysis of possible consequences of a full-scale "absorption" of the industry by the global economy may thwart hopes for accelerated innovative development of industry, disturb enterprises' resources reproduction and their stability [7-9]. Therefore, of interest far from abstract become design and modernization of the industrial enterprise stability control system; and the very factors of current business activities of the enterprises determine the need for theoretical and methodological and application-oriented development of this kind of system in the face of escalating competition and contradictions in the global economic space [10].

5. The Concept of industrial enterprises stability management

In the proposed concept, the industrial enterprise stability control system bases oneself on widespread use of professional knowledge, on algorithms for search and maintenance of enterprise stable operation at high environment disturbance and shortage of available information about it [2].

Computer technology of the management system uses algorithms of search and maintenance of a rational mode of enterprise operation in conditions of incomplete relevant information. For this purpose, formation and implementation of the production plan are carried out giving due consideration to expected (with the possible degree of certainty) future environment of the enterprise and maintenance of its stability to external and internal disturbances. The latter orients towards the use of not only production planning models but also of production systems simulation models that "play through" the process of the plan implementation and report dynamic properties of the system.

The structure of technology of such adaptive management includes the following modules responsible for:

- forecasting changes in the external environment;
- adapting the management system;
- forming the production plan and simulating its implementation;
- evaluation and analysis of the enterprise stability against the forecast background;
- diagnostics thereof;
- correction of planning conditions;
- provision for implementation of the production plan.

We draw attention to the fact that formation of the enterprise production plan is carried out by a set of the two above-mentioned interacting models: one of production planning and one of simulation of the former model's activity on implementation of this plan. The first model is a tool for the plan calculation, the second one is an experimental means of testing its feasibility against the background of ex-

ternal and internal disturbances, which “designs” the plan implementation process close to the real one.

In this case, simulation of upcoming behaviour of the enterprise is performed taking into account inevitable in the planning period corrective measures aimed at neutralizing or easing anticipated disturbances. Generating of the latter and prognostic estimate of resource expenses or losses caused thereby is the very function of the simulation model; and the magnitude of deterioration of an observed indicator occurring due to the disturbing factors influence will allow making a conclusion about the degree of the enterprise stability in the expected conditions of its operation. Such planning is carried out in a mode of multiple-path calculations and an “intelligent” dialogue between the analyst and the computer, in the course of which they are interchanging input data and intermediate solutions. Thereby, numerical simulation of the planning solutions is enriched by the analyst’s non-formalizable expertise; while the plan under development accumulates in itself the relevant information.

Applying heuristic models built with the help of the fuzzy sets theory algorithms [3-5] enables entering and processing both quantitative and poorly formalizable qualitative information, which better corresponds to the analysts’ way of thinking and to the tradition of using approximate solutions. Innovative support for adaptive management of the enterprise’s complex monitoring system is enhanced by analytic functions and the intellectualization of computer dialogue participants, and, above all, their ability to perceive weakly structured problems and exchange heuristic information that contributes to the generation of new knowledge about the stability properties of enterprise production systems.

Meanwhile, objectification of picture of their behaviour has led, in a logical manner, to analysis of an informational aspect of industrial enterprises activities, which not only meets the paradigm of innovative development thereof, but also is interpretable in terms of thermodynamics, statistical physics [11, 12] and information theory [13-17]. In turn, application of concepts of bifurcations and catastrophes in nonlinear processes, concepts of synergetics allows taking a step closer to understanding the essence of dramatic changes in the economy, when steady course of the process gives way, under the influence of small perturbations, to “explosive” one and loses its former stability [18-23]. Such transition of behaviour often reflects crisis functioning of industrial enterprises, which is usually accompanied by arrhythmia of resource flows and by economic activity fading with soft or hard loss of stability. Apparently, also a transfer of knowledge with its embodiment in technology, instruments and products of labour is able both to strengthen stable operation of enterprises and, under certain conditions, to take it away to the area of future bifurcations.

6. Practical relevance

Based on the concepts and methods of cybernetics, information theory, nonlinear dynamics and synergetics, it becomes possible to understand the peculiarities of the influence of perturbations on the functioning of economic systems with their inherent smooth and sharp, slow and fast phases of behavior. In practical terms, it is essential that the response of Russian industry to the impact of strong perturbations and challenges of a globalizing environment prompts attention to the need to study the dynamic qualities of industrial enterprises and the development of effective innovative production. The perturbed environment of a developing economy is saturated with hard-to-predict risk factors that initiate fundamental changes in the activities of industrial enterprises and the processes of combining stable and unstable conditions. Moreover, the growing pace of change and the turbulence of the “vortex” environment of industrial enterprises lead to an increase in non-linear phenomena and the generation of their inherent metamorphosis.

7. Conclusion

In the environment of globalization of economic interactions, the impact of tricky disturbing factors exposes the domestic industry to the risk of systemic decomposition, disruption of production and economic activity and stability of functioning. Against the background of the restructuring of world economic relations and the expectations of overcoming the depression of the Russian industry, the conditions for innovative modernization of the industry as the main direction of transformation and

development of industrial enterprises are deteriorating. In this regard, research on the nonlinear dynamics of economic processes, the detected metamorphosis in the activities of an industrial enterprise and the development of technologies to manage the stability of its activities are relevant, theoretically and practically significant. The subject of further in-depth analysis are innovative perturbations, behavioral models and scenarios of changes in stable and unstable states of industrial enterprises.

References

- [1] Lyapunov A 1892 The general problem of the stability of motion Doctoral dissertation Univ. (Kharkov)
- [2] Chuprov S 2012 Management of production systems' stability: theory, methodology, practice 2nd edn. *Irkutsk, BNUEL Publishing*
- [3] Zadeh L 1965 Fuzzy sets *Information and Control* **8** 338 –353
- [4] Zadeh L 1973 Outline for a new approach to the analysis of complex systems and decision processes *IEEE Trans. Syst. Man. Cybern SMC* **3** 28 – 44
- [5] Zadeh L 1975 The Concept of a linguistic variable and its application to approximate reasoning Parts 1 *Information Sciences* **8** 199 – 249
- [6] Trapeznikov V 1983 Management and scientific and technological progress (Moscow) *Nauka Publishing*
- [7] 2015 5th International Conference on Leadership, Technology, Innovation and Business Management 2015 *Procedia Social and Behavioral Sciences* **229** 1-452
- [8] Proceedings of the 4th International Conference on Leadership, Technology, Innovation and Business Management *Procedia Social and Behavioral Sciences* 210
- [9] 2015 World Conference on Technology, Innovation and Entrepreneurship *Procedia Social and Behavioral Sciences* 195 1–2934
- [10] Glazyev S 2015 On urgent measures to strengthen the economic security of Russia and the conclusion of the Russian economy on the trajectory of advanced development Report (Moscow) Institute of Economic Strategies Russian Biographical Institute
- [11] Boltzmann L 1970 Articles and Speeches (Moscow) *Nauka Publ*
- [12] Gibbs J 1982 Thermodynamics Statistical Mechanics (Moscow) *Nauka Publ*
- [13] Shannon C 1949 The Mathematical theory of Communication Urbana, Illinois *The University of Illinois Press*
- [14] Shannon C 1963 Works on Information Theory and Cybernetics (Moscow) *Inostrannaya literatura Publ.*
- [15] Wiener N 1983 Cybernetics or Control and Communication in the Animal and the Machine 2nd edn. (Moscow) *Nauka Publ*
- [16] Brillouin L 1966 Scientific Uncertainty and Information 5th edn. (Moscow) *Mir Publ.*
- [17] Beer S 1965 Cybernetics and Management 2nd edn. (Moscow) *Nauka Publ.*
- [18] Prigogine I, Stengers I 2005 Time, chaos and the quantum Towards the resolution of the time paradox. 6th edn. (Moscow) *KomKniga Publishing*
- [19] Nicolis G, Prigogine I 1989 Exploring complexity: An introduction (New York) *NY: W H Freeman*
- [20] Arnold V 1990 Catastrophe theory 3rd edn. (Moscow) *Nauka Publishing*
- [21] Zhan W-B 1991 Synergetic economics Time and change in nonlinear economics (Berlin) *Springer-Verlag Berlin Heidelberg*
- [22] 2002 The new in synergetics: propection in the third millenium In: Malinetskii G, Kurdyumov S (Eds.) (Moscow) *Nauka Publishing*
- [23] 2017 Economy and management in the conditions of nonlinear dynamics In: Babkin A (Eds.) (St. Petersburg) *Polytechnic University Publ.*