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Strategic approach to assessing economic sustainability objects of mineral resources sector of Russia

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The article gives a new definition of economic systems (ES) stability with its distinct strategic content. The main approaches to assessment of sustainability, based on the use of strategic cards, including Balanced Scorecard (BSC), are considered. Synchronous management of effectiveness, risks and chances of the ES exhausts the agenda of managing economic sustainability of ES when it operates in the face of a wide range of challenges. BSC in mineral resources sector (MRS) can be built during the aggregation of BSC by industry and individual enterprises. The use of 4 × 6 matrix formalism is proposed as the main tool for modeling economic sustainability of the ES.

Key words: mineral resource complex; economic system; economic sustainability; risks; odds; cybernetic system; balanced scorecard

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Introduction. The problem of assessing and ensuring sustainability of economic systems (ES) is not new; they tried to solve it with varying degrees of success in the USSR, then in Russia and abroad for many decades. By ES we understand not only purely economic, but also social and economic systems. But only now ES sustainability has become a full-fledged scientific category (in foreign scientific publications it has consistently been called stability, sustainability; now the most well-known term expressing system sustainability is resilience, and this term denotes sustainability of systems of various classes, both technical and economic and social). The main foreign publications on the subject of ES sustainability over the past few years are presented in [10, 27, 29, 30, 33-35]. In modern Russia the topic of economic sustainability is highly relevant; monographs are published, dissertations are defended [1, 2, 6, 9, 13-15, 21, 22, 31, 32, etc.]. However, as we see it, the moment has come when the «economic sustainability» category itself should be substantially rethought, as well as approaches to its identification and analysis. The reasons for this are the following:

• few researchers consider sustainability of ES in the context of strategic goal-setting. ES stability, taken on its own, is not critical for the functioning of such systems; but it is especially important how sustainably strategic goals set for the ES are achieved according to the main indicators of its economic efficiency;

• in many studies, the focus is made on market conditions as the most important indicator of ES on sustainability. At the same time, ES operate in a wide range of challenges, both positive and negative, generated by both natural market and artificially created reasons;

• in our opinion, the most complete picture of ES stability can be obtained when considering ES as *a cybernetic system* [3, 7, 19, 20].

In considering aspects of sustainability of the mineral resource complex of Russia (MRC of the Russian Federation), there is some scientific «stagnation», low rates of current knowledge accumulation. In general, work, materials accumulated so far in science on this subject can be attributed to the achievements of Soviet scientific schools. In general, stability of MRC of the Russian Federation was considered in the framework of technical paradigms of reliability, survivability and safety, economic aspect of MRC stability was practically not affected.

A significant part of current studies of sustainability of the MRC of the Russian Federation affects only individual mining enterprises. In order to raise the level of scientific understanding of MRC sustainability, it is necessary to present this branch structure as an integral economic system. The purpose of the study is to formulate a certain system of «reference points», which will make it possible to form the basis for the process of studying the economic sustainability of the MRC of the RF.

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Urgency of the problem of assessing stability MRC of the RF. Under the conditions of administrative management of the economy, basic economic sectors had one acting owner – the Soviet state, which strictly dictated certain rules, formulated activity standards and set work plans for industries and enterprises in accordance with national economic necessity. With the transition to new principles of management, the former system of command and control of the economy was completely destroyed, and it was replaced by a form of cooperation between the state and business, which was designed to harmonize the interests of states, society and business. In the mineral resource sector, a public-private partnership (PPP) was considered as a mechanism that could significantly improve organization of environmental management processes, including strategic direction [24]. However, what seemed completely realizable in the favorable economic and political conditions in the world and the end of the Cold War for our country very soon turned out to be very difficult.

Review of definitions of the term «economic sustainability». At the beginning of our research we will define terminology. Many authors interpret the concept of «economic sustainability» in different ways. We give the definition of the category of «economic sustainability» by the authors who studied sustainability of various economic systems (watch the table).

Basic definitions of sustainability

Sources of definition	Definition
[18]	State of sustainability of the economic system – the ability, after an unfavorable deviation beyond the limits of permissible value, to return to a state of equilibrium at the expense of own and borrowed resources
[15]	Sustainability and sustainable development of business entities – the ability to adequately respond to changes in the external infrastructure and the ability to ensure sustainable development in the interrelation of the conditions of product competitiveness with social and environmental problems, which is relevant not only for an individual enterprise, but also at the level of the region and the state
[4]	Economically stable are enterprises that, in conditions of uncertainty, market instability, provide the most advanced organization of scientific and reproductive activities (the definition is based on the reproduction approach)
[23]	The activity of the economic system will be economically sustainable if this system corresponds to the formed resulting vector of goals, and possible adverse situations are neutralized by an adequate response of the system due to the stocks and reserves created by it.
[5]	Economic sustainability is such a state of an enterprise in which socio-economic parameters that characterize it retain initial balance and are within specified limits when exposed to the internal and external environment (the definition comes from the enterprise's planning system and its equilibrium, in terms of planned indicators, condition)
[8]	Economic sustainability of an enterprise is a complex of organizational, innovative, logistic, industrial, financial and credit properties, taking into account their mutual influence and interaction.
[20]	Organizational and economic sustainability is financial and economic stability (sustainability), namely, the ability of an industrial enterprise to maintain its financial stability while constantly changing market conditions by improving and purposefully developing its production, technical and organizational structure using logistic-oriented management methods.
[11]	Sustainable development of a socio-economic system is understood as its development, whereby management structures can achieve planned results while preserving the properties inherent to this system and realizing its ability to innovate changes in order to achieve positive economic changes consistent with social interests. Sustainable development is development that corresponds to the parameters of socio-economic efficiency.

Analysis of presented definitions allows us to conclude that they are of different quality and diversity. Often, researchers are trying to adapt the category of resistance to specific scientific problems, which reduces the level of generalization required by scientific abstraction.

Since a strategic approach to the category of «economic sustainability» requires taking into account depth of the time period, a significant dependence of this state on external and internal factors, in relation to the objectives of this work, we propose the following definition of economic sustainability of the ES: *this is property of the ES to achieve strategic goals set by the strategy period in terms of external and internal challenges of negative and positive direction.*

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Features of the definition, its main aspects:

• the definition is formulated at the highest level of abstraction;

• the concept of «sustainability» is linked to the concept of «sustainable development» in the context of strategic goal-setting pursued by the economic system. In spite of the fact that the target levels for indicators of ES are put forward subjectively (by business owners, top management, government bodies), they express the most significant expert judgment about the features of the object of management (enterprises, industries, MRC);

• the property of economic sustainability is manifested in the medium and long term, depending on the period of time which certain strategic goals are set for. Any economic system may experience temporary difficulties, fall into an unprofitable state by the results of work for a month or a quarter. But this does not indicate a loss of stability, but may be a tactical or local result;

• stability is defined not only in relation to negative challenges (threats), but also in relation to positive challenges (opportunities). The sustainability of an ES is conditioned not only by how successfully it fights against a negative situation, minimizing risks, but also by how actively it uses the opening window of opportunities, maximizing its chances of a breakthrough, with a transition to a qualitatively new level of its development; negative challenges (threats), but also relatively positive challenges (potential). The sustainability of an ES is conditioned not only by how successfully it fights against a negative situation, minimizing risks, but also by how actively it uses the opening window of opportunities, maximizing its chances of a breakthrough, with a transition to a qualitatively new level of its development;

• disturbances affecting the ES can be generated not only outside the ES perimeter, in the external environment, but also inside the system itself (for example, when it comes to destructive behavior of employees of organizations or accidents of critically important equipment).

Thus, the main advantages of the definition of the category «economic sustainability» given by us are a higher level of abstraction, strategic orientation, understanding of sustainability not as stability, but as properties to resist negative impacts and use a favorable situation for development.

The economic system is a cybernetic system. This thesis, previously mentioned in [3, 25, 26], is directly related to economic sustainability.

Stability of the cybernetic system is achieved when three criteria are implemented:

1) the system is observable, and its corresponding factors are to be measured;

2) the system is controlled when information received is the basis for decision-making, and the number of control varieties exceeds the number of varieties of the controlled object;

3) the system is in the condition of dynamic balance, i.e. homeostasis with external environment. With regard to the economic system, the named basis of sustainability must be supplemented by another condition:

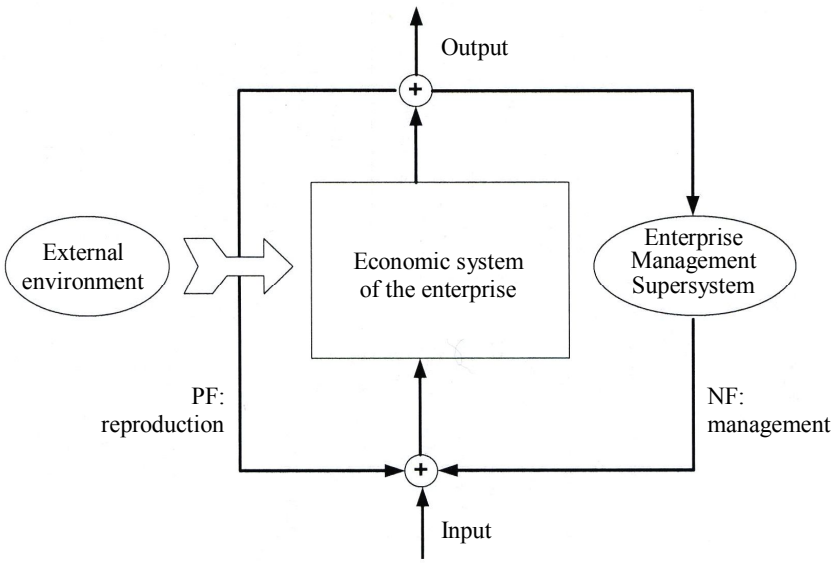


Fig.1. Management scheme of the economic system [16]

4) the system seeks to achieve its strategic goals, i.e. implements the principle of making a profit to the owners.

Consider the ES management scheme of the industrial enterprise (Fig.1). The goal of management is to ensure that enterprise achieves its strategic objectives by maintaining the enterprise in a state of dynamic balance (homeostasis), in balance with the external environment.

The economic system is covered by two types of feedback – positive and negative

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feedback (PF and NF). The presence of PF in the system expresses its ability to expanded or narrowed reproduction. For example, profit received by the company is partly directed to dividend payments (in other words, it goes beyond the perimeter of the system), and partly increases the company's own capital and the corresponding resource base.

NF is implemented by the enterprise management super-system, and its task is to process information signals received at the output of the enterprise, reconcile these signals with reference levels (targets), estimate the resulting mismatch and generate appropriate corrective actions that go to the logical input of the enterprise. It is NF that is an element of the ES, which is directly responsible for ensuring sustainability of the enterprise in terms of external and internal impacts. In exceptional cases, NF action of sometimes coincides with the action of PF in focus. But, as a rule, NF action is in the opposite direction – in the case when PF action damages the enterprise as a result of contracted reproduction. For such cases, the structure of the enterprise management supersystem should include specialized means of ensuring sustainability.

The same principles retain their force in relation to the larger economic systems – holdings, industries and MRC as a whole. The cybernetic paradigm applied to ES stability, absorbed all the most valuable knowledge gained by natural sciences – biology, physics, mechanics, electrical engineering, as well as specialized sciences related to system theory – automatic control theory, theories of reliability, survivability and security of complex systems, etc. At one time it was assumed that all significant facts and best practices obtained by cybernetics in relation to biological and technical systems with certain reservations can be transferred to the practice of ES research. One of such attempts is presented in the monograph [7], where management of regional development is considered from the standpoint of the theory of technical reliability.

Application of the approach to the ES as a cybernetic system requires a special study taking into account its features and ability of «survival» in changing external and internal conditions.

The mineral resource complex should be an integral ES, which is managed within a public-private partnership (with the state prevailing in this partnership), according to unified rules, using uniform economic and administrative management mechanisms.

Strategic aspects of assessing the sustainability of mineral resource complex enterprises. In addition to already identified issues of strategic goal-setting in the interests of ensuring sustainability of the ES, it stands to mention the need for regularization of the ES concept, which is achieved in the course of modeling. The simplest complex model of an enterprise's ES is the Balanced Scorecard (BSC). It is directly inherited from Forrester – Medouz dynamic models [24] and is a directed graph in which vertices are separate indicators of the BSC: key performance indicators (KPI) and financial and financial and economic performance data (FEPD). The vertices of the graph BSC connected directional arcs – models of the relationship between indicators, which can be functional-algorithmic or fuzzy-logical. Communications in BSC are subject to calibration (balancing) on the basis of special principles [16, 17]. Part of the graph vertices are exogenous factors that are affected by external environment and control system (Fig.2).

The presented model is fuzzy-logical for two reasons: a) composition of the BSC indicators includes both quantitative and qualitative factors; b) relations between the factors are of the form of fuzzy-logical models, which sometimes act as functional-algorithmic or even arithmetic.

All indicators in the BSC of ES are divided into four strategic perspectives: Resources – Processes – Relations – Effects. This distribution is due to the logic of making a business. Achieved level of business and possibility of its enhancement are the result of quality of relationships with key stakeholders: customers, suppliers, staff, and banks, and they must be harmonious and balanced, formed on the terms of a mutual equivalent exchange. Mutual relations of the ES with its stakeholders should be harmonious and balanced, formed according to the principle «winner – winner», on the terms of mutual equivalent exchange, as the variables CR, SR, HR, and BR act as exogenous inputs of the model (Fig.2, dotted oval). Setting up such relations is one of the key aspects of ensuring the economic sustainability of the ES, along with the aspect of balancing the resource base of the ES and its economic result.

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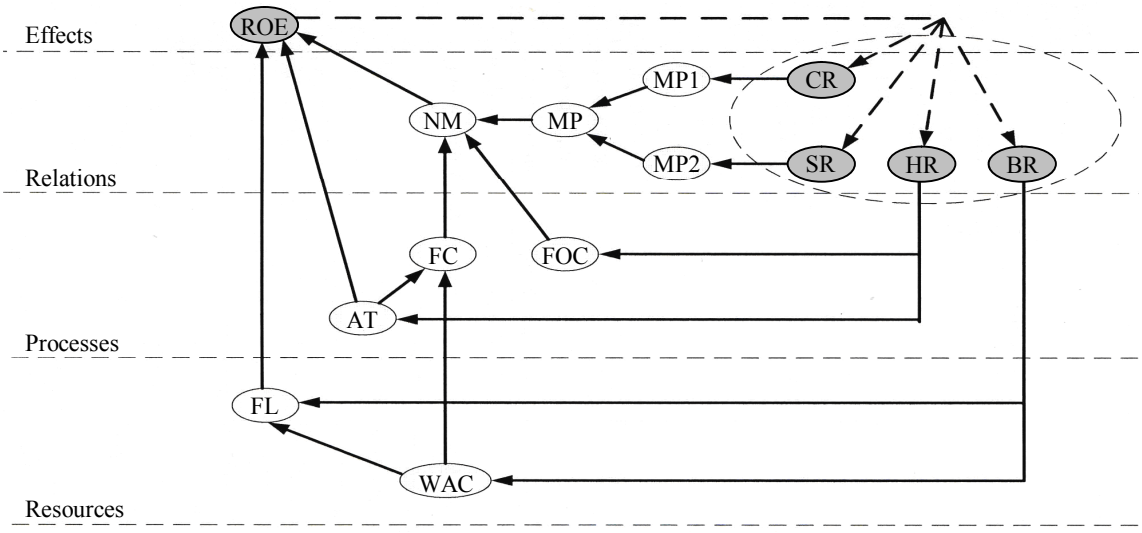


Fig.2. The example of the BSC economic system [16]

CR – quality of customer relations; SR – quality of supplier relationships; HR – quality of relations with staff; BR – quality of relations with banks; WACC – weighed average capital cost, % per year;
FL – financial leverage, unitless; AT – asset turnover, times per year; FC – financial costs, million rubles; FOC – fixed operating costs, million rubles; MP – marginal profit, % , incl. MP1, MP2 – marginality delivered by the client in the form of trade mark-up and trade discount, respectively (in the absence of detailed information on the trade mark-up and trade discount MP1 = MP2 = MP/2); NM – net margin, %;
ROE – return on equity, % per annum.

Within the framework of the BSC model, strategic goals presented at the Effects level are cascaded (decomposed) into the level of individual KPIs and FEPD, acting as normative values for them. Achievement of a goal is a positive state of the organization and its individual links; failure to achieve a goal, failure to complete a task is a negative (negative effect). The lingering negative, reproduced by the company over a long period of time, indicates the loss of stability of the corresponding economic system for the long term, until its liquidation due to bankruptcy.

If BSCs are formed for each enterprise in the structure of the industry, then you can get an integrated BSC for the industry as a whole, using specialized card consolidation mechanisms. On the basis of industrial cards, it is possible to build an integrated BSC for the MRC as a whole, having constructed a single model representation for the MRC on this base.

Consistently developing the idea of cards and filling them with indicators, we turn to modeling the external environment of the economic system. Two more maps appear: the Threats (negative external challenge) card and the Occacions (positive external challenge) card. The indicators of these maps are linked by arcs with exogenous factors of BSC. Thereby, the fact that an enterprise has an impact on negative and positive challenges, which spread its influence inside the ES along logical chains represented by arcs in the BSC graph, is modeled. There is a reconciliation of the current level of ES functioning with standard values for key indicators. If the standard is violated by a negative scenario, then risk is realized. Accordingly, a new card is being created – the Risks card, which is connected by arcs with the BSC.

According to the alternative logic, the impact of positive challenges on the ES entails propagation through the system of favorable waves, which ultimately leads to realization of the system chance, project or program for a transition to a new quality. The fact of such a realization of a Chance is recorded through a positive violation of the norm, when a positive effect substantially overlaps the starting expectations. As a result, sustainability model is complemented by a strategic Chances card.

On its own terms, risks and chances of an ES are also subject to rationing. This regulatory framework is the basis for governance. If you manage risks, you should quantify the levels of acceptable, borderline and unacceptable levels of risk – in the local aspect (at the level of individual factors of the BSC) and in the integral aspect (in terms of the integral effects of ES). On the contrary, if you manage chances, you need to distinguish levels of incentive, borderline and low

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chances. Corresponding indicators of chances can be structured both locally (with respect to individual indicators of BSC) and integrally (with respect to generalizing effects). For example, success of an innovation project is estimated by whether it has moved from the category of «question marks» to the category of «stars» (in the sense of the Boston Matrix). The effect to this condition is simply a binary sign which a certain level of integral chance is associated with.

The last card you need to fill with indicators is the Solution card. Indicators of Risk and Chance cards are sources of information for it. Depending on what levels of risks and chances are observed, the control super-system of the ES prepares the corresponding strategic, anti-risk and proximity decisions, and then implements them. Between the indicators from the Solutions card and BSC, arcs link them. Thus, modeling of NF in the structure of the ES is carried out, the ES model is self-closing.

Further development of this approach allows to make the listed cards, along with the BSC, by layers of strategic perspectives «Resources – Processes – Relations – Effects» and get the resulting model for analyzing ES sustainability as a 4×6 matrix. Rows in the matrix are strategic perspectives, and columns are individual scorecards in its composition.

Conclusion. Economic sustainability of the ES should be analyzed and ensured taking into account strategic goal-setting of relevant systems and subsystems within the ES. Understanding the ES as a cybernetic system allows us to involve in a scientific review a wide range of influences exerted on the ES from the external and internal environment, and to simulate these effects in a special way. The same understanding dictates the need for modeling and analyzing the mechanisms of positive and negative feedbacks involved in ensuring the ES sustainability. Strategic goal-setting, implemented at the level of integral factors of company business success or an entire industry, is subject to decomposition (cascading) into levels of individual divisions and local key efficiency factors. Such cascading provides a balance between the ES work and its homeostasis with external environment.

Consideration of the ES properties as a cybernetic and at the same time living system allows us to state with a high degree of probability that it has the potential for internal stability, which can be either increased or weakened.

The use of BSC concept and a 4×6 matrix allows to model not only challenges themselves, but also response of the ES to these challenges, measured in terms of efficiency, risk and chance. The fact of stability loss by the system can be fixed by the result of the output of marked indicators for pre-established standards. It is advisable not to miss this, but to fully interpret the «weak signals» and use the early warning subsystems about the expected negatives.

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