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## DEVELOPMENT TRENDS AND ECONOMIC ASSESSMENT OF THE INTEGRATION PROCESSES ON THE METALS MARKET<sup>1</sup>

*The article examines the integration process from the perspective of three dimensions, which characterize the increase in quantity and appearance of new relationships; strength, character and stability of emerging communications; dynamics and the proper form of the process. The authors identify the development trends of the integration processes in the metals market and provide justification for the breaking of the period of Russian metal trading for 1991–2016 into five stages of development. We propose a step by step approach to the implementation of the integration process, and we developed a methodical approach to the economic feasibility assessment of integration processes between metal manufacturing companies and metal traders, including three consecutive stages of its implementation, which are based, respectively, on the principles of reflexive control, entropy approach, and the traditional assessment of mergers and acquisitions. An algorithm for the realization of the author's approach is suggested, which allows to identify the optimal route for the integration process seen as a series of horizontal and vertical integration steps.*

**Keywords:** The metals market, the integration process, step of the integration process, metal producers, metal traders, economic evaluation, reflective analysis, entropy.

### Introduction

The volatility in the global metals market determines the need to find new forms of development of the metal business that would ensure higher added value and reduce various risks. A special place in this process belongs to an activity that is new for Russia; it involves the provision of metal processing services. It is the segment of business activity where the development of integration processes is successful.

The integration process can be regarded as a phenomenon of the current economic situation not only in the context of globalization of the world economy, but also in the sectoral aspect [15]. An important part in this process is played by the establishment of relationships between previously disparate elements of the system. At the same time, it is practical to analyze the integration process as such from the three interrelated semantic perspectives. The first perspective refers to the process of increasing the number of connections and establishing new ones (with the emerging market agents), which determines the quantitative characteristics of the future economic system (horizontal and vertical integration, mergers and acquisitions, etc.); the second perspective refers to the strength and character of the resulting relationships, their stability and their importance for the improvement of the economic efficiency of the system; the third perspective is required for the evaluation of the dynamics of the process and is instrumental in the selection of the most appropriate form of the integration process, contributing to the manifestation of synergy in the new integrated system.

Such an understanding of the integration process allows us to review the process by stages and introduce the concept of a “step of the integration process.” It describes a single act of the integration process that results in the increase of the number of links between elements, provides control over the emergence of the new properties of the system and evaluates the interim results of the integration process, which makes it possible to arrange links in order and ensure a steady increase of their number. In the course of the study of the metals market and the analysis of literature on the integration issues related to this market, we have determined that it was practical to distinguish between the horizontal step and the vertical step of the integration process. A “horizontal step of integration process” refers to a single act aimed at the acquisition of enterprises that are at the same level of the production chain, or the same level of the supply chain, working and competing in the same market segment, in the same industry and specializing in the production of the same or similar type of products or providing

<sup>1</sup> The translation has been made from the Russian version of the Journal of Economy of Region, No 1, 2015, with the consent of the authors.

the same or similar services. A “vertical step of integration process” refers to a single act aimed at the acquisition of enterprises that are at the different levels of the production chain hierarchy and belong to industries specialized in different business processes [23, p. 149].

Thus, the entire integration process is broken down into specific steps, and the total of such steps constitutes a certain route of the integration process. This path is a finite set of specific steps defined according to the conventional classification (vertical, horizontal, conglomerate-wise and concentric). At each step, the decision has to be made on the choice of the type of integration. Such an understanding of the integration process will provide an opportunity to review one of the components of the synergistic effect, namely, the effect of the optimal route of the integration process. The separation of specific steps of the integration process will reduce the enormous risks of this process due to rational resource allocation strategies in respect of the economic entities subject to the intended integration, in both financial and economic aspects. I would also like to note that the goal of any integration process is to provide a synergy effect due to the deepening and strengthening of the links and cooperation between the economic agents and the market, which enhances manageability due to the fact that each agent involved in the integration process makes better use of their economic potential.

Thus, we understand integration process as a managed process, which includes a specific set of steps that form its route. In this sense, the optimization of the integration process in the broad sense is associated with the search for the best route and is based on sound economic evaluation conducted in respect of the enterprises within the economic system under consideration. Such optimization is a really challenging task, although we believe that certain groups of companies can manage to solve this problem.

### **The Trends and Development Stages in the Russian Metal Trading**

Due to the great demand for metals and metal products and the fact that they are indispensable in most sectors of the modern economy, they are a compulsory element in all the known technological waves, and they form the metals market. However, the constant, although uneven, demand in the metals market, and the increased social needs determine the need not only to continuously improve metallurgical equipment and technology, but also to constantly monitor and analyze global trends in the economy of metallurgical processes and scientific and technological modernization of the manufacturing process in metallurgy/

In the mid-1990s, metal trade started its new development in Russia due to the liquidation of the former supply and sales chain of the metallurgical industry, and the vacant place on the market gave rise to the metal trading, which was a new phenomenon for Russia. This segment of the metals market includes economic agents who only sell products and are not involved in the core business processes of metal producers. These agents acting on the market of ferrous and non-ferrous metals are called metal traders. Originally, the mission of metal traders was to make profit from reselling metal and, therefore, they have taken all the responsibility related to finding customers, releasing metal producers from this non-core activity; in return, they get maximum discounts from the manufacturer. This brought profit to metal traders, first of all, due to the price difference.

Thus, the integration processes in the metals market are in fact the implementation of the step-by-step integration between metal producers and metal traders. The development trends of the metals market in the context of the research into the behavioral paradigm of the metal producers are described in many studies of many domestic economists, among which the works of the Ural School [17, 19, 20, 21] are of a special value, as they provide a system-wise review of the integration processes in this market since the 2000s. However, it is clearly not enough to identify the development trends only in respect of metal manufacturers in the market in question. In order to identify the patterns, principles and development trends, we also have to consider the behavioral characteristics of the second segment of the metal market, i.e., the metal traders. This logical and historical analysis is represented by the Figure 1. The breakdown of the Russian metal trading development process was based on the structural changes that took place in the market as a part of the integration process. The authors identify five stages of development, each of which had its own unique system of economic characteristics and problems, which later became drivers of change in the metals market. Besides, each stage is characterized by a certain economic result, which makes it possible to evaluate the trends in metal trading. The flow chart is based on the comprehensive analysis of the publications on this subject, including a variety of paper and electronic editions, periodicals, analytical reports and market research.

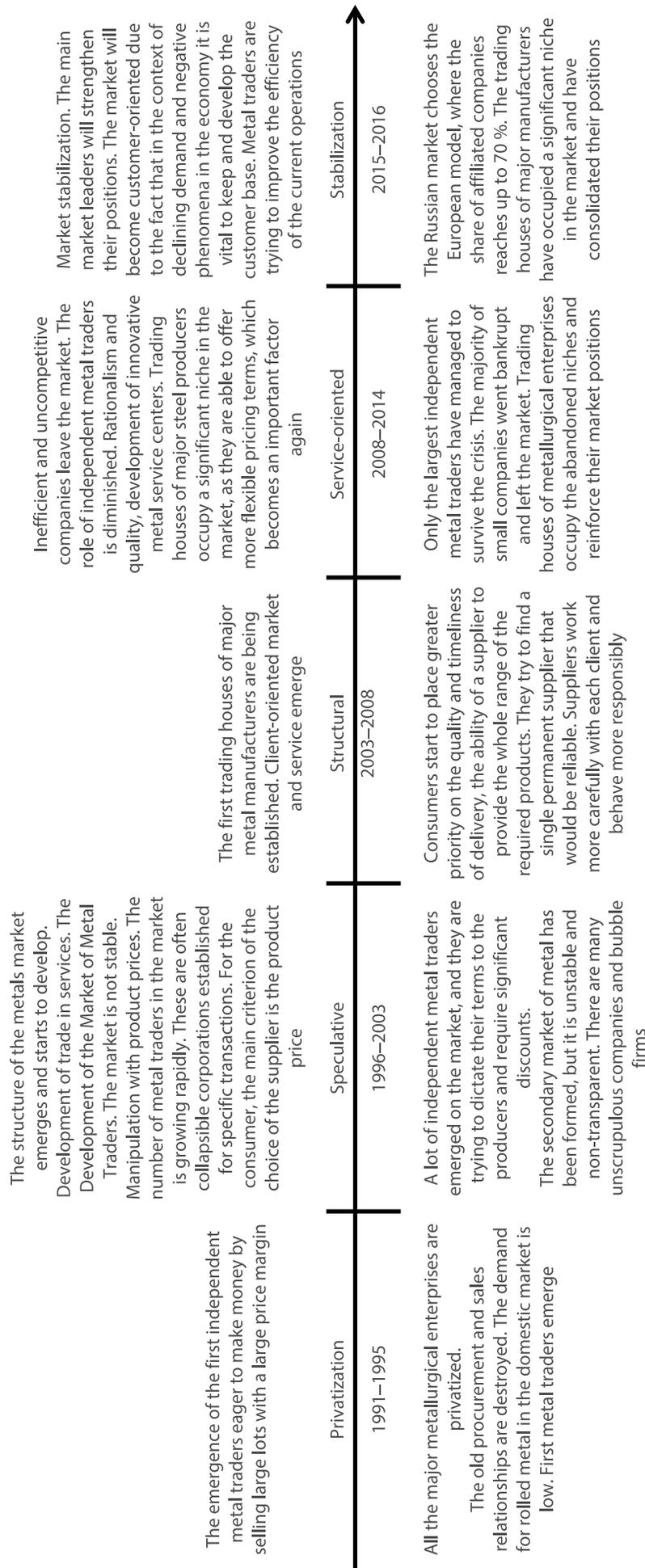


Fig. 1. Trends and stages in the development of the Russian metal trading

On the last three stages, “structural”, “service-oriented” and “stabilization”, the trends in the market of metals associated with the integration process become particularly obvious. As a matter of fact, the modern structure of this market is as follows: virtually all major Russian metal manufacturers have sales divisions with the economic and legal status of a trading house, which are not involved in the main business processes and are intended mainly for effective sales of the products. It means that, to put it formally, metal producers have common business processes with metal traders, and according to the theory of mergers and acquisitions, this inevitably brings about integration process which eventually leads to a merger or acquisition in the metals market, which is represented by two segments: metal traders and metal producers.

Based on the analysis of the changing developmental stages of metal trading in Russia, the authors highlight the important trends in its modern development:

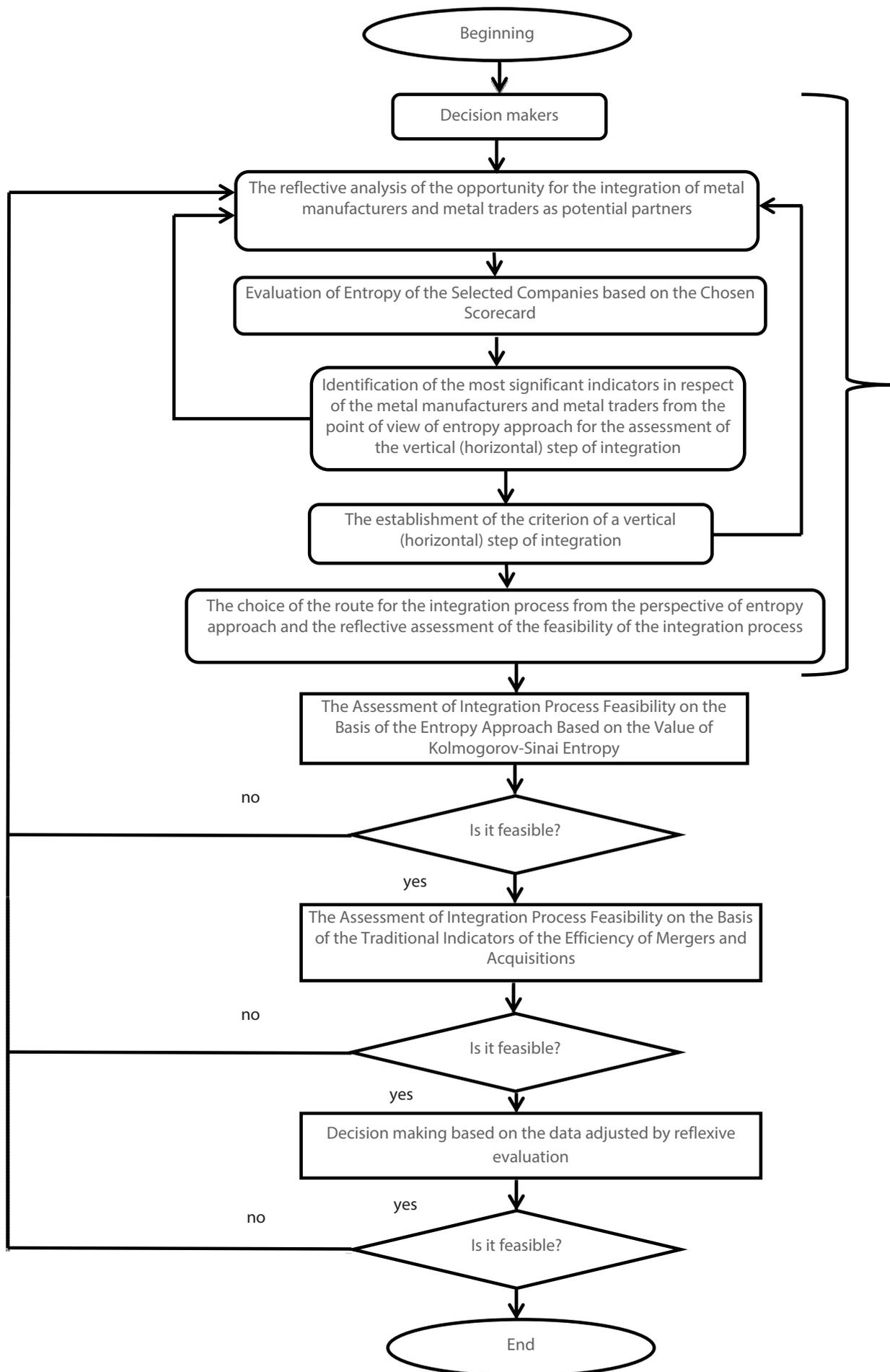
- Rationalism and quality, development of innovative metal service centers (MSCs).
- The successful development of companies that have managed to offer a high level of service and logistics and operate under just-in-time principle.
- Active developing of integration in the production sphere and the desire to offer unique products to consumers (construction of mini-factories, factories producing steel structures, welded products, fashioned products, etc.).
- The increase of the share of affiliated companies that include metal manufacturers and metal traders.
- The significant share of the market is secured by the trading houses of major manufacturers.
- The reduction of the proportion of independent metal traders, who have to offer additional services and metal processing, and integrate into manufacturing sector.

### **Methodical approach to the assessment of the integration processes in the metals market**

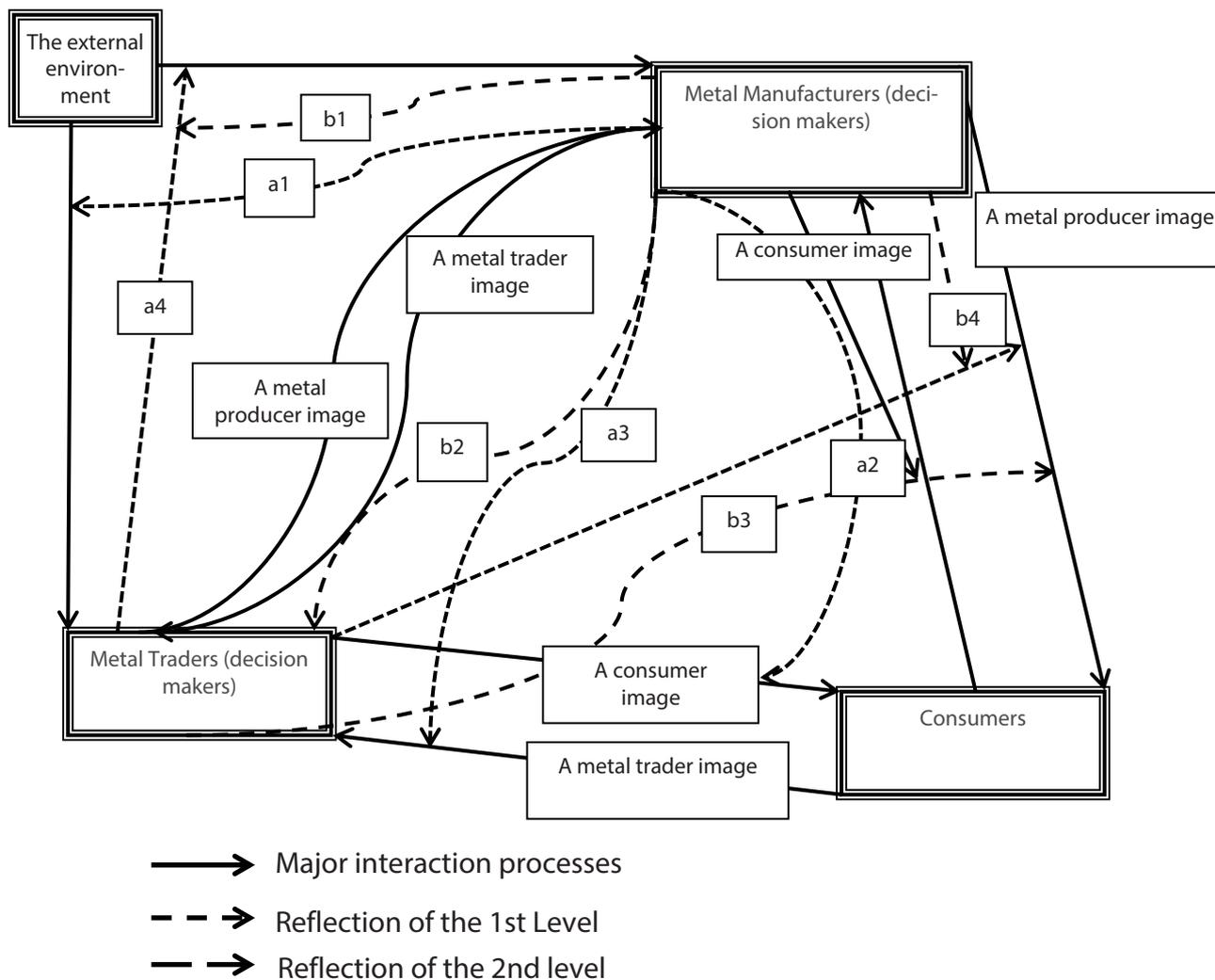
The study examines the system of enterprises of the metals market which are divided into two subsystems: metal traders and metal manufacturers. One of the most important characteristics of any system is the structure that, in fact, defines the spatial arrangement of its elements, the rules that govern the interaction between them, a set of stable relationships between the elements, and its internal structure. In our case, the interesting structural aspect of the approach used is the fact that the system under consideration includes two types of links: vertical (subordination) and horizontal (coordination). It should be noted that the development of the integration process as of today has not reached its final stage. The manufacturers change the channel partners involved in the distribution of their products, and metal traders always search for new partners and conclude various agreements, form new alliances, consider the options for the establishment of new integrative associations. In this context, it becomes very important to assess the economic feasibility of their formation.

Our research has made it possible to develop a methodical approach to such assessment. Its implementation includes a number of stages, which, each in their turn, evaluate integration processes based on the use of the principles of the methodology of reflexive control, entropy approach, and the traditional evaluation of the effectiveness of mergers and acquisitions, respectively. This approach allows to perform a preliminary rapid assessment, where necessary, on the basis of the first two stages, and detailed time-consuming calculations of the efficiency of the integration process are only performed in respect of the most likely partners. The algorithm used to assess the feasibility of integration processes in the “metal manufacturer – metal trader” system is shown by Figure 2.

The behavioral paradigm, based on the reflective approach, is becoming more and more prevalent in today’s economic science, which can be explained by the fact that in any system, the role of human factor is becoming more recognized. As practice shows, any economic system is characterized by the presence of both rational and irrational behavior. Human behavior largely determines the strategy, tactics and operational activities associated with the development of both the system as a whole and its elements [3]. The phenomenon of reflection was noticed and described in terms of psychology in the early 1960s by the founder of the reflexive approach in psychology, V. A. Lefebvre. It extends the traditional boundaries of “reflection (from Latin reflexio, bending back) from reflection as a study of the cognitive act as people examine their actions, thoughts,” which is also called self-reflection or reflection of the first type, to reflection in the broader sense, that of the second type, which involves making decisions on the basis of self-reflection of other people [18]. According to Lefebvre, “reflexive management is the influence upon the subjects that encourages them to make decisions which have



**Fig. 2.** The algorithm for the assessment of the feasibility of integration in the system "metal producer — metal trader"



**Fig. 3.** Reflective interaction within the system "metal trader — metal manufacturer — consumer"

been earlier prepared by the managing part." The results of such an impact are multifaceted and include both the technologies of social control and the technologies of manipulation at various levels. [13, p. 89].

R. N. Lepa complements the model introduced by V. A. Lefebvre et al. by approximating it to the main provisions of behavioral economics. He considers the behavior of decision-makers in the context of limited time and bipolar choice of "accept vs. reject". R. N. Lepa argues that if the decision maker believes that the question is not so important, the decision will be made based on the existing "samples", and the decision maker will rely on intuition and knowledge and look for similar situations in the business environment rather than analyze the available data thoroughly, with the involvement of experts, use of detailed calculations, etc. [11]. That is, there are two types of reflection that can be used: Of the 1st type (own experience, intuition) and of the 2nd type (based on the external expertise of the decision maker in similar situations).

As we have already noted, the metals market had a complex structure, where, in addition to large and medium metal manufacturers, there were numerous metal traders, which have been actively involved in the integration processes. Reflexive interactions in the system "metal producer > metal trader > consumer" can be presented by the form of Figure 3. The scheme above shows the reflection of the first type and reflection of the second type. The first one includes exposures a1–a4, which show that the subject is aware of making a decision and conducting self-assessment of the results. The second includes the influence of the second type, b1–b4, which form the so-called reflective safety [1, 4], because they reflect the thoughts of the subject on the evaluation of his/her performance by other people.

A metal trader builds its relations with a metal manufacturer based on the image that was formed partly by the metal manufacturer and partly under the influence of the market environment. The image formed by the metal trader may differ in some parameters from the actual status and characteristics of

the metal trader at a given time period. A similar process takes place in case of a metal manufacturer: its perception of the metal trader may be distorted by various external factors, so that it is different from the actual characteristics of the trader. A metal trader can also be mistaken in its assessment of the actual needs of the consumer because the image of the consumer that the trader has developed may be distorted. The consumer perceives a metal manufacturer partly due to the image created by the metal trader, because it is the metal trader who ultimately brings the product to the consumer. The activities of a metal trader can spoil as well as embellish the consumer's perception of the manufacturer of the goods the consumer purchased.

The proposed procedure, based on the reflexive approach (i.e., the first stage of economic evaluation) can be used to pre-select potential participants of the integration process and define the intended route of integration. At the next stage, the feasibility of integration between certain participants is assessed on the basis of the entropy approach. The diagnostics of entropy of any system requires the construction of the model of such system and the description of its possible states. The integration model contains two types of parameters:

— the parameters that are invariant under all the possible transformations of the model (the structure of the model);

— parameters that change their values in case of various transformations (variables).

The complete set of all the variables characterizes the phase status of the model, and the set of specific values of these parameters describes the phase points, or microstates. The set of all the possible phase points is the phase space of the model. Entropy is the possibility that the system is in one of these states (its capability of being in one of these states) (a measure of uncertainty of the phase point). Calculation of entropy requires not only a mathematical model of the object and its phase space, but also a metric by which we can determine the numerical values of entropy indicators as a measure of the uncertainty of the phase point.

The interrelated elements of the system “metal manufacturer — metal trader — consumer” seek to reduce the uncertainty of the environment in order to act in a coordinated manner to achieve economic growth and synergy effect. In this case, it is advisable to use the Kolmogorov-Sinai entropy index, which characterizes the behavior of points in terms of “proximity” in the phase space at different times. To identify the opportunities for the development of the integration process between enterprises, it is necessary to shift from the limited (continuous) option to the discrete form of the model. The phase points in the economic space include companies (metal traders and metal producers), which are described by a set of parameters of the integration process. Their behavior is different at the moments of time ( $t = 0$ ) and ( $t = 1$ ) in full compliance with the notion of a “step of the integration process” explained above, and the distance between them is characterized by the modulus of the difference between the parameters that determine the position of the enterprises in the phase space. Then the Kolmogorov-Sinai entropy index will be as follows:

$$h = \frac{\ln \frac{d(1)}{d(0)}}{1} = \ln \frac{d(1)}{d(0)} = \ln \frac{|x_2(1) - x_1(1)|}{|x_2(0) - x_1(0)|},$$

where  $h$  — index of entropy,  $d$  — the distance between the corresponding points of the trajectories,  $x_2(1)$  — an indicator that determines the position of company 2 at the time  $t = 1$ ,  $x_1(1)$  — an indicator that determines the position of company 1 at the time  $t = 1$ ,  $x_2(0)$  — an indicator that determines the position of company 2 at the time  $t = 0$ ,  $x_1(0)$  — an indicator that determines the position of company 1 at the time  $t = 0$ .

This formula is universal, as it describes the integration step regardless of its direction: vertical or horizontal. The differences in the directions are reflected in the choice of the indicators of the integration process. In addition, the Kolmogorov-Sinai entropy index provides for the analysis of the possibilities of integration of enterprises based on the selected performance indicators of such enterprises for different time periods. In order to evaluate the system “metal manufacturer — metal trader — consumer”, it is crucial to establish the indicators characterizing the elements of the system and the links they form. Based on the measure introduced (Kolmogorov-Sinai entropy), it becomes possible to determine how close the companies to be integrated are, within the system under consideration.

The analysis of the effectiveness of integration interaction of metal manufacturers and metal steel traders in the Ural Federal District for the period 2003–2012, as well as the systematization of research

**The system of indicators for assessment of the steps of integration**

Criteria indicator	Indicator
<i>horizontal step of the integration process</i>	
Market share (significance coefficient 1/2)	1. The market share of goods; 2. The structure of the product range of an enterprise; 3. The market share of the weakest and the strongest competitors
Market attraction of the enterprise to be integrated (significance coefficient 1/3)	1. The level of concentration in the market where the company to be integrated operates (the market share of the three largest players in the market); 2. The Herfindahl-Hirschman index — an indicator of the concentration
Investment attraction of the enterprise to be integrated (significance coefficient 1/6)	1. The annual amount of investment resources 2. Market capitalization of the company at the end of the reporting year
<i>Vertical step of the integration process</i>	
The degree of business interactions (significance coefficient of 1/2)	1. The coefficient of self-supportability with raw materials. 2. The share of products shipped to businesses partners
The share of transaction costs (significance coefficient 1/3)	1. The share of the costs of information search, 2. The share of the costs for the protection of property rights, 3. Share of market analysis costs, 4. Share of product promotion costs, 5. The share of the costs of measures aimed against opportunism
Investment attraction of the enterprise to be integrated (significance coefficient 1/6)	1. The annual amount of investment resources 2. Market capitalization of the company

on the efficiency of mergers and acquisitions, made it possible to identify the indicators that are most commonly used for the assessment of the feasibility of the implemented forms of integration [6, 7, 9]. It has been proved advisable to assess the performance of the integration process at its horizontal step based on the indicators characterizing the market share, marketing appeal and investment attractiveness. The best indicators to assess the performance of the integration process at its vertical step are such criteria indicators as the degree of business interactions, the share of transaction costs, investment attractiveness. Each of the above criteria indicators is formalized in the system of indicators shown in Table 1. The integral criterion for horizontal and vertical steps of the integration process is formed on the basis of calculations of the criteria indicators and is presented in the form of a factored convolution resulting from the aggregation of indicators for the corresponding step of the integration process [22].

The significance coefficients for the criteria-based indicators shown in Table 1 were calculated in accordance with P. Fishburn's rule.

The proposed system of indicators is not universal, it can be used as reflective building blocks for the construction of the final efficiency indicator for the integration process. That is, depending on the step of the integration process, the availability of information on the selected criteria, and the goals and opinions of the decision maker, the set of indicators, including the criterion indicators, can be changed, and the calculation model will remain the same. This ensures flexibility of the proposed method and the universal nature of its application to various types of companies in the metals market: metal traders and metal manufacturers. The decision makers have an opportunity to make a choice based on the reflexive idea, i.e., there is bipolarity, with each criteria indicator assigned the value of either 0 (if the decision maker is not going to use the criterion) or 1 (if it is going to be used).

According to the meaning of the Kolmogorov-Sinai entropy index set forth above, if the criteria indicator of the vertical or horizontal step of the integration process is less than zero, then the integration process in this step is advisable, and the larger the module of the criteria indicator of the corresponding step is, the more effective the integration process will be for the market under consideration. If the criteria indicator of the corresponding step of the integration process is greater than zero, then the integration process in the form of such step is not feasible. In this case, the possibility of the integration process is reviewed through a reflective analysis, and if the answer in respect of the selection of the prospective partners is positive, the entire situation is then assessed

from the perspective of the entropy approach. For this purpose, criteria indicators for horizontal and vertical steps of the integration process are defined, which makes it possible to define an integral criterion for each step, and, therefore, there is also an opportunity to draft the route of the integration process as a clear sequence of steps.

The analysis of the results of previous calculations for the selection of the best options for the integration process among metal producers and metal traders of the Urals Federal District has confirmed that the results obtained on the basis of the entropy approach are consistent with the results of the economic evaluation carried out on the basis of quite labor-intensive calculations based on the traditional indicators of efficiency used in respect of mergers and acquisitions. The results of the calculations based on the entropy approaches provide an overall assessment of the feasibility of the integration process. And if it is positive, then the specific values for the economic indicators are determined by further calculations on the basis of the traditional methodologies for the assessment of mergers and acquisitions. After performing all calculations and obtaining the opinion on the economic feasibility of the integration process, the decision maker makes reflective evaluation of the results, analyzes the economic conclusions and makes the final decision.

The proposed methodological approach has been tested by the example of the integration processes in metallurgy of the Ural Federal District. The subject of assessment was a system of enterprises that included both metal traders (Steel Industry Company CJSC (SIC CJSC), Metallinvest Management Company CJSC) and metal producers (EVRAZ Nizhny Tagil Metallurgical Plant OJSC (EVRAZ NTMK OJSC)). In order to select the most efficient path for the integration process, we have evaluated two alternative options. As the first possible option, we reviewed the route with two successive vertical steps of the integration process with each metal trader of metal producers, and the second option under consideration was the route in which at first there was a horizontal step between two metal traders, and then a vertical one, which created an alliance between the new metal trader and a metal producer.

For the purposes of calculations based on the principles of reflexive control, the reflexive management building blocks are set in the appropriate manner, and only those indicators are left for which data are available and which would not cause computational complexity for decision-makers. In accordance with the proposed system of indicators (Table 1), we have carried out the required calculations in respect of the vertical and horizontal steps of the integration process. Detailed calculations of the feasibility of the corresponding steps based on the entropy approach are presented in [22, p. 72–73]. The initial data for the calculation are derived from the financial statements of the companies, as well as from their quarterly and annual reports. First, the indicators of the integration process were calculated in respect of the vertical step by EVRAZ NTMK OJSC and SIC CJSC. The integral criterion for the vertical step for EVRAZ NTMK OJSC /SIC CJSC was found to be a positive value, that is, within the meaning of the Kolmogorov-Sinai entropy index, the vertical step of the integration process for the two companies would not be appropriate at the current stage. Thus, further study of the first option of the route is not practical, as its very first step has already been proved to be ineffective, i.e., the route of the integration process that consists of two vertical steps similar in nature will not result in the desired outcome.

In order to consider the second option of the route proposed, we calculated the integration process parameters for a horizontal step between Metallinvest Management Company CJSC and SIC CJSC. In this case, the resulting value of the integrated criterion turned out negative, that is, the horizontal step of the integration process between the two companies is effective and should be considered as a priority measure. As the horizontal step has been assessed as effective, it is necessary to evaluate the next, vertical step in the selected route, which can be done after the horizontal step of the integration process towards the merger of the united metal trader of Metallinvest Management Company and SIC CJSC with metal manufacturing company EVRAZ NTMK OJSC. The indicators for the united metal trader have been calculated by summing up the corresponding values for both companies. The estimated indicators for the vertical step in the integration process of EVRAZ NTMK OJSC and the merged metal trader company clearly show that such new merger will be advisable in this market segment, as the value of the integral index of the vertical step of integration process is negative. Further calculations performed on the basis of the traditional indicators used to assess mergers and acquisitions have confirmed that the results obtained on the basis of the entropy approach are consistent with the results of the economic evaluation carried out on the basis of these relatively labor-intensive calculations.

## Conclusion

Thus, an algorithm has been developed for the implementation of the proposed method in a regional segment of the metals market. The methodology used for economic evaluation of the effectiveness of the integration processes in the metals market is based on the refined system of criteria and indicators for the economic evaluation of the integration process ranked in accordance with P. Fishburn's rule. The suggested method takes into account the reflexive interaction between the participants of the metals market, as well as the level of entropy in the system of enterprises of the metals market, and provides the tools for allows qualitatively assessment of the efficiency of each step of the integration process, offer a cost-effective route for the integration process with its subsequent evaluation, and, when applicable, provides such evaluation based on the traditional performance indicators of mergers and acquisitions. All this allows a decision maker to obtain consistent results when selecting one or another variant of the integration process as the best available option.

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