DOI: 10.17580/cisisr.2019.01.11

ASSESSMENT OF INTEGRATION RISKS FOR METALLURGICAL ENTERPRISES USING THE FUZZY SET METHOD

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Key words:

fuzzy set theory, expert assessments, integration, integrating risk, consolidation, metallurgical complex, synergy.

ABSTRACT

Timeliness of this article is determined by necessity of rise of competitiveness for the Russian metallurgical enterprises, of achievement of integration synergetic effect by these enterprises, of improvement of the results of integrating development of the RF iron and steel works. It will allow Russian companies to rise efficiency of capital operation, to enter the new markets, to get the new technologies, to increase competitiveness at global markets. In this connection, risk management regarding reveal, assessment and control of the risks of integrating development of the a.m. plants.
Expedience of usage of fuzzy set descriptions for identification, analysis and management of risks at the RF iron and steel works is proved in this article. It will help to improve the methods of risk management on the base of harmonization of the interests of participants using synergy criterion. The projects of Severstal and Novolipetsk Iron and Steel Works are recommended to be put into practice based on assessed synergy cost in the conditions of local consolidation of these companies and a buyer of aggregate risk.

Introduction

Integration of metallurgical enterprises is the base of their development at present time, in the conditions of quickly varying and volatile political and economical situation in the markets. Statistical methods of analysis allow to conduct investigation of the concrete social and economical structures in the determined time and place conditions. This investigation includes first of all the exact quantitative measurement of such conditions.

The modern Russian metallurgical companies have to solve the complicated problem — to reach the new level of competitiveness in the conditions of a high risk component of integrating processes, what defines searching of the ways of application of assessment methods.

At present time Russia occupies stable 5th place in steel production worldwide (**Table 1**).

According to the data of World Steel Association, global steel production increased in 2017 by 5.3% in comparison with 2016 and made 1.691 bln. t. At the same time steel production increased in the most regions of the world, especially in India (+6.2%), Turkey (+13.1%), Brazil (+9.9%) and Iran (+21.4%). Serious decrease of steel production was observed in Ukraine (–6.4%), this country lost its position in the first ten leaders of steel production and is now only on the 12th place. It can be also mentioned that Vietnam who rose its steel production almost by 32% entered top 20 global steel producers.

Six large integrated holding were formed in the Russian metallurgical market; they unite enterprises within the whole technological chain, and it allows to decrease risks both in domestic and international mar-

Table 1. **Steel production worldwide in 2016–2017, mln. t**

Place	Country	2016	2017	Variation
1	China P.R.	786.9	831.7	+5.7 %
2	Japan	104.8	104.7	-0.1 %
3	India	95.5	101.4	+6.2 %
4	USA	78.5	81.6	+4.0 %
5	Russia	70.5	71.3	+1.3 %
6	Korea	68.6	71.1	+3.7 %
7	Germany	42.1	43.6	+3.5 %
8	Turkey	33.2	37.5	+13.1 %
9	Brazil	31.3	34.4	+9.9 %
10	Italy	23.4	24.0	+2.9 %
11	China (Taiwan)	21.8	23.2	+6.8 %
12	Ukraine	24.2	22.7	-6.4 %
13	Iran	17.9	21.7	+21.4 %
14	Mexico	18.8	20.0	+6.3 %
15	France	14.4	15.5	+7.6 %
16	Spain	13.6	14.5	+6.2 %
17	Canada	12.6	13.7	+8.3 %
18	Poland	9.0	10.3	+14.8 %
19	Vietnam	7.8	10.3	+31.9 %
20	Austria	7.4	8.1	+9.4 %
	...			
	World	1606.3	1691.2	+5.3 %

Source: World Steel Association

Table 2. **Financial parameters of the leading Russian metallurgical companies in 2016–2017**

	Income, USD mln.		EBITDA, USD mln.		Profitability,%	
	2017	2016	2017	2016	2017	2016
EVRAZ	10827	7713	2624	1542	24	20
NLMK	10065	7636	2655	1941	26	25
Severstal	7848	5916	2577	1911	33	32
MMK	7546	5630	2032	1641*	27	29
Metalloinvest	6231	4261	2120	1258	34	30
Mechel	5128	4122	1391	988	27	24

kets, to optimize investing policy and to provide self raw material safety (**Table 2, Fig. 1**).

Integration of the companies is the effective way of lowering the risks in metallurgical area, it allows to decrease complexly risk effects. Expedience of integrating development of the enterprises finalizes in economical effects that increase after consolidation of the companies. The following arguments supporting integration processes in metallurgical companies can be presented:

1) achieving of synergetic effect (in forming of Arcelor, thyssenkrupp Stahl, Corus, Ispat International, JFE Holdings, AK Steel, EAU Steel, Arcelor-Mittal);

2) usage of economical effect based on spreading of activity range of a holding or its integrated components (in forming of thyssenkrupp Stahl, Corus, JFE Holdings, AK Steel);

3) improvement of market positions and rise of competitiveness in the global market (in forming of Corus, Gerdau/Co-Steel, JFE Holdings, AK Steel, EAU Steel);

4) restructuring in order to rationalize works and/or to cut the excessive production capacities what leads to economical effect (thyssenkrupp Stahl, JFE Holdings).

Integrating solutions are not always confirmed by adequate methods of substantiation of their approval. High risk level of integrating processes in the metallurgical industry is determined by high uncertainty both in domestic and international media; thereby it is necessary to identify, analyze, assesse and manage integration risks.

The apparatus of fuzzy set theory was chosen for assessment of integrated parameter of a risk project, taking into account complex influence of the each integrating risk.

The fuzzy set theory was suggested by Lotfi A. Zadeh, the professor of Californian university, in his work “Fuzzy Sets” [1]. This work made the basis for the fuzzy set theory and creation of intellectual systems able to interface with a human adequately. This theory also became the base for building the systems for management of complicated technological processes and made it possible to simulate economical objects based on the experts’ opinions [2]. It is also possible to formalize and process different indefinite factors in the conditions of lack of sufficient data and to determine more exactly aggregate integrating risk.

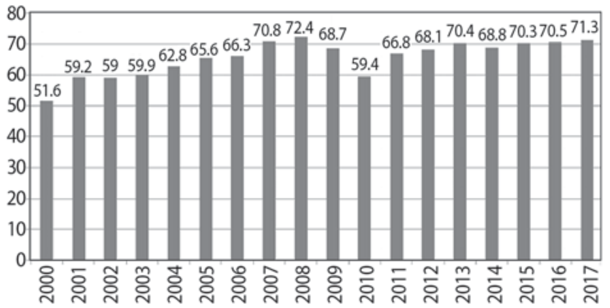

Fig. 1. Dynamics of steel production in Russia in 2001–2017, mln. t

The hypothesis of this investigation is that b usage of the apparatus of fuzzy set theory allows to take into account more wide range of integrating risks, to rationalize the systems of risk management in the Russian iron and steel industry and finally to optimize the level of profitability and capitalization of integrated structures.

Methodology of investigation

The fundamental works of the leading foreign [3–7] and Russian [8–12] scientists and practical specialists, devoted to up-to-date methods of reveal, assessment and management of risks at metallurgical works are considered as theoretical and methodological base of this investigation. Methodology of building of the integrating risk parameter is used for integrated projects at the Russian enterprises is based on the works of M. G. Karelina [13–16], S. N. Zhuravin and V. N. Nemtsev [17, 18]. These projects are based on the apparatus of fuzzy sets and allow to assesse objectively the results of integrating activity and to substantiate statistically consequences of approval of the project directed on providing of competitiveness of the Russian enterprises.

Obtaining of the expert assessment for alternative integrated projects by risk criteria is the feature of usage of fuzzy set apparatus applying to this article. As soon as opinion of one expert is always subjective, it is necessary to use the methods of group expert inquiry and analysis of its results.

Obtained results

Weak predictability of integrating risks, difficulty of their identification stipulates usage of the methods of expert assessments that are included in the group of heuristic analytical methods and present the complex of techniques for collection and processing of information based on skills, experience, intuition and professional competence of the specialists [19].

A group of experts is forming for determination of assessments of alternative integrating projects by risk criteria. While forming the expert groups, each expert becomes his qualification category δ based on his personal data. It is expedient to restrict the total number of categories as 4: $\delta \in \{I, II, III, IV\}$.

In this case the personal data for each expert are characterized by the three main parameters (1):

$$(e, s, t) \in E \times S \times T, \qquad (1)$$

where E, S and T are quotients of skill parameters and objective data, corresponding to alternative testaments in their connotation; E is expert education aster high university; S is expert scientific qualification; T is expert operating experience within the expertise profile.

Characteristics of the expert's high after-university education is expressed as (2):

$$E = \{e_1, e_2, e_3\}, \qquad (2)$$

where e_1 is the basic education that coincides with the profile of priority direction; e_2 is the basic education that coincides with the adjacent specialty; e_3 is the basic education for other specialty.

Characteristics of the expert's scientific qualification is expressed as (3):

$$S = \{S_1, S_2, S_3\}, \qquad (3)$$

where S_1 is an academician or corresponding member of Russian Academy of Sciences (RAS) or any industrial branch academy; S_2 is a professor or Dr. Sci; S_3 is a Cand. Sci., Associate Prof, Senior Researcher.

Characteristics of the expert's operating experience within the expertise profile is expressed as (4):

$$T = \{t_1, t_2, t_3\}, \qquad (4)$$

where t_1 is experience for more than ten years; t_2 — experience for more than five years; t_3 — experience for more than one year.

The rule for determination of the qualification category δ of the same expert is preset as (5; 6):

$$E \times S \times T \to \{I, II, III, IV\}. \qquad (5)$$

$$\delta = \delta(e, s, t). \qquad (6)$$

Calculating the partial qualification parameters e, s, t, the following function of the expert's qualification category can be formed (7):

$$\delta = \begin{cases} I, \text{ если } \overline{e}s_1t_1 \vee e_1s_1t_2 \vee e_1s_2t_1; \\ II, \text{ если } e_1s_1t_3 \vee e_1s_2t_2 \vee e_1s_3t_1 \vee e_2s_1t_2 \vee e_2s_2t_1 \vee e_3s_1t_1; \\ III, \text{ если } e_1\overline{s}t_3 \vee e_1s_3t_2 \vee e_2s_1t_3 \vee e_2s_2t_2 \vee e_3s_1t_2 \vee e_3s_2t_1; \\ IV, \text{ если } \overline{e}\,\overline{s}t_3 \vee \overline{e}s_2\overline{t} \vee e_3s_1t_3 \vee e_3s_2t_2, \end{cases} \qquad (7)$$

where $\overline{e}$, $\overline{s}$, $\overline{t}$ are negation of e, s, t, respectively; $\vee$ is a logical disjunction.

The authors are persuaded of preferable involvement of the experts from I and II categories for expertise; the experts from III category are recommended to be used sometimes, and as for the exoerts of IV category, it is deter not to invite them for expertise at all.

Table 3. **Expert assessments about risk of information leakage**

Experts	Alternatives						
	1	2	3	4	5	6	7
1	3	3	2	2	2	2	2
2	3	3	2	3	2	3	3
3	2	2	2	3	2	3	3
4	2	2	2	3	2	3	3
5	3	2	2	3	4	3	3
6	3	3	2	3	2	3	3
7	4	3	2	2	3	3	3

Table 4. **Ranks of projects' alternatives**

Experts	Alternatives						
	1	2	3	4	5	6	7
1	16.5	16.5	10	10	3	3	3
2	16.5	16.5	10	10	3	3	3
3	10.5	10.5	3	10.5	17	17	3
4	11	11	11	11	2,5	2.5	2.5
5	13.5	3	13.5	5,5	3	3	3
6	16.5	16.5	11	11	2	2	2
7	16.5	16.5	11	11	2	2	2

The questionnaire among seven experts was conducted for determination of assessments of each projects according to the chosen criteria; this survey used Delphy method for achievement of the acceptable degree of correspondence between the experts' opinions.

The variants of local consolidation of the seven corporations (Severstal, NLMK, EVRAZ, TMK, ChTPZ, Metalloinvest and Eurasian Group — ERG) were taken as the projects.

The Kendall concordance ratio was used for assessment of correspondence between the experts' opinions, while the Pearson distribution was applied as assessment criterion of its importance [20].

Let's consider determination of correspondence between the experts' opinions about the risk of information leakage as an example. Initially we had the expert opinions of alternatives by this criterion obtained from the conducted questionnaire (**Table 3**). These assessments were prepared by the experts according to five-point grading scale of risks, where 1, 2, 3, 4 and 5 are low, medium low, medium high, high and very high risk respectively.

Then it was necessary to calculate the ranks for all alternatives within assessments of each expert. Table 3 shows that many alternatives are characterized by equal assessments bi i^{th} expert and such alternatives will be equivalent for this kind of risk. The connected ranks are given to equivalent alternatives. The values of connected ranks are determined as the average value of summarized places divided within alternatives with equal ranks. These values r_{ij} are presented in the **Table 4**.

Concordance ratio is calculated using connected ranks according to the formula (8):

$$W = \frac{S}{\frac{1}{12} \times m^2(n^3 - n) - m\sum_{j=1}^{m} T_j}\ , \quad (8)$$

where S is dispersion of ranks; m is number of experts; n is number of alternatives; T_j is parameter of connected ranks in ranking of the j^{th} expert.

In this case $m = 7$, $n = 7$. Dispersion of ranks is calculated according to the formula (9):

$$S = \sum_{i=1}^{n}\left(\sum_{j=1}^{m} r_{ij} - \overline{r}\right)^2 , \quad (9)$$

Where $\overline{r}$ is the average rank calculated according to the formula (10):

$$\overline{r} = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{m} r_{ij}\ . \quad (10)$$

$$\overline{r} = \frac{1}{n}\sum_{i=1}^{n}\sum_{j=1}^{m} r_{ij} = (19{,}5 + 19{,}5 + 11 + ...)/20 = 73{,}5\ .$$

In this case the following value of dispersion of ranks was obtained:

$$S = \sum_{i=1}^{n}\left(\sum_{j=1}^{m} r_{ij} - \overline{r}\right)^2 = 10785.5$$

Parameters of connected ranks are calculated according to the formula (11):

$$T_j = 1/12 \times \sum_{K=1}^{H_j}(h_K^3 - h_K)\ , \quad (11)$$

where h_K is the number of equal ranks in the k^{th} group of connected ranks.

Calculation of parameters of connected ranks is presented in the **Table 5.**

In the same way the concordance ratio (see formula 8) is equal to 0.65.

As soon as assessment of significance of concordance ratio W is conducted via the Pearson criterion χ^2 at $n \geq 7$, observing value of this ratio is calculated via the formula (12):

$$\chi^2 = \frac{S}{\frac{1}{12} \times m \times n(n+1) - \frac{1}{n-1}\sum_{j=1}^{m} T_j}, \quad (12)$$

where χ^2 is the Pearson criterion.

The calculated value of χ^2 Pearson criterion is compared with the value $\chi^2_{tab}(\alpha, K)$ presented in the table; this value is characterized by significance level α and number of freedom degrees $K = n - 1$. In this case the value pre-

Table 5. **Calculation of parameters of connected rank for each expert**

Parameter	Experts						
	1	2	3	4	5	6	7
Connected rank	341	341	155	285	230	282.5	282.5

Table 6. **Conclusions on assessment of concordance of experts' opinions**

Risk criterion	Hypothesis
Risk of information leakage	Accepted
Risk of incorrect substantiation of integration efficiency	Accepted
Risk of incomplete account of possible dangers	Accepted
Risk of taking decision by a buying company owner against integration deal	Accepted
Risk of requirements of mandatory buying of shares by shareholders of a buying company	Accepted
Risk of taking decision by a selling company owner against integration deal	Accepted
Risk of requirements of conducting of anti-despoliation measures by shareholders of a selling company	Accepted
Risk of selling the company's shares to external investors	Accepted
Risk of non-acceptance of consolidation deal by the boards of directors	Accepted
Risk of interference of the board of directors in current operations (within integration)	Accepted
Risk of pressure of the board of directors on the company's management	Accepted
Risk of overestimation of integration project efficiency by management of a buying company	Accepted
Risk of fraudulent operations by management of a buying company during company reorganization	Accepted
Risk of conducting of anti-despoliation measures by management of a selling company	Accepted
Risk of fraudulent operations by top management of a selling company during company reorganization	Accepted
Risk of requirements for early repayment of financial obligations during company reorganization	Accepted
Risk of presenting overestimated social requirements by the state authorities	Accepted
Risk of creating the conditions hindering business development by the state authorities	Accepted
Risk of non-correspondence of a deal conditions to the practice of proper corporate management	Accepted
Risk of non-application of a regional franchise package	Accepted
Risk of appearance of delays in infrastructure development and operation that hinder business development	Accepted
Risk of initiation of antimonopoly investigations by competitors	Accepted
Risk od suggesting more profitable conditions (price) for an aimed company by competitors	Accepted
Risk of buying the creditor liability of an aimed company by competitors	Accepted
Risk of refuse of competitors to prolong contracts	Accepted
Risk of presentation of debt payments from the side of contractors	Accepted
Risk of unauthorized operations of the board of directors	Accepted
Risk of fraudulent operations of the board of directors	Accepted
Risk of unauthorized operations of the administrative board	Accepted
Risk of fraudulent operations of the administrative board	Accepted
Risk of liquidity loss	Accepted
Risk of non-execution by insurance companies of their obligations	Accepted
Risk of confidence lowering from contractors to the goods of integrated companies	Accepted
Risk of lowering of consumer's demand on products	Accepted
Risk of non-acceptance of the new corporate culture by staff of a united company	Accepted

Table 7. **Values of average group assessments at the first iteration stage**

Number of alternative	1	2	3	4	5	6	7
Average group assessments	8.28	12.00	8.21	10.71	9.29	12.00	13.29

sented in the table is expressed as χ^2_{tab} (0.05, 19) = 30.14. As soon as $\chi^2 \geq \chi^2_{tab}$, there are no grounds to reject the hypothesis about concordance between all experts.

The results of assessment of concordance of the experts' opinions for all criteria are presented in the **Table 6**.

So, opinions of the experts about all risk criteria are agreed and we can start to determine competence ratios.

Calculation of competence ratios of the experts is conducted on the base of A. S. Rykov iteration algorithm by stages [21].

Initial values of competence ratios of the experts are calculated at zero stage via formula (13):

$$K_i^0 = \frac{1}{m} = 7\ ,\ i = 1, ..., 7, \qquad (13)$$

where K_i^0 is initial competence ratio.

Average group assessments are calculated at the first iteration stage (14):

$$x_j^1 = \sum_{i=1}^{m} K_i^0 \times x_{ij} \qquad (14)$$

where x_j^1 is average group assessments.

Values of other average group assessment are presented in the **Table 7**.

Then it is necessary to calculate correction coefficients of the experts' competence ratios via the formula (15):

$$\Delta K_i^1 = \frac{1}{\varepsilon + \max\limits_{j=1,n}\left\{\left|x_j^1 + x_{ij}\right|\right\}}, i = 1, \ldots, m, \quad \varepsilon = 0.001 \quad (15)$$

Values $\left|x_j^1 + x_{ij}\right|$ are presented in the **Table 8**.

The competence ratios obtained via Rykov algorithm are used as scales during calculation of weighted-average assessment of each enterprise according to all criteria (16):

$$Risk^k(j) = \sum_{i=1}^{m} K_i^k \times Risk_i^k(j), k = 1..42, j = 1...7\ , (16)$$

Таблица 8. **Values** $\left|x_j^1 + x_{ij}\right|$

Expert	Alternative 1	2	3	4	5	6	7	Maximal value
1	2.21	1.50	2.29	0.21	1.21	1.50	2.79	2.79
2	4.21	0.50	5.21	1.79	6.29	0.50	0.79	6.29
3	6.79	2.50	6.29	5.21	5.21	2.50	1.21	6.29
4	2.21	1.50	2.29	0.21	1.21	1.50	2.79	2.79
5	0.71	3.00	6.71	7.29	0.29	3.00	4.71	7.29
6	4.21	0.50	5.21	1.79	6.29	0.50	0.79	5.21
7	6.79	2.50	6.29	5.21	5.21	2.50	1.21	6.79

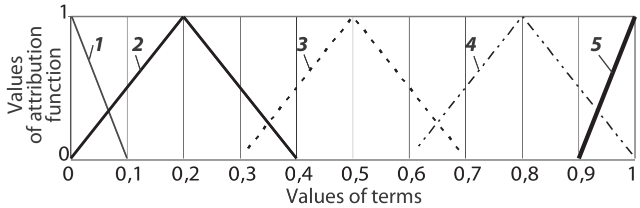

Fig. 2. Attribution functions of terms of alternatives assessment:
1 — very low risk; *2* — low risk; *3* — medium risk; *4* — high risk; *5* — very high risk

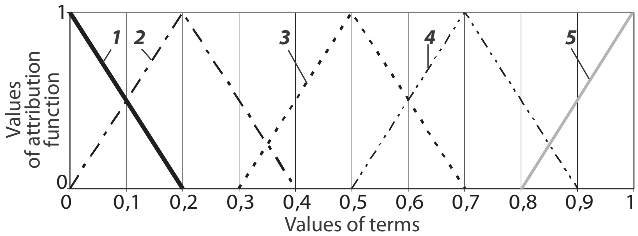

Fig. 3. Attribution functions of terms of criteria importance:
1 — practically unimportant; *2* — not very important; unimportant; *3* — medium important, *4* — important; *5* — very important

where $Risk^k(j)$ is weighted-average assessment of j^{th} project according to k^{th} risk; K_i^k — competence ratio of i^{th} expert according to k^{th} risk; m — number of experts (m = 7); $Risk_i^k$ — assessment of i^{th} expert to j^{th} project according to k^{th} risk.

Taking into account expert assessments of alternative projects, the functions of attribution of chosen risk criteria were built. For this purpose it was necessary to transit the scale of expert assessments in the scale of attribution functions, i.e. for the interval from 0 to 1, where high values are corresponding to large risk and low values — to small risk.

assessment of alternative integration projects was conducted on the base of multi-criteria choice of alternatives based on crossing of fuzzy sets [17, 18, 22]. 39 linguistic variables (corresponding to the number of risk criteria) were built for realization of additive convolution; each of these variables has terms of risk sets — "Low", "Medium low", "Medium high", "High", "Very high". Values of set terms are preset by fuzzy numerals having triangle expression of attribution functions (see **Fig. 2**).

Linguistic variable "*W*" = {"Practically unimportant", "Not very important", "Medium important", "Important", "Very important"} is used for assessment of criteria relative importance. The functions of terms attribution are presented on the **Fig. 3**. Weighted assessment of k^{th} alternative Z_k (k = 1...n) is a result of linear combination of fuzzy numerical and will be also characterized by attribution function of triangle kind.

Priority of each alternative is calculated by choosing the minimum among the points of crossing of right boundary of fuzzy numeral Z_j corresponding to this alternative with the boundaries of fuzzy numerals presenting weighted assessments of alternatives located on the

Table 9. **Value of aggregate risk parameter determined by additive convolution**

Project	Risk assessment	Risk level place	Risk group
1	0.5821	4	Medium high
2	0.5534	5	Medium high
3	0.6692	3	High
4	0.1911	6	Low
5	0.1778	7	Low
6	0.7507	2	High
7	0.7735	1	High

numerical axis to the right side. It is proposed in this case that the right boundary of the determination area of fuzzy numerals corresponds to the most high risks, while the left boundary — to the most low risks. The results of this convolution are presented in the **Table 9**.

Magnitogorsk Iron and Steel Works (MMK) assessed synergy cost for presented consolidation projects (**Table 10**).

Qualitative analysis of obtained results displayed that this convolution finalized in adequate assessment of integration risk. Additive convolution is based on realistic approach when lower assessments on criteria have equal status in comparison with higher ones. This method is mostly suitable for calculation of risks of integration projects, by opinion of the authors.

It was decided during analysis of convolution results to divide all integration projects in 4 risk groups: with low, medium, strong and critical risk level (**Table 11**).

The decision on expediency of realization of an integration project can be taken on the base of aggregate risk parameter and priority of integration projects. Conclusion on efficiency of integration project is conducted on the base of priority and risk level (see table 11). The Severstal and NLMK projects are recommended for realization based on synergy assessment cost during local consolidation of the companies and aggregate risk parameter.

Table 11. **Taking of decision based on risk priority parameter**

Risk priority	Low	Medium low	Medium high	High	Very high
$\mu_j(j)$ — aggregate risk	to 0.2	>0.2–0.4	>0.4–0.6	>0.6–0.8	over 0.8
1	Positive	Positive	Positive	Positive	Negative
2	Positive	Positive	Positive	Negative	Negative
3	Positive	Positive	Negative	Negative	Negative
4	Positive	Negative	Negative	Negative	Negative

Conclusions

Building of the aggregate risk parameter for an integration project will allow to correct the amount of the main financial parameters, taking into account the risk factor. It will help to predict the results of realization of integration projects with higher reasonability.

Management based on harmonization of the interests of participants of merging, acquisition and consolidation processes is required for a complex system for management of integration risks in large Russian industrial companies (e.g. in metallurgy). The new management mechanism for integration risks is suggested for this purpose; it is based on expert assessments using apparatus of the fuzzy sets theory and on standardization of risk management procedures on the base of synergetic effect criterion. The method is based on harmonization of interests of participants of integration processes with assessment of the level of integration risk, its identification and analysis within the framework of standard procedures.

The fuzzy sets method was chosen as a mechanism for assessment of aggregate risk of an integration project with account of complex influence of separate integration risks typical for this project. Integration risks at all integration stages are weakly subjected to economical and statistical assessment methods, while the suggested method allows to formalize and process heterogeneous factors in the conditions of lack of sufficient data amount; it is possible now to determine more precisely the risk of an integration project.

Table 10. **Assessed synergy cost at local MMK consolidation with other companies [23]**

Project	Company	Main business	Synergy area,%			Assessed synergy cost, USD mln.
			Management quality (capacity management)	Sales management	Supply	
1	Severstal	Steel / mining	100	100	75	500–700
2	NLMK	Steel / mining	75	75	75	300–500
3	EVRAZ	Steel / mining	25	25	75	100–300
4	TMK	Tubemaking	25	50	25	100–300
5	ChTPZ	Tubemaking	25	50	25	100–300
6	Metalloinvest	Iron ore / steel	25	25	75	100–300
7	Eurasian Group — ERG	Iron ore	0	0	75	100–200

The paper considers the project of local consolidation of Magnitogorsk Iron and Steel Works (MMK) with other companies (see table 10). Local consolidation is the term of a stock market characterizing one of its development stages during narrowing of market volatility. In this case organizers of integration process hope that local consolidation will allow to rise capitalization of the company (it is expressed in increase of stock price), and necessity of accounting of aggregate integration risk is actual as a result. Seven alternative projects based on synergy assessment cost and aggregate risk parameter of an integration process were considered, and the projects of Severstal and NLMK are recommended to be put into practice.

It is concluded that management based on harmonization of interests of participants of merging, acquisition and consolidation processes is necessary for the complex system of management of integration risks in large Russian metallurgical companies.

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