

Assessing the Innovative Attractiveness of Industrial Companies in the Conditions of High Uncertainty

Evaluar el atractivo innovador de las empresas industriales en condiciones de alta incertidumbre

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ABSTRACT:

The article presents the authors' algorithm of innovative attraction assessment of industrial enterprises in Russia, as well as the results of its implementation. We suggest conducting the monitoring of innovative attraction of industrial enterprises based on a system of index numbers, taking into consideration the enterprise environment's uncertainty level. In high uncertainty conditions, synergetic approach is advisable, while in the medium and low uncertainty conditions complementary approach is more preferable. The index numbers of innovative attraction assessment are achievements in the scientific and technical, human resources activities as well as in the sphere of financial management. The results of our calculations indicate, that the environmental uncertainty level of the industrial enterprises described here in 2012-2015 is high, what implies the necessity of using synergetic approach for managing their innovative attraction. Formation of the flow processes logistic algorithm allows to optimize the technologies, inventory and logistics management and other logistic operations, create highly efficient communicative infrastructure and organizational structure of management and

RESUMEN:

El artículo presenta el algoritmo de los autores para la evaluación de atracción innovadora de empresas industriales rusas, así como los resultados de su implementación. Se sugiere realizar un seguimiento de la atracción innovadora de las empresas industriales a partir de un sistema de números índices, teniendo en cuenta el nivel de incertidumbre del entorno empresarial. En condiciones de alta incertidumbre, es aconsejable el enfoque sinérgico, mientras que en las condiciones de incertidumbre media y baja es más preferible el enfoque complementario. Los números índices de evaluación de atracción innovadora son logros en las actividades científicas y técnicas, de recursos humanos y en la esfera de la gestión financiera. Los resultados de nuestros cálculos indican que el nivel de incertidumbre ambiental de las empresas industriales descritas aquí en 2012-2015 es alto, lo que implica la necesidad de utilizar un enfoque sinérgico para gestionar su atracción innovadora. La formación del algoritmo logístico de procesos de flujo permite optimizar las tecnologías, la gestión de inventario y logística y otras operaciones logísticas, crear una infraestructura comunicativa altamente eficiente y

finally decrease the uncertainty level of industrial enterprise environment. Consequently, new additional opportunities for industrial enterprise innovative development appear for the top-management, which proves the necessity and urgency of our research.

Keywords: innovative development, innovative attraction, uncertainty, synergetic approach, complementary approach, logistic algorithm of flow processes

una estructura organizativa de gestión y, finalmente, disminuir el nivel de incertidumbre del entorno empresarial industrial. En consecuencia, aparecen nuevas oportunidades adicionales para el desarrollo innovador de empresas industriales para la alta dirección, lo que demuestra la necesidad y la urgencia de nuestra investigación.

Palabras clave: desarrollo innovador, atracción innovadora, incertidumbre, enfoque sinérgico, enfoque complementario, algoritmo logístico de procesos de flujo

1. Introduction

Nowadays the innovative vector of development is aimed at stimulation of development of Russian industrial enterprises, whole industries, regions and can make cumulative impact on the potential of Russia's economy, provide the growth of competitiveness of domestic goods and services, diversification of different kinds of manufacturing, accelerated modernization of technics and technologies, as well as the solution of many social problems. Yet risks and uncertainty don't allow detecting and predicting innovative activity status at industrial enterprises, industries and regions of Russia exactly. Due to statistical data no conclusions about a remarkable increase of innovative activity of subjects of entrepreneurship could be made (Dolzhenkova et al., 2015). The share of industrial enterprises developing and implementing technological innovations is no more than 10%. The share of innovative production in the total volume of industrial manufacturing production is only 5.5%.

During the last years, the state has actively exercised measures aimed at the development of national innovative system (NIS) of Russia (Smelova, 2012). A number of state institutions of development are functioning, which activate innovative processes and infrastructure potential with the help of state-private partnership mechanisms. Besides, amendments were added to the Tax Code of Russia, aimed at the decrease of the tax duty for innovation –active companies. However, it is too early to talk about the effectiveness of measures of innovative system development in the conditions of turbulence of external and internal environment.

In such conditions for innovative development of an industrial enterprise, the algorithm of monitoring its innovative activity should be formed allowing to take into consideration the environmental uncertainty, changes of status and characteristics of environment in time.

The building of economic patterns in the uncertainty conditions using the games theory and the theory of probabilities was studied by the following scientists:

Borch K.H. (Borch, 2015); Marinacci M. (Marinacci, 2015); Abdellaoui M., Baillon A., Placido L., Wakker P.P. (Abdellaoui et al., 2011); Gilboa, I. (Gilboa, 2010); Li, Ya., Li, Yo., Zhao, Y. (Li et al., 2014) and others.

Research of theoretical aspects of institutional factor analysis in the innovations development was made by such scientists, as: Stroeva O., Lyapina I.R., Konobeeva E.E., Konobeeva O.E. (Stroeva et al., 2015); Wu W., Chen Q., Yu B., He H. (Wu et al., 2008); Zdrzil P., Kraftova I., Mateja Z. (Zdrzil et al., 2016); Zieba M., Zieba K. (Zieba et al., 2014); Rodriguez M. (Rodriguez, 2014) and others.

Interesting approaches of using ABC-analysis are presented in the works of Alsharari N.M. (Alsharari, 2016); Askarany D., Yazdifar H., Askary S. (Askarany et al., 2010). Practical experience of using logistic technology «lean production» is described in the works of Sahno J., Shevtshenko E., Karaulova T., Tahera K. (Sahno et al., 2015, 2014, 2012); Breuer C., Siestrup G., Haasis H.-D., Wildebrand H. (Breuer et al., 2013); Wiengarten F., Fynes B., Onofrei G. (Wiengarten et al., 2013); Paulraj A. (Paulraj, 2011, 2007); Holweg M. (Holweg, 2007); Sakakibara S., Flynn B.B., Schroeder R.G., Morris W.T. (Sakakibara et al., 1997) and others.

Yet, the specifics of theoretical principles and methodical instruments concerning industrial enterprises innovative activity management in uncertainty conditions have not been disclosed fully enough. We would also like to point out, that methodical aspects of innovative

attraction assessment have not been studied thoroughly enough, which slows down the process of mass use of principles and methods of administrative analysis for increasing efficiency and quality of decisions taken in the reproduction process innovative segment.

The review of existing scientific works has allowed to summarize the experience gained, to reveal the most characteristic features of industrial enterprises innovative activity development and to notice the absence of complex technologies that allow engaging all the potential at the disposal of an enterprise considering the level of its innovative development.

Hence, it is necessary to clearly determine and differentiate the sphere of use of one or other methods of innovative development in each industrial enterprise functioning conditions, which will allow integral problem-solving in the conditions of changing external and internal environmental factors, giving such solutions a scientific character and avoiding extra social-economic losses.

In the given research the logistic algorithm of flow processes is used, which allows to optimize the industrial enterprise useful resources flow and decrease its environment uncertainty level. The algorithm we offer will allow to receive the highest result when the implementation of rapid changes in the work of industrial enterprises is necessary.

2. Research Methods

For quantity assessment of industrial enterprise environment's uncertainty level, we suggest the use of the theory of self-organization of complex well-ordered systems, applying synergetic approach.

The simplest and less time-consuming index of critical (high) level of environment uncertainty is industrial enterprises efficiency E_{ie} as a ratio of net profit to costs. This index number can be calculated using the formula 1:

$$E_{ie} = \frac{\Delta P}{C} \quad (1),$$

where ΔP is changing of industrial enterprise net profit; C means the costs for the analyzed time period.

If we deal with abrupt fluctuations of this index number, it must be considered as an important signal of increasing the level of uncertainty of industrial enterprise. In this case, the use of synergetic approach is quite necessary for improving the industrial enterprise activity in managing its innovative attraction. If the index number of efficiency is permanent or has a relatively stable tendency for increasing, it means that processes regulating an enterprise activity are reversible. The environment uncertainty level of such enterprises is rather low. Consequently, we suggest, that the use of complementary approach to managing the innovative attraction of industrial enterprises is quite necessary.

In other words, the use of synergetic approach may possibly give the best results if the implementation of rapid changes in the work of an industrial enterprise is necessary. The complementary approach is more appropriate for use in the conditions of target management of innovative processes, when there is an opportunity of development and step-by-step implementation of the planned changes (Kazakova et al., 2015).

Figure 1 presents the structure of monitoring innovative activity of industrial enterprises.

First of all, the innovative attraction has an effect on improvement of the financial situation at the enterprise, the main indices of which are the financial sustainability indices as major signs of decreasing the level of environmental uncertainty of an enterprise. We suggest using the system of group indices for innovative activity assessment. The above-mentioned indices include achievements in human resources, scientific and technical activity as well as financial management activity.

For assessment of property, scientific, technical and labor potential in high uncertainty conditions, we suggest using the logistics algorithm of flow processes at the enterprise. Due to this algorithm each flow can be represented as directed transfer (transformation) of a certain amount of useful resources (a shipping lot, a portion) in space and time. Thus, a flow is a function, comprising two components: scalar (a scalar component of the flow (SFC)) P_0 – a certain kind (volume, portion) of useful resources and vector (a vector component of the flow (VFC)). $\overline{P}_0(t, z)$ – flow orientation in space (time): where from (the

source, flow generator), where to (sink point, consumer), the speed (v) the SFC moves. Then the flow is (formula 2):

$$\overline{P} = P_0 \cdot \overline{P}_0(t, z) \quad (2),$$

where t is time, z – space coordinate.

Equation 2 is an elementary flow representation. Each flow of useful resources has its own elementary representation. In general, the existence of other flows is a necessary condition for any kind of flow formation. For example, for normal functioning of the material flow, financial, information and other constituents are necessary. In that way, each type of flow in the logistic system has a number of vector constituents that ensure its formation and movement.

In this case, the equation for the flow is the following (formula 3):

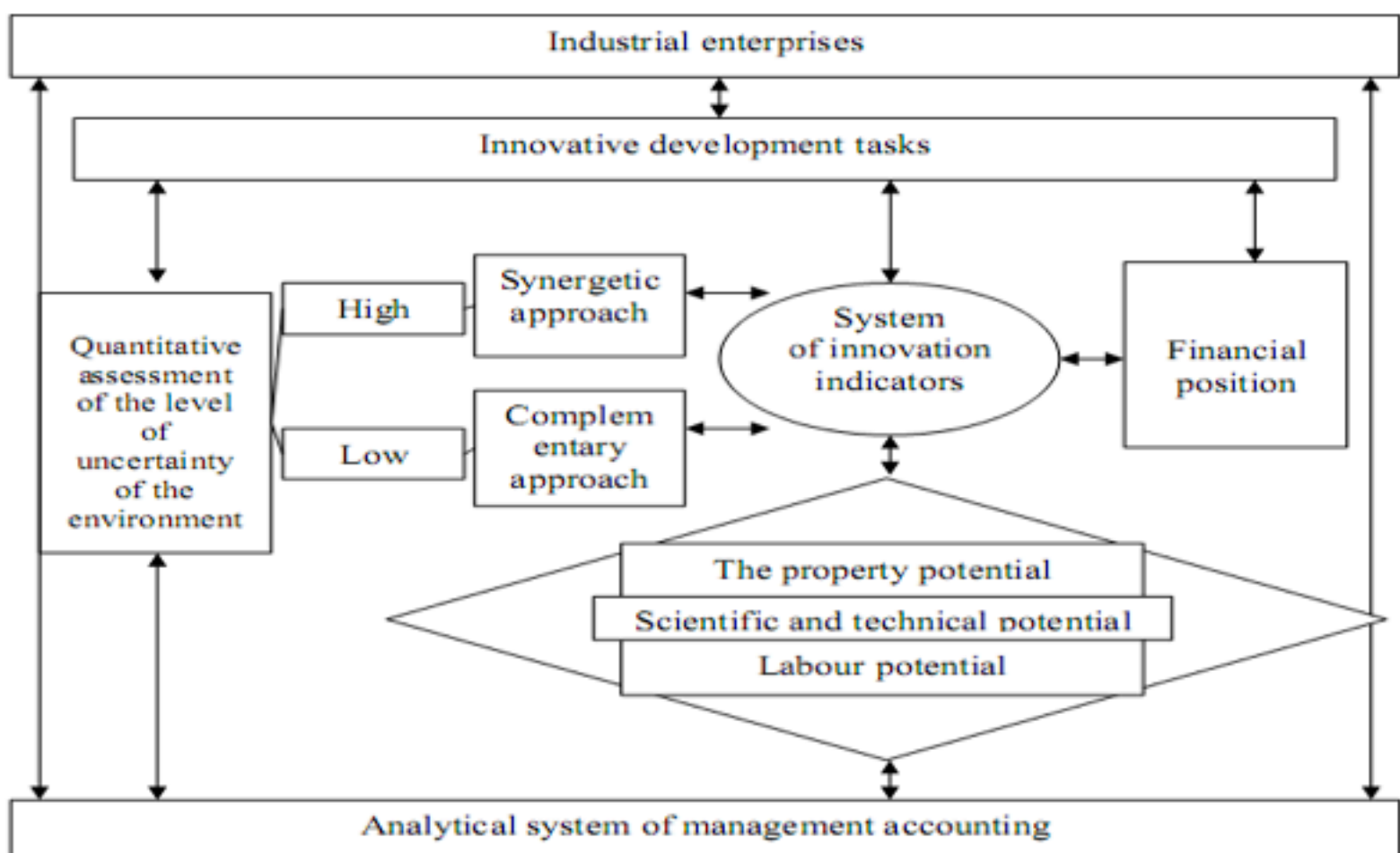
$$\overline{P} = P_0 \cdot \sum_{i=1}^N \overline{P}_{0i}(t, z) \quad (3),$$

where N – the number of vector constituents, concurrent and supporting flows. If we examine the flow without its transfer in space (space variable z does not exist), then it moves to the stock: $P_0(t)$. As a rule, at the absence of movement in space, the stock most often changes in time (its quality, cost, volume and so on.).

Each kind of useful resources flow is correlated with a certain form of stock. In general, stock and SFC are not the same things – SFC is formed from stock, and stock is one of the forms of SFC existence. Thus, there is a close correlation between the stock quantity and SFC parameter:

Figure 1

The structure of monitoring industrial enterprise innovative activity



The equation, describing the labor resources flow is the following: $\overline{W}_i = f(W_{0i}, \overline{W}_{0i}, \overline{I}_i, \overline{F}_i)$. Then the dependence of labor force flow on its main components can be represented in the following way (formula 12):

$$\begin{aligned} \overline{W}_i &= W_{0i}(\overline{W}_{0i} + \overline{F}_i + \overline{I}_i) = W_{0i} \cdot \overline{W}_{0i} + \\ &+ W_{0i} \cdot F_{0i} \cdot \overline{F}_{0i} + W_{0i} \cdot I_{0i} \cdot \overline{I}_{0i} = \\ &= W_{0i} \cdot \overline{W}_{0i} + F_{W0i} \cdot \overline{F}_{0i} + I_{W0i} \cdot \overline{I}_{0i} = \\ &= W_{0i} \cdot \overline{W}_{0i} + \overline{W}_{qi} \end{aligned} \quad (12),$$

where F_{W0i} – financial costs; I_{W0i} – information about labor force; \overline{W}_{qi} – total costs (formula 13):

$$\overline{W}_{qi} = F_{W0i} \cdot \overline{F}_{0i} + I_{W0i} \cdot \overline{I}_{0i}. \quad (13).$$

In general, service flow can be represented as following: $\overline{U}_i = f(U_{0i}, \overline{U}_{0i}, \overline{F}_i, \overline{I}_i, \overline{W}_i)$. Then the dependence of service flow on its main components can be represented like this (formula 14):

$$\begin{aligned} \overline{U}_i &= U_{0i}(\overline{U}_{0i} + \overline{F}_i + \overline{I}_i + \overline{W}_i) = U_{0i} \cdot \overline{U}_{0i} + \\ &+ U_{0i} \cdot F_{0i} \cdot \overline{F}_{0i} + U_{0i} \cdot I_{0i} \cdot \overline{I}_{0i} + U_{0i} \cdot W_{0i} \cdot \overline{W}_{0i} = \\ &= U_{0i} \cdot \overline{U}_{0i} + F_{U0i} \cdot \overline{F}_{0i} + I_{U0i} \cdot \overline{I}_{0i} + W_{U0i} \cdot \overline{W}_{0i} = \\ &= U_{0i} \cdot \overline{U}_{0i} + \overline{U}_{qi} \end{aligned} \quad (14),$$

where F_{U0i} – financial costs; I_{U0i} – information about services; W_{U0i} – necessary labor force; \overline{U}_{qi} – total costs (formula 15):

$$\overline{U}_{qi} = F_{U0i} \cdot \overline{F}_{0i} + I_{U0i} \cdot \overline{I}_{0i} + W_{U0i} \cdot \overline{W}_{0i}. \quad (15).$$

On the basis of the above-offered classification, there is a correlation between different kinds of flows in the logistics system. The property potential is defined as a sum of material, financial and informational flow vectors. The estimation of scientific and technical potential is based on sum of financial and informational flow vectors. To estimate the labor potential it is necessary to sum the vectors of labor force flow and financial flow. As a result, the lower the sum is, the lower the environment uncertainty of an enterprise is.

In such way, the forming of innovative attraction of an industrial enterprise is based on the additive algorithm, which includes labor force flow (specialists, who develop and implement the innovation into the manufacturing process), financial flow (monetary security of developing innovation and its implementation), material flow (the changing of material flow structure influenced by the innovation), informational flow (where to and for what purpose is the innovation implemented). After that a thorough analysis of the structure of flows is needed for revealing supporting flows and combined cost optimization.

For property, scientific and technical and labor potentials assessment in low or medium uncertainty conditions the use of integrated index of innovative activity at industrial enterprise is offered, which is calculated based on a complex of group functional indices. Each of group indices has a different number of unit indices, which are taken and calculated from different sources and estimated in fractions, per cent or do not have measurement at all.

The indices are calculated by norm setting (information on each index is depicted on the interval [0;1]). We suggest using the following function here

$$y_N = \frac{y_i}{\sqrt{y_1^2 + y_2^2 + \dots + y_n^2}} \quad (16),$$

where y_i – a unit index of industrial enterprise innovative activity.

Group indices are estimated by calculating the function φ_i , that reflects the level of innovative activity development in a certain area:

$$\varphi_i = \sum_{j=1}^m s_j y_{ij}; \quad \sum_{j=1}^m s_j = 1 \quad (17),$$

where y_{ij} – the i-index of j-constituent of innovative activity; s_j – the rating of index i; m – the number of indices in this constituent of innovative activity.

Integrated index of development of enterprise innovative activity is calculated by sum of all group indices:

$$\varphi = \sum_{i=1}^l r_i \varphi_i; \quad \sum_{i=1}^l r_i = 1 \quad (18),$$

where r_i – the rating of the i-group of indicators, l – the number of groups of innovative activity indices. (Iurieva et al., 2014).

1) stock reflects the result of SFC changing and accumulation (formula 4):

$$\bar{P} = P_0 \cdot \sum_{t=1}^N \bar{P}_{0i}(t, z) |_{z=0} = P_0 \cdot \sum_{t=1}^N \bar{P}_{0i}(t) = P_0 \cdot \bar{P}_0(t) = P_0(t) \quad (4)$$

where N – the number of concurrent vector components, and since there is no movement, then $N = 1$; $\bar{P}_0(t)$ – a parameter, characterizing the changing of stock in time.

2) SFC characterizes the process of stock changing (formula 5):

$$P_0 = \frac{dP_0(t)}{dt} \quad (5)$$

In this case, we suggest examining the following flows: \bar{M} – material flow; \bar{F} – financial flow; \bar{I} – informational flow; \bar{W} – labor force flow; \bar{U} – service flow.

In case of existence of several flows in the system, speculation is held on i -flow.

For successful solution of the tasks of flow processes optimization, exact assessment of scalar and vector constituents of the flow is necessary.

In general, the material flow may be represented like this: $\bar{M}_i = f(\bar{M}_{0i}, \bar{M}_{qi}, \bar{I}_i, \bar{F}_i, \bar{W}_i)$.

The study of material flows serves as a basis for optimization of technological processes of manufacture, inventory and logistics management, transportation and product distribution, workflow rationalization, production premises, warehouses and service room design, highly effective communicative infrastructure and management organizational structures creation. If we consider the material flow separately from its main components, then we have the following (formula 6):

$$\begin{aligned} \bar{M}_i &= M_{0i}(\bar{M}_{0i} + \bar{F}_i + \bar{I}_i + \bar{W}_i) = \\ &= M_{0i} \cdot \bar{M}_{0i} + M_{0i} \cdot \bar{F}_i + M_{0i} \cdot \bar{I}_i + M_{0i} \cdot \bar{W}_i = \\ &= M_{0i} \cdot \bar{M}_{0i} + F_{M0i} \cdot \bar{F}_i + I_{M0i} \cdot \bar{I}_i + \\ &+ W_{M0i} \cdot \bar{W}_i = M_{0i} \cdot \bar{M}_{0i} + \bar{M}_{qi} \end{aligned} \quad (6)$$

where F_{M0i} – financial costs; I_{M0i} – costs on gaining information about the goods; W_{M0i} – labor costs (for example, on salary); \bar{M}_{qi} – the vector of general costs on material flow formation (formula 7):

$$\bar{M}_{qi} = F_{M0i} \cdot \bar{F}_i + I_{M0i} \cdot \bar{I}_i + W_{M0i} \cdot \bar{W}_i \quad (7)$$

In general, the financial flow can be represented like this: $\bar{F}_i = f(\bar{F}_{0i}, \bar{F}_{qi}, \bar{I}_i, \bar{W}_i)$. Then the dependence of financial flow on its components is represented like this (formula 8):

$$\begin{aligned} \bar{F}_i &= F_{0i}(\bar{F}_{0i} + \bar{I}_i + \bar{W}_i) = F_{0i} \cdot \bar{F}_{0i} + \\ &+ F_{0i} \cdot \bar{I}_i + F_{0i} \cdot \bar{W}_i = \\ &= F_{0i} \cdot \bar{F}_{0i} + I_{F0i} \cdot \bar{I}_i + W_{F0i} \cdot \bar{W}_i = \\ &= F_{0i} \cdot \bar{F}_{0i} + \bar{F}_{qi} \end{aligned} \quad (8)$$

where I_{F0i} – costs on information about finance; W_{F0i} – costs on labor force required; \bar{F}_{qi} – the vector of general expenses on financial flow (formula 9):

$$\bar{F}_{qi} = I_{F0i} \cdot \bar{I}_i + W_{F0i} \cdot \bar{W}_i \quad (9)$$

In general, the informational flow can be represented like this: $\bar{I}_i = f(\bar{I}_{0i}, \bar{I}_{qi}, \bar{F}_i, \bar{W}_i)$. Then the dependence of informational flow on its components is the following (formula 10):

$$\begin{aligned} \bar{I}_i &= I_{0i}(\bar{I}_{0i} + \bar{F}_i + \bar{W}_i) = I_{0i} \cdot \bar{I}_{0i} + \\ &+ I_{0i} \cdot \bar{F}_i + I_{0i} \cdot \bar{W}_i = \\ &= I_{0i} \cdot \bar{I}_{0i} + F_{I0i} \cdot \bar{F}_i + W_{I0i} \cdot \bar{W}_i = \\ &= I_{0i} \cdot \bar{I}_{0i} + \bar{I}_{qi} \end{aligned} \quad (10)$$

where F_{I0i} – financial costs on information administration; W_{I0i} – labor force required; \bar{I}_{qi} – gross expenses (formula 11):

$$\bar{I}_{qi} = F_{I0i} \cdot \bar{F}_i + W_{I0i} \cdot \bar{W}_i \quad (11)$$

3. Analysis Results

The analysis has shown that the enterprises under inquiry function in high-level uncertainty conditions due to intensive competition, unstable levels of sales and profit (table 1).

The analysis of the above-mentioned enterprises shows abrupt fluctuations of the index of effectiveness for industrial enterprises, calculated from Formula 1. This fact defines the necessity to use synergetic approach to the innovative activity management for the examined enterprises.

We use logistic algorithm that allows decreasing the industrial enterprise uncertainty level as a result of useful resources flows optimization.

The interconnection between the flows of useful resources in micro-logistics system of an industrial enterprise is shown in Figure 2.

On the basis of the algorithm offered, we make analysis of the useful resources flows structure of the PSC «Chelyabinsk Metallurgical Plant» (PSC «ChMK») with the aim of

revealing supporting flows and optimization of total costs of their logistic operation.

PSC «CMK» is one of the biggest iron-and-steel works in Russia, which produces fine and extra-fine steel. The enterprise manufactures wide range of metallurgical products: cold pig iron, steel semi-finished products for further conversion, rolled steel and bar sections produced out of carbon steel, constructional steel, tool steel, corrosion-resistant steel, shaped steel-rolled stock and rail production. PSC «ChMK» is an industrial enterprise being a part of a leading Russian mining and metallurgical company «Mechel».

Table 1
Degree of uncertainty of industrial enterprises environment, %

No.	Name of the Enterprise	Period			
		2012	2013	2014	2015
1	PSC «Beriev Taganrog Aviation Scientific technical Complex»	-16,55	-9,84	11,70	-18,01
2	OJSC «SEGP»	7,27	2,15	5,71	-3,05
3	JSC «Research and Production Corporation «UralVagonZavod»	0,71	-8,81	-5,83	-5,27
4	PSC «VSMPO-AVISMA Corporation»	9,90	0,24	-6,37	17,43
5	JSC «Proletarsky Zavod»	-3,24	-0,02	0,16	-14,46
6	JSC «Kurskmedsteklo»	-18,79	-5,00	-2,04	15,92
7	PSC «KAMAZ»	3,61	-1,88	-1,96	-2,37
8	OJSC «Polymer»	-0,04	4,03	-3,04	7,68
9	JSC «Lomo»	-0,05	0,24	2,38	-5,25
10	OJSC «Kaluga turbine plant»	-4,11	5,04	8,32	6,92
11	OJSC «Zvezda»	0,04	0,69	6,02	-22,08
12	JSK «Kuibishevazot»	-12,60	-0,13	-2,26	7,74
...
34	PSC «ChMK»	-0,22	-8,61	6,86	4,96
35	PSC «Chimprom»	29,62	-2,54	-0,62	3,41

In the framework of this article we shall consider a fragment of optimization mechanism of the flow processes at the PSC «ChMK» at the purchasing stage, where the material flow is the main flow of useful resources.

In the given circumstances of supply logistics functioning at the industrial enterprise, the task of considerable incoming and outgoing flows management development becomes one of the most important directions of its efficiency improvement. Based on the data obtained from the analysis of the purchasing process, the mechanism of material flows optimization has been recommended, on the ground of their grouping and improving the material asset (inventory) management.

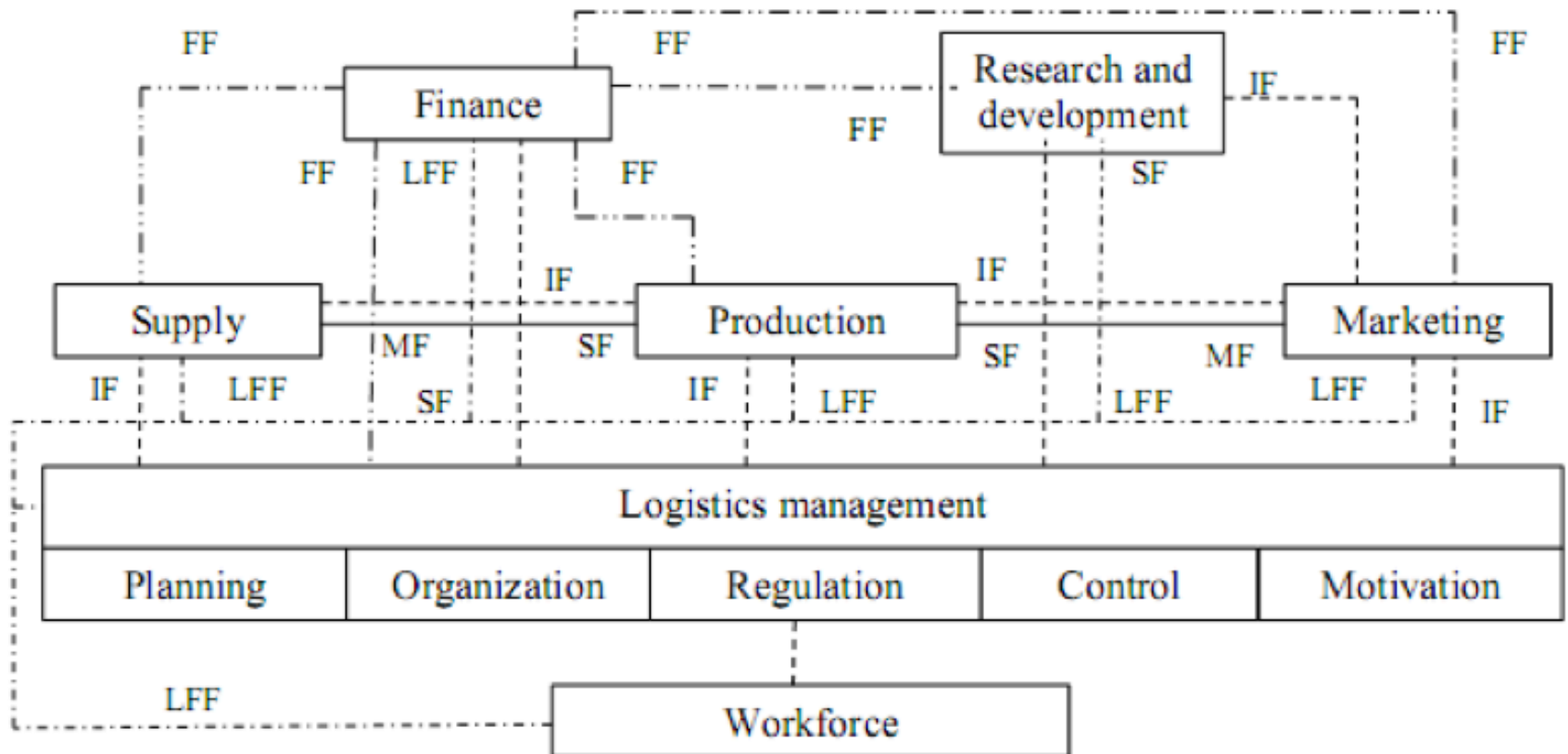
The basic amount of incoming material flows at the stage of purchasing at the PSC «ChMK» was about 5000 (according to the assortment list of purchased stock of materials (inventory)), this means, that the incoming material flow can be represented in the following way:

$$\overline{M}_{\text{in}} = \sum_{i=1}^{5000} \overline{M}_i \quad (19),$$

where i – components of the incoming material flow.

Figure 2

Useful Resources Flows in the Micro-logistics System of an Industrial Enterprise



MF –material flow, FF – financial flow, IF – information flow, LFF – labor force flow, SF – service flow

The initial stage of the research resides in the analysis of incoming material flows in accordance with stock items, given by the enterprise supply service, taking into account their value, based on the ABC-analysis. As a result, incoming material flows were divided into 25 quasihomogeneous flows, 7 of them belong to the A-group, 5 – to the B-group and 13- to the C-group of the ABC-analysis, i.e.:

$$\overline{M}_{\text{in}} = \sum_{j=1}^7 \sum_i \overline{M}_i + \sum_{n=1}^5 \sum_i \overline{M}_i + \sum_{k=1}^{13} \sum_i \overline{M}_i \quad (20),$$

where i – the number of flows in a group; j, n, k – the number of flow grouped A, B and C due to the ABC-analysis. Thus, after the grouping the following flows can be presented (Table 2)

Table 2
Analysis of the Incoming Flows at the PSC «ChMK» as of 01.01.2015

No.	Name of stock	Overall value as of 01.01.2015, RUB thousand	Share in the overall value	Share in the accrual-based value	Name of group
1	ALLOY-FREE SCRAP	2 481 140	0,277	0,277	A
2	PELLETS	1 096 393	0,123	0,400	A
3	OTHER MATERIALS	1 073 593	0,120	0,520	A

4	RECYCLED SCRAP AND IRON-AND-STEEL WASTE	976 722	0,109	0,629	A
5	FERRO-ALLOY	811 899	0,091	0,720	A
6	SPARE PARTS	614 828	0,069	0,788	A
7	INTEGRAL IMPLEMENTS IN USE	392 845	0,044	0,832	A
8	MATERIALS IN TRANSIT	346 440	0,039	0,871	B
9	FIREBRICKS	252 567	0,028	0,899	B
10	SINTERING ORE	197 612	0,022	0,921	B
11	STAINLESS SCRAP B26	144 136	0,016	0,938	B
12	FUEL	128 577	0,014	0,952	B
13	MATERIALS TO CONVERSION	94 819	0,011	0,962	C
14	ELECTRODES	82 819	0,009	0,972	C
15	INTEGRAL IMPLEMENTS AT STOCK	79 609	0,009	0,981	C
16	OTHER RAW MATERIALS	73 444	0,008	0,989	C
17	EQUIPMENT	23 952	0,003	0,992	C
18	ALLOYED SCRAP	18 994	0,002	0,994	C
19	CHARGE MATERIALS (SLAG)	12 111	0,001	0,995	C
20	NON-FERROUS SCRAP	11 913	0,001	0,996	C
21	WORKWEAR AT STOCK	11 796	0,001	0,998	C
22	TIMBER AND CONSTRUCTION MATERIALS	10 297	0,001	0,999	C
23	WORKWEAR AND FOOTWEAR IN USE	7 704	0,001	1,000	C
24	PACKING MATERIALS	1 871	0,000	1,000	C
25	SLAG MUCK	1 287	0,000	1,000	C

The next stage aims at optimizing the incoming flow movement based on cutting management costs on the C-group material flow stocks.

Subsequently, the duration of C-group stock rotation is analyzed. The comparison of the results with the limits (regulations) of the rotation indices, specified at the PSC «ChMK» is

demonstrated in Table 3.

Table 3
Comparison of Actual and Standard Stock Rotation

Name of Stock	Actual Rotation (days)	Standard Rotation (days)	Standard Rotation Deviation (days)
MATERIALS TO CONVERSION	16	30	-14
ELECTRODES	64	20	44
INTEGRAL IMPLEMENTS AT STOCK	21	30	-9
OTHER RAW MATERIALS	9	20	-11
EQUIPMENT	139	150	-11
ALLOYED SCRAP	25	30	-5
CHARGE MATERIALS (SLAG)	4	20	-16
NON-FERROUS SCRAP	117	30	87
WORKWEAR AT STOCK	63	90	-27
TIMBER AND CONSTRUCTION MATERIALS	13	30	-17
WORKWEAR AND FOOTWEAR IN USE	48	60	-12
PACKING MATERIALS	144	150	-6

According to the data in the table, duration of stock rotation (in days) of two items: electrodes and non-ferrous scrap, exceeds the set limits and is 64 and 117 days respectively.

Study of stock movements of two selected positions of materials, i.e. "electrodes" and "non-ferrous scrap" as of the end of each month in 2014 and their writing-off (sending) from inventory to production during these months shows unevenness of the material flow movement. Every month there is a 3-4-month supply of non-ferrous scrap and a 2-month supply of electrodes in stock.

Now let us calculate total average monthly cost of inventory availability and writing off stocks of non-ferrous scrap and electrodes, which are available in stock and sent to production. For the calculations we take value of average prices per year and average stock availability (Table 4).

Table 4
Calculation of Total Average Monthly Cost of Availability and Writing off Non-ferrous Scrap and Electrode Stock

	Average	Average Stock Availability as of the End of a Month in 2014	Average Stock Discharge into Production per a

Kind of material	Price for 2014	Month in 2014			
		Ton	Total cost (RUB thousand)	Ton	Total cost (RUB thousand)
NON-FERROUS SCRAP	93,07	128	11 913	33	3 071
ELECTRODES	140,37	590	82 819	279	39 163
IN TOTAL			94 732		42 234

The results of our research demonstrate, that discharge of these two positions to production totally is equal to 42 234 RUB thousand in average, while there are stocks at the enterprise warehouses for 94 732 RUB thousand, which indicates a 2-month stock availability (provided, there will be no additional purchase of these materials).

Consequently, we suggest stock decreasing (in these two positions) to the level of monthly rate (as purchasing is done each month, transportation costs will not increase anyway).

In future the enterprise should purchase these materials (non-ferrous scrap and electrodes) according to new established requirement (standard) – in the amount of monthly rate – 33 and 279 ton accordingly with a small reserve (10%) in case of supply disruption (risks are rather low, because the suppliers are reliable according to preliminary estimates).

Thus, monthly procurement established requirement (standard) is equal to the following:

$33 \cdot 1,1 = 36$ tonnes of non-ferrous scrap and

$279 \cdot 1,1 = 307$ tonnes of electrodes.

Taking into consideration a 2% - price increase for these materials in 2015, their value is equal to:

$93,07 \cdot 1,02 = 94,93$ RUB thousand for one ton of non-ferrous scrap

$140,37 \cdot 1,02 = 143,18$ RUB thousand for one ton of electrodes.

Let us consider how the rotation indices (the length of rotation) of these materials will change (Table 5).

Table 5
Duration of Material Rotation if Purchased in the Suggested Amount

Name of Stock	Balance on 01.01.15		Placing in Property at Stock		Inventory Discharge		Balance on 01.02.15		Rotation
	tonnes	RUB thousand	tonnes	RUB thousand	tonnes	RUB thousand	tonnes	RUB thousand	days
ELECTRODES	0	0	307	43 956	279	39 947	28	4 009	3
NON-FERROUS SCRAP	0	0	36	3 417	33	3 133	3	28	3

Thus, the duration of these materials rotation is 3 days, it means that we have managed to decrease it for 61 and 114 days correspondingly.

Consequently, the use of logistics algorithm of flow processes managed to decrease the scalar component of the material flow vector of an enterprise at the purchasing stage, and therefore to decrease the property potential rate, which is one of the components

characterizing an industrial enterprise innovative attraction. As a result of our calculations the environment uncertainty level at the industrial enterprise has decreased and in this way, additional opportunities for its innovative development have emerged.

4. Conclusions

The results of the calculations made in accordance with the author's algorithm demonstrate, that environment uncertainty level at industrial enterprises in Russia is rather high, and consequently, synergetic approach to innovation activity management at such enterprises is necessary. For decreasing environment uncertainty level, the logistic algorithm of flow processes is proposed.

Such algorithm ensures optimization of technology, inventory and logistics management, product transportation and distribution, workflow rationalization, production premises, warehouses and service rooms design, highly effective communicative infrastructure and management organizational structures creation by means of decreasing total costs on logistics management of industrial enterprises innovative activity.

In our research, the example of optimization of flow processes at the stage of purchasing at the PSC «CHMK» has been demonstrated. Finally, we have conducted the detailed analysis of incoming and outgoing flows of purchasing logistics and have carried out the sequence of decreasing logistic costs on the management of material flow at the stage of enterprise supplying with material assets (inventory).

The demonstrated decrease of costs has made a positive impact on the property potential index at the PSC «ChMK», allowing to implement additional opportunities of innovative development.

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