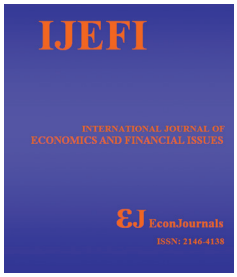

International Journal of Economics and Financial Issues

ISSN: 2146-4138

available at http: www.econjournals.com

International Journal of Economics and Financial Issues, 2015, 5(4), 1011-1016.

Methodological Tools for Risk Assessment in Industrial Enterprises

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ABSTRACT

This article deals with methodological propositions for risk assessment in industrial enterprises on the basis of the theory of statistical modeling and planning from ultimate goals with account to optimal use of limited productive resources; instruments for grouping simple and complex risks according to their probability. Existing processes of economic instability stipulated some topical problems. Construction of the system of management of an economic entity that provides stable dynamics of its development depends on how we solve the problems. Problems of creating an effective system of economic-organizing measures to reduce negative impact of risk factors on their effectiveness are important for stable functioning of industrial enterprises. We can single out several causes of risk situations: Impossibility to get exact knowledge about future, lack of information about the environment conditions, uncertainty of financial and economic activities, etc. Moreover industrial production has its specific features that require people making management decisions to do a thorough analysis of risks. These risks make an impact on functioning of economic agents to the utmost degree. It is important to be able to single out and systematize objective and subjective; external and internal; manageable and unmanageable; simple and complex risks and to provide objective and reliable appraisal of them in order. It should be done in order to reduce negative impact of uncertainty in market environment on conditions and results of implementation of economic processes. We should also remember that risks can cross each other, superimpose on one another or develop separately.

Keywords: Industry, Risk, Methods, Assessment, Expert Method, Complex Risks, Simple Risks, Statistical Modeling
JEL Classifications: C13, D81, L51

1. INTRODUCTION

Existing processes of financial destabilization and current political changes determine the necessity to create an economic mechanism that ensures well-balanced and stable development of both national economy (as a whole) and economic sectors as economy's constituent parts. Decrease in efficiency of traditional anti-crisis measures stipulate objective necessity of creating new approaches to risks study. These approaches favor creating a system of economic-organizing measures to decrease negative impact of uncertainty factors on results of manufacturing output. It is important to choose the strategy for risks management together with system approach to a problem analysis. Fundamental analysis of the problem suggests identification of risk's sources, assessment of the degree of risk's effect, substantiation of ways and methods of adaptation to risk factors and uncertainty factors.

Native and foreign scholars' transactions deal with decision making problems in the context of risks. Such scholars as Al'gin (2001), Bakanov et al. (2005), Granaturov (2009), Kachalov (2002), Raizberg et al. (2013), Tepman (2002), Khokhlov (2001), Chernova (2000), Fomichev (2011), etc. made a significant contribution to development of these questions. It is possible

to note transactions of foreign scholars such as Ayyub (2014), Coleman (2011), Hopkin (2014), Pritchard (2014), etc.

However, some applied aspects of methodological, methodical and practical kind and creation of efficient measures for risk management in industrial enterprises are debatable and little-investigated from the point of the risk theory. Thus, methodical approaches to identification and systematization of various types of risks in industry are not enough developed yet. Problem of how to improve instruments for qualitative and quantitative assessment of risks is important. These circumstances stipulated timeliness of scientific and practical realization of tasks set in this research.

It is necessary to point out that there is no unanimous interpretation of the economic category "risk" in scientific literature. Research of the interpretations of the essence of risk carried out by the authors testifies to the fact that it is illegitimate to analyze the meaning of the risk from the point of negative consequences, losses, dangers and failures (Raizberg et al., 2013; Chernova, 2000; Khokhlov, 2001) or on the basis of possible successful results (Kachalov, 2002; Kulagovskaya, 2007) that can emerge in the process of realization of a chosen alternative. Identification of risk with uncertainty (Pindaik and Rubenfeld, 2001) is questionable too as uncertainty is the feature of the environment where the economic player functions and it just stipulates the emergence of risk situations.

At the same time situation must be interpreted as a set of various conditions and circumstances that create certain setting for a certain type of activity. This setting may either favor or impede realization of the action. Risk situations take special place among various types of situations. If there's a chance to get qualitative and quantitative assessment of probability of this or that scenario that will actually be a risk situation. Seeking to "solve" a risk situation the entity chooses a management decision and tries to implement it. This process is interpreted in the notion of risk that exists both at the stage of searching grounds for a decision and at the stage of decision implementation (Granaturov, 2009).

As a result definition of risk by means of the notion of purpose (Al'gin, 2001; Khozyaistvennyi risk i metody ego izmereniya, 1979; Ter-Grigor'yants, 2006) is most full. And it helps to interpret risk not from the point of process or activity but as a category that defines quality of management decisions made.

There is no doubt that in flexible and rapidly changing market environment economic entity management system must be based on flexible decisions. From our point of view, each definition of risk has right to exist, yet all definitions do not take into account diversity of management in industry, its complexity, its specific character and universality that makes the borders of possible management activity narrow.

Consequently it is possible to give the following definition of risk with regard to industrial production: Risk is a generalized feature of the situation in the context of uncertainty when cause-effect result does not allow to make an unambiguous management decision on how to achieve a desired goal.

It is necessary to point out that methods of risk management envisage following steps: Identification of risk situations; emphasis on risks and their acceptance; risks assessment; analysis of the situation; analysis of the past situations; drawing up strategic and tactical plans; choice of the control action for a risk situation; regular monitoring and control of risks and their consequences.

Efficiency of measures aimed at decreasing negative impact of risks on conditions and results of functioning of industrial enterprises depends mostly on completeness, objectivity and credibility of economic risks assessment.

2. MATERIALS AND METHODS

Generalizations of scientific literature made by the authors and practical experience testify to the fact that purposes of risk analysis in industry and possibility to get necessary information as well as expenditures of time, financial and other resources acceptable for this research can differ dramatically. Existing approaches, specific methods and forms of presenting information are different. Along with it the risk level in manufacturing output as a complex notion is characterized by the set of criteria and indices that stipulates necessity of their grouping and systematization.

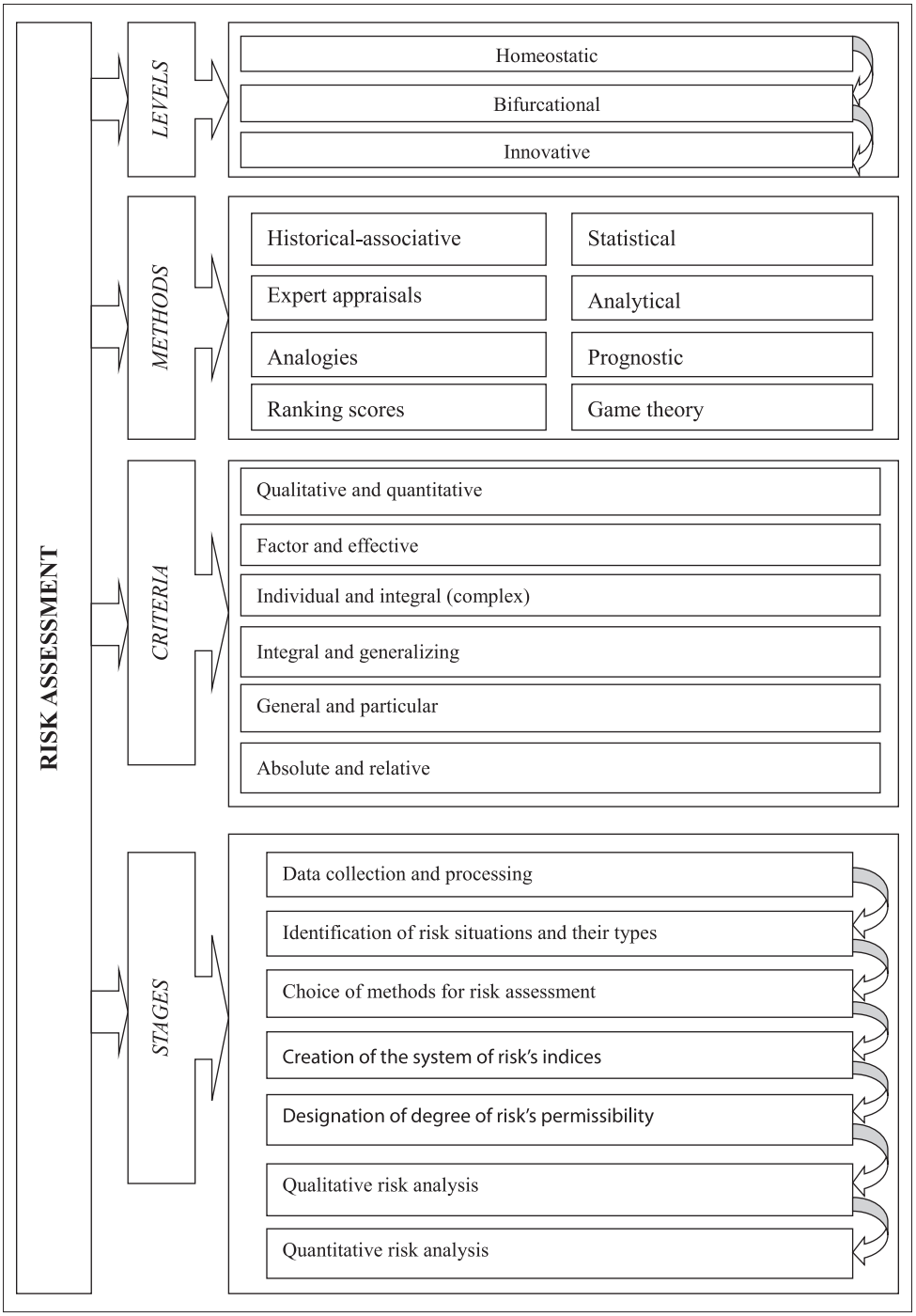
Each current method of risk assessment has its own field of use and its own procedures (Figure 1).

All methods of risk assessment can be divided into two groups: Qualitative and quantitative (Tepman, 2002). Qualitative assessment can be quite simple and its major tasks are to identify possible types of risk and to emphasize internal and external factors that make an impact on the risk level while carrying out certain activity. It is logical to start the analysis of factors, reasons or sources of risks with making their list and verbal description (of their features). We find it important to point out that it is necessary to sort out simple and complex risks, estimate chance of their emergence and analyze the degree of their impact on achieving set goals. In addition to it complex risks consist of the set of types that characterize them while simple risks characterize a certain type of risk that cannot be divided into subtypes.

In scientific literature devoted to problems of risk various approaches to identification of criteria and indices of its qualitative assessment are observed. We can rarely make a real choice of management decisions based on criterion of absolute preference. In most cases we have to use approaches and methods where expected result and risk are possible to calculate. And it is the situation that presents most scientific and practical interest.

At the same time it is necessary to take into account, first, all possible consequences of a management decision, secondly, probability of their emergence in order to get objective qualitative risk assessments irrespective of applied measuring. Thereupon speak of two basic characteristics of risk: Probability and gravity. In general, gravity of risk is a value of possible deviation from a

Figure 1: The general provisions of risk assessment in industrial enterprises



goal set by a person making decision in connection with emergence of risk situation. With regard to manufacturing output the gravity of risk is identified with negative economic consequences to which a decision can lead. Undoubtedly risk is a probabilistic category, and in this sense there are good reasons to characterize and consider risk as a probability of a certain feature value.

As a result we find it possible to use mechanism of identifying characteristics of integral assessments of simple and complex risks based on statistical, analytical and expert methods of risk assessment as exemplified by large and medium industrial enterprises in Stavropol territory.

Analysis of possibility of risk situations in activity of 17 industrial enterprises in Stavropol territory allowed us to make a list of most probable complex risks in functioning of industrial enterprises:

- Risks of lack of need for products;
- Risks of non-fulfillment of contractual obligations;
- Risks of increased competition and changing market conditions;
- Risks of unforeseen expenses and loss of revenue;
- Risks of late delivery of raw materials by suppliers;
- Risks of loss of financial benefit;
- Risks of losses connected with the certification system;
- Risks of losses connected with the system of standards.

Within the scope of the groups of complex risks mentioned above we can sort out simple risks in activity of industrial enterprises in the region. We used following indices in order to get quantitative indicators of risk assessment (Proizvodstvennyi menedzhment, 2000):

$$W_i = W_k \cdot \frac{(k-i)\cdot f + i - 1}{k-1} \quad (1)$$

$$\sum_{i=1}^{k} W_i = 1 \quad (2)$$

$$f = \frac{W_1}{W_k} \quad (3)$$

$$W_k = \frac{2}{k(f+1)} \quad (4)$$

Let W_i denotes weight number of risk by priority groups $i = 1, 2,\ldots, k$;

k – Amount of priority groups if risks are divided according to degree of their importance;

f – Factor of priority ratio;

W_k – Weight number of the lowest priority group.

After calculation of the following rates we identified weight numbers of simple risks within the scope of each complex risk:

$$W_i^0 = \frac{W_i \cdot M_i}{\bar{M}} \quad (5)$$

Let W_i^0 denotes weight number of i^{th} priority group after adjustment for number of simple risks in a certain group of complex risks;

M_i – Amount of simple risks in each priority group of complex risks;

$\bar{M}$ – Average number of risks by groups.

We adjusted obtained results (weight numbers of priorities) in connection with miscalculation using the following formula:

$$W_i^1 = W_i^0 : \sum_{i=1}^{k} W_i^0 \quad (6)$$

Let W_i^1 denotes weight number of i^{th} priority group after adjustment.

We calculated integral assessment of each complex risk (R) using the following formula:

$$R = \sum_{i=1}^{n} W_i \cdot V_i \quad (7)$$

Let V_i denotes average probability of a simple risk.

3. RESULTS AND DISCUSSION

Methodological tools for risk assessment were implemented with the use of systematic approach that assumes identifying sources of a risk, assessment of the degree of risk's effect, substantiation of ways and methods of adaptation to risk factors and uncertainty factors. In the course of the research we formed a set of complex risks for functioning of industrial enterprises. Within the scope of complex risks we sorted out simple risks, identified their weight numbers, priorities and probability. Results of risk assessment in industrial enterprises in Stavropol territory on the basis of offered methodological instruments are presented in Table 1.

Calculations made by the authors testify to the fact that most important risks for industrial enterprises in Stavropol territory are risks of lack of need for products while risks connected with the certification system are the least important.

Within the scope of complex risks presented by the authors simple risks were sorted out. Moreover weight numbers of simple risks, priorities and probability were identified. Expert assessment of probability of each simple risk comprising certain complex risks has specific significance in the process of qualitative and quantitative risk analysis.

In the process of the research experts representing bodies of state power, business and scientific community were invited to create a map of simple and complex risks that shows probability of risks. In the course of expert risk appraisal the following risk probability assessment system was used (by %):

- 0 – Risk is considered as insignificant;
- 25 – Risk is unlikely to emerge;
- 50 – Nothing particular can be said concerning a risk situation;
- 75 – Risk is likely to emerge;
- 100 – Risk is quite probable.

Along with it works made by experts were checked to verify their consistency based on the following rules:

$$\max | A_i - B_i | \leq 50 \quad (8)$$

$$\sum_{i=1}^{N} \frac{| A_i - B_i |}{N} \leq 25 \quad (9)$$

Table 1: Calculated rates of complex risks for large and medium industrial enterprises in Stavropol territory based on their revenues in 2009-2014

Risk groups	Weight number		
	W_i	W_i^0	W_i^1
Risks of lack of need for products	0.222	0.419	0.453
Risks of non-fulfillment of contractual obligations	0.195	0.331	0.185
Risks of increased competition and changing market conditions	0.167	0.122	0.112
Risks of unforeseen expenses and loss of revenue	0.139	0.148	0.126
Risks of loss of property by an enterprise	0.111	0.083	0.073
Risks of loss of financial benefit	0.071	0.039	0.033
Risks of losses connected with the certification system	0.035	0.017	0.018
Risks of losses connected with the system of standards	0.034	0.016	0.017

Table 2: Assessment of simple and complex risks in industrial enterprises in Stavropol territory based on their revenues in 2009-2014

Simple risks S_i	Priorities, P_i	Weight number, W_i	Probability, V_i	Point, W_i*V_i
Risks of lack of need for products				
Risk connected with poor organization of the production process	0.270	0.118	100.0	11.800
Risk connected with low quality of industrial products	0.225	0.106	85.0	9.010
Risk connected with incompetent staff	0.165	0.073	90.0	6.570
Risk connected with poor organization of supply of the enterprise with material resources	0.130	0.063	90.0	5.670
Risk connected with advertising of goods	0.091	0.039	50.0	1.950
Risk connected with poor organization of production distribution	0.050	0.024	60.0	1.440
Risk connected with mistakes in production management	0.038	0.017	25.0	0.425
Risk connected with amount and structure of pent-up demand	0.031	0.013	25.0	0.325
Group total		0.453		37.190
Risks of non-fulfillment of contractual obligations				
Risk of refusal of a supplier to make a treaty after negotiations	0.308	0.050	50.0	2.500
Risk of emergence of accounts receivable	0.234	0.047	25.0	1.175
Risk of emergence of accounts payable	0.187	0.037	25.0	0.925
Risk of conclusion of contracts with conditions that differ from common ones	0.162	0.033	6.7	0.220
Risk connected with irregular arrivals of goods	0.109	0.018	16.7	0.300
Group total		0.185		5.120
Risks of increased competition and changing market conditions				
Risks of emergence of new competitors	0.493	0.057	25.0	1.425
Risk connected with bad marketing policy	0.325	0.034	16.6	0.567
Risk connected with slow adoption of new technologies compared with competitors	0.182	0.021	8.3	0.175
Group total		0.112		2.167
Risks of unforeseen expenses and loss of revenue				
Risks of mistakes in purchase policy	0.419	0.052	33.3	1.733
Change in pricing policy of suppliers	0.303	0.039	36.7	1.430
Risk of loss of profits in the result of forced disruptions of production	0.194	0.025	8.3	0.208
Risk of loss of profits in the result of adoption of new forms and ways of organization of production	0.084	0.010	41.7	0.417
Group total		0.126		3.788
Risks of loss of property				
Risk of loss of property in the result of incidents	0.492	0.036	16.6	0.600
Risk of loss of property in the result of stealings	0.326	0.023	23.3	0.537
Risk of loss of property in the result of natural disasters	0.182	0.013	11.7	0.152
Group total		0.073		1.288
Risks of loss of financial benefit				
Risk of selling goods on credit	0.789	0.026	33.3	0.867
Risk of failure of an activity (insurance, hedging)	0.211	0.007	20.0	0.140
Group total		0.033		1.007
Risks of losses connected with the certification system				
Risk of selling goods that do not meet international standards of quality	0.610	0.011	11.7	0.128
Risk of selling defective goods	0.390	0.007	15.0	0.105
Group total		0.018		0.233
Risks of losses connected with the system of standards				
Risk that products do not meet required standards	1.0	0.017	20	0.340
Group total		0.017		0.340

Table 3: Grouping simple risks according to their probability

Probability of risk's emergence, %	Risk amount
0-25	17
25-50	6
50-75	1
75-100	4
Total	28

Let A_i and B_i denote assessments of each i^{th} expert pairs, $i = 1, 2,\ldots, N$.

Analysis carried out by the authors testifies to the fact that maximum disparity between assessments made by two experts for all simple risks in industrial enterprises does not exceed 25, that is it does not exceed criterion value and helps to confirm consistency of subjective judgements presented by the experts.

According to experts assessments the risk connected with the level of production distribution is most probable (100 points out of 100), while group of the least probable risks includes: Risk of conclusion of contracts with conditions that differ from common ones; risk connected with slow adoption of new technologies compared

with competitors; risk of loss of profits in the result of forced disruptions of production; risk connected with loss of property in the result of natural disasters and risks of losses cconnected with the certification system.

Results of calculations for assessment of simple and complex risks in industrial enterprises according to methodological propositions presented by the authors are in Table 2.

Simple risks are grouped according to their probability in Table 3.

It is necessary to sort out risks with the point index (W_i*V_i) close to 10 in order to identify most important simple risks in industrial enterprises in Stavropol territory. As a result we consider risk connected with poor organization of the production process (11.80 points) and risk connected with low quality of industrial products (9.01 points) as most important risks.

Research carried out by the authors testifies to the fact that among all groups of complex risks the group of risk of lack of need for products is the most important one and requires special attention as four out of eight types of simple risks that comprise it are characterized by probability level higher than 75%.

4. CONCLUSIONS

Methods of risk management suggested by the authors envisage implementation of successive research process that includes following steps: Identification of risk situations; emphasis on risks and their acceptance; risks assessment; analysis of the situation; analysis of the past situations; drawing up strategic and tactical plans; choice of the control action for a risk situation; regular monitoring and control of risks and their consequences.

The methodical approach to risk assessment in industrial enterprises developed by the authors helps to identify simple and complex risks of enterprises' functioning as well as it helps to single out most important ones. From our point of view decision of the problem of efficient risk management in industry must be based on full and reliable assessment of economic processes as it serves as a prerequisite for creation of economic-organizing areas for ensuring stable and less risky development of production process.

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