firm automobile service network; complex risk management

Irina MAKAROVA, Rifat KHABIBULLIN,
Polina BUYVOL*, Larisa MOUKHAMETDINOVA
Kazan (Volga Region) Federal University
Mira prosp. 68/19, 423810, Naberezhnye Chelny, Russian Federation
**Corresponding author*. E-mail: skyeyes@mail.ru

SYSTEM APPROACH AT RISK MANAGEMENT OF THE AUTOSERVICE ENTERPRISE

Summary. In the article methods of control over risks of the service enterprises during creation of customer-oriented firm service system are analyzed. It is shown that system approach to risk management ensures the adoption of science-based solutions, minimizes consequences of risk situations. One of ways to calculate an integrated indicator of the risk of loss of the service enterprise competitiveness is described. Variants of the risk assessment to reduce the effectiveness of service enterprises by monitoring indicators based on the results of their monitoring are given.

СИСТЕМНЫЙ ПОДХОД ПРИ УПРАВЛЕНИИ РИСКАМИ АВТОСЕРВИСНОГО ПРЕДПРИЯТИЯ

Аннотация. В статье анализируются методы управления рисками сервисных предприятий при создании клиентоориентированной системы фирменного сервиса. Показано, что системный подход к управлению рисками обеспечивает принятие научно-обоснованных решений, минимизирует последствия рисковых ситуаций. Описан один из способов расчета интегрального показателя риска потери конкурентоспособности сервисного предприятия. Приведены варианты оценки риска снижения эффективности деятельности сервисных предприятий путем контроля показателей по результатам их мониторинга.

1. INTRODUCTION

In the conditions of rising competition, development of firm service for the automobile building enterprises is the most important factor for promoting products, both on the domestic and foreign markets. As the service system in the organizational plan represents the dealer service network (DSN) consisting of a set of the dealer service centers (DSC), which operates in different conditions and differ in a number of parameters, adoption of reasonable and rational decisions is impossible on the basis of usual intuition, experience, commonsense of the manager. Analysis of cause-and-effect relationships between network subjects complicated by the large number of factors, many of which are stochastic and difficult to formalize that, in many cases, does not allow to optimize the structure and improve the efficiency of the system by traditional methods. Strategy of DSN development is connected with risks assessment, which should provide adoption of science-based decisions and minimize risks of all categories.

Functioning of any difficult system, which is exposed to influence of a lot of number of stochastic factors, inevitably leads to emergence of risk situations. Risks can be caused by the different reasons and, respectively, have various characters: financial risks, investment risks, environmental risks, etc.

Completely it isn't possible to eliminate risks in view of their probabilistic nature, however it is necessary to operate them.

2. RISK MANAGEMENT

Risk management is applied to ensuring sufficient confidence of providing achievement conditions of the enterprise strategic and operational objectives at decision-making, and also for the purpose of identification of potential events, which can affect organization activity, and maintenance of extent of their influence in the borders acceptable (established) for the organization. The risk management process includes the following steps [1]:

1. Drawing up a risk management plan – choosing methods and planning for risk management.
2. Identification of risks – selection of those risks, which can have impact on organization activity, and also definition of the list of their characteristics.
3. Qualitative assessment of risks – a qualitative analysis of risks and conditions of their emergence.
4. Quantitative assessment – a quantitative analysis of probability of emergence and assessment of influence of risk events consequences.
5. Planning of response to risks – definition of regulations and measures for leveling of negative consequences of a risk situation and use of possible advantages.
6. Risk monitoring and control - monitoring and risk assessment, finding of residual risks, evaluation of the plan of risk management and assessment of the effectiveness of measures to minimize the risks.

Risks identification provides risks definition that could affect the project and documenting their characteristics. In operations on the risks identification, if necessary, can be involved: the project manager, project team members and the team of risk management (if established), experts in certain areas that are not part of the project team, customers, end users, other project managers, project participants and experts in risk management. Though the leading role in risks identification belongs to these experts, it is necessary to encourage participation in this process of all personnel. Risk identification is an iterative process at the next stage of which the new risks can be detected [2].

Risk management, their timely identification and, whenever possible, elimination, can considerably decrease in probability of emergence of a crisis situation at the service enterprise. Thus, effective actions for risk management can be considered as "preventive" measures of emergence of crisis [3].

Risk analysis in the context of risk owners, emergence spheres, and allocation of the reasons, ways of influence, possible consequences is necessary for realization of strategy of effective management by risks of the enterprise (Fig. 1).

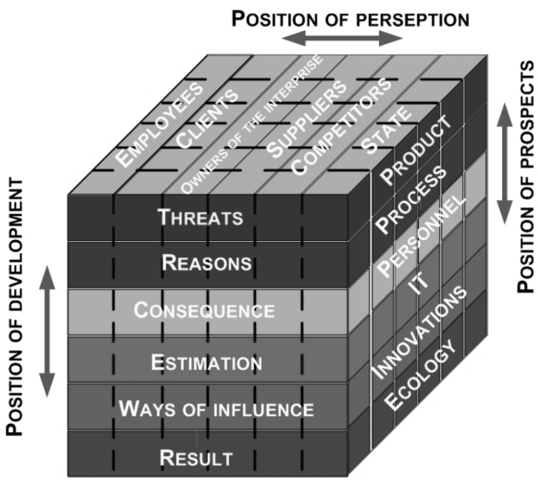

Fig. 1. Interrelation cube between components of risks management process, its participants and owners
Рис. 1. Куб взаимосвязи между компонентами процесса управления рисками, его участниками и владельцами

Table 1 shows the results of the risk analysis from the perspective of the owners of service enterprise.

Table 1

The risks from the perspective of enterprise owners

№	Risk	Reasons of a risk situation	Consequences	Ways of influences
Product				
1.	Decrease in rates of the customs duties	Entry of the country into the international trade unions, revision of customs policy of the state	Noncompetitive price of a product	Introduction of offers on the state measures directed on realization of Strategy of development of Russian Federation automotive industry for the period till 2020
2.	Increase competition	Entry into the market of new dealers and service enterprises	Decrease in competitiveness, car sales and related service	Development and implementation of the plans of measures on counteraction to competitors
3.	Reduction in car sales	Reduction of volumes of government procurements, decrease in consumer ability, discrepancy of characteristics of cars to needs of clients	Decrease in volume of services	Decrease in prime cost of a product. The study of consumer preferences. The development strategy of customer-oriented service. Development of own programs of leasing.
4.	Decrease in volume of service	Reduction of sales volumes of cars, refusal of clients of firm service in favor of not authorized in view of the high cost of services and a holding time	Idle times of equipment and workers	Continued work with customers, attract new customers. Development of evaluation systems of service quality. Optimization of management
Process				
5.	Technological (incorrect organization of technological process)	The increase in service time, growth numbers of complaints and claims to the service quality	Reduction of customer loyalty, increase in the number of lost customers	Analysis of the experience of world manufacturers that produce similar services. Analysis of satisfaction with the service quality.
6.	Errors of planning and forecasting of sales and services volumes	Increasing volatility between predicted and actual levels of sale volumes of service	Idle times or failures in service due to incorrect plan of capacity utilization	The use of IT-technologies in forecasting and planning, ABC, XYZ-analysis
7.	Growth of a share of low-quality spare parts and expendables from suppliers	Wrong choice of spare parts and consumables suppliers	The growing number of complaints and claims on the quality of spare parts and service, reduced operational reliability. Growth of cost of cars service for clients.	The introduction of mechanisms to identify and track the mass defects of spare parts from other manufacturers. Diversification and careful selection of suppliers.

Personnel				
8.	Low qualification of the personnel	Inefficient work of personnel services, problems of educational system	Release of low – quality production	Development of actions for an assessment of workers competence at employment, interaction with educational institutions
9.	High fluidity of the personnel	Lack of mechanisms of stimulation of workers, low level of a salary	Low overall performance of the personnel	Development of methods to retain personnel
10.	Low labor productivity of the personnel	Low motivation and lack of control of workers, non-optimal number of the personnel, low level of automation	High cost of services	Optimization of technological process, mechanization and automation of work, development of methods of the personnel motivation
Information technologies (IT)				
11.	Unjustified investment in introduction of innovations and information technologies	Lack of a system approach to development of innovative projects, at expertise, development and implementation of IT-solutions. Insufficient competence of developers.	Low efficiency of processes due to the use of outdated technologies and management practices at the enterprise	High-quality examination at an analysis stage of functionality of software products and selection of IT solutions, careful study of specifications and business plans at introduction of innovations.
12.	Unauthorized access and information damage	High level of information threats, the low budget on information security	Disruptions in business, financial instability of the enterprise	Measures to improve information security
Ecology				
13.	The negative impact on the environment	Non-compliance with ecological rules and norms	The negative impact on the environment, penalties from environmental services	Environmental certification of vehicles, the systematic training and development of personnel in the field of environmental protection, compliance technologies in the works and waste management

3. RISK ASSESSMENT

Risk assessment in the enterprise allows not only to reduce possible losses but also to make the relevant strategic decisions on their decrease in long-term prospect. There are different ways of the risk analysis, to some extent supplementing each other therefore using several of them, or their combination can receive rather full information [4].

Strictly speaking the risk assessment of the loss of competitiveness by the service enterprise is the complex indicator which characterize stability and development quality of the enterprise and, finally, has to have quantitative expression .One of the methods to risk assessment of the loss of competitiveness by the service enterprise can be Altman`s method which is widely applied to the risk analysis of bankruptcy in the United States [5] and comprises the following steps:

• In relation to this subject of DSN and to an interval of time there is formed the set of N-number separate indicators of the enterprise which influence its competitiveness on the basis of the preliminary analysis.

• In the N-dimensional space defined by the selected indicators, there is a hyper plane, which is based on the collected statistical data and best separates the successful enterprises from enterprises-outsiders. The equation of this hyper plane looks like:

$$Z = \sum_{(i)} \alpha_i \times K_i , \qquad (1)$$

where: K_i - levels of indicators, the α_i–-weight, received as a result of the analysis.

• Carrying out parallel transfer of the plane it is possible to observe redistributing the number of the successful and unsuccessful enterprises getting to this or that subarea cut by this plane. Respectively, it is possible to establish threshold standards of Z_1 and Z_2: at $Z<Z_1$ the risk of enterprise is high, at $Z<Z_2$ - the risk is low, with $Z_1 <Z <Z_2$ condition of the enterprise is vague.

A key limitation of this method will be the inability to account the specifics and differences of both the companies and the environment in which they operate. Uniqueness of any enterprise is that it can survive at very weak chances, and, certainly, on the contrary. Uniqueness of the enterprise causes of the careful analysis both characteristics and specifics of the enterprise, and results of its activity, the identification and the accounting of its differences. At the considered approach the statistical probability is inapplicable as it is necessary not only to calculate and predict level of critical risk, but also to identify current situation, and to define a distance separating the enterprise from a condition of critical risk.

Using of fuzzy sets allows to synchronize two scales - the scale of objective measurement and the scale of subjective assessments of these measurements [6].

Fuzzy descriptions in structure of a method of risk analysis appear in view of expert's uncertainty, which is inevitable when classifications are carried out. In the case when the expert is not able to distinguish clearly between concepts (eg, "high" and "maximum" probability), or when it is necessary to distinguish between low and middle values of the index the use of fuzzy descriptions means the following:

1. The expert builds a linguistic variable with the term-set of values. For example, the variable "Level of management" can have the term-set of values such as "Very Low, Low, Medium, High and Very High".
2. In order to constructively describe linguistic variable, the expert selects the corresponding quantitative trait - for example, a specially designed indicator of management level, which takes values from zero to one.
3. Further, the expert matches the membership function of management level to one or another fuzzy subset to each value of the linguistic variable (which, in its construction, is a fuzzy subset of the values of the interval (0,1) - the range of the indicator of management level). In this case commonly used functions are the trapezoidal membership functions (Fig. 2). The upper base of the trapezoid corresponds to the full assurance of the expert’s correctness of his classification, and bottom - confidence in the fact that no other values of the interval (0,1) do not fall in the selected fuzzy subset.

For a compact description of the trapezoidal membership function $\mu(x)$ it is convenient to describe them by the trapezoidal numbers of the form:

$$\beta(a_1, a_2, a_3, a_4), \qquad (2)$$

where: a_1 and a_4 -abscissa of the lower base, and a_2 and a_3-abscissa of the upper base of the trapezoid (Fig. 2) defining $\mu(x)$ in area of a non-zero membership of value x corresponding fuzzy subset.

According to the definition given Nedosekin A.O. [7] thus introduced Linguistical variable defined in the 01-value, together with a set of nodes is called a standard five-level 01-fuzzy classifier.

After a description of the linguistic variable is completed, the analyst can use it as a mathematical object in the corresponding operations on fuzzy sets.

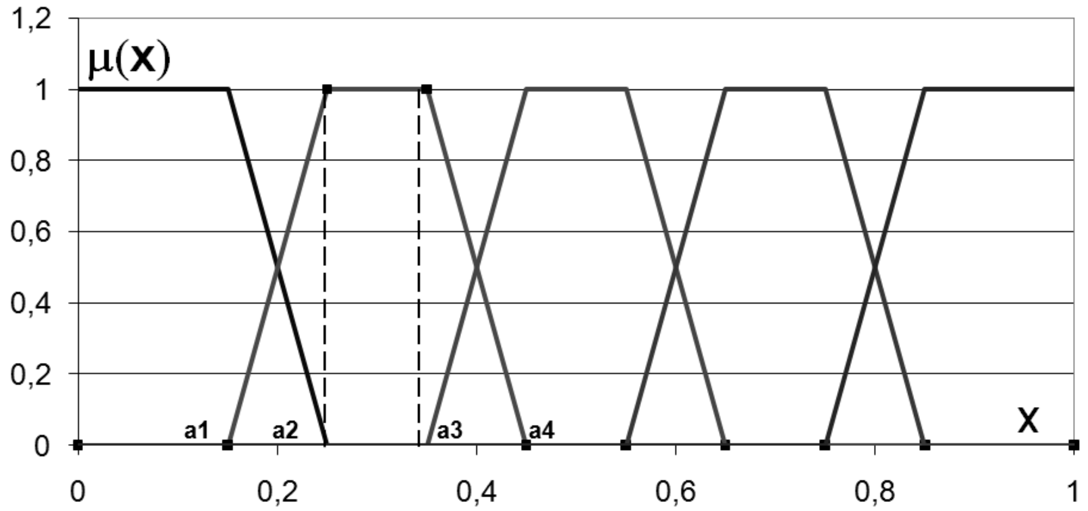

Fig. 2. Trapezoidal membership functions
Рис. 2. Трапециевидные функции принадлежности

The sequence of calculation of an integrated risk indicator of the service enterprise with use of fuzzy approach [7] is look as follows:

1. The introduction Linguistical variable G –"The risk level of service enterprise" defined in the 01-value.
2. The definition of a set of individual indicators X = {X_i} by the total number of N, which, in the opinion of an expert analyst, on the one hand, influences on the risk assessment of the enterprise, and, on the other hand, assess the nature of the various aspects of his competitiveness.
3. The definition of linguistic variables B_i for the selected set of indicators, also on the 01-value.
4. Determining the importance of indicators.

It is necessary to compare each indicator X_i with level of its importance r_i for analysis. To estimate this level, it is necessary to arrange all indicators in the order of importance decrease so that the rule is carried out:

$$r_1 \ge r_2 \ge ...r_N . \tag{3}$$

If the system of indicators is ranged in decreasing order of their importance, r_i (the importance of i-indicator) should be determined by Fishburne's rule [8]:

$$r_i = \frac{2(N-i+1)}{(N+1)N} . \tag{4}$$

Fishburne's rule reflects that it isn't known anything about a significance value of indicators except (3). Then the assessment (4) matches a maximum of entropy of available information uncertainty concerning object of research.

If all indicators possess the equal importance (or the system of preferences isn't present), then:

$$r_i = 1/N. \tag{5}$$

5. The construction of the classification of the current values g of the risk indicator as a criterion for the partition of this set into fuzzy subsets (eg, as shown in Table 2):

Table 2

Classification of risk degree of loss of the service enterprise competitiveness

Interval of values g	Classification level of the parameter	Degree of estimated confidence (membership function)
$0 \le g \le 0.15$	G_5	1
$0.15 < g < 0.25$	G_5	$\mu_5 = 10 \times (0.25 - g)$
	G_4	$1- \mu_5 = \mu_4$
$0.25 \le g \le 0.35$	G_4	1
$0.35 < g < 0.45$	G_4	$\mu_4 = 10 \times (0.45 - g)$
	G_3	$1- \mu_4 = \mu_3$
$0.45 \le g \le 0.55$	G_3	1
$0.55< g < 0.65$	G_3	$\mu_3 = 10 \times (0.65 - g)$
	G_2	$1- \mu_3 = \mu_2$
$0.65 \le g \le 0.75$	G_2	1
$0.75 < g < 0.85$	G_2	$\mu_2= 10 \times (0.85 - g)$
	G_1	$1- \mu_2 = \mu_1$
$0.85 \le g \le 1.0$	G_1	1

6. The classification of the current values x of indicators X as criterion of splitting of a full set of their values on fuzzy subsets of a B-type.
7. Assessing the current level of indicators, the results of which are reduced in Table 3.

Table 3

Current level of indicators

Name of indicator	The current value
X_1	x_1
…	…
X_i	x_i
…	…
X_N	x_N

8. Classification of level of indicators (the current values x from the table 3) which results register in table 4 where λ_{ij} – level of accessory of the x_i – values to a fuzzy subset B_j.

Table 4

Levels of accessories of values to fuzzy subsets

Name of indicator	Result of classification on subsets				
	B_{i1}	B_{i2}	B_{i3}	B_{i4}	B_{i5}
X_1	λ_{11}	λ_{12}	λ_{13}	λ_{14}	λ_{15}
…	…	…	…	…	…
X_i	λ_{i1}	λ_{i2}	λ_{i3}	λ_{i4}	λ_{i5}
…	…	…	…	…	…
X_N	λ_{N1}	λ_{N2}	λ_{N3}	λ_{N4}	λ_{N5}

9. Risk assessment. Having executed a double aggregating convolution, the assessment g of the risk of loss of the service enterprise competitiveness is turned out:

$$g = \sum_{j=1}^{5} g_j \sum_{i=1}^{N} r_i \lambda_{ij} , \quad (6)$$

where: g_j = (0.1, 0.3, 0.5, 0.7, 0.9) – a set of nodal points, λ_{ij} is defined in Table 5, and r_i - according to formula (4) or (5).

10. Linguistic recognition of the received value of risk degree on the base of table 2. Result of classification are the linguistic description of risk degree and (in addition) degree of the expert's confidence in correctness of his classification, therefore the conclusion about risk degree of the enterprise gets not only a linguistic form, but also the characteristic of quality of the expert's statements.

4. RISK MONITORING

In accordance with the requirements of the system analysis, a clear classification of all types of risk, that will provide maximum account of them is necessary .In turn, such approach expresses aspiration to the fullest forecast of emergence of possible risk situations that allows to minimize uncertainty degree. Adequacy of reaction to risk situations means ability of fast response to any changes of parameters of system functioning and entering their values into critical area. The reasonable risk is possible only in case its identification and an assessment is made, the mechanism of its monitoring is developed and introduced and, the main thing, the actions minimizing its negative consequences are provided.

As a result of developing strategy of the enterprise using the balanced scorecard (BSC) set of interrelated standards for Key Performance Indicators (KPI) was defined, that is representing a comprehensive assessment system for DSN. These values are stored in a database. No entrance of KPI into the standard values indicates the target is not achieved within the framework of BSC. In the strategic card of purposes each of KPI is associated with the risk of occurrence of an event, while the corresponding KPI is out of set norm (Fig. 3).

Such approach to risk management is clear and transparent, so in information system in case of KPI entering in critical area there is a signal about need of carrying out correcting actions for the decision maker, (the calculated indicators of efficiency for DSN subjects are painted in red color).

After identifying risks qualitative and quantitative assessment of risk is made and the map is built, one of the "axis" of which contains the impact force or risk significance, and on the other – the probability or frequency of its occurrence. According to statistics collected in a database of decision support system, the risk probability can be calculated as dispersion or standard deviation of the sample values of the efficiency indicator, which corresponds to this risk. Big dispersion testifies to high disorder of values of an indicator and its considerable instability, also to existing risk of its exit into critical area.

If KPI is defined by an interval [a, c], and the norm on this KPI is b, and the condition $a \le b \le c$ is true, then risk of that KPI will accept value below norm, is defined by following formula:

$$Risk = (b-a)/(c-a) \quad (7)$$

If $b \ge c$, then Risk = 1. If $b \le a$, then Risk = 0 (Fig. 4).
$Risk(b_1) < Risk(b_2)$, if $b_1 < b_2$.

If KPI is defined as triangular fuzzy number (Fig. 5), it is designated as $Z = \{ Z_{min}, Z_{av}, Z_{max} \}$, and the norm of this indicator as P. Then the risk of that Z becomes below the norm P is calculated by the following formula:

$$Risk = \frac{1}{2} + \frac{\lambda}{2}(\ln \lambda + 1) , \quad (8)$$

when $Z_{av} > P$, $Z_{av} = (Z_{max} + Z_{min}) / 2$, $\Delta = Z_{av} - Z_{min} = Z_{max} - Z_{av}$, $\lambda = (Z_{av} - P) / \Delta$ (Fig. 6) [7].

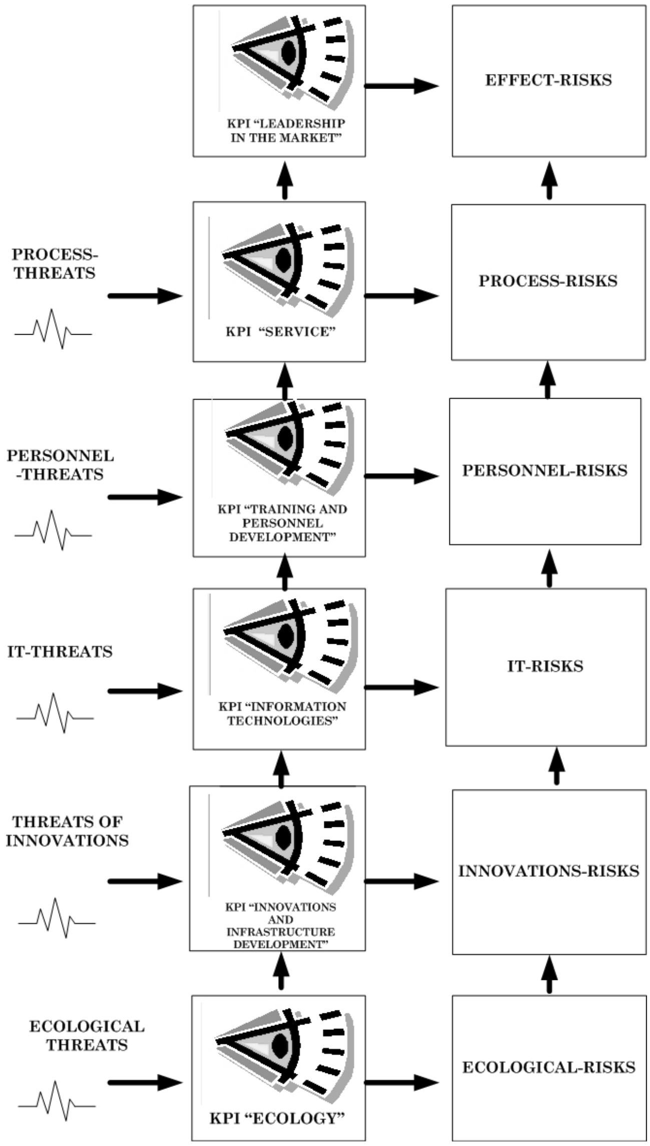

Fig. 3. The ratio of the strategic card of purposes of the DSN subject and risk card
Рис. 3. Соотношение стратегической карты целей субъекта ДСС и риск-карты

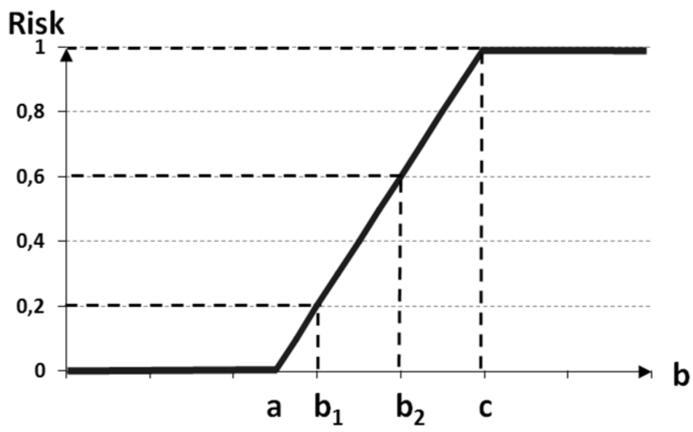

Fig. 4. The schedule of dependence of risk from value of the norm *b* if the KPI is defined as an interval
Рис. 4. График зависимости риска от значения норматива *b*, если ключевой показатель эффективности определен как интервал

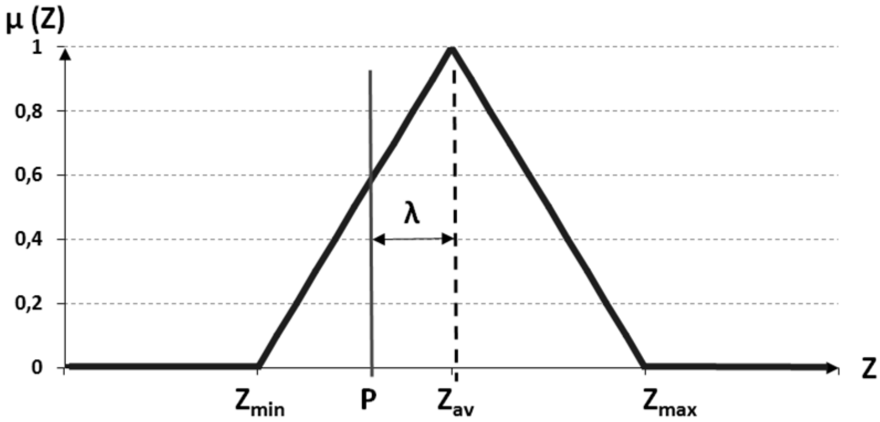

Fig. 5. Definition of KPI as triangular fuzzy number
Рис. 5. Определение ключевого показателя эффективности как треугольного нечеткого числа

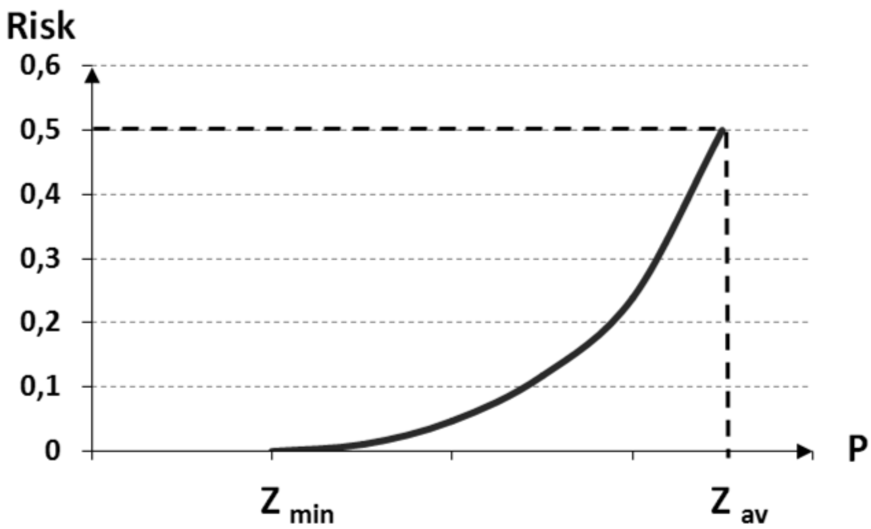

Fig. 6. The schedule of dependence of risk from value of the norm P if KPI is defined as triangular fuzzy number
Рис. 6. График зависимости риска от значения норматива P, если ключевой показатель эффективности определен как треугольное нечеткое число

During a choice of development strategy of the customer-oriented service enterprise minimization of own risks is connected with search balance between risk of the enterprise and risk of the client. For DSC providing sale, maintenance and repair of automobiles, the risk associated with the process of providing maintenance and current repairs - is the value describing the probability of loss from underutilization of capacities, or reduction of profits from the lost customers because of insufficient production capabilities [10]. Obviously, the risk is reduced in the presence of government guarantees [9].

Effective tool of risk management is analysis of the current performance of the service enterprise, comparing them with the data of the previous period and the expected values and the development of recommendations for the adjustment of the control actions (Fig. 7).

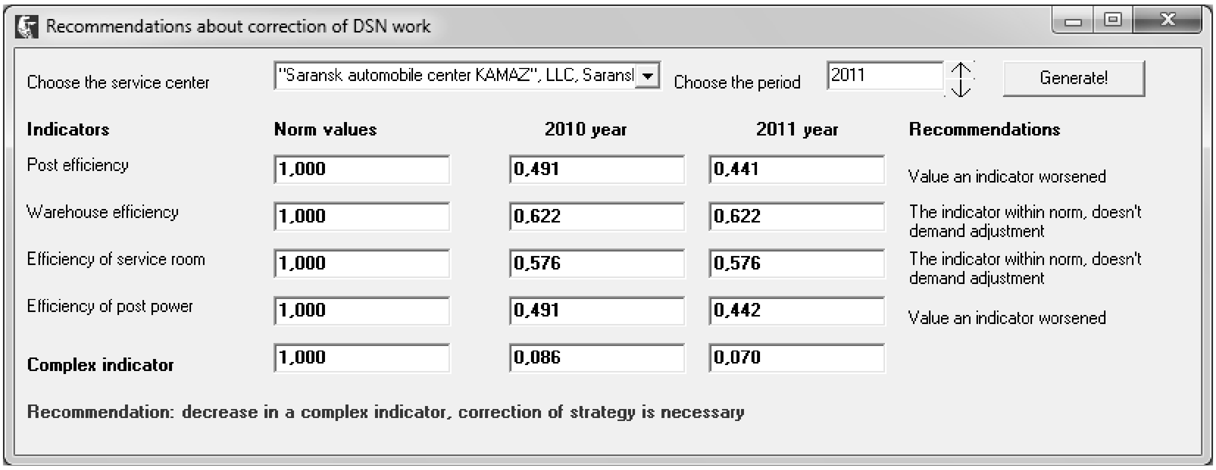

Fig. 7. The program window of the choice of development strategy of service enterprises on the base of the analysis of their performance
Рис. 7. Окно программы выбора стратегии развития сервисных предприятий по результатам анализа их деятельности

5. CONCLUSION

Effective model of risk management should be built on the principles of systematic, so that every management decision was made taking into account the risk factor. It should be borne in mind that the risks can’t be removed completely, as they arise in all areas of the company. In this regard, it is necessary to create self-regulating methods: recognition of risks, assessment of gravity of consequences owing to their emergence, ways of influence, development of strategy and tactics of risk management. It is necessary to develop risk strategy, which would allow to influence on the complex multi-directional risk directly [11].

Considering constantly changing conditions of the enterprise and environment, quick risk management on the basis of monitoring of KPI values becomes possible only on the basis of using decision support system. Timely definition of risk, its assessment and control allows to reduce loss, to prevent the adverse events connected with approach of risk situations. Thus considerably the complex system of ways of risk assessment with application of information technologies allows to increase quality of forward-looking statements and risk management at the enterprises.

Bibliography

1. *Управление рисками, риск-менеджмент на предприятии*. Available at: http://www.risk24.ru/index.htm. [In Russian: *Risk management, risk management at the enterprise*].
2. Duncan, B.A. *Guide to the Project Management Body of Knowledge. PMBOK GUIDE.* Project Management Inst. 2004. 216 p.
3. Хизёва, А.С. & Ситникова, О.Д. Управление рисками и их минимизация, как "профилактика" кризиса на предприятии. In: *Шестая научно-практическая конференция "Инновационный потенциал украинской науки – XXI век".* Available at: http://nauka.zinet.info/6/hyzyova.php [In Russian: Hizyova, A.C. & Sitnikova, O.D. Risk management and their minimization, as crisis "prevention" at the enterprise. In: *Sixth scientific and practical conference "Innovative Potential of the Ukrainian Science – the XXI Century"*].
4. *Анализ рисков в деятельности предприятия*. Available at: http://www.puckinet.ru/inc/an44.htm [In Russian: *Risk analysis in enterprise activity*].
5. Altman, E.I. Futher Empirical Investigation of the Bankruptcy Cost Question. *Journal of Finance*. 1984. Vol. 39. No. 4. P. 1067-1089.

6. Zadeh, L. & Bellman, R. Decision-making in a fuzzy environment. *Management Science*. 1970. Vol. 17. No. 4. P. 141-164.
7. Недосекин, А.О. & Абдулаева, З.И. *Управление корпоративными рисками и шансами: Учебный курс*. Санкт-Петербург. 2010. 125 p. [In Russian: Nedosekin, A.O. & Abdullaeva, Z.I. *Management of corporate risks and chances: Training course*. St. Petersburg. 2010. 125 p.].
8. Fishburn, P. *Utility Theory for Decision-Making*. New York: Wiley. 1970. 234 p.
9. Kokkaew, N. & Chiara, N. A modelling government revenue guarantees in privately built transportation projects: a risk-adjusted approach. *Transport*. 2013. Vol. 28. No. 2. P. 186-192.
10. Макарова, И.В. & Хабибуллин, Р.Г. & Мухаметдинова, Л.М & Шакирова, Д.Ю. Оценка рисков предприятий сферы автосервиса на основе системы сбалансированных показателей. In: *Международная научно-практическая конференция "Новые подходы в экономике и управлении"*. Пенза-Прага: Научно-издательский центр "Социосфера". 2011. P. 118-121. [In Russian: Makarova, I.V. & Khabibullin, R.G. & Mukhametdinova, L.M & Shakirova, D.Yu. Risks assessment of the car service enterprises on the basis of system of the balanced indicators. In:*International scientific and practical conference "New Approaches in Economy and Management"*. Penza-Prague: Scientific and publishing center "Sotsiosfera". 2011. P. 118-121].
11. *Условия и основные факторы эффективной организации и функционирования механизмов управления рисками*. Available at: http://finmagazine.ru/temanomera/1681-conditions-and-main-factors-for-the-efficient-organization.html// [In Russian: *Conditions and major factors of the effective organization and functioning of mechanisms of risk management*].

Received 13.09.2012; accepted in revised form 25.10.2013