

## **Conceptual Model of Risk-Management in Complex Energy Systems**

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### **Abstract**

*The present article sums up the results of the theoretical and scientifically applied research for systematization of the basic methodical approaches for identification and management of risks within the company. Main goal of the present article is the general procedures for management of risks to be differentiated and analyzed and to be systemized in a general conceptual model on the basis of analysis of the basic approaches for minimization of the unfavorable influence of the risk events and their consequences. On the basis of extensive theoretical research the basic principles of the new paradigm of risk-management are drawn up. The main elements of the system for management of risk are characterized. The logical and technical succession of the stages and procedures of risk-management in the company are described. The developed conceptual model for management of risk will be recommended to the electricity distribution companies operating on the territory of Republic of Bulgaria*

**Keywords:** Risk-management, Management of risk, Energetics

### ***1. Introduction***

The electric power system of Republic of Bulgaria is of infrastructural significance for the national and European industrial complex which predetermines *the increased criteria for continuity and reliability* of its functioning. The increasing of the risks from the external environment and the inclusion of qualitatively new type “green” sources turned the energy industry in one of the most complex and at the same time one of the riskiest industrial systems. The management of the national energy power system today is impossible without the construction of reliable system for identification and management of the risks as inseparable part of the general management of the electricity producers and the electricity distribution companies. Such system shall have hierarchical character and cover all levels of the management in the branch. The conception for risk is ambiguously defined which predetermines the fact that in scientific literature and in practice *many approaches, methods, procedures and instruments* for neutralizing or minimizing of the risks and their consequences are described. Different models for management of the risks are also suggested. [1, p. 102; 2, p.37; 3, pp.17-18; 10, p. 72].

**The basic goal** of the present article is the common procedures for management of the risks to be differentiated and analyzed on the basis of analysis of the basic approaches for minimization of the unfavorable influence of the risk events and their consequences and to be systemized in a *general conceptual model*, which is to be recommended to the electricity distribution companies operating on the territory of Republic of Bulgaria.

The main tasks of the present project are drawn up from the practical necessities of the Ministry of Economy and Energy for development of effective and competition resistant energy system.

## 2. Development of the conception for management of the risks.

The retrospective researches indicate that there is no unambiguously accepted opinion regarding the division into periods of the development of the concept for management of the risks. *G.Kervern (1994)* distinguishes three consecutive periods: 1) philosophical period from 1755 till 1940; 2) technological period from 1940 till 1980 and 3) scientific period from 1980 till today [14, p.43-44]. *V.Vyatkin and J.Hampton (2003)* expand this classification to five stages: 1) prophetic; 2) empirical; 3) philosophical; 4) technological and 5) scientific [21, p. 1-3]. There is indisputably accepted evidence in the scientific theory regarding the hypothesis that practically all modern instruments of risk-management from the theory of the games, the theory of chaos and insurance have roots in the century 1654-1754. The term “*risk*” was used for the first time by *Richard Cantillon* in his fundamental work “*Essay on the Nature of Trade in General*”, written in the period 1729-1733. Here the risk is examined as an irreversible essential characteristic of the entrepreneurship, and the entrepreneur as “a person who takes (handles) risks, different from the risks of the owners of capitals” [21, p. 1-3].

The major scientific discoveries which create the prerequisites for systemizing of the concept for management of the risks are also related to that period. In 1720 the German mathematician *Gottfried Wilhelm von Leibniz* developed the mathematical analysis and the idea of the large numbers which was seen in a finished state in the research of Swiss mathematician *Jacob Bernoulli* and the Law of large numbers which he formulated. His achievements in the development of the analysis of infinitely small numbers, theory of the rows, variation calculus and probability theory initiated the beginning of the *scientific period* in the theory of evaluation and management of the risk. In 1725 the government of England applied for the first time tables for calculating and prognostication of death rate on the principle of the probabilistic calculations. This instrument spread fast and nowadays it is still applied for practical purposes. In 1718-1730 the French mathematician *Abraham de Moivre* in his fundamental works “*The Doctrine of Chance: A method of calculating the probabilities of events in play*” (1718) and “*Miscellanea Analytica*” (1730) researched the structure of normal distributions and came to the brilliant conjecture that standard deviation could be used as “*risk measure*”. Eight years later, the Swiss mathematician *Daniel Bernoulli*, determining the “expected usefulness”, initiated the research of the portfolio risks. In his work “*Exposition of a New Theory on the Measurement of Risk*” (1738), he defined the basic concepts “usefulness”, “risk”, and “risk premium”.

The dissertation work of the American economist *Frank Hyneman Knight*, “*Risk, Uncertainty, Profit*” (1921) marked a qualitatively new stage in the systematization of the theory for the management of risk. In his work, for the first time the two key concepts *risk* (fortuity with known possibilities) and *uncertainty* (fortuity with unknown possibilities) [15] were distinguished. The further development of the theory of risk is related to the name of the Nobel laureate *Harry Max Markowitz* and his works “*Portfolio Selection*” (1952) and “*Portfolio Selection: Efficient Diversification of Investments*” (1959). They initiated the theory of portfolio management of risks which was further developed in the works of the Nobel laureate *Franco Modigliani* “*Capital Markets: Institutions and Instruments*” (1996) and “*Foundations of Financial Markets and Institutions*” (1998). In 1955 *Wayne Snider*, an American professor at the University of Pennsylvania in the USA suggested and grounded the concept *risk management* as a “system of principles and methods for monitoring and transformation of risks” [20, p.12]. He was the first one to create the thesis that the “profession of insurance manager should be risk-manager”. In 1956 in an article of *Harvard Business Review* “*Risk Management: A new Phase of Cost Control*”, *Russell Gallagher*, an insurance manager in *Philco Corporation* in Philadelphia gave the first description of the profession of *risk-manager* [21, p. 5].

In the 1960s the interest in the theory of monitoring and management of risk increased significantly. The development of the theoretical research and the increased practical necessities of their usage resulted in the setting up of the first international organizations *Risk and Insurance Management Society - RIMS (1950)* and *International Federation of Risk and Insurance Management Association – IFRIMA (1984)*. Their influence expanded fast. Through their congressional and exhibition activities, each year they organize the work of more than 3500 corporation members and more than 7000 associated organizations, forming the powerful infrastructure of the development of the theory and the practice of risk-management in global economy. Today that infrastructure includes more than 40 types of organizations: state agencies, banks, insurance companies, scientific centers and educational institutions, legal organizations and software companies, institutions of standardization, control and licensing, associations of producers and consumers, consultant companies, specialized in the technique and the technologies for management of the risks and others.

With expanding of the knowledge and the concept for the phenomena *risk, uncertainty, danger* and the founding of new organizations, that infrastructural complex expanded and became complicated. With the help of RIMS in 1985 Fortune Magazine published a special article, named “*The revolution of the management of the risk*”, which suggested the coordination of the work on management of risk within a single organization. In 1980 the Society for Risk Analysis was created in Washington. The same year the publishing of the “Risk Analysis” journal was started. To 1999, the Society had more than 2200 members all over the world, as well as working structures in Europe and Japan. With its help the concepts “evaluation of risk” and “risk management” entered the legislation of North America and Europe.

In 1986 an Institute for management of risk started work in London. Here, under the management of *Gordon Dickson*, an “international block of exams” for the candidates for members of the Institute was started. This is the first officially recognized educational program for risk-management. In 1998 under the management of *Lev Borodovsky* in New York *Mark Lore* in London, *The Global Association of the Risk Professionals* was set up. It works only electronically with no offices and personnel. Today it is the largest professional organization of risk management in the world, with more than 80 000 members.

In that period the foundations of a new scientific trend “cindynics”, from Greek “kyndunos” (threat), were laid as a “new philosophy of the management which is based on the conceptually overall approach to the business as to realized acceptance of the risks at reading of the desired results”[21, p. 6].

### **3. The new paradigm for risk-management<sup>1</sup>**

Till the beginning of the 1990s risk-management was associated with the specific activity of the management related to single, detached (private) risks, such as production, financial, insurance risks, and was applied mainly in big companies with complex structure – aviation, marine, oil-producing, chemical, electricity-producing etc. In that period *closely specialized, fragmentary* approach of management of risks was applied at which - and the appearing risks – the risks that arose were examined separately as unbound elements in the system of the company management and were managed by different specialists depending on their competency. This *subjective* attitude to the perception of the risk raised conflicting evaluations of the character and origin of the risks, as well as the consequences of the specific risk situations.

During the last decade of XX century a new methodological approach to risk-management started forming. This approach required *complex, integrated and continuous* examination of risks on all levels of the management of the company. Some of the main *factors* leading to such transformation were related to growth of rate of the changes and the increasing uncertainty in the conditions of the “new economy”: 1) increasing globalization and competition; 2) fast development of the high-tech branches and the Internet; 3) increasing of the dimensions of free trade and investments worldwide.; 4) the development of the financial markets and the appearance – arrival of complex financial tools; 5) reducing of the state regulation in the basic branches of economy; 6) dynamic changes of the organization structures of the business as a result of dismissals, re-engineering, merging and overtaking; 7) the increasing expectations of the consumers and the like. These factors, as well as some others, made the global environment of the business more dynamic and increase its uncertainty, as a result of which the companies are forced to constantly review their strategies and the model of their behavior so that they can adapt to the dynamically changing environment. Risk-management turned into *strategic means* for increasing profitability and smoothing the constantly changing levels of the profit. [3, p.12].

At the basis of the development of the conception of the management of risks is *the evolution in the perception of risk* as universal phenomenon. In the classical conception the concepts “risk” and “uncertainty” are similar in meaning and are often used as synonyms. What they have in common is that both concepts are used for designation of “*lack or deficiency of certainty*” [15, p.12]. The differences between the two concepts can be formulated on the basis of *the information approach*. It is based on the idea that the differences between uncertainty and risk are brought to the accessible volume of the information about the analyzed situation. In spite of the theoretical discussions, the axiomatic affirmations of *Frank Knight* formulated in 1921 have not been disputed so far. *The term “risk”* shall be used when the distribution of the random value with which the risk situation is modelled is known. We will call it “measurable uncertainty” or “probability certainty”.

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<sup>1</sup> Here, paradigm means *methodological approach to the risk-management*.

We will apply the term “*uncertainty*” in cases when the outcome is not defined and the distribution of probability remains unknown, that we will call “*immeasurable uncertainty*” [15, p.12]. Such classification presumes *objective* and *subjective* perception of the risk, as far as the different persons treat the possibility of arising of the unfavorable outcome of the situation differently. The risk can be objectively or subjectively assessed depending on the ambiguity of the future outcome of the risky situation being connected with the objective nature of the object or with the subjective lack (shortage) of knowledge in the managers who manage it.

The new methodological approach to risk-management examines the risk as a *three dimensional system*, a model in three dimensions: the *first* dimension examines the risk as threat, the *second* – as uncertainty, the *third* – as possibility, a chance. The statistical research of *Lee Puschaver* and *Robert Eccles* (1996) showed that four out of five American managers described the risk with negative terms and they did not think about, discuss and analyze its positive aspects [17, p.12]. When analyzed in their deeper essence, all risks contain not only the undesired destructive charge, but positive potential as well. In this meaning the new methodological approach to risk-management examines the management of risks as a process of their *optimization*, not just a process of their *minimization*. Such approach expands the understanding about the risk to “each event or action which can affect the achievements of the organization and its business targets unfavorably and prevent the successful realization of its targets” [3, p.15].

The year 1992 is accepted to be the one when a new integrated approach to risk-management started forming. In 1992 the Committee of Sponsoring Organizations of the Treadway Commission (COSO) published its document „Internal Control – Integrated Framework, (ICIF)”. That document introduced a new model of internal financial control that differed from the traditional one. This model, essentially, was a scheme for integrated control on five interconnected components of the system of company management 1) control of environment factors; 2) risk evaluation; 3) control of management activities; 4) control of information and communications; 5) monitoring. The risk evaluation was considered a new and most important element. The document provided for distribution of the control functions at all levels of the company management – from the Board of Directors through the tactical and operational management to the experts in the departments. In this way the risk management turned from *episodic* and *fragmentary actions* of the financial-accounting system into *complex, integrated system*, part of the strategic management of the company.

That concept spread fast in the practice and in the period till 2000 several leading international organizations accepted documents in which they further developed the conception of risk-management as a hierarchical system within the company: 1) Economist Intelligence Unit – *Managing Business Risks: An Integrated Approach* (1995); 2) The Conference Board of Canada – *A Conceptual Framework for Integrated Risk Management* (1997); 3) Institute of Internal Auditors Research Foundation – *Risk Management: Changing the Internal Auditor’s Paradigm* (1998); 4) Joint Australian/New Zealand Standard, *Risk Management* (1999); 5) American Institute of Certified Public Accountants/Canadian Institute of Chartered Accountants Risk Advisory Services Task Force, *Managing Risk in the New Economy* (2000) and the like.

Table 1 contains systematization of the general characteristic features of the old and new paradigm of risk-management. In scientific literature and practice the concepts “*complex risk-management*”, “*integrated risk-management*”, “*strategic risk-management*”, “*risk management within the frameworks of the entire company*” are also used to mark this new model of risk-management.

From the positions of such approach we can define Risk management as *a process of making and carrying out of management solution which optimize the risk and minimize the material, financial and other consequences when unfavorable outcome of the risk situation occurs*. That definition makes it possible to reveal the three essential characteristics of management of risky situation:

- Management of risk is not a single act, but an uninterrupted *process*, a part of the entire management cycle.
- Management of risk is oriented to *neutralizing the unfavorable influence* from occurrence of random events.
- Management of risk goals *prevention and minimizing* of the negative effect from occurrence of the unfavorable outcome of the risky situation.

This definition has universal nature and can be applied at the three levels of management of the energy system:

- *on national level* for making Governmental decisions and decisions of the Ministry of Industry, Energy, and Tourism;

- on company level for making decisions by the management of the companies, producers of electric energy and the electric distribution companies;
- on the third, lowest level – on the working place itself where human factor can also be a generator of unforeseen risks.

The process of management of risks in the energy systems is *complex, multistage and multistep process* which presumes more complex research methods based on the systematic approach.

#### **4. Risk-management as integral part of the general management of the company**

The construction of a complex, integrated and hierarchy-structured system of risk-management within the company requires defining of its principles and properties. The system of management of risks has certain specifics related to the characteristics of the object, the goals and the methods of management. That is reflected in the principles it is based on:

- 1) *the system for management of risk is a part of the system and procedures of the general management of the company* which requires its conformity with the strategy for development of the company and the institutional characteristics of its functioning.
- 2) *the characteristics of the system for management of risks affect its goals and tasks*, which presumes the highly specialized character of the accepted decisions.
- 3) *the management of risks in the company should take the internal and external limitations into account* which requires coordination of the relevant activities with the abilities and conditions for operating of the company.
- 4) *the system should provide a uniform policy during the management of the entire combination of risks* which requires complex, integrated management of all risks of different nature.
- 5) *the process of management of risks has a dynamic character* which defines the continuous character of the decisions made for management of risks.

Before analyzing the characteristics of the procedures and standards of the risk-management we need to analyze the properties of the system for management of risks.

- 1) *Systematic character of management of risks* – that property presumes complex examination of all risks as a unified entity, as the interconnections and all possible consequences are taken into account. The “general picture” described this way allows taking into account not only the influence of the different instruments used for certain risks but also their influence on the remaining risks depending on their place in the system. Such approach presumes examination of the following aspects:
  - *integrity*, orientation to general evaluation of the combination of the risks and the negative consequences of their realization taking into account the character of the interdependence between them.
  - *complexity* and necessity of taking into account the intricacy of the object of management (the combination of risks), their interdependence and the variety of possible consequences of the manifestation of the risk and the characteristics of the influence of the applied procedures on the risk including situations when the fight with certain risks brings forward other risks.
  - *ability of the system to integrate new risks* or possibility for a flexible reaction of the entire system when new risks appear, including risks originating from the system of management itself.
- 2) *Complex structure of the system for management of risk* – that property presumes not only a necessity of simultaneous analysis of large number of risks of different origin and testing of heterogeneous combination of risks and their interconnectivity. That property presumes studying the character and the rate of influence of a large number of factors on the development of the risk situation and the appearance of the unfavorable consequences. The following aspects of the system for management of risks should be taken into account during that research:
  - *multi-functionality and universality*, expressed in the ability to control a large number of risks of different nature and different consequences of their realization.
  - *modularity*, expressed in the ability to use different combinations of the procedures for management of risks in different situations, which allows the specifics of the concrete situation to be taken into account and in case of necessity allows for the system to be “adjusted” for solving problems related to the individual needs of the users.

- *hierarchy*, expressed in providing proper multi-rate structure for making and realization of the decisions providing adequate distribution of the powers and responsibilities.
- 3) *High efficiency of the system for management of risks* – that property reflects the ability of the tested combination of activities to reduce the possibility for arising of unfavorable events and overcoming their consequences. The system shall operationally react to the changes of the conditions and have extended contour of feedback, generate active solutions, orientated to fast enough reaching of the planned result (minimization of the unwanted consequences). The ensuring of those requirements presumes conformity of the system with aspects such as:
- *flexibility and adaptability*, expressed in the ability to adapt to dynamically changing conditions, high speed of reaction, ability for fast handling of unfavorable situations.
  - *adequacy*, expressed in the conformity of the realizable procedures for management of risk of the concrete situation and the ability to operatively select all resources that are needed for the achieving of the set goals.
  - *effectiveness*, expressed in the ability to overcome the negative consequences from arising of unfavorable situations with minimum volume of resources. The system has to provide “pure effect”: the expenses for risk-management and the size of the possible losses after the completion of the procedures and measures have to be less than the potential losses before the measures for protection of the company have been carried out.

The formulating the *goals* and *tasks* of the system for management of risk is an important step in the construction of the conceptual model:

- *The main goal* is ensuring the successful functioning of the company in the conditions of risk and uncertainty. That means that even if a risk situation arises, the implementation of the measures and activities of the system should provide the company with continuity of business processes, their stability and resistance corresponding to the money flows, ensuring the profitability and growth of the company, as well as achieving the other current and strategic goals. Except the main goal, the system for management of risk also has a series of many *subsidiary goals* in which we can include the following.
- *Providing the efficiency of the operations* – the reaching of that goal means realization of economies from costs as the possibility for losses is taken into account. That presumes an increase of the expenses for carrying out activities for management of risks aimed at achieving certain protection from big losses, from events that may arise even in minimum probability.
- *Sustaining proper level of uncertainty* regarding the arising of possible losses. That objective presumes a reduction of the risk to the allowable level if its complete rejection is not possible.
- *Legality of the actions* – that is a very important goal because it is possible for illegal actions to protect and prevent certain risks, but at the same time to create others. Such an approach contradicts the main goal of the system for management of risk in the company.
- *Other goals*, the structure and the content of which depend on the specifics of business and the planned activities for management of risk. The social and humanitarian goals requiring conformity of the suggested measures with the accepted public ethical norms might be an example.

Depending on the specifics of the risks and the measures on their managing a certain *hierarchy* of the system of goals is formed. It conforms to the *hierarchic character* of the system for management of risks. One more argument to the idea of hierarchy of the goals is the fact, that the interconnection between them is very complicated and needs simplification through hierarchic composing and coordinating. In connection with this during the developing of the system of goals for management of risk, the following additional requirements have to be performed:

- *the priorities of their realization shall be defined* and the way the groups differentiated under that indication can affect the activity of the company shall be fixed.
- *the necessities of resources* for achieving the goals should be assessed. Ensuring the meeting of certain goals requires larger efforts and resources than the meeting of others and it is important for familiarizing with the abilities of the system for management of risk to take this circumstance into account.
- *taking into account the interconnection and the contradiction of the goals* and the fact, that achieving some goals can further help or the opposite, obstruct the achievement of others. In other words, taking the internal connections between the researched goals into account helps the increase of the efficiency of the entire system for management of risk in the company.

The tasks of the system for management of risk specify the set goals. Their specificity is defined by the specificity of the risks themselves and the chosen methods for their management. We can systematize the tasks in the following interdependence (Fig.1).

The task for revealing the possible risks is of primary importance because it defines the objects which are placed in focus and the characteristics on the basis of which all further actions of the management are defined. A direct continuation of that task is the assessing of the influence of the expected risks on the activity of the company. That provides the information basis for the further process of decision-making. Defining the principles and the procedures of risk management and the evaluation of the financial losses related to the risks determine the relevant methodological and financial borders of the relevant activities. The central group of tasks is related to the forming and the realization of the program for management of risks, including a list of measures for reduction and liquidation of the unfavorable consequences and the criteria for the efficiency of their realization. The last group of tasks for evaluation of the efficiency of these activities provides the feedback to all previous tasks.

### **5. Limitations of the Risk-management system**

The successful functioning of the system for management of risk in the company presumes exact taking into account of the limitations of the external environment and the internal characteristics of its development. We will call the limitations of the first type “*external*”, and of the second type “*internal*”. The precise defining of these limitations allows the process of taking a decision to be more precise and effective.

The *external limitations* are related to the factors that cannot be affected directly by the management of the company. Such limitations can manifest in the following forms:

- 1) *Legislation limitations* – they can be introduced in legislative and normative acts reflecting the micro, macro and mezzo economical regulation. For example, the necessity of the company of following the tax legislation and state requirements for working conditions are sample methods of micro economical regulation. The requirements for protection and providing balance of the ecological system are part of the macro economical regulation. These limitations reflect the obligations of the company in vertical plan.
- 2) *Limitations related to obligations to and from the contractors of the company*. By contractors, we understand the different business partners who ensure the course of the business processes in the company. Examples of such liabilities can be bank credits, trade deliveries, logistic operations, obligations of the subsidiary companies, obligations to the workers and employees and the like. Each of them affects the potential risks in the company in a different way. This form of limitations forms the limitations in horizontal plan.
- 3) *State of business limitations*. These limitations are related to the characteristics of the macroeconomics processes and the specificity of development of the different markets. The risk of loss of financial stability increases in certain stages of the business cycle and more precisely in time of recession and drop, so the possibility of reducing that risk in such periods is reduced. The changes which characterize the dynamics of the currency and financial markets belong to that group. They abruptly increase the possibility of loss of solvency of companies which operate on these markets for acquisition and sale of financial assets.

The *internal limitations* are related to the characteristics of functioning of the company and of the management decision-making. The analysis of those limitations allows the management to analyze the problematic points of the system for the management of risk. The following limitations can be included in this group:

- 1) *Institutional limitations*. These are limitations are determined by the specificity of functioning of the different subdivisions of the company and the mechanisms of their interaction, the goals and traditions of the company as a whole as well as the style of management. All these factors have major influence upon the forming of certain decisions. For example, the quality and characteristics of the management can affect the choice of various methods of management of risk.
- 2) *Budget limitations*. They are related to the existence of limits during the financing of activities of management of risk. The risk-management is only a part of the general system of management in the company, although one of considerable *importance*. That is why it obeys the general limitations of costs. Spending more than the company has provided in the budgeted on activities of management of risk is not expedient. That is why only measures with proven expedience should enter the program.

- 3) *Information limitations*. They affect the process of making decisions through the deficiency of information which can appear in the volume, as well as the content of the accessible data. Lack of information or mistakes in its content lead to wrong decisions in the sphere of management of risk which forms the information providing of risk-management.

## 6. Portfolio risks management

In the process of its functioning a company encounters not only a single risk but a wide combination of risks, heterogeneous by their character and origin. This necessitates an important requirement to the system for management of risk: providing unified system of effective measures for overcoming the negative consequences of each element of the combination. The term complex management of *portfolio risks* is more often used in the scientific literature [1, 6, 19]. That requires studying the risks on two levels:

- *Analysis of the single risks separately* which creates conditions for the management to analyze the characteristics of the risk situations and the negative consequences of their realization. That differentiated analysis makes it possible to choose the most appropriate instruments for management of each risk separately.
- *Analysis of the portfolio as a whole* which allows for the general influence of the risks upon the analyzed company to be determined. Some authors call that complex introducing of the combination of risks “*risk profile* and its documental mapping – “*risk passport*” [19, 21]. That provides a unified point of view for all risks of the company and therefore a unified policy for their management.

The system for management of risk should be constructed on these two levels and combine instruments and methods that are typical for each of them. Ignoring that condition can lead to loss of adequacy of the implemented policy and consequently, to reducing the financial stability of the company.

The research of the entire risks portfolio presumes that at analyzing the risk situation one more aspect shall be included along with the sources of uncertainty that are related to the behavior of the separate risks – *the rate of interconnection between the risks*. In most cases complete information on such interconnection is not available. For example, it is known that the risks in the portfolio are correlated but the character of that correlation is not known. In other cases, the nature of the interconnection is not known. That aspect can be a major source of uncertainty.

Risks have different origin and nature, and that is why the management of such portfolio should be *complex*, taking the specific characteristics of the internal connections between the risks in the portfolio into account. That is why the management of risks in complex systems imposes involving and integrating the efforts of specialists from different areas of science and practice.

## 7. The management of risk as a dynamic process

The management of risk is not a single act of decision or action but a complex multi-staged process. In the conditions of fast changing global environment of functioning of the business, the static approach of examining and analyzing risks can contradict the principle of effectiveness. The management of risk is a *dynamic process*. That means that collecting and processing of information about risks, making and implementing the decisions of choice and application of method of management, monitoring and analysis of the results of the application of the chosen method should be examined as a continuous process, a part of the general process of management of business. As an important element of the general management of the company, the management of risk should correspond with the requirements for dynamics, flexibility, and adaptability of the adopted business decisions.

As a dynamical process, the management of risks passes through several stages. In scientific literature there is no uniformly adopted opinion regarding the number and names of the stages. Models with different number and name of the stages are proposed. [1, p. 102; 3, pp.17-18; 10, p. 72]. The problem is also complicated by the fact that in practice differentiating and separating of the stages in their succession is very hard because some of them run in parallel and not consecutively.

We will examine a conceptual model with six stages of the process of management of risk (Fig.2):

Step 1 – *Identification of the risk*. the first very important stage which aims at the collecting and presenting of the most important information that is needed for defining of the specific characteristics of the risk situation.



By identification of the risk we mean the revealing of the risks, their specificity conditioned by their origin and nature, their characteristics, the characteristics of their realization including the presumed size of the losses, the expected change of the risk situation in time, the rate of interconnection between the different risks and studying the factors affecting them. To be able to identify of the risk, the management have to answer the following more essential problems:

- Which the sources of the risk are?
- What situations and negative consequences may occur as a result of manifestation of the action of the risks?
- How the particular risks interact and what the power of their interconnected influence is?
- Which the sources of the most important information needed by the management for decision-making are?
- Is it possible for the risk to be quantitatively evaluated and the like.

The specificity of that stage is connected not so much with the general characteristics of the management system which were examined above, but with its significance as *information basis* for further development of the process of management of risks. On that stage, precise and quality information about the probability for realization of risk and its parameters and consequences should be received, as well as a quantitative evaluation of the losses and the other indexes needed for making the necessary decisions. On this stage the informative bases of all risk management procedures shall be provided. It is necessary to clarify that on all following stages the information about the risks shall be completed and clarified because the actions of that stage are not one-time but to the point they represent a continuous process of collecting and processing of information.

*Step 2 – Risk analysis.* That stage is a key element in the process of management of risk and the effectiveness of the subsequent decisions of the management depends on its correct orientation. The main objective on this stage is the forming of “the overall picture” of the risks from which the risk situation arises and which threaten the company business, the lives and health of the people in it, the interests of the owners (shareholders), the relations with its business partners and all people who are affected by the activity of the company. It is important not only for the risks to be specified in a comprehensive list, but to be analyzed in qualitative and quantitative aspect. *The qualitative analysis* of the risks presumes researching of the origin and characteristics of the risks, their detailed classification and analysis of the form and type of the possible consequences. *The quantitative analysis* requires precise and complete information which should contain the following main data that is needed for evaluation of the predictability of risk: frequency (probability) of manifestation, character, size and mathematical or statistical dependences of the losses, as well as other characteristics needed for the process of decision-making.

An important decision on this stage is the defining of the rate of *trust to the various sources of information*. Processing the accumulated data is an essential part of that stage. To that purpose, different methods for statistical processing of the information can be used: correlation and disperse analysis, analysis of time rows, multi-factor analysis and other methods based on multivariate classification, as well as mathematical modeling and matrix games.

In some literary sources, that stage is structured in three sub-stages based on the detailing criterion:

- 1) *Rationalization of the risk*, or qualitative analysis related to the testing of the structural characteristics of risk – danger, disclosure to risk and vulnerability.
- 2) *Analysis of the concrete reasons* for rising of the unfavorable events and their negative consequences. That stage includes a detailed examination of the separate risks and the causality dependencies between the factors from which the risk arises, the arising of the unfavorable events and the appearance *arrival* of the consequences.
- 3) *Complex analysis of the risks*. That stage requires examination of the entire combination of risks, outlining the complete, complex picture of the risks encountered by the company. That allows forming and conducting a unified policy of management of risks. On that stage a complex inspection of the safety of the company is performed, as well as a complex examination of the activity of the company, the methods for making decisions aiming to reveal all risks threatening the company.

All three described stages are not always realized in practice. As a rule, they are realized consecutively in big companies with complex business.

*Step 3 – Risk evaluation.* This is the stage where numerical values of the probability for occurrence of the risk events and their consequences are defined, the quantitative evaluation of risk rate is calculated, and the allowable level of risk for the specific situation is found. After comparing the received values for the risks to their allowable value the strategy for their management is developed and on this basis the measures for minimizing the consequences are developed.

The risk is a probability value and the research of its connection with profit as a summarizing index for the activity of the company is of fundamental importance (Fig.3).

As pointed in Fig.3, the dependence of profit on risk is a *direct ratio*. If the company chooses minimum risk ( $r_1=0$ ) solution, then the expected profit will be minimum, too ( $P_1$ ). And vice versa, in case of the highest rate of risk ( $R_3$ ) the expected profit will be of maximum value ( $P_3$ ). This dependence presumes that the theoretical model for economic evaluation of risk is based on two parameters: the size of the possible losses and the probability for their arising. That requires defining the quantitative rates of the two characteristics after which the risks can be examined as *comparable values*. To examine that assumption in more detail, we will develop the scheme of distribution of the probabilities for receiving profit. (Fig.4). There are three defined risk areas: area of the allowable risk  $-r_1$ , area of the increased risk  $-r_2$  and area of the critical risk  $-r_3$ , as well as a riskless area where no unpredicted losses are expected. The curve of the probability of risk is formed from the *set of points* which are defined for each value of the rate of profit and the corresponding probability for arising of that rate.

The construction of such a curve for all risks threatening the company is a complicated and difficult task of risk-management. That's why a limited approach for risk evaluation under the most important parameters is used in practice. The constructing of the curve of risk is an initial stage of the analysis of the risk situation. Its practical value is that it graphically shows the management the allowable and the effective areas of risk and gives a qualitative evaluation of the risk profit which can be realized.

*Step 4 – Selection of methods for management of risk.* On this stage the policy of the company for fighting risk and uncertainty is formed. The necessity of selection is related with the fact that different methods are put into practice with different amounts of resources and have different effectiveness. In relation with that, the basic questions which the management should answer on this stage are:

- Which methods for management of risk are most efficient under the certain budget limitations?
- How the combination of risks in case of putting the selected methods in practice will change?

The selection of methods for management of risk can be examined *as a problem of optimization in the conditions of limitations*. The criteria for that selection can be different but the financial-economical one which requires providing of efficiency is defining. Together with it, other criteria like the technical one which reflects the technical and technological possibilities for reduction of risk, the social which requires reducing the risk to a level that is acceptable for society should also be taken into account.

Differentiated and independently examined, the problem of *classification of the methods for management of risk* is a complex theoretically-methodological and practical one. In scientific literature there is no synonymously accepted approach to the criteria and structure of such classification. Methods that are different in content and technology, based on different principles of influence on risk are described [1, 2, 3, 10, 13]. Table 2 contains a classification of the most reliable and most popular methods of management of risk. Within the frames of this stage *strategic* in nature management decisions are made and realized. They are expressed in systemizing the combination of methods selected on this stage, in a *Program for management of risk in the company*. By its nature, the Program is a *strategic document* and includes systematization and characteristics of all activities which will be taken, their information and resource provision and the criteria for efficiency, as well as their performance, the system for authorization and responsibilities for the adopted decisions. Such a program is a basis for all further actions of management of risks threatening the company.

*Step 5 – Effect on the risk.* On that stage the decisions for applying the selected methods of influence on risk adopted in the previous stage should be realized. Within the frameworks of that stage within this stage, management decisions of *tactical* nature are adopted and realized. The characteristics of the procedures of risk-management on that stage find their manifestation in the specifics of the accepted decisions and not in the way they are realized.

That is why the most important questions the management has to answer on this stage are related with the procedures for carrying the decisions out.

- What activities should be realized and what should their priority be?
- What the time intervals and the terms for their realization are?
- What resources in what amount should be used?
- Who bears the responsibility for carrying the realization and control on the performance of the adopted decisions?

*Step 6 – Monitoring of the results and improvement of the system for management of risk system.* That stage provides the feedback in the system of management of risk. It provides the flexibility and adaptability of the management of risk as well as the dynamic nature of that process. Within this stage the management should answer the following essential questions:

- Is the management of risk system effective and how the problematic points in its functioning are displayed?
- What factors have affected the realization of the risks and should some changes be implemented in the system of management of risk because of that?
- Is it necessary to replace some of the measures with more effective ones?
- Does the system have the flexibility and adaptability that are needed?

On that stage the information about the risks is completed and updated which is the basis for inspection of the topicality of the adopted decisions. The most essential element of that stage is the efficiency of the inspection of the activities and measures that have been carried out. The complexity of this evaluation is revealed in the possibility for *the risks not to manifest* during the analyzed period but the company has already invested costs in the implementation of the program. That's why it is necessary for the invested costs to be compared to the hypothetical losses which would arise in case of realization of the risk situation.

Main goal of the evaluation of the efficiency of the activities is adapting the system to the changed conditions of the environment of the company and the changes that have occurred in its internal environment. The decisions that are made on this stage should provide:

- 1) Replacement of the inefficacious activities with more effective ones within the fixed budget of the program. These activities provide an increase of the total effectiveness of the system for management of risk.
- 2) Changes in the organization of performance of the program for management of risk. Because it is defined by the specificity of the institutional foundation for protection of the company from risks, its change also leads to increase of the efficiency of the system for management of risk.

The six stages of the conceptual model of the system for management of risk in the company that have been described are logically connected in an order that is determined by the logic of the management process. We should note that the stages we studied can be implemented not consecutively but in order determined by the natural logic of the risk situation, including by going back to previous stages and reviewing of the decisions made.

## **8. Conclusion**

1. The process of management of the risk in the company is multi-rate and multi-staged process which characterizes it as complex because of the content of the decisions that are made and carried out, as well as the system of developed internal interconnections. That also defines the complicated complex character of risk-management and its relative detachment as sphere of the common system of management in the company.
2. From point of view of the system approach, the management of risk in the company represents a relatively detached sphere of activity characterized by internal unity and specification of targets, methods and results. At the same time it is an integrated part of the general system of the company management.
3. Main objective of the system of management of risk is providing the successful functioning of the company in the conditions of risk and uncertainty. The internal and external limitations should also be taken into account during its designing and functioning.
4. The management of risk should provide a unified system of effective activities for overcoming and minimizing the negative consequences for each element of the risk situation which presumes a complex management of the entire combination (portfolio) of risks. The research of the portfolio of risks in its integrity means that in the research of the risk situation, along with the sources of uncertainty related to the behavior of the separate risks, one more aspect is included – the rate of interconnection between the risks.

**References**

[1] Качалов P.M., Управление риском на производственном предприятии, Издательство „Юнити-Дана“, 1996.  
 [2] Хохлов B.H., Управление риском, М., Издательство „Юнити-Дана“, 1999..  
 [3] Barton T., W.Shenkir, P.Walker, Making enterprise risk management pay off, Prentice-Hall PTR Pearson Education, Inc., 2002.  
 [4] Barlow D., The Evolution of Risk Management // Risk Management, 1993.  
 [5] Bernstein P.L., The New Religion of Risk Management // Harvard Business Review, V.74, 1996.  
 [6] Bohlman H., Mathematical methods in Risk theory, N.Y. John Wiley & Sons, 2007.  
 [7] Brealey R., S. Mayers, Principles of corporate Finance, McGraw-Hill Book Company, 1988.  
 [8] Clark J., Th. Hindeland, R. Prithard, Capital Budgeting, N.Y., Prentice-Hall, 1989.  
 [9] Danthine J.P., Donaldson J.B., Risk sharing in business cycle // European Economic Review, V. 36 (2/3) 2000.  
 [10] Dikson G., Cassidy D., Gordon A., Wilkinson S., Risk Management, Prentice-Hall International, London, 2008.  
 [11] Dorfman M.S., Introduction to Risk management and Insurance, Insurance Institute of America, New York, 2009.  
 [12] Fumas V.S., Relative Performance Evaluation of Management: The Effects on Industrial Competition and Risk Sharing // International Journal of Organization, V.10 (3), 2002.  
 [13] Head G.L., Horn S., Essentials of Risk Management, Insurance Institute of America, V. 1-2, N.Y., 2001.  
 [14] Kervern G., Latest Advances in Cindynics, Paris: Economics, 1994.  
 [15] Knight F.H., Risk Uncertainty and Profit, Boston, 1921.  
 [16] March J., Shapira Z., Managerial perspectives on risk and risk taking // Management Science, V. 33 (11), 2010.  
 [17] Puschaver L., Eccles R., In Pursuit of the Upside: Opportunity in Risk Management // PW Review, December, 1996.  
 [18] Rawls S.W., Smithson C.W., Strategic Risk Management // Journal of Applied Corporate Finance, V. 2 (4), 1990.  
 [19] Risk Management: Practical Techniques to Minimize Exposure to Accidental Losses, 2-nd / Jardine Insurance Brokers Ltd., Chartered Institute of Management Accountants, London: Kogan Page Ltd., 1977.  
 [20] Snider W., Managing Business Risk – An Integral Approach, N.Y., The Economist Intelligence Unit, 1956.  
 [21] Vyatkin V., J.Hampton, Risk Management, Edited by I.Jurgens, Dashkov&Co., Moscow, 2003.

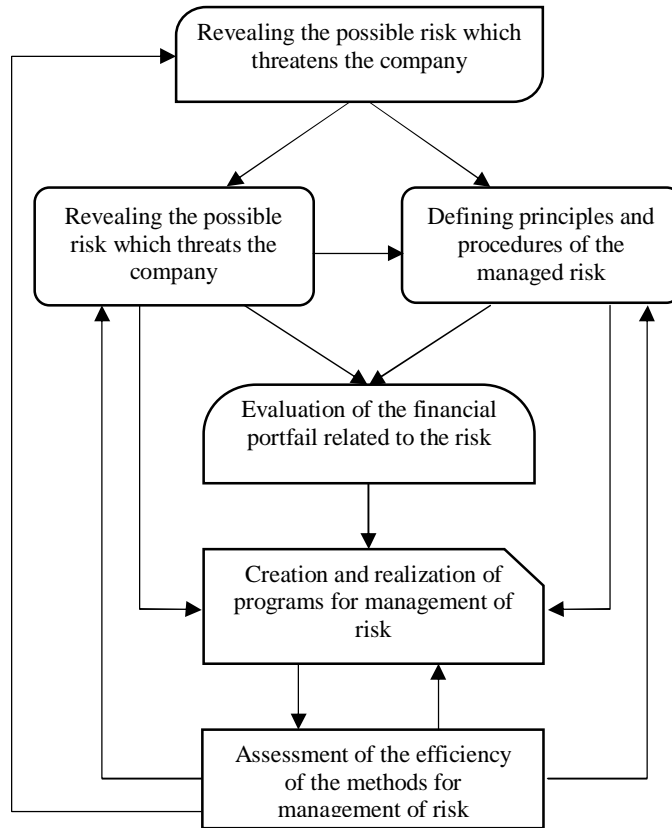
**Table 1: Basic characteristic features of the old and new paradigm of risk-management**

	<b>Old paradigm</b>		<b>New Paradigm</b>
<b>1</b>	Fragmentary risk-management Each department manages the risks independently (in accordance with its risks). This mostly refers to the accounting, financial and auditing department.	<b>1</b>	Integrated, united risk-management. The management of risk is coordinated by the senior management; each employee of the organization examines the risk-management as a part of their job.
<b>2</b>	Episodic risk-management. The management of risks is performed when the managers consider it necessary.	<b>2</b>	Continuous risk-management The process of management of risk is continuous.
<b>3</b>	Restricted risk-management. Mostly refers to insurance and financial risks.	<b>3</b>	Expanded risk-management Examines all risks and the possibilities for their organization.

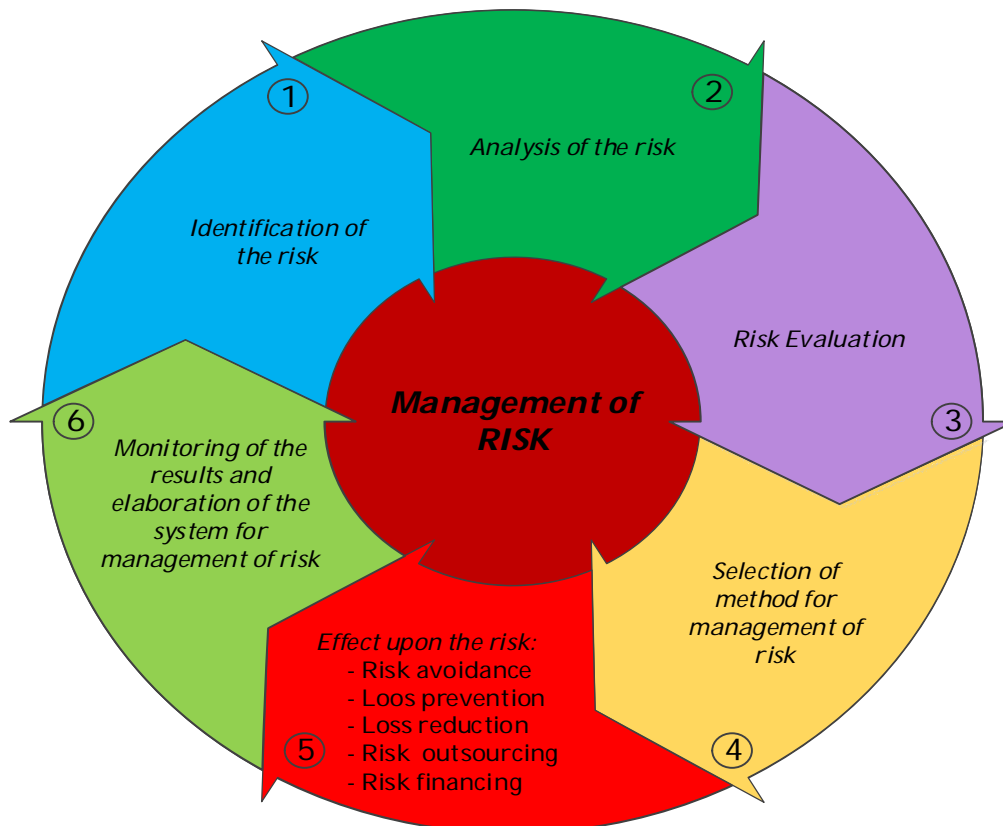
**Table 2: Classification of the methods for management of risk**

Procedures for management of risk	Group of methods	
	Methods for transformation of the risk	Methods for financing the risk
<b>1. Deviation of risk</b>	1. Rejection of the risk	1.Coverage for losses at the expense of current proceeds
<b>2. Reducing (minimizing) of risk</b>	1. Methods for distribution (differentiation of risk) 2. Methods for reducing frequency of risk 3. Method for reducing the size of losses 4. Other methods	1. Covering the losses from the current assets of the company 2. Covering the stakes from reserves 3. Covering the losses on account of credit 4. Covering the losses on account of self-insuring. 5. Other methods
<b>3. Passing the risk to external organization</b>	1. Outsourcing of risk 2. Other methods	1. Covering the losses by insurance company 2. Covering the risk on the account of state and municipality anti-crisis campaigns 3. Covering the losses by signing contract with external organization – a sponsor 4. Other methods

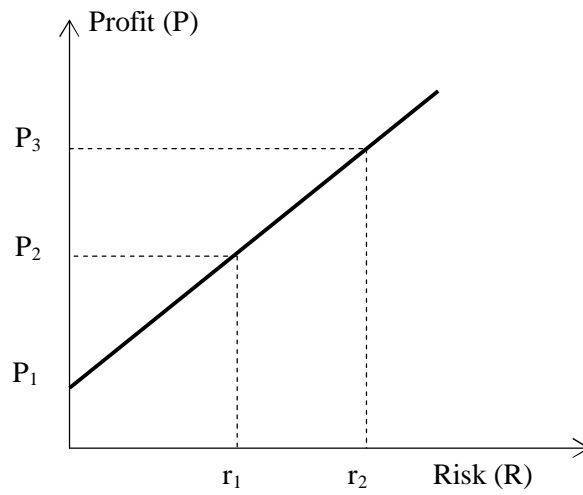
**Fig 1: Interconnection of the main groups of tasks of the system for management of risk**



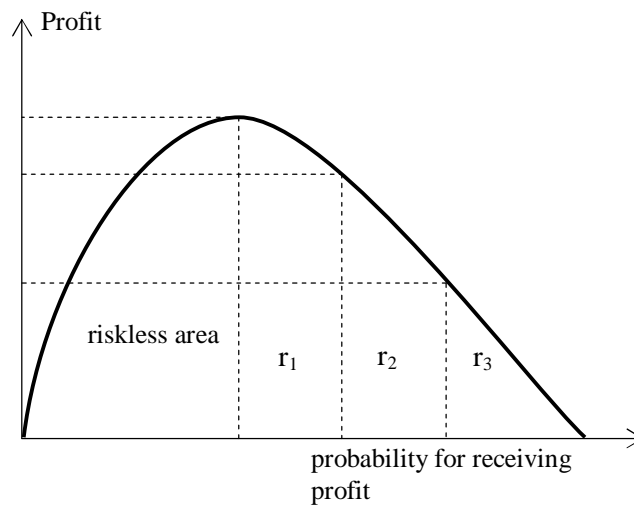
**Fig.2: Conceptual model of the process of the management of risk**



**Fig.3: Dependence of profit from on risk**



**Fig.4: Curve of the risk and the probability for gaining a certain amount of profit**



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