

# Project Risk Management: Methodological Guidance

Lilyana V. Stankova<sup>1</sup>

**Abstract** The paper offers methodological guidance for efficient project risk management. To that end, the essence of the terms “uncertainty”, “risk” and “project risk” is firstly explained; a review of the concepts and models of project risk assessment, existing in the specialized literature, is developed; the most popular and frequently used quantitative and qualitative methods for project risk assessment are presented in brief; the different elements of the project risk management process are presented in details. The thesis that project risk cannot be fully eliminated is sustained. Yet, through purposeful and continuous actions, it could be forecasted and managed.

**Index Terms:** risk, project risk, project risk management, project-oriented organizations

**JEL:** D81, O22, M21

## I. INTRODUCTION

Modern organizations tend to increasingly use the project-oriented approach as a response to the dynamically changing environment. The growth of competition, necessity of timely and adequate response to market changes, need of prompt adaptation to changes in the environment, limited resources are all only a part of the major reasons that force organizations to apply project management principles and methods.

Managing a certain project is a temporary, unique, nonrecurring activity, hiding a number of risks. This makes project management rather difficult and further consolidates the key role of the effective management in the progress of project implementation. In order to successfully cope with this task, i.e. to measure the actual outcome of the project activities on a regular basis, to compare them to the plan indicators and to forthwith take corrective measures, if necessary, it is important that the project manager know in details the complete process in the progress of project implementation, have a clear idea about the project risk management and consider “the important role of project funding as an additional source of financial resources for SME, which is significant for their sustainable growth” (Bakardzhieva, R., 2003).

Implementing a unified project risk management system will not simply ensure taking adequate actions in response to identified risks that endanger proper achievement of the project objectives in the progress of project implementation

but it will also facilitate the process of taking a positive decision for funding and initiation of the project.

Project risk cannot be fully eliminated but through purposeful and continuous actions it could be forecasted and managed. For the purpose, first, the sources of risk and the possible undesired events have to be identified and second, a risk analysis and assessment has to be made, i.e. a risk management plan has to be developed. Based on this assumption, this report provides methodological guidance for project risk management.

The presented guidelines are meant to systematize and illustrate the complete process of project risk management. They set up a framework designed to facilitate project managers in the development, implementation, and maintenance of a working system for risk management in a given project but in order to be effectively applied they have to be adjusted and further developed according to the specifics of each particular project.

## II. ESSENCE OF THE TERM RISK

It is an important prior condition for effective project risk management to elucidate the essence of the term *risk* in advance.

Some authors believe that the term *risk* originates from the Latin word *risico*, meaning danger, uncertainty. Others assume that its origin lies in the Greek work *rhiza*, meaning root and/or precipice. The word *risk* appears in many European languages and it is difficult to identify how it has entered Bulgarian. According to the Dictionary of Foreign Words in the Bulgarian Language, the word *risk* originates from (French *risqué* from Italian *risico*). The meaning of the word is described as “a possible danger”, “a hopefully successful random action” or “a possible loss”. The meaning of the identical words in German and English is analogous.

The term *risk* may be discussed from two perspectives: a positive one – the possibility of achieving better results than the ones expected after taking the risk actions, and a negative one – the possibility of suffering failure and loss (Alexandrova, M., 2009, p.40). In everyday life, the term *risk* is more frequently used as a synonym of danger and it is associated with the occurrence of unfavorable events.

Risk has four structural elements, which describe its essence:

- Risk is always associated with some kind of danger, with the possibility of something bad happening;
- Risk is always associated with taking decisions in conditions of uncertainty;

<sup>1</sup> Lilyana Stankova is with Faculty of Management and Administration, University of National and World Economy, Bulgaria

- Risk is always associated with the hope of achieving success;
- Risk can be measured.

In order to elucidate the essence of the term *risk*, we must first differentiate it from the term *uncertainty*. In general, the two terms, *risk* and *uncertainty*, are very close and even quite often used synonymously. Both terms are used to identify absence or lack of certainty, but while “risk is an unknown event, which might occur and can be assessed”, “the situation where the possibility of a certain event occurring is unknown and cannot be assessed using traditional methods or cannot be assessed at all, is called uncertainty” (Draganov, H., 2003, p. 18).

D. Dochev and R. Nikolaev define uncertainty as a source of risk, which needs to be minimized by collecting information. For the purposes of reducing uncertainty to zero, full and reliable information needs to be collected. Since practically, this is not always possible, the authors add: “This is why, when taking decisions in conditions of uncertainty, it needs to be formalized and the risk, arising out of it, needs to be assessed.” (Dochev & Nikolaev, 2007, p. 20).

In project management, the term *risk* is associated with an event or condition, which once occurring could cause positive or negative consequences for the project realization. In the context of project management, Tom DeMarco and Timothy Lister formulated the following definition for project risk: “Risk – this is a problem, which has not yet occurred, and the problem is a risk, which has already materialized. Until the moment of its manifestation, risk is simply an abstraction; it might affect the project and it also might not affect it.” (DeMarco & Lister, 2005, p.15)

Gary R. Heerkens has a similar interpretation. According to him, risk is in a close relationship with uncertainty. He defines uncertainty as an absence of information or understanding of a particular action or decision and indicates that uncertainty has a leading role in the project because, according to him, uncertainty is the one to “drive everything else”. Based on this, he also identifies the degree of risk, depending on the degree of uncertainty and availability of information. According to him, the more uncertainty grows and the less information is provided, the greater the degree of the project risk is. Gary R. Heerkens continues that the effect of the risk might be either negative or positive. The positive effect he calls an opportunity and the negative one – a threat to the project. (Heerkens, G., 2002, 142).

### III. PROJECT RISK MANAGEMENT CONCEPTIONS AND MODELS

In literature, there are a number of conceptions and models for project risk management, based on standards, tested and proven in practice. Most of them are based on the theoretical developments in the field of risk management and treat project risk management as a process, which incorporates interrelated and purposeful actions for minimizing the negative impact of risk on the project outcomes.

The project risk management model presented by Gary R. Heerkens (2002) includes four stages: (1) Identification of all important and potential problems, endangering the project; (2) Quantitative assessment of the threats to the project; (3) Analysis of the threats and deciding on which of them represents greatest danger for the project; (4) Coping threats. The contribution of this model lies within its working and relatively simple approach to project risk management, which could be used in every project, irrespectively of its specifics, both by experienced project managers and by those with less experience. An important contribution of the model to project risk management is the identification of the fields with high uncertainty – scope of the project, timeframes, budget, technologies, resources, organization and external factors. Another contribution of the model is the provided list of over 60 possible problems /classified in 10 groups – scope of the project, time schedule, marketing, materials, technology, resources, organization, personal, interpersonal, external influences/ that go along with the project realization, which, as the author suggests, could be used as a basis during the first stage, when the possible problems are identified. He recommends using this list at a meeting of as much as possible project team members and one of the options for its use that he suggests is expanding and adjusting the list to the particular project, based on the brainstorm method.

Similar to Gary R. Heerkens’ model is the project risk management model, presented by R. Lvovich, V. Ivanovich and Ya. Vasilyevich (2000). Again they present project risk management as a process but instead of potential problems, they directly speak of management of the possible risk. The stages that they define are the following: risk identification (identification of the sources and types of risk), risk assessment (analysis of the factors and conditions that influence the probability of risk events occurring), selection of techniques and means for reducing and managing the risk, risk diversification, situational control of the risk, summary of the accumulated experience.

In their model, authors draw attention to the impact on risk management that all possible participants in a certain project have, such as producers, consumers, banks, business and industrial organizations. Another important point in their model, which is usually omitted in most project risk management models, is the summary of the accumulated experience, which the authors isolate as a different stage of the process. What they recommend is collection and processing of information about risk situations, the offered solutions and the actual outcomes; description of the consequences of occurred risk events; collection of good practices, basic conclusions, recommendations and proposals to be applied in the realization of future projects.

The model presented by Razu, Broninkova, Titov and Yakutin (2006) studies project risk management as a dynamic system, based on a set of multiple factors with great depth and complex interconnections. Project management is presented as a subsystem divided in two – project risk analysis and project risk minimization. The following methods are suggested for project risk analysis:

Decision Tree, Game Theory, and Sensitivity Analysis, and the basic methods for risk minimization are defined as the following: diversification or distribution of risks, identification of a reserve of resources and insurance.

Each project risk management model is based on the assumption that the preliminary risk assessment, on one hand, facilitates identification of the most important areas that project managers should focus on, and on the other hand, provides guidance on how the duties related to its management should be distributed. The introduction of such a system provides information, based on which, apart from principle risk identification, the risk significance, probability of occurrence could also be determined and appropriate responses and techniques for its effective management could be considered.

#### IV. QUANTITATIVE AND QUALITATIVE METHODS FOR PROJECT RISK ASSESSMENT

For the purposes of project risk assessment both quantitative and qualitative methods could be used. Qualitative methods are mainly based on expert valuations, accumulated prior experience and subjectivism, while quantitative methods provide an objectively worth risk assessment. In practice, for the purposes of risk assessment and analysis, a combination of qualitative and quantitative methods is most frequently applied.

The main task of qualitative analysis in project risk assessment is to identify the sources of project risk; to define the factors that cause risk; to describe the stages and particular actions from the project life cycle, which, when implemented, could cause risk, etc., i.e. to determine the potential risk areas and thereafter, to identify all possible risks. In qualitative analysis for project risk assessment, the risk is measured in qualitative terminology, defined based on preliminary determined degrees, which allow, for example, assessment of the probability of occurrence of a particular risk as “low”, “medium” or “high”. Some of the most frequently used methods for qualitative project risk assessment are presented below.

- List of Risks – a simplified form of project risks identification; usually in the form of a table, in which typical risks are listed and classified; a specific list of the possible risks is developed for each different project; in the process of project implementation, the list could be expanded and updated;

- Brainstorm Method – a relatively easy and widely applicable method for generating thoughts and ideas related to a particular problem that has to be solved; this method allows generating a large number of ideas for a short period of time.

- Delphi Method – this method requires a collective assessment, realized with the assistance of experts; it is assumed to be one of the most reliable methods for this type of assessment; it is conducted in several stages related to the anonymous opinion of the experts and analyses of their opinion for the purposes of achieving consensus as a result; when using this method, certain conditions should

be created to ensure productive work of the committee of experts;

- Fishbone Diagram – this method allows analysis of the most important reasons for a particular problem and based on it, identification of solutions for it; defining the problematic situation and identifying the reasons could be realized using the Brainstorm Method;

- Mind Maps – (intellectual maps) are a highly effective tool for reaching information in someone’s brain – they are a creative and logical instrument for taking notes; they combine words, pictures, digits, logic, rhythm, colors and space.

The quantitative analysis in project risk assessment, on the other hand, refers to identification of the numerical values and parameters of the possible types of project risk and the risk of the project in general. Quantitative methods require thorough and detailed analysis of the existing facts, which makes them a safe and reliable source of information. One of the weaknesses of quantitative methods is related to the high costs and required competence for collection of the information and its processing. Some of the most frequently used methods for qualitative project risk assessment are presented below.

- Sensitivity Analysis – it is a method that allows quick identification of the variables, which mostly contribute to the risk in a certain project.

- Fault Tree Analysis – a structured model that presents in a graphic hierarchical form the logic of the connections between the events that cause failures in a complex system; this model analyses the functioning of the system in terms of the behavior of its building elements and in connection with the elaboration of the final assessment of its reliability and associated risk;

- Bowtie Method – in the form of diagrams, the risk path is being described and analyzed – from dangers to consequences, as well as the weaknesses in the management; it could be discussed as a combination of the logic of the Fault Tree method, analyzing the reasons for a particular event (presented as the bowtie knot), and the Event Tree, analyzing the consequences;

- Monte Carlo Simulations – a universal simulation method, which finds application in different fields of research and in practice; a basic technique for studying and modeling events with high degree of uncertainty and risk; the main advantages of the approach lie in “its accuracy (it sets up a full picture of the risk), flexibility (it allows risk managers to use different theoretical distributions and dynamic correlation dependencies), generality and opportunity to be integrated in different risk modules”.

#### V. METHODOLOGICAL GUIDANCE FOR PROJECT RISK MANAGEMENT

Project risk management is viewed as a process, which incorporates risk identification, analysis, assessment, counteraction, monitoring and control, aiming strengthening the positive and reducing the negative consequences of the risk events occurring during project realization. In literature, there are many models and

conceptions of the different stages of the process of risk management. The described models mostly concur and mainly differ in the way the activities, included in the process, are grouped, in their number and sequence.

Based on a thorough analysis of the existing models that describe the different stages of the project risk management process, for the purposes of this report, a project risk management model is developed (see Fig. 1). Each of the stages of the process is elaborated in details in terms of the activities it incorporates, the methods that could be used, the work maps that are to be filled, the people in charge of the different activities and the expected outcomes of each stage.

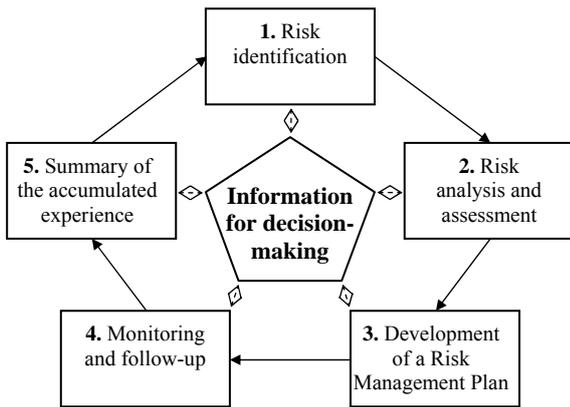


Fig. 1. Project risk management methodological diagram

**Stage 1: Risk identification.**

Identification of the risks that affect the project (positively or negatively) and documentation of their specifics. For the purposes of risk identification, the risk areas and the sources of risk for the project are studied and defined. The final product of this stage is a filled card of potential risk events (see Fig. 2).

Risk factors and potential risk events	
Project:	
Period of project realization:	
Filling date:	
Used method: /questionnaires, brainstorm, scenario method, focus groups.../	
Participants:	
<u>Factors:</u>	<u>Potential risk events:</u>
1.	1.1. 1.2. ...
2.	2.1. 2.2. ...

Fig. 2. Risk factors and potential risk events

Risk identification comprises the following activities:

1. Systematic study of all aspects of the activities, included in the project;
2. Defining project risk factors / sources of risk;

3. Determining potential risk events;
4. Documentation of the possible risks.

Risk identification is realized by the application of a number of methods and techniques for finding and defining the possible risks. Some of the most frequently used methods are: Brainstorm, Scenario Method; Focus Groups; STEEP Analysis; SWOT Analysis, etc.

**Stage 2: Risk analysis and assessment**

Risk analysis studies the identified risks and seeks the possible reasons for them. Based on this, the risks are assessed in terms of their probability of occurrence and in terms of the potential negative consequences for the project. The final product of this stage is filling in a risk assessment card, which indicates values of the probabilities of risk occurrence and values of the consequences of occurred risks (see Fig. 3).

In determining the risk components and level for different risk events, the degrees with their respective numerical values from tables 1 and 2 are used. Once the risk elements are determined, the risk ranking is identified. (see Table 3) The risk ranking is calculated according to the following formula:  $R = P * (C_T + C_B + C_Q) / 3$

Probability (P) is coded as specified in Table 1, consequences (C) are coded as specified in Table 2 and the risk is classified in degrees as specified in Table 3. Based on the number of identified risks in each of the above degrees, the project can be generally classified, as specified in Fig. 4.

TABLE 1  
PROBABILITY

Coefficient	Description of the Probability
0	Practically impossible
1	Probability is small
2	Probability is below average
3	Probability is average
4	Probability is above average
5	Probability is high

TABLE 2  
CONSEQUENCES

Coefficient	Description of the Consequences
0	No consequences
1	Little
2	Significant
3	Serious
4	Dangerous
5	Catastrophic

TABLE 3  
RISK

Degree	Ranking	Description of the risk
I	0 – 1	Insignificant, minimum risk
II	2 – 4	Acceptable, not high risk – attention required
III	5 – 9	Moderate risk – measures for reducing it required
IV	10 – 16	High risk – measures need to be immediately taken
V	17 – 25	Critical risk – suspension of the activity until elimination of the risk

Risk assessment card						
Project:						
Period of project realization:						
Filling date:						
Participants:						
Risk event	Probability of occurrence	Consequences on			Risk $R=P*(C_T+C_B+C_Q)/3$	Classification
		timeframe	budget	quality		
1. Factor 1.1. ... 1.2. ... ...						

Note:  $B$  – Probability of risk event occurrence,  $C_T$  – Consequences on timeframe,  $C_B$  – Consequences on budget,  $C_Q$  – Consequences on quality,  $R$  – Risk

Fig. 3. Risk assessment card

		Degree of risk				
		I	II	III	IV	V
Project classification	Critically risky	Random number	Random number	Random number	Random number	More than 1
	Highly risky	Random number	Random number	Random number	Random number	None
	Risky	Random number	Random number	More than 5	None	None
	Moderately risky	Random number	Random number	Between 1 and 5	None	None
	Low risky	Random number	Random number	None	None	None

Fig. 4. Project classification

At this stage, in order to effectively assess the risk, the following activities are to be carried out:

1. Analyzing each identified risk for the purposes of determining the probability of occurrence;
2. Analyzing each identified risk for the purposes of determining the expected consequences in terms of the preliminary planned project timeframes, budget and quality;
3. Documentation of the results from the risk analysis and assessment.

Risk assessment is not a one-time action. It is to be conducted periodically during the progress of performance of the activities, incorporated in the project. The values of the identified risk events are most frequently determined

using: past experience – records, documents, statistics; expert knowledge and valuations.

Stage 3: Development of a risk management plan

The goal of the risk management plan is to develop in advance measures that are specific to each risk event, aiming reduction of the risk to the set acceptable levels. For the development of these measures, additional joint work and cooperation with specialists and experts may be required. The counteractive measures could be focused on reducing the probability of occurrence of the risk and/or on limiting the scope of the expected consequences. The final product of this stage is the development of a risk management plan. (see Fig. 5).

Risk Management Plan				
Project:				
Period of project realization:				
Filling date:				
Participants:				
Identified risk event	Classification	Required measures for management and control of the identified risk events	Roles, rights, responsibilities	Additional resources for risk management
1. Factor 1.1. 1.2. ...				
2. Factor 2.1. 2.2. ...				

Fig. 5. Risk Management Plan

The development of a risk management plan comprises the following activities:

1. Accurate defining of the counteraction measures;
2. Selection of the participants in the process – roles, rights, responsibilities;
3. Planning additional resources for risk management.

The action plan must be realistic and the basic requirements for the risk counteractive measures are that they are effective and efficient. For the development of these measures, additional joint work and cooperation with specialists and experts may be required.

**Stage 4: Monitoring and follow-up of the risk management process**

Monitoring and follow-up of the risk management process is realized by continuous and systematic supervision of the risks and reporting on their status, the purpose being to keep track of how successfully risks are being managed.

The identified risks could change under the influence of different external and internal for the project factors. Therefore, continuous supervision and regular review of the activities related to project risk management is of primary importance. The regularity of control supervision depends on the degree, scope and duration of the project. For the purposes of effective follow-up of the risk management process and taking timely measures, summary of the control observations at the end of each different activity, incorporated in the project, is required.

Effective follow-up of the risk management process involves the following activities:

- Introduction of an internal reporting procedure for identification of the risks, in adherence to the requirements for timeliness, regularity and thoroughness;

- Review, analysis and documentation of the status of the identified risks on a regular basis.

All newly arising problems and changes as a result of the changes in environment are to be entered in the Adjusted Risk Management Plan card (see Fig. 6). It is advisable to get the information from this card visualized on a notice-board, made visible and accessible to all participants in the project.

The responsibilities for effective follow-up of the risk management process are distributed as follows:

- The project manager is in charge of the risk management; he endorses the risk management rules and reports to the superior bodies within the set deadlines and in case of occurrence of critical risks;

- Project team members – they take part in the risk management processes by applying certain control procedures, adhering to the set rules and timely informing the project manager about any occurred problems and found violations;

- For bigger and more complex projects, appointment of a Project Risk Coordinator is advisable, who is in charge of filling and announcing the risk register, keeps documental reports on risk management, provides updated information to the project manager on the risk register and the plan for realization of control activities in project risk management.

Adjusted Risk Management Plan						
Date of problem arising	Description of the problem	Name of the person, who has registered the problem	Required actions	Person in charge	Deadline	Status

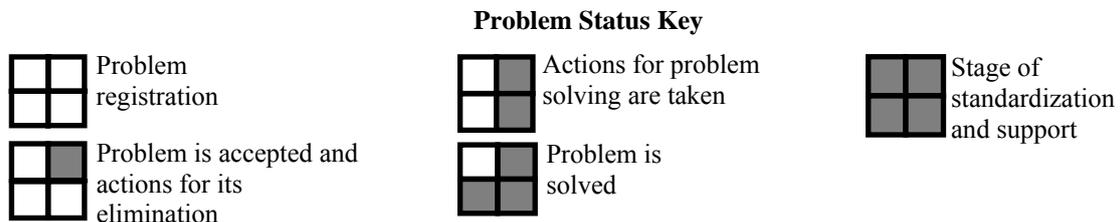


Fig. 6. Adjusted Risk Management Plan

**Stage 5: Summary of the accumulated experience**

The last stage of the project risk management process comprises an analysis and summary of the accumulated experience and identification of the good practices. The main goal of this stage is development of a final report to document the complete information on project risk management, which will be useful not only to the project

manager, team members and interested participants, but also to any future managers, who could use the gathered information while planning their future projects.

The final product of this stage is the development of a report, containing a summary of the accumulated experience (see Fig. 7).

Summary of the accumulated experience	
Project:	
Period of project realization:	
Filling date:	
Participants:	
Successful activities: 1. 2. ...	Conclusions:
Unsuccessful activities: 1. 2. ...	Ideas:
<u>To reduce:</u>	<u>To increase:</u>
<u>To stop:</u>	<u>To begin:</u>

Fig. 7. Summary of the accumulated experience

## VI. REQUIREMENTS TO PROJECT MANAGERS FOR EFFECTIVE PROJECT RISK MANAGEMENT

The main requirements that should be met by project managers in project risk management are:

- Project managers should treat risk management as a priority process. They should pay special attention to the factors that represent a drawback to achieving the project goals and take the required actions.
- A key factor to effective project risk management is the understanding and commitment to this process of both the project manager and the project team members.
- A main precondition for effective project risk management is setting up clear objectives. Each objective should meet the following criteria: specific, measurable, achievable, realistic and time-bound. (SMART technology for setting objectives). The proper formulation of the project objectives is decisive for the concrete risk identification.
- Project objectives should be understood by all project team members, which will ensure their achievement by realizing particular actions and tasks.
- The complete project risk management process (decisions made and actions taken for management of the identified risks) should be documented.
- Project managers should ensure regular review of the complete process for the purposes of its timely and proper updating.
- Before application, the presented project risk management model should be adjusted to the specifics of the particular project.

## VII. CONCLUSION

Due to its complexity, project realization can often face unexpected problems that lead to falling behind deadlines, exceeding budgets and even development of a product below the level of the set standards. Although these problems cannot be fully eliminated, they can be controlled by the application of risk management methods, which could help for solving the problems before they arise.

The organizations that apply procedures and techniques for risk management have greater control on the overall project management and considerably increase their chances of achieving the project objectives within the limits of the provided resources, budgets and set deadlines.

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