ANALYSIS OF ECONOMIC RISK IN EUROPEAN INVESTMENT PROJECTS

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Abstract: *Risk is a reality of the economic environment, with consequences which cannot always be foreseen or anticipated. Risk management becomes more stringent as potential exo/endogenous vulnerability factors are rapidly increasing. Identifying risk areas, structuring risk factors and defining their probability, optimal management of resources in order to reduce risk factors, creating alternatives for each high-probability risk factor are part of project risk management. Risk is quantified through probability and incidence and is assessed using quantitative and qualitative methods.*

Keywords: *risk, risk management, risk methods, risk analysis in European projects*

Jel Classification*: C44; D81; G31.*

Introduction

Risk is taken into account in any economic field, with consequences which cannot always be foreseen or anticipated. Risk occurs because future actions or events are unknown; almost any change induces a certain risk. Risk is *omnipresent* – any activity or project must take into account that a risk situation may occur. Risk describes the possibility for an anticipated result to be better or worse than expected (different than expected), which is a characteristic quality

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that emphasizes the equivalence of the risk with the variability of potential results. Most times, *the risk connotation is negative*[1], managers, investors and ordinary people being interested especially in the non-capitalization of certain earnings. Recently, risk is also perceived as the possibility to obtain better results than anticipated – for instance, in describing the risk of a project, *Project Management Institute*[2] mentions that "*the risk of the project includes both threats to the project's objectives and opportunities to improve these objectives*".

Management and risk analysis in projects

Risk management[3] (RM) is defined as the management of uncertain events in order to achieve success. The term "risk management" appeared for the first time in the 1950s when integrated, independent departments whose tasks concerned the insurance programs of the enterprise, as well as loss control, industrial safety and accident prevention were created within enterprises. The suggestion was then made that such departments should be run by a *risk manager* instead of an insurance manager.

Risk management is increasingly considered a general function of the organization's management whose objective is to identify, analyze and control causes and effects of uncertainty and risks within an organization[4].

Risk management is characterized by the methods and means through which risk is managed in order to meet the objectives described in the technical, social, human or political event that needs to be analyzed, uncertainty being the major basis for risk factors (Rogester, 2003).

Risk management uses the following three fundamental components**: risk assessment, planning the response to risk factors, risk monitoring and control**.

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[1] A first definition for risk, to this effect, is credited to Abraham Moivre (1711) in the work "*De Mensura Sortis*", who specified that "the risk of losing any sum is the opposite of what is expected and its extent depends on the "hazardous" sum and the chances of losing".

[2] *Guide to the Project Management Bogy of Knowledge*, Project Management Institute, 2004

[3] One of the most important standards in *The Internal Control Framework*, approved through the Ordinance no. 946/2005 of the Minister of Public Finance, is the standard regarding risk management. According to this standard, every public entity must analyze systematically at least once a year risks related to its activities, elaborate adequate plans in order to limit possible consequences of these risks and to designate people to apply these plans.

[4] Arthur, Williams, *Risk Management and Insurance*, 7th edition, New York, McGraw-Hill, 1995, pp. 27-29.

A. **Risk assessment involves** the systematic search for risk factors within the event that needs to be carried out.

B. **Planning the response to risk factors is done by** identifying every risk according to its type and severity degree for the analyzed event, as well as by finding an adequate response strategy for each case.

C. **Risk monitoring and control** concerns the implementation of response strategies and the monitoring of effects these changes can bring to the analyzed event.

Risk management is influenced by a multitude of factors that can occur randomly, and are hard to define, and therefore, hard to manage. Among **the factors influencing risk management**, we find:

- Particularity
- Indecision
- Complexity
- Non-isomorphism, non-auto-isomorphism
- Lack of information
- Direct responsibility
- Information flood

While studying managerial behavior, Mac Crimmon and Wehrung noticed that one of the techniques used by administrators of certain institutions in relation to how risks are approached is avoiding them and postponing decisions by appointing other people to carry out managerial activities (*apud.* Knutson, 2001). Other opinions in this field show that managers avoid facing risk because they see it as a controllable element, not accepting its uncertainty and implicitly its inherent acceptance. In this regard, Keyes shows how entrepreneurial-oriented and risk-aware people try to overcome the uncertainties of destiny rather than accepting risks.

Project risk management is the process of systematically approaching risks within a project. Risk management is a process of planning, identifying, analyzing, monitoring, controlling and offering solutions to the potential risk of the project.

The risk management process includes many different elements from the original identification and risk analysis to the evaluation of tolerability and identification of

options to reduce potential risks, undergoing selection, implementation and supervision of adequate measures to reduce and keep control of risks.

Of all the identified risks, the organization will take into account the analysis of only some of them, more precisely, the ones capable to cause substantial losses. As regards certain projects, risks may be so serious that a complete reevaluation is necessary in order to lessen or remove some of them from the design phase.

A risk management plan must be elaborated for every project. A reference risk plan model is used to carry out the plan.

After the plan is validated by the CEO, it is revised periodically by the Project Manager while the project is being carried out, usually at the end of each month.

An element of the project, referenced as (a), can be considered a risk element if the following two conditions are simultaneously met:

$0 < P(a) < 1$ $\qquad$ $L(a) = Ø$

where:

P (a) = the probability of an event (a) to occur

E (a) = the effect of the event (a) on the project

L (a) = the monetary evaluation of E (a)

Project risk management includes the following processes: **planning, identification, qualitative analysis, quantitative analysis, communication and planning a response to risk.**

A. Risk identification

In the risk identification phase, potential dangers, their effects on the project and the probability of their occurrence are assessed, in order to decide which risk must be prevented. Risk identification must be made regularly in the course of the entire project. This must take into account both internal and external risks.

Risk analysis tools allow the project team to make *an estimation in terms of complexity, probability and severity*. This estimation is made in a simple manner and must not be considered a very precise evaluation tool. This step tries to offer indications concerning risks considered important, in order to take the most effective prevention and protection measures.

The risk assessment phase based on the use of risk *analysis methods* mainly allows the hierarchical classification of identified risks. A detailed analysis is mandatory for major risks. This evaluation starts with incident scenarios, through models conceived according to the complexity of the involved phenomena and environment.

A. Risk analysis
The risk analysis phase takes into consideration risks identified in the first phase and carries out an in-depth quantification.

B. Communication
Most risk analysis methods have maximum effectiveness when applied within a multidisciplinary work team. In this regard, the methods are tools of information exchange and communication between people with different specializations and different ways of approaching problem management. The value and importance of methods are not direct results from basic principles, but rather from the experience of the risk analysis team members. Various experiences acquired in similar previous situations are discussed during analysis meetings, with the purpose of carrying out a realistic overall analysis on the safety of the analyzed project.

C. Response to risk
The response to risk is the action phase within the risk management cycle with the purpose of: removing risks; reducing risks and/or assigning risks. These actions take place according to a risk management plan which includes actions that will be used to manage and overcome risks, by people responsible for certain actions in various risk fields, resources assigned to this effect, and find how results obtained in risk management are estimated.

Risk management aims at a reduction of risks, regardless of their nature, along with the achievement of the project objectives, which involves changes in the outlook and structure of decisions. The basis of risk management is the in-depth evaluation of relations, doubled by intense anticipative efforts.

The process of risk management helps project sponsors/beneficiaries and project teams popularize decisions regarding the project's possibilities.

Analysis of economic risk within investment projects

Risk analysis involves the systematic evaluation of risks which an organization is subject to. The first step consists in identifying threats which the organization is subject to, then in estimating the capitalization probability for every threat, as

well as the effect it can have on the organization's activities. Every risk is associated with a value of its occurrence probability (how often the specific risk usually occurs in a year), then the level of the impact on the organization is estimated (the gravity). The results of the values from these two columns represent the loss probability caused by the respective risk. Which risks must be approached first and what resources are necessary for these measures are determined according to this data. The organization may be subject to a high risk, but with an unnoticeable occurrence probability, therefore at an intermediate level. On the other hand, certain low risks can occur often, the cumulated effect being significant. The risk has two main components for a given event:

- *The occurrence probability* of the event
- The impact of this occurrence (*the magnitude* of the risk)

Conceptually, for any event, risk can be defined according to *probability* and *impact*:

Risk = f (probability, impact)

This way, if the occurrence probability or its impact rises, the risk increases, hence why both must be carefully taken into consideration in risk management. The risk can be presented according to its components – Figure 1.

Figure 1. The risk probability according to impact

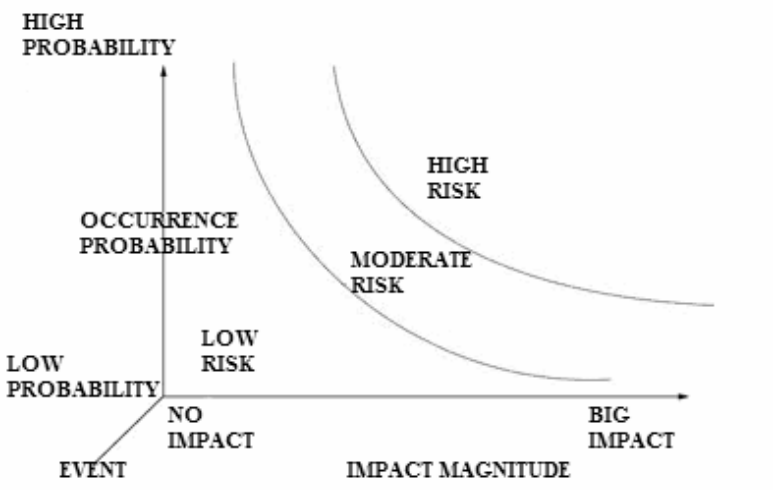


Table 1. Risk analysis according to the risk level

Impact severity of the risk / the occurrence probability of the risk	*General risk level*
High level negative impact / High occurrence probability	High
High level negative impact / Intermediate occurrence probability	High
High level negative impact / Low occurrence probability	Intermediate / Low
Intermediate level negative impact / High occurrence probability	Intermediate
Intermediate level negative impact / Intermediate occurrence probability	Intermediate / Low
Intermediate level negative impact / Low occurrence probability	Low
Low level negative impact / High occurrence probability	Low
Low level negative impact / Intermediate occurrence probability	Low
Low level negative impact / Low occurrence probability	Low

For more precision, the number of options for risk probability can be increased. For instance, a scale of 5 values can be created for probability – Table 2:

Table 2. Risk probability according to the impact level

Probability	*Low level impact*	*Intermediate level impact*	*High level impact*
Very improbable (<10%)	Low	Low	Low
Improbable (<35%)	Low	Low	Intermediate
Possible (35% - 65%)	Low	Intermediate	Intermediate / High
Probable (>65%)	Low	Intermediate / High	High
Very probable (>90%)	Low	Intermediate / High	High

Another example of introducing a higher precision is risk impact. Instead of a low, intermediate and high impact scale, a more elaborate system can be introduced. For instance, a scale of 5 values can be introduced, as follows:

- 1, low impact (or no impact) on the cost and the program
- 2, possible impact, 2%-4% on the cost **or** the program
- 3, possible impact, 5%-7% on the budget **or** the program
- 4, possible impact, 8%-10% on the budget **or** the program
- 5, high, possible impact, over 10% on the budget **or** the program.

As for **the investment economic risk analysis**, we present various theoretical, methodological and qualitative analysis aspects for single investment projects or a portfolio and various quantitative methods for the estimation of economic risk.

The operational risk (OR) and ***the financial one (FR)*** are the main forms of economic risk, both categories are risks evaluated usually for establishing the internal capital budget (they are relevant for international investment projects as well).

● *OR* concerns the probability of occurrence of various existing cash flow evolutions in a certain business sector, but independent from the country's political risk (the probability of a certain number of economic units to be sold at a given selling price). Economic activities with an acute cyclical character (which produce capital goods, e.g. in metallurgy or ferrous metallurgy) have a higher operational risk than non-cyclical ones (e.g. from food product manufacturing and disassembly).

OR refers to the relative dispersion (or variability) of the company's earnings before interest and taxes (*EBIT*). OR is measured through the coefficient of variation of EBIT – the bigger the coefficient of variation is, the more acute the OR is.

OR is determined mainly by the nature of the company's activity (as a function of the branch the company works in). Among the influence factors, we mention: the sensitivity of general economic fluctuation sales, the intensity of the competition and the company's dimension, the fixed cost ratio (the higher the fixed cost percentage in contrast with variable ones is, the bigger the exploitation activity dependence and the business risk is), the variability of prices for raw materials , the capacity to adapt flexible negotiable prices.

● FR refers to the variability of earnings caused by various ways a project can be financed. As loans are bigger or the capital structure is increasingly based on preferential actions, the probability that the company cannot is not able to pay preferential actions during a given period rises; the risk of the respective company's investors rises accordingly as well. This translates into a higher rate of return for investors (especially for share holders that have a right to remuneration only after primary investors/creditors have been paid).

FR is a result of long-term financing decisions adopted by the company and refers to: the increased variability of earnings available for usual shareholders of the company and to the high probability of financial difficulties felt by the company's owners if the company resorts to debt. (The debt requires that the company uses the financing means which materialize in fixed costs and

generally resorts to the following sources: bank loans, bonds, leasing contracts, preferential actions, etc.).

Besides OR and FR, **an international investment project** also presents risks generated by the monetary conditions' instability (the inflation risk and the currency exchange rate). Even when the project leads to a certain sale of an amount of products at a given price – a project with a low operational risk – uncertainties related to cash flows obtained from sales according to currency exchange flow fluctuations and the inflation rate are taken into account. A company's capacity to increase the price of its products depends on the existing request for these products, the competitive environment the company works in and the governmental regulations as far as prices are concerned. The impact of the monetary and currency context on the local cost of the capital depends on the efficiency of the local financial market and the capacity to anticipate future inflation rates. If a project cannot adapt quickly to changes in the currency exchange rate and the increase in prices, earnings will depend on how big these changes are and how receptive the project is.

The minimization of these monetary risks involves the signing of long-term contracts in which measures of anticipating effects of such fluctuations are taken. For instance, a manager could establish selling prices adjustable to the increase in the inflation rate or to the fluctuations of the national currency exchange rate. This type of economic risk is somewhat voluntary; economic agents engage consciously and deliberately in "risk-bearing" actions/activities. The risk is generated by the uncertainty of making a "precise" forecast for the future or caused by numerous imprecision factors (incomplete pieces of information or estimation errors, indicators with measurement deviations, etc. can be provided).

Nevertheless, what most risk analyses have in common is the attempt to find an answer to at least two questions: *which is the minimum security level* or *what does "certain enough" mean* and *which is the acceptable risk level*. Because the company's action takes place in a general economic environment, there are numerous factors determining the variability of its economic performance (turnover, productivity, etc.), with consequences on financial performance (gross profit, liquidity flow, etc.). The institution inherently confronts an *economic* risk caused by the unpredictability of certain general economic factors and the capacity to control them. Apart from these, there is also a *financial* risk which occurs when the institution resorts to sources with a predilection for financing. As for the investment decision, risk involves any situation in which the characteristics of a future event are not precisely known, but at least the number of possible investment alternatives and the occurrence probability of certain

future events relevant for the success of the investment project are known. Among the **risk sources** in the investment decision we find:

- errors in the analysis of the investment opportunity;
- the estimation of data regarding an investment project (decrease through the forecasting theory);
- the incorrect evaluation of certain phenomena or economic processes;
- unpredictable change of the economic environment;
- the complexity of the economic environment and the extent of the project.

Methods of measuring risk in investment projects

A risk analysis model[1] can be based on three general elements: variability, risk cost and risk „treatment" (solution). *Variability*[2] refers to the significance of the loss, the importance and magnitude of the consequences. The risk cost evaluates the significance of probable and possible losses. The risk treatment corresponds to all the techniques an economic agent employs in order to decrease consequences and, implicitly, the risk cost.

The qualitative analysis of the risk is the process of carrying out an evaluation of qualitative nature of risks identified in the previous stage. This

[1] The approach known as *risk analysis* was developed by Herz and Hespos-Strasman, based on H. Markowitz's research regarding portfolio selection and investment diversification. Previously, uncertainty in the investment theory had been approached in a necessitarian manner – in the uncertainty hypothesis manifested through a single estimation of the interest variable. The main limit of the necessitarian analysis consists in the estimation of a punctual value (considered the best) for every significant variable, so that the distribution of probabilities for every factor impacting a decision is not taken into account. The very procedure of the three estimations (the optimistic one, the more probable one and the pessimistic one), although partially completes the prediction limitations through unique values, describes however narrowly the amount of possible results. In essence, risk analysis suggests applying the probability distributions identified for all key variables influencing the evolution of an investment and the determination of the distribution law characteristics for a performance indicator through a variety of techniques – for instance, the discounted net income.

[2] Variability is the maximum level of losses (prejudice) which can be associated with taking such a risk. If the risk could be totally assured, variability would be null. Since this does not actually happen, unwanted events are also evaluated. This is why the risk management cost is given by the sum of all expenses related to the presumptive risk.

process establishes a risk priority, according to their potential effect on the project objectives. Qualitative analysis is a way of determining the importance of identified risks and a guide for the measures for solving risk; this requires the estimation of the probability and the impact of the risk, by using qualitative analysis methods and techniques. *This process must be redone during a project life cycle* (for instance), in order to reflect changes occurred within the project and changes in the project risk. The results of this process can lead to a quantitative analysis of the risk or directly to the planning of the solution to risk.

Table 3. Qualitative risk analysis means and techniques

1) Probability and risk impact: they are described in qualitative terms (very high, high, moderate, low or very low). These risk dimensions apply to the specific risks and not to the entire project. Risk analysis helps us identify risks with major consequences on the project and risks against which actions must be taken.
2) The risk score matrix: it is a matrix created by combining probability and impact scales. The risk probability scale has values between 0 (the probability of an impossible event) and 1 (the probability of a certain event). A general scale contains the values 0.10, 0.30, 0.50, 0.70, 0.90. The risk impact scale reflects the severity of risk impact on the project objectives. The scale usually has values 0.05, 0.10, 0.20, 0.40, 0.80.
3) The testing of the project hypotheses: the identified hypotheses must be tested according to two criteria: establishing the hypothesis and its impact on the project if the hypothesis is false. In this situation, real alternative hypotheses must be identified and their impact on the project objectives must be tested in the qualitative analysis process.
4) Data precision classification: a qualitative risk analysis that requires precise data to help project management. The classification technique of data precision evaluates the extent to which risk-related data are useful for risk management. This involves the evaluation of data as far as quality, integrity and reliability go.

Quantitative risk ***analysis*** is the process meant to carry out a numerical evaluation of the probability and impact of every risk on the project objectives and their influence on the general risk of the project. This process used quantitative *techniques* (such as the Monte Carlo simulation, the sensitivity analysis and the decision tree analysis) in order to develop valid *models* to:

1. determine the probability of not meeting the project's specific objectives;
2. quantify the project's exposure to risk and to determine the amount of unforeseen reserves for costs and for the program which might be necessary;
3. identify the risks requiring a bigger attention by quantifying their contribution related to the general risk of the project;

4. identify realistically the costs, program and objectives that can be met.

In general, quantitatively oriented methods derive from the scientific method (developed by F. Bacon and later by E. Descartes) and they involve the following steps:

1. Observation – consists in attentively observing the phenomenon that defines the problem: facts, opinions, symptoms, etc. Identifying the problem takes place during this step.
2. Defining the real problem – is made by attentively analyzing all the factors and parties involved in the respective problem.
3. Developing alternative solutions – various evolutions of the action or solutions to the real problem are described. If possible, by using an automatic calculating system – a computer – quantitative models can be developed.
4. Selecting the optimal solution – the various quantitative models/solutions are evaluated until an optimal one is found. If mathematical ratios are too complex, a customized model can be developed in order to choose the optimal solution or sensitivity analyses can be carried out.
5. Verifying the optimal solution – involves determining a target population and implementing the solution on this population.
6. Establishing the adequate verification and validation – a solution remains optimal as long as the original (undistorted) cause-effect type relations are kept.

Figure 2. The total portfolio risk – the portfolio risk variation according to the size of the portfolio

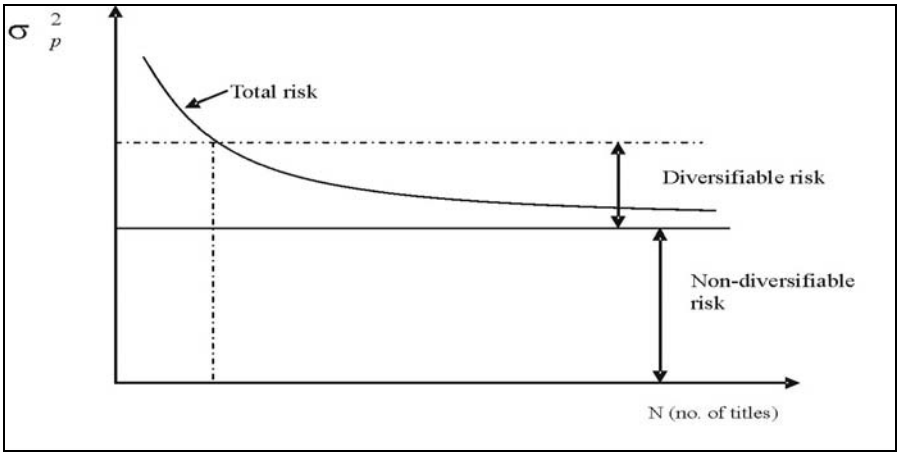


Figure 2 emphasizes the fact that however big the effect of the diversification may be, the risk cannot be totally diminished (removed), the common risk portion of all titles on the financial market remains. Risk evaluation includes both the identification of risk factors and cause-effect type evaluation, the occurrence probabilities and the "severity" of associated negative consequences.

A. CASE STUDY: FEATURES OF RISK MANAGEMENT IN EUROPEAN FRAMEWORK PROGRAM 7 PROJECTS

Well-managed European Framework Program 7 projects, which apply best practices, use management techniques and implement them according to the established rules, do not have delays in delivering results or large budget deviations. **Risk management** is part of best practice and contributes to a harmonious implementation and development. By focusing on risk management in the planning stage of the project and on implementing the strategy that reduces risks the potential costly surprises can be avoided. A very rigorous risk management supports the project manager in maintaining the project within limits (budget and time) and in the direction established upon its definition. Adopting a risk management process promotes an open decision-making mechanism and improves communication among team members, on the one hand, and between the project team and stakeholders, on the other hand. It also presents to the upper hierarchies of the organizations participating in the Framework Program a register of major risks which affect the project and the mechanisms which ensure that resources are allocated to high risk areas.

The risk management plan must include the following:

- The description of each risk and how it may affect the project
- The probability of that risk to occur and its associated impact
- A rating of the risk (severe, major, moderate, minor, insignificant)
- The description of the minimizing strategy for each risk, which may comprise specific actions
- The persons in charge of each action and particularly in charge of the impact mitigation strategy

Project risks are generally identified and analyzed by a large number of people, including stakeholders. From the perspective of the organization, identifying risks and establishing the intervention plan (including the necessary corrective actions) can be done in a single meeting. For small projects, it is enough that

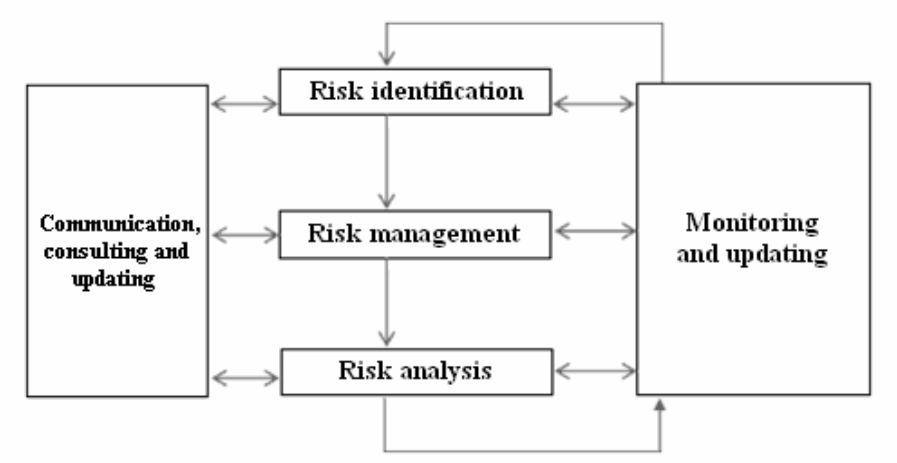
risks be analyzed by the project manager (who also proposes the intervention plan) and these should be approved by the Management Committee of the project. The analysis process involves discussions related to potential risks. Each project has individual risks; therefore, management strategies are unique as well.

Risk minimizing strategies are generally of two types:

- *Preventive:* comprising actions required in order to reduce the risk and its related impact;
- *Emergency:* comprising actions aimed at reducing the impact of the risk, in case it occurs.

Risk management is not an activity that begins and ends at a specific date; it is a continuous activity, because new risks (types of risks) may occur simultaneously to project implementation. Therefore, risk minimizing strategies must be monitored and reviewed regularly by the project manager. Communication of (potential) risks must also be regularly directed to stakeholders. The risk plan must be updated, because risk factors are changing. The figure below presents an implementation diagram for the risk management process.

Figure 3. The main elements of the risk management process



Identifying risk areas, structuring risk factors and defining the probability of their occurrence, optimal management of resources for reducing risk factors, creating

alternatives for each risk factor with high occurrence probability are all part of project risk management. There is no easy way to identify all the risks of a project. The risk register is an essential part of documentation for the project. It lists the identified risks, the probability of their occurrence and their consequences on the project.

A risk register template is presented below.

Table 4. Risk register template

Risk no.	Person in charge	Risk description	Probability	Impact	Strategies	Current position
1						
2						
3						
4						
etc.						

All risks will be ranked in terms of probability of occurrence, on a scale of 1 to 5, as presented in Table 3. This template involves various degrees of risk severity, measured by combining impact and probability of occurrence.

Table 5. Grading scale for risk assessment in European FP7 projects

Impact		Probability	
5	Fundamental	5	Almost certain
4	Major	4	Probable
3	Moderate	3	Possible
2	Minor	2	Improbable
1	Insignificant	1	Rare

The grades given to risks fall into three categories:

a) Risks with a score lower than 10 can be managed and monitored using existing management processes

b) Risks scoring between 12 and 16 must be managed so as to ensure a residual risk lower than 10 (see above)

c) Risks with a score higher or equal to 20 must be considered very serious. Risk management strategies must be adopted and implemented, so that the

risk would be eliminated or minimized in a reasonable period of time. Continuous monitoring is necessary.

Table 6. Method of assessing risk in European FP7 projects

Severity of impact	Multiplier					
Fundamental	5	5	10	15	20	25
Major	4	4	8	12	16	20
Moderate	3	3	6	9	12	15
Minor	2	2	4	6	8	10
Insignificant	1	1	2	3	4	5
	Multiplier	1	2	3	4	5
Probability of occurrence		Rare	Improbable	Possible	Probable	Almost certain

Table 7. Risk degree matrix

	Grade	
Fundamental	20-25	Unacceptable level of risk exposure which requires immediate corrective actions
Major	12-16	Unacceptable level of risk exposure which requires continuous monitoring and exposure reduction measures
Moderate	5-10	Accepted level of risk exposure, but continuous active measures for risk monitoring are required
Minor	3-4	Accepted level of risk exposure, but passive measures for risk monitoring are required
Insignificant	1-2	Accepted level of risk exposure, but periodic measures for risk monitoring are required

In order to identify risks associated to a project, the following techniques are used:

1. Brainstorming sessions;
2. Questionnaires and interviews;
3. Analysis of final reports of other projects;
4. Scenario method;
5. System analysis;
6. Knowledge and personal experience of team members.

Consolidating the optimal decision in the decision-making process of risk management is done using the method of expected value, through the calculation of an indicator such as *mathematical hope* or *expected value*. Thus, for each decision variant, the expected value is calculated:

$$VM_i = \sum_{i=1}^{n} p_j C_{ij} \; ; \; i = 1,\ldots,m,$$

where: p_j represents the probabilities associated to states of nature (provided that $0 \le p_j \le 1$,

$\forall \; j = 1,\ldots,n$ şi $\sum_{j=1}^{n} p_j = 1$).

From the previous equation it results that the expected value is a weighted average, with weights equal to the probabilities of payment occurrence. In other words, if V_i strategy is applied several times in similar states of nature, we can expect an *average* loss equal to VA_i. Comparing several decision variants, the decision maker will choose the one which corresponds to a *minimum expected value*.

However, there may be situations where several decision variants have equal expected values. In this case, in order to choose between V_k and V_l for which $VA_k = VA_l$, another indicator will be used – *degree of risk*. Since the expected value is a measure of the central tendency, the degree of risk can be interpreted as being the degree to which possible payments deviate from the expected value, considered a secondary measure of the expected value.

In order to measure the risk corresponding to each decision variant, the following indicators are studied: *average, variance and coefficient of variation* – calculated based on the consequence matrix (C) and the probability vector (if $n=3$ and $m=3$):

$$C = \begin{pmatrix} C_{11} & C_{12} & C_{13} \\ C_{21} & C_{22} & C_{23} \\ C_{31} & C_{32} & C_{33} \end{pmatrix}$$

In order to choose the minimum risk variant, the average expected value is calculated for the decision consequences: $\overline{C_1} = p_1 \cdot C_{11} + p_2 \cdot C_{12} + p_3 \cdot C_{13}$ and analogously: $\overline{C_2}$ and $\overline{C_3}$.

Corresponding variances are calculated as follows:

$1 \cdot (C_{11} - \overline{C_1})^2 + p_2 \cdot (C_{12} - \overline{C_1})^2 + p_{3 \cdot (C_{13} - \overline{C_1})^2}$ and enable the calculation

$\sigma_1^2 = p$

of standard deviation $\sigma_1 = \sqrt{\sigma_1^2}$, etc. and of coefficients of variation: $CV_1 = \frac{\sigma_1}{\overline{C_1}} \cdot 100$.

Such an analysis associated to the matrix model under risk conditions allows more rigorous justifications of the final choice at least in two directions:

1 a risk-adjusted matrix of decision-making consequences can be constructed;

a confidence interval can be constructed for each element of the consequence matrix, as follows: $\left\{\overline{C} \pm 1.96 \cdot CV\right\}$

Risk determination involves the project manager in elaborating an **action plan** to prevent or accept risks, which would ensure:

- establishing responsibilities and people in charge of each identified risk;
- monitoring and reporting performed actions;
- quantifying effects which may occur as a result of potential changes.

The experience of Romanian organizations in obtaining European funds through projects, as well as in implementation, has so far shown that the culture of project management and risk management is only emerging in our society. Beyond the obvious problems of fund management in public institutions with responsibilities in this area, there is also a lack of experience of economic entities, and not only, in starting and developing a project financed through European funds[1].

A series of risks associated with this type of projects is less taken into account by applicants, with unfortunate consequences, from losing funds to exceeding budget.

[1] Risk management in organizations – Short considerations on projects financed through European funds – July (2010) no. 127.

Risks occur since the initial concept of the project, and usually lead to rejection of financing: lack of harmony between objectives of the project and objectives of the financing program; choosing wrong target groups; erroneous budget construction; inadequately quantified benefits; project team members who lack qualifications or experience required by the financer.

Risk in projects can be defined as the degree of exposure to an event which may occur to the detriment of benefit of a project or of an activity of the project. It can be described as a combination between the probability that the risk occurs and the consequences in terms of loss or gain as a result of the risk. Risk is an inherent component of all activities of a project, whether it is a simple or a complex activity. That is why the size or complexity of an activity is not always an appropriate measure of the potential degree of risk. However, dependence is direct; in most cases complex activities are associated to higher risks.

The success of a project activity implies that the activity in question is feasible technically and in terms of scheduling, and it can be done within the established budget and deadline. Project risk is an uncertain event or a condition, which, if it occurs, it may have a positive or negative impact on the project objective. Risk has a cause, and once it has occurred, it also has an impact.

Project risk includes both threats to the project objectives and opportunities to improve these objectives. This risk stems from the uncertainty which is present in all projects, regardless of their amplitude or complexity.

Risks can be known variables, that is, risks which have been identified, assessed and quantified, and for which plans have been elaborated. At the same time, risks can be unknown variables, risks which have not yet been identified or are impossible to foresee.

It is obvious that the amplitude of the risk depends first of all on the size of the project itself.

In the case of small projects, there is usually not much risk. Risk involves problems which may occur in the future. Since small projects do not usually last long, there are not many occasions for future problems. If the project manager has knowledge of future risks, he may apply risk procedures for medium projects. Medium projects: when the project is defined, a complete assessment of project risks is also performed. The project manager may create an initial version of project risks based on the information he acquired and then he may send it to team members for additions, modifications and comments. Another technique is to summon all project stakeholders and discuss potential risks in a facilitated meeting.

Risk for large projects is similar to that for medium projects, taking into account two additional elements: using quantitative risk analysis techniques (in addition to qualitative techniques) and creating a contingency plan, in order to document the consequences on the project if risk plans fail and the risk actually occurs.

The highest risks, however, occur during implementation.

Financial risks. Frequently there is a situation of projects which, although having respected all indications of the financer regarding budget preparing, are based on a faulty financial forecast, where necessary resources are undervalued, which leads to either the impossibility to develop the project or to a negative balance of the project.

Human resource risks. They refer to the lack of technical qualifications necessary for the organization in question for a high-quality implementation, due to a wrong analysis of human resource involved in the project or of requirements imposed by each activity (external consultants, partner organizations, etc.). This includes risks associated to the project team, which sometimes does not have enough skills to manage all project stages under optimal conditions.

Technical risks. The quality of the project's final results, either a product, a building or a course, is not the same as the one considered in the project. It frequently happens that the technical conditions established in the project, for instance, those related to acquisition of materials or equipment, cannot be met for various reasons, which implicitly change the quality of the project as a whole.

External risks. Currency risks, changes in tax policy or administrative procedures, delayed returns have visibly hindered development of Romanian projects financed through European funds and have been less taken into account by the beneficiaries in preparing the initial documentation.

Conclusions

Considering the above-mentioned, the following conclusions may be drawn:

- The question of risk arises in any area of the economic activity, with consequences which cannot always be foreseen or anticipated in terms of consequences. Risk occurs because we do not know future actions or events; almost any change induces a certain risk.
- Risk management uses the following three fundamental components: *risk assessment, planning the response to risk factors, risk monitoring and control.* Risk management aims at a reduction in risks, regardless of their nature, correlated with accomplishing project objectives, which implies changes in the

decision perspective and structuring. The basis of risk management is a thorough analysis of relationships, doubled by intense anticipatory efforts.

- In economic risk analysis in investment projects, a few theoretic, methodological and qualitative aspects of risk analysis for singular investment projects or for those from a portfolio and a few quantitative methods to assess economic risk.
- The paper highlights an analysis of qualitative and quantitative methods of measuring risk in investment projects.
- The case study highlights best practices of risk identification and assessment in European projects of the Framework Program 7. Risk identification and assessment involves, in the first stage, specifying internal risks (which the project team can control and influence) and external risks (which are not under the control of the project participants), and in the second stage, establishing the causes which may lead to such events. Project risk assessment and monitoring is a dynamic process which takes place throughout the lifecycle of a project and constitutes risk management.
- Risk is quantified through probability and incidence and is assessed through its consequences. Consequences can be substantially diminished through risk management which requires advanced schemes to exploit cause-effect relationships.

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