Marijana Lazarevska 1[1]

RISK MANAGEMENT OF INVESTMENT PROJECTS

Abstract:Risk represents an uncertain condition that, if occurs, it might have one or more impacts with positive or negative effects on the project objectives.Risks can occur during all investment project activities. They cannot be totally avoided, but with proper risk management they can be minimized. Risk management is formal process of systematic risk identification, analyses and responses, towards elimination, mitigation and/or control of the risks.The goal of risk management is not to completely remove all project risks. Its aim is to produce an organized framework for managing project risks, especially the crucial ones, in a more efficient and effective way.

Key words:risk, management, construction project.

[1]Assist. Prof. at Civil Engineering Faculty, Skopje, Macedonia, marijana@gf.ukim.edu.mk

1. CONCEPTS OF PROJECT AND RISK MANAGEMENT

1.1. Concepts of project and risk management

Project Management is the science which applies skills, tools and techniques to complete project activities in a way that the expectations and requirements of stakeholders are fulfilled or exceeded.

Risk Management is an integral part of the process which aims at identifying the potential risks associated with a project and responding to those risks.It includes activities which aim to maximize the consequences associated with positive events and to minimize the impact of negative events.

Risk can occur during all project activities; it is only the amount which varies from one activity to another. The riskier the activity is, the costlier will be the consequences in case a wrong decision is made.

Proper evaluation and analysis of risks will help decide about implementing a costly measures to reduce the level of risk. It can also help to decide if sharing the risk with an insurance company is justified.

Risks cannot be totally avoided, but with proper risk management they can be minimized!

1.2. Uncertainty and risk

Uncertainty is not the same as risk. These two terms are distinct and have different meanings. 'Risk' describes a situation, in which there is a chance of loss or danger. 'Uncertainty' refers to a condition where we are not sure about the future outcomes. 'Uncertainty' refers to the occurrence of an event about which little is known, while a 'risk' is the outcome of an event which is predicted on the basis of statistical probability.

Risk can be measured and quantified, through theoretical models. On the other hand, it is not possible to measure uncertainty in quantitative terms, as the future events are unpredictable.

The potential outcomes are known in risk, whereas in the case of uncertainty, the outcomes are unknown. Risk can be controlled if proper measures are taken to control it. On the other hand, uncertainty is beyond the control of the person or enterprise, as the future is uncertain.Minimization of risk can be done, by taking necessary precautions. As opposed to the uncertainty that cannot be minimized.Managing risk is easier because risks can be identified and a response plan can be developed in advance based on the past experience.

Managing uncertainty is very difficult as previous information is not available, too many parameters are involved, and outcome cannot be predicted.However, to complete the project successfully we must be very cautious, proactive, and open minded to manage risk and uncertainty.

1.3. Risk definitions

The word 'risk' is used with many different meanings.

The European Commission suggests that a risk is any factor, event or influence that threatens the successful completion of a project in terms of time, cost or quality.

Risk represents a situation where there is no knowledge of its outcome. Or, risk is the variation in possible outcomes that exist in nature in a given situation.

Risk is a high probability of failure - the chance of something happening that will have an impact on project objectives.

According to PMI risk represents an uncertain condition and, if it occurs, it may have one or more impacts which in turn may have positive and negative effects on the project objectives.

The classic definition of risk is: the probability of occurrence of an unwanted event multiplied by the consequence (loss) of the event (impact of this risk):

R = P * I

R – grade (rang) of the risk

P – probability of occurrence of a defined event

I – quantified level of the consequences caused by that event

The formulation "risk = probability (of a disruption event) x loss (connected to the event occurrence)" is a measure of the expected loss connected with something (i.e., a process, a production activity, an investment...) subject to the occurrence of the considered disruption event. It is a way to quantify risks.

1.4. Project risk

Project risk is an uncertain event or condition that, if it occurs, has an effect on at least one project objective: cost, time, scope or quality.

Generally, risks can occur during every project or process, so any project uncertainties can be considered a project risk.

Project risks include events or conditions that could be positive or negative in nature. Positive risks are also known as opportunities. Negative risks are also known as threats.

The most common project risks are:

- Cost risk, typically escalation of project costs due to poor cost estimating accuracy and scope creep.
- Schedule risk, is the risk that the project takes longer than scheduled. It can lead to cost risks, as longer projects always cost more, and to performance risk, if the project is completed too late to perform its intended tasks fully.

- Performance risk, the risk that the project will fail to produce results consistent with project specifications.
- Governance risk relates to board and management performance with regard to ethics, community stewardship, and company reputation.
- Strategic risks result from errors in strategy, such as choosing a technology that can't be made to work.
- Operational risk includes risks from poor implementation and process problems such as procurement, production, and distribution.
- Market risks include competition, foreign exchange, commodity markets, and interest rate risk, as well as liquidity and credit risks.
- Legal risks arise from legal and regulatory obligations, including contract risks and litigation brought against the organization.
- Risks associated with external hazards, including storms, floods, and earthquakes; vandalism, sabotage, and terrorism; labor strikes; and civil unrest.

2. RISKS IN CONSTRUCTION PROJECTS

2.1. Introduction

The construction industry is characterized with the largest exposure to risks and uncertainties from the whole industry sectors!

Records obtained from the statistical analyses of risks – for the last 3 decades – show that the construction process is extremely sensitive to risks! After mining and agricultural sector, the construction industry demonstrate the major number of accidents with critical consequences (average 4.8 accidents on 100 000 workers every year).

Compared to many other industries, construction industry is subjected to more risks due to its unique features, such as: long duration, complicated processes, unpredictable environment, financial intensity and dynamic organizational structures.

The process of planning, executing and maintaining all construction project activities is very complex and time-consuming. The whole process require many people with diverse skill sets and coordination of a vast amount of complex and interrelated activities. The situation is made even more complex by many external factors that influence directly on the construction project activities.

The specific characteristics of construction projects are, in fact, a possible risk sources: uniqueness, complexity, long project life-cycle, large number and variety of project participants, specific construction conditions, human factors that influence the decision-making etc.

Construction projects are very complex and can face various internal and external risks. Some risks can be easily predicted or identified; still some can be totally unforeseen.

In general, construction risks can be related to technical, management, logistical, or socio-political aspects or can be related to natural disasters.

Some of the critical effects of risks are:

- failure to achieve operational requirements and the required quality,
- non completion of the project within stipulated time and estimated cost.

Unfortunately, there is no way to completely avoid risks as there are bound to be unknown factors that arise over the course of a project.That is why, in the construction industry, a strict set of codes, laws and regulations must be followed during the construction process in order to best avoid these risks.

The influence on the project cost and time is more efficient at the beginning phases of the project life-cycle. The influence is decreasing as we reach the final project realization (Figure 1). That is why, identification and analysis of the potential risks, as well as Risk Management, should be performed at the beginning of the project. But, it is important to note that risk management should be in accordance with the strategic project management.

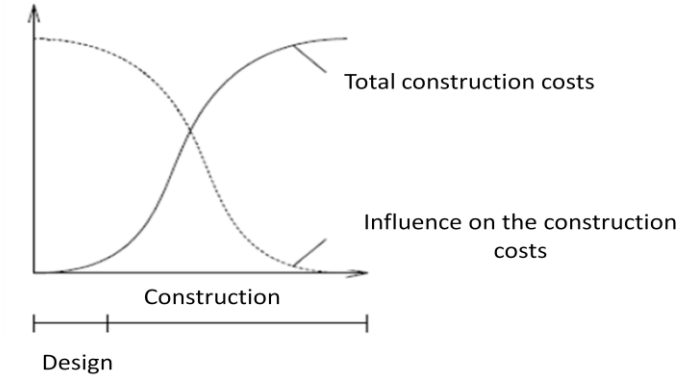

Figure 1 – Dependence between the total construction costs and the influence on the cost

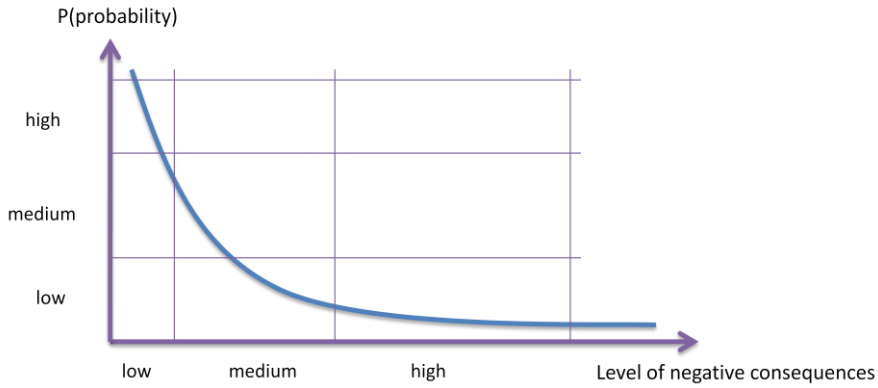

Figure 2 – Dependence between the probability of risk occurrence and the level of negative consequences

Figure 2 presents the dependence between the probability of risks occurrence and the level of negative consequences. It is evident that if the risk has high probability of occurrence, than the level of negative consequences is usually low. If the risk has low probability of occurrence, than the level of negative consequences is increasing significantly. Speaking about the construction projects, this means that we should identify and analyze all the possible risks during the beginning phases of the project, and that we should put all our resources and time into a longer planning and designing phase. In that way we will be able to achieve shorter construction time and plan our respond strategies accordingly.

2.2. Risks in construction projects

One of the best ways to manage risks is to know the various types and to learn how to manage them. If we can identify and categorize risks before we start a project, we can optimize our risk management activities and avoid possible losses.

Risks can be Known or Unknown:

- Known risks are handled with contingency reserves
- Unknown risks are handled with management resource

The risks can be characterized as internal or external.

- An internal risk is unique to a project and is caused by sources inherent in the project; example can be the inability of a product to function properly.
- An external risk has origin in sources external to the project scope, such as cost cuts by senior management.

Risks can be either acceptable or unacceptable. An unacceptable risk is one which has a negative impact on the critical path of a project.

Risks can be viewed as manageable and unmanageable. A manageable risk can be accommodated, example being a small change in project requirements. An unmanageable risk, on the other hand, cannot be accommodated, such as turnover of critical team members.

Risks can either have short term or long term duration. In case of a short term risk, the impact is visible immediately, such as a requirement change in a deliverable. The impact of a long term risk is visible in the distant future, such as a product released without adequate testing.

Many examples from the practice show that construction project risks are actually interrelated and interdependent.Risk are peculiar to each particular project and each project participant. However, it is recognized that all construction projects do share some common risks that can be classified as follows:

- Technical risks
- Logistical risks
- Environmental (external) risks

- Management related risks
- Financial risks
- Socio-political risks

Technical risks include anything that restricts us from creating the project that the investor wants. They include uncertainty of resources and availability of materials, inadequate site investigations, or incomplete design etc. These risks can usually occur when there are changes in project scope and requirements, and if there are some design errors or omissions.

Technical risks – examples:

- Owner involvement in design
- Inadequate and incomplete design
- Late drawings and instructions
- Late surveys, incomplete or wrong
- Errors in structural / geotechnical / geological / foundation conditions
- Wrong selection of materials
- Uncertainty over the source and availability of materials and resources
- Site access
- Changes in the project requirements
- Cost of tests and samples
- Inaccurate contract time estimates, Inaccurate quantities of work
- Work permissions
- Unsuitable equipment and materials
- Equipment commissioning
- Construction occupational safety, Worker and site safety
- Accidents (such as collision, fire and so on)

There are various **logistical risks** that need to be addressed before beginning a project. Without addressing these logistical issues, you risk huge project delays and losses. These risks can be associated with: procurement, planning and execution of resources (ordering, reception, transport and storage), availability of transportation facilities and availability of resources (equipment such as spare parts, fuel and labor), supply chains delivering products from external sources to the building site (supply logistics) and coordination of material flows on the construction site (on-site logistics).

The most common **management** related **risk**is uncertain productivity of resources. Before we begin a project we need to be sure that we have sufficiently skilled staff and that we have adequately defined their roles and responsibilities.Failing to do this can lead to disastrous losses.

Management related risks – examples:

- Project purpose definition, needs, objectives, costs, deliverables are poorly defined or understood

- Uncertain productivity of resources
- No control over staff priorities
- Too many projects
- Consultant or contractor delays
- Estimating and/or scheduling errors
- Lack of coordination / communication
- Inexperienced workforce / inadequate staff / resource availability

Environmentalrisksinclude natural disasters, weather and seasonal implications.These risks are commonly overlooked when people are unfamiliar with local conditions. If we are going to be working on a project in a new city, we need to become familiar with that region's weather patterns, because if we prepare for possible weather risks, we are much more likely to avoid potential delays and losses.

Environmental risks – examples

- Environmental regulations change
- Water quality issues
- Environmental analysis incomplete or wrong
- Hazardous waste, preliminary site investigation wrong
- Historic site, endangered species, or wetlands present
- Subsurface geology and geotechnical conditions, ground water
- Weather and seasonal implications
- Natural disasters

Inflation, local taxes and availability and fluctuation of foreign exchange are few of the possible **financialrisks**that can occur during a construction project. Different countries have drastically different taxes that need to be taken into account before starting a international project. The project finances look very different when working in a tax-free city versus a high-tax city.

Financial risks – examples:

- Funding
- Inflation
- Delays in payment
- Availability and fluctuation in foreign exchange
- Local taxes
- Repatriation of funds

Customs and import restrictions and difficulties disposing of equipment are a few of the **socio-political risks** that might occur during a construction.

Socio – political risks – examples:

- Different regulations and codes depending on where our project is.
- Constraints on the availability and employment of expatriate staff

- Customs and import restrictions and procedures
- Difficulties in disposing of plant and equipment
- Insistence on use of local firms and agents
- Local communities pose objections

Force majeure risks. The term 'force majeure' comes from French law, where it translates as 'superior force'. Very broadly, it relates to exceptional, unforeseen events or circumstances that are beyond the reasonable control of a party to a contract and which prevent or impede performance of their obligations under the contract.Generally it cannot be an event that the party could reasonably have avoided or overcome, or an event attributable to the other party.

Force majeure risks – examples:

- Political factors change (political interference)
- Political climate
- Economic instability
- Market conditions
- Exchange rate fluctuation
- Public safety regulation
- Unforeseen changes to legislation
- Wars and other hostilities (such as terrorism)
- Fires
- Exceptionally adverse weather
- Civil unrest, such as riots or revolution.
- Strikes (other than by the contractor or subcontractors).
- Natural catastrophes such as earthquakes, floods and volcanoes.
- Epidemics or pandemics.

2.3. Risks classification for Investment projects

To better understand risks, it is essential that we understand that risks fall into categories!

According to the level of occurrence risks can be divided into 3 main categories:

- Strategic risks (represent systematic threats that significantly influence on the Company as a whole)
- Operational risks (occur during the project realization and are mostly caused by the ongoing work activities)
- Project risks (all risks that can occur during the project realization)

According to the geographical classification, risks are divided according to the market, culture, tradition, habits, applied materials, methods of work in the country, region or location of project realization, into 2 groups:

- Risks at national projects

- Risks at international projects

Classification according to the size and project complexity defines that number of risks that might occur is not proportional to the size, scope of work and financial value of the project. All risks should be identified on time, before the beginning of the design phase, regardless of the complexity of the project, Risks under this category can be divided into 4 main groups:

- Risks at small projects (IV <1 mil. Euros)
- Risks at average projects (1<IV<50 mil. Euros)
- Risks at big projects (50<IV<500 mil. Euros)
- Risks at capital projects (IV>500 mil. Euros)

Classification according to the type and intensity of the possible consequencesincludes the possibility of the occurred events and the type and intensity of the uncertain events. Risks can be dividedas:

- Damaged property
- Exceeded costs
- Exceeded time
- Damages to people (accidents, deaths)

According to the chronological classification project risks can be divided as:

- Risks before construction (Risks during the initial phase of the project and Risks during the design phase)
- Risks in the construction phase (risks of location, technical risks and risks cause by the people actions)
- Risks after construction phase

Risks can be classified according to the possibility for insurance, as:

- Risks that can be insured
- Risks that cannot be insured

According to the location of the risk source, risks can be classified as:

- External risks – risks from the surrounding area for which it is hard to mitigate, avoid or lower their effect (force 'majeure', ecological, political, economic, legal etc)
- Internal risks – risks that are directly connected to the project realization and can be effectively managed (non-technical, technical, financial, management related etc.)

3. RISKS MANAGEMENT

3.1. Introduction

Risk management is formal and regular process of systematic risk identification, analyses and responses, towards elimination, mitigation and/or control of the risks. The decision making process in the risk environment has to be iterative, adaptive and open!Special attention has to be paid at the beginning project phases, because they are the most risky ones and can cause major consequences on the project goals.

The general purpose of risk management is to maximize the chances and the impact of positive events and to minimize the probability and the impact of negative events, in order to meet the project objectives.

Risk management is a decision-making process, and it involves having a full understanding of a known risk and/or necessary actions to reduce the effect and chances of the event of such risks, in other to reduce its complications and increase the chances of success

The goal of risk management process is not to completely remove all project risks. Its aim is to produce an organized framework for managing project risks, especially the crucial ones, in a more efficient and effective way.

Risk management, as a part of the total project management, can improve the other management processes, especially the cost, time and quality management.

The three main stages of risk management are:

- Risk identification
- Risk analysis and evaluation
- Risk response

3.2. PMI Standard for Risk Management

The American standard **ANSI/PMI 99-001-2004**is recommended for professional project management in the field of civil engineering. It has a well-established position on the investment market and it has been accepted in the international engineering practice: This standard has a practical and concrete approach for project management.

Risk management is one of 10 fields of project management process, according to PMI. The appendix of PMBOK for construction defines 4 additional areas: management of project safety, management of environmental safety, management of project financing, claims management.

Project Risk Management includes the processes of conducting risk management planning, identification, analysis, response planning and controlling risk on a project!

The objectives of PRM are to increase the probability and impact of positive events and decrease the probability and impact of negative events in a project.

Risk management processes are divided into 5 phases:

- Risk management planning
- Risk identification
- Analysis and risk assessment
- Planning of risk responses
- Risk control

For each phase the standard defines the: input data, tools and techniques and the output data.

Risk management planning(Phase 1) is the process of defining how toconduct risk management activities for a project. Because risks can arise from the very beginning of a project, risk management should begin right away, and continue throughout project. Early planning allows sufficient resources and time to be allocated to risk management.

The main purposes of risk management planning are to:

- Outline how Risk Management will be conducted on the project
- Identify techniques to be used in risk discovery, analysis and management
- Discover and document potential project risks
- Catalog risk characteristics and attributes
- Sort and prioritize project risks
- Determine probability or risk transpiring

Risk management planning aims to:

- Determine impact of risk on project should it occur
- Determine which risks require a response, then draft responses accordingly
- Quantitatively analyze the impact risks can have on the project
- Generate plans to reduce or mitigate threats and enhance opportunities
- Derive specific projections of cost and schedule implications
- Implement risk response plans
- Track and monitor risks / Identify new risks that arise
- Gauge effectiveness of risk management

Table1- Phase 1 - Risk management planning

Inputs	**Tools & techniques**	**Outputs**
✓ Project Management Plan ✓ Project charter ✓ Stakeholder Register ✓ Enterprise Environmental Factors ✓ Organizational Process Assets	✓ Analytical Techniques ✓ Meetings ✓ Expert judgment All inputs are analyzed during the meetings lead by project manager	✓ **Risk management plan**

Table2- Risk management plan - example

Content	What is included?	Example
Methodology	How to identify and rang risks?	Meetings, expert judgment, engagement of the management team participants
	Which tools and techniques will be used?	MS Excel
	Simplification of the risk management process	The quantitative analysis will be conducted only for the 20 most important risks
	Types of communication	E-mails
Input data	List of project input data	Historical project data, company's forms and policies, official approval of the project, description of the scope of work, WBS, plan for the project realization, cost and time estimations, management plans, list of project limitations and assumptions
Responsibility	Who initiates meetings and make conclusions?	Project manager
	Who organizes meetings and who is responsible for their content?	Design manager (for the design phase) Construction manager (for the construction phase)
	Who participates?	In the pre-design phase: project manager, financial consultants, legal experts During the project course: project manager, members of the construction team, main designer and contractor representatives
	What is the role of the company leadership?	To study the main 10 risks and to make crucial decisions (for an example: to approve the main design criteria before the design phase begins)
Budget and time schedule	Time and money planned for the risk management processes	Money for organization of meetings and for engaging experts Planning of the working hours required for risk management processes The procedure is applied in each project

		phase at least once
Grading system and interpretation	Scales for quantitative and qualitative risk analysis	Scales from 1 to 10 will be used for assessment of the risk probability and risk impacts The consequences are divided on: cost, time, quality, scope of work, safety and influence on the project environment

Risk identificationis a process of determining which risks may affect the project and documenting their characteristics. Analysis conducted in this phase make team aware of potential risks and allow a suitable preparation if risk occur.

Table3- Phase 2 - Risk identification

Inputs	Tools & Techniques	Outputs
✓ Risk management plan ✓ Cost management plan ✓ Schedule management plan ✓ Quality management plan ✓ Human Resource management plan ✓ Scope baseline ✓ Activity cost estimates ✓ Activity duration estimates ✓ Stakeholder register ✓ Project documents ✓ Enterprise environmental factors ✓ Organizational process assets	✓ Documentation reviews ✓ Brainstorming ✓ Delphi method ✓ Interviewing ✓ Root Cause Analysis ✓ Checklists analysis ✓ Assumptions analysis ✓ Diagramming techniques (cause-and-effect diagrams) ✓ System or Process Flow Charts ✓ Influence Diagrams ✓ SWOT analysis ✓ Expert judgment	✓ **Risk register**

Qualitative risk analysisis a process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact. It puts risks in perspective by comparing them with each other and predicting their effects on the project.

Risks can be rated based on type of impact: cost, schedule, scope and quality.

Table4- Phase 3 - Qualitative Risk Analysis

Inputs	Tools & Techniques	Outputs
✓ Risk management plan ✓ Scope baseline ✓ Risk register ✓ Enterprise environment factors ✓ Organizational process assets ✓ List of probability and impact of risks	✓ Risk probability and impact assessment ✓ **Probability and impact risk rating matrix** ✓ Risk data quality assessment ✓ Risk categorization ✓ Risk urgency assessment ✓ Expert judgment	✓ **Risk score list**

Probability and impact matrix is one of the mostly used tools for qualitative risk analysis

This is a team technique for all engaged project stakeholders who can analyze the risk probability of all identified project risks and their effect on the project goals. It can be completed quickly and at low cost.

The qualitative risk analysis consists of assessment of two risk factors: probability and impact of risks in order to obtain the risk priority.

Probability measures the likelihood an event will occur. Impact measures the effect a risk may have on a project. Risk ratings are created by multiplying probabilities and impacts!

Risk ratings indicate how priority each risk should be in risk management.

According to the obtained risk ratings a risk priority is gained, as an input for preparation of risk strategies and risk responses that are required for other project management phases as well.

Teams and organizations may weight different risk types differently. The scale is usually defined by the Company.Risk thresholds and number of thresholds may vary, and are also set by the project team

Scales for risk factors can be different:

- High, moderate, low risk
- Catastrophic, high, moderate, minimal, insignificant risk
- Almost certain, probable, possible, less possible and rare influence
- 1, 3, 5
- 1, 2, 3....9, 10

Table5- Probability and impact matrix - example

		Probability				
		1 - Low	2- Low/Medium	3-Medium	4- Medium/ High	5-High
Impact	5 – High	Low (5)	Medium (10)	High (15)	High (20)	High (25)
	4- Medium/High	Low (4)	Medium (8)	Medium (12)	High (16)	High (20)
	3 - Medium	Low (3)	Medium (6)	Medium (9)	Medium (12)	High (15)
	2 – Low/Medium	Low (2)	Low (4)	Medium (6)	Medium (8)	Medium (10)
	1 - Low	Low (1)	Low (2)	Low (3)	Low (4)	Low (5)

Table6- Probability and impact matrix - example

		Impact			
		Minimal	Moderate	High	Catastrophic
Probability	Probable	moderate	moderate	high	high
	Possible	low	moderate	moderate	high
	Less probable	low	low	moderate	High

Table7- Risk priority scale - example

Risk	Probability	Impact	Priority
Elementary trouble	Less probable	Catastrophic	High
Delays in completion of works from the Contractor	Possible	High	Moderate
Unscheduled materials cost increase	Less probable	Moderate	Low
Changes of low regulative	Probable	High	High

The **Quantitative Risk Analysis** follows the qualitative analysis, but it is more costly and time – consuming. This analysis provides firmer numbers to indicate the risk impact on the: project costs and project schedule.

It may not be always possible to perform this analysis, it mainly depends on the amount of available information. Also, it is not always necessary to perform such an analysis, because it generally depends on probability and potential impact of identified risks.

Table8- Phase 4 - Quantitative Risk Analysis

Inputs	Tools & Techniques	Outputs
✓ Risk management plan ✓ Cost management plan ✓ Schedule management plan ✓ Risk register ✓ Enterprise environment factors ✓ Organizational process assets	✓ Data gathering and representation techniques ✓ **Quantitative risk analysis and modeling techniques** ✓ Expert judgment	✓ **List of priority quantified risks** Risk list should consists of risk description and the measures for its control. ✓ Project Documents Updates

Often times the Quantitative analysis alone doesn't provide enough information about what risks should have the highest priority. That is why it is usually combined with sensitivity analysis.

Sensitivity analysis represents a modeling technique that determines which risks have the most impact on the project and rioritizes risks by potential outcome variance.One way of conducting sensitivity analysis is by using Tornado diagrams (special bar chart that is used to compare the importance (relative) of different variables).

Another tool for quantitative risk analysis is and EMV (Expected Monetary Value) Analysis. Through this analysis we can discover the optimal decisions for a project, given the different risks, probabilities and benefits (depending on the path that is chosen). EMV analysis calculates the average outcomes of future scenarios. It is very good at comparing effects of various decisions and scenariosPositive values represent opportunities, while egative values represent threats. (Example – one risk may cost the project an additional 20 000 Euros if it occurs, but there is only a 20% probability of the event happening. So EMV for above example would be 4000 Euros).

EMV analysis often powers the Decision Tree Analysis. In this analysis the possibilities are sketched out based on different decisions and potential outcomes. Each decision (path/branch) is evaluated for Risk and Impact i.e. EMV. The resulting net value are calculated for each set of decisions and possibilities. The rule is tha the option offering the highest EMV should be selected.

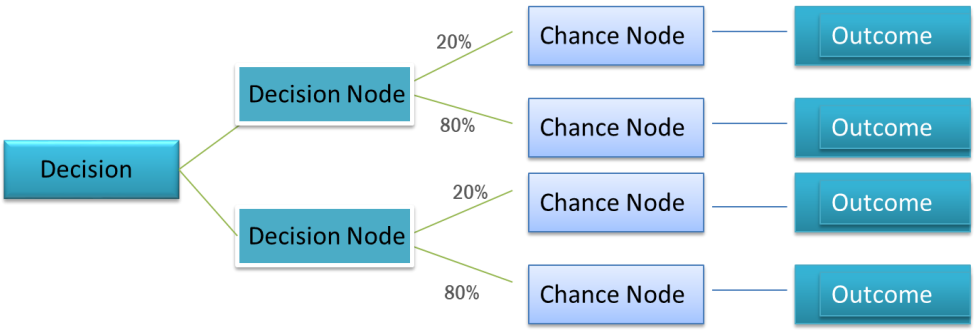

Figure 3 – Decision Tree Analysis

The main differences betwen the qualitative and quantitative analysis are:

- The qualitative analysis is required for project planning, while the quantitative analysis is not
- The qualitative analysis represents a subjective assessment of the risk factor and its influence
- The quantitative analysis represents an exact (objective) calculation of the risk effect and risk factor

Phase 5 is about **planning of the risk risponses**. It is a process of developing options and actions to enhance opportunities and to reduce threats to project objectives.

This phases is addressing all the risks that have been prioritized by qualitative and/or quantitative analysis. The responses are being planned in an order based on this prioritization. Planned responses might addadditional resources and activities to project plan, budget and schedule.

Table9- Phase 5 – Plan Risk Responses

Inputs	Tools & Techniques	Outputs
✓ Risk management plan ✓ Risk register	✓ Strategies for negative risks or threats ✓ Strategies for positive risks or opportunities ✓ Contingent response strategies ✓ Expert judgment	✓ **Plan for Risk Responses** ✓ Project management plan updates ✓ Project documents updates

In general, there are 4 basic strategies of how to handle a project risk, whether it is negative or positive.

Negative risks may impact the project cost, schedule, quality, performance or ability to complete objectives. Strategies for handling a threats can be:

- Avoidance (preparation of revise plans to steer clear of the potential risk, when possible)
- Transference (to shift the ownership and responsibilities to a third party, often in the form of insurance or special structured contracts)
- Mitigation (development of strategies to reduce the likelihood or impact of threats to the project)
- Acceptance of the risk (team defers any action until a risk comes to pass; often dealt with using a contingency reserves at that point)

Positive risks may allow project work to be completed: more quickly, at lower cost, with better quality and with secondary objectives being achieved. Strategies for handling an opportunities can be:

- Exploitation (preparation of a revise plans to guarantee opportunity can be leveraged, often by applying its best resources or technology)
- Sharing (developing a joint venture or partnership that allows a third party to exploit an opportunity to the benefit of both parties)
- Enhancement (developing a strategies to increase the likelihood or impact of opportunities to the project)
- Acceptance of the risk (team defers any action until and opportunity comes to pass; may apply contingency reserves at that time)

Risk responses must be appropriate for the risk they address. They have to fulfill the 4 main criteria, they have to be:

- Cost – effective
- Time – effective
- Realistic
- Supported by the key stakeholders

Controlling and monitoring of risks (Phase 6) is the process of implementing risk response plans, tracking identified risks, monitoring residual risks, identifying new risks, and evaluating risk process effectiveness throughout the project.

During the project realization new risks can emerge, known risks may change, some risks can become outdated. That is why risks and risk responses must be controlled throughout the project lifecycle. All of the project data should be constantly reviewed, in order to be able to react quickly if a new risk is uncovered or to implement one of the proposed response strategy.

Table10- Phase 6 – Control and Monitor Risks

Inputs	**Tools & Techniques**	**Outputs**
✓ Project management plan ✓ Risk register ✓ Work Performance Data ✓ Work Performance reports	✓ Risk reassessment ✓ Risk audits ✓ Variance and trend analysis ✓ Technical performance measurement ✓ Reserve analysis ✓ Meetings	✓ **Plan for Unpredicted Risk Responses (workaround plans)** ✓ Work Performance Information ✓ Changes requests ✓ Project management plan updates ✓ Project Documents Updates ✓ Organizational process assets updates

Furthermore, it is recommended to mark the risk activities into the dynamic plans of project realization and to control and monitor them on the same way as for the critical activities. An additional column for risks should be added into the project Gantt charts for easier and efficient risk control and monitoring. The priority risks, the responsible for risk response and the risk status should be subject of discussion of every monthly meeting and should be included into the official Reports for project work progress.

Without careful monitoring even the best plans and strategies will not get implemented in time to save the project if a risk happens!

If previous phases of PRM are not properly conducted:

- The project managerscould make unplanned decisions as risk responses that are not systematically identified and analyzed, or
- The project managers will spend lots of time to solve problems for risk scenarios that could have been avoided

4. CONCLUSIONS

The general recommendation is that all risk management processes has to be iterative. Each project change requires immediate identification of new possible risks, risk analysis and preparation of new risk response strategies and tactics.

Risk management has to be:

- Thorough (it has to include all project activities and components (human resources, processes and technological elements)
- Systematical (it has to include the iterative management processes through precisely defined phases and activities
- Continuous (it has to be implemented throughout the project life-cycle)
- Proactive (to aim towards prevention or mitigation of risk impact and consequences)
- Adjustable (to include a wide spectrum of quantitative and qualitative methods for risk analysis)
- Oriented towards the future (dedicated to continuous individual learning and improvement of the company's knowledge)

Proper risk management leads to more successful projects and more successful companies.

History shows that no investment project is immune to risk. Risks can be managed, minimized, allocated or accepted, but, for sure, risks cannot be ignored.

5. REFERENCES

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