

# Risk Management in Different Construction Phases

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**Abstract**—Everyday thousands of building projects are realized all over the world. Each phase requires good decisions in order to take a step further towards the successful finish of the project. Negative consequences of made decisions or activities that can have different probabilities of occurrence and impact on other phases of the project are defined as risks. The purpose of risk management is to predict, reduce and avoid the risks and their consequences. Risks can also be transferred to other parts of the project in order to achieve the best final results in each area of the project. The goal of this paper is to show how important risk assessment and management in different phases of building projects. One concept which is widely used within the field of RM is called the risk management process (RMP) and consists of four main steps: identification, assessment, taking action and monitoring the risks (Cooper et al., 2005). In each of these steps, there are a number of methods and techniques which facilitate handling the risks.

**Key Words:** Construction Phases, Risk, Risk Management (RM), Risk Management Process, Uncertainty.

## I. INTRODUCTION

Risk management (RM) is a concept which is used in all industries, from IT related business, automobile or pharmaceutical industry, to the construction sector. Each industry has developed their own RM standards, but the general ideas of the concept usually remain the same regardless of the sector.

According to the Project Management Institute (PMI), project risk management is one of the nine most critical parts of project commissioning. This indicates a strong relationship between managing risks and a project success. While RM is described as the most difficult area within construction management (Winch, 2002; Potts 2008) its application is promoted in all projects in order to avoid negative consequences (Potts, 2008).

The construction industry operates in a very uncertain environment where conditions can change due to the complexity of each project. The aim of each organization is to be successful and RM can facilitate it. However it should be underlined that risk management is not a tool which ensures success but rather a tool which helps to increase the probability of achieving success. Risk management is therefore a proactive rather than a reactive concept.

## II. WHAT IS RISK MANAGEMENT?

Risk management is a process of thinking systematically about all possible risks, problems or disasters before they happen and setting up procedures that will avoid the risk, or minimize its impact, or cope with its impact. It is basically

setting up a process where you can identify the risk and set up a strategy to control or deal with it. It is also about making a realistic evaluation of the true level of risk. The chance of a tidal wave taking out your annual beach picnic is fairly slim. The chance of your group's bus being involved in a road accident is a bit more pressing.

## III. UNCERTAINTY

In a building project and in the service life there are many situations that cannot be predicted. The execution of the construction process can become even more difficult than it was assumed before and unexpected events can take place. This state of lack of information is called uncertainty.

In almost every field in the construction process there are uncertainties. Even the best prepared risk management, organization of work or good decision making will not protect the project from uncertainties. The uncertainties can be related to new critical events, so also to risks that these events represent. It is important to bear in mind that not only known critical events exist in building projects, but also these ones that were not identified and can occur unexpectedly. The amount of uncertainties is largest at the beginning of a building project, because of lack of detailed information see Figure 2. However, the amount of uncertainties decreases more the project is advanced and it reaches minimum in the end of the service life.

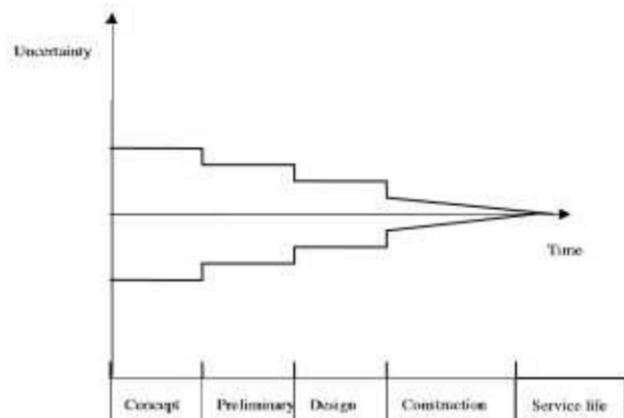


Fig. 1: Uncertainty in building project, adopted from Smith (2006)

(Source: Joanna Goral(2007)Risk Management in the Conceptual Design Phase of Building Projects)

## IV. RISK AND UNCERTAINTY

can be defined as an uncertain event or condition that, if it occurs, has a positive or a negative effect on a project objective. Uncertainty is a situation in which a number of possibilities exist and which of them has occurred, or will occur, is unknown. Considering all risks are uncertain but

not all uncertainty is risky (Yoe, 2000). Risk is defined as the exposure to loss/gain, or the probability of occurrence of loss/gain multiplied by its respective magnitude. Events are said to be certain if the probability of their occurrence is 100% or totally uncertain if the probability of occurrence is 0%. In between these extremes the uncertainty varies quite widely (Jaafari, 2001). Risk also can be defined as a characteristic of a situation, action, or event in which a number of outcomes are possible, the particular one that will occur is uncertain, and at least one of the possibilities is undesirable (Yoe, 2000). Zayed and Chang (2002) defined risk as the presence of potential or actual constraints that could stand in the way of project performance, causing partial or complete failure either during construction or at time of use. Greene (2001) stated that there is no all encompassing definition of risk and provided his interpretation of what risk constituents:

$$\text{Risk} = \text{Hazard} \times \text{Exposure} [1]$$

He defined hazard as the way in which an event can cause harm and exposure as the extent to which likely recipient of harm can be influenced by the hazard.

### V. DIFFERENCE BETWEEN RISK AND UNCERTAINTY

RISK	UNCERTAINTY
<i>Winch (2002)</i>	
A stage where there is a lack of information, but by looking at past experience, it is easier to predict the future. Events where the outcome is known and expected.	Uncertainty is a part of the information required in order to take a decision. The required information consists of the amount of available information and uncertainty. The level of uncertainty will decrease the further a project is proceeding throughout the lifecycle.
<i>Cleden (2009)</i>	
Risk is the statement of what may arise from that lack of knowledge. Risks are gaps in knowledge which we think constitute a threat to the project.	Uncertainty is the intangible measure of what we don't know. Uncertainty is what is left behind when all the risks have been identified. Uncertainty is gaps in our knowledge we may not even be aware of.
<i>Smith et al. (2006)</i>	
Risks occur where there is some knowledge about the event.	There might be not enough information about the occurrence of an event, but we know that it might occur.
<i>Webb (2003)</i>	
Risk is a situation in which he possesses some objectives information about what the outcome might be. Risk exposure can be valued either positively or negatively.	Uncertainty is a situation with an outcome about which a person has no knowledge.

Table. 1: Difference between Risk and Uncertainty

### VI. PROJECT LIFE CYCLE

The best way to present how a typical building project is structured is by help of the project life cycle. A typical project life cycle is divided into phases, each with a predetermined purpose and therefore an identifiable scope of work. The project begins with an idea, and then it is developed in many steps and at the end closed and terminated. Every project has its design phase, construction phase and closing- termination phase, which are partly overlapped from phase to phase. The phases can be defined in different ways. Below an example of how a typical building project can be divided into several phases is presented in Figure 2

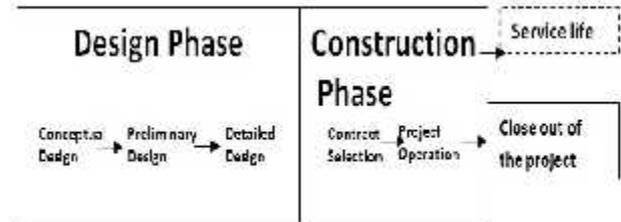


Fig. 2: Project's life cycle

(Source: Joanna Goral(2007)Risk Management in the Conceptual Design Phase of Building Projects)

At completion of each phase the progress in time is controlled and forthcoming actions are identified.

#### A. Conceptual Design Phase

The conceptual design phase is the initial phase of the building project. Most important decisions about the planning, organization, design and type of contract takes place in this stage. The initial ideas about the project turn out in various concepts. The alternatives are evaluated and the final conceptual solution is chosen.

#### B. Preliminary Design

After the conceptual design phase, where one concept is chosen, this is further analyzed, taking into consideration technical requirements. More details are considered, a project brief is developed, and preliminary cost estimation is prepared in order to assess the economy of the project and of the chosen solution. The concept is not a ready project in this phase, still detailed studies are going to be done to identify potential risks, plan for a proper organization and prepare a sufficient space for changes.

#### C. Detailed Design

The detailed design is the next task to solve after the final concept has been chosen and the preliminary design has determined the initial cost and 'constructability' of the project. The designers use information from the final concept evaluation in order to prepare final drawings, select materials, determine component sizes, determine methods of construction et cetera , in order to make the project cleared and ready to implement and construct. The technical specification and requirements together with drawings are the set of documents for potential contractor who is selected in the contractor selection phase.

#### D. Construction Phase

The selection of a contractor is the initial part of this phase. Depending on the form of the project roles and responsibilities of the contractor are prescribed. After the

contractor has been selected, the necessary agreements, licenses and insurances must be secured. The critical events and risks in this point depend on the type of construction. The construction phase should be carefully planned and placed in time and duration of the project. Each delay is connected with money, which the contractor has to pay to the client. Monitoring and control of the work progress and the budget are essential parts of the construction phase in order to avoid future problems and punishments according to contract.

#### E. Closure of the Project

The closure is the final phase of a building project. According to Bennet (2003) inspections and maintenance should be scheduled before the object is taken into operation. During this phase a pre-final inspection of the building is made by the designer, the client and the contractor. Depending on the project it takes one or few days in order to check or test the individual components or parts of the structure. If some defects are found or need of improvements is identified the contractor has time to make corrections until the final inspection takes place. In this phase, the final payment to the contractor and cost control completion take place and the certificates of the guarantee are given to the client. It is valuable that the contractor makes feedback visits to the building/structure after some time from the closure of the project, to hear the opinion from the owner about the usage of the owned structure. Such kind of activity gives the possibility to keep the contact between the project participants and may result in further cooperation concerning new projects in the future.

#### F. Service Life

The service life period is the time when the constructed structure is operated and should be durable and maintained after the building project has been closed and the structure delivered to the client. Service life design prepared in a good way ensures that the durability and intended functions as load-bearing capacity of the structure will last the period as it was assumed in the design phase. The service life design might have a large influence on the economy of the building after the project's completion. Sometimes it is a matter of discussion between the client and the designer whether to use more expensive solutions in the project to ensure a better quality during the service life. The client considers the risk in making such decisions, taking into account the costs of the project and the service life costs in the future.

### VII. RISKS IN BUILDING PROJECTS

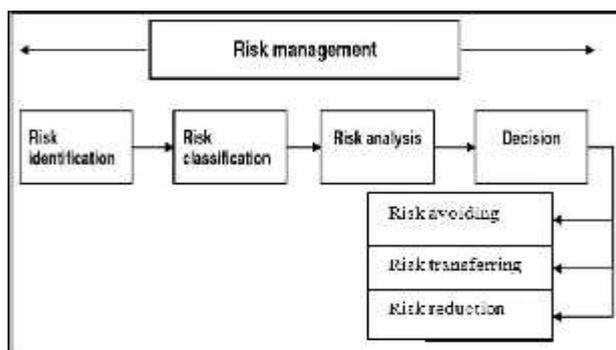


Fig. 3: Activities in risk management

(Source: Joanna Goral(2007)Risk Management in the Conceptual Design Phase of Building Projects)

In Risk management, risk identification and classification are needed in order to analyze the risk and start to treat process in the project. Risk management also concerns the decisions that are made when the results from the risk analysis are obtained. The decisions can be made towards risk reduction, avoiding or transferring to another phase of the project task, the building project or the project participants.

#### A. Risk identification

It is a first activity that has to be realized to start the risk analysis in the building project. During the risk identification sources and reasons of risks are stated and implemented to the risk classification. Information about possible risks is mainly gained from the experience feedback or from documentation if a database is available. Risks can be identified during the meetings where project participants are able to point out the critical events that may occur during the current project realization and occurred in previous project. The information gained is stored in reports or checklists in order to be classified.

#### B. Risk classification

It is the step in the risk analysis where the identified risks are classified according to their types, categories, correlation with other risks and impact on other phases of the building project. It also defines whether the risk in the project is worked out in different business areas of the company.

#### C. Risk analysis

It is a stage where the classified risks are analyzed according to probability of occurrence, costs or other consequences that they can have on different aspects of the building project and the project task in the company. In order to analyze the risks, qualitative and quantitative methods are used.

#### D. Reduction of risk

It is about making improvements or decisions in the project in order to minimize the consequences of critical events and the probability of such events.

#### E. Risk avoiding

It is about modification of a realization plan of the project in order to eliminate the critical events from the tasks or to change the conditions related to risks. In practice it is difficult to omit risky situations. However the activities in the project can be modified in such a way that the critical events are reduced.

#### F. Transfer of risk

It is an activity where the responsibilities for risk consequences are prescribed to another project participant.

### VIII. TYPICAL RISKS IN BUILDING PROJECTS

Different projects bring different risks to consider, although, among different types of risks in the projects, the typical construction risks can be distinguished with the groups and classification according to the allocation in individual project phases.

A. Conceptual design phase

The risk can be related to incorrectly selected alternatives for final solutions, lack of information or information transfer with wrongly estimated objectives of the project, system of organization process, utilization of gained experience and knowledge management, bad decision making and risk identification and environmental risk.

B. Detailed design phase

Risks can occur in badly estimated or incomplete designs, difficulties in dealing specification and standards concerning existing conditions and client’s requirements, prediction of possible changes in design during the construction phase, weak or lack of knowledge about technical conditions.

C. Construction (Implementation phase)

Relations between participants, damage and failure of structure or equipment, delays, construction organization and techniques, technology, type of contract, quality, resource management, labour, weather conditions, ground conditions, physical obstructions.

- 3) Unlikely events can occur, but if the likelihood of the risk occurrence is too low, then it is better to retain the risk and deal with the result if the risk in fact occurs.

XI. VARIOUS IDENTIFIABLE RISKS IN DIFFERENT PHASE OF CONSTRUCTION PROJECT

Sr. No.	Risk Event
1	Project funding difficulties during feasibility phase due to bad financial situation of financier(s)
2	Unavailability of needed information, code and standards
3	Poor planning of site and ground investigation during by owner
4	National political conflict
5	Lack of needed materials in project region or country
6	Poor assessment and evaluation of project options
7	Poor preliminary assessment and evaluation of costs, health, safety and program implications

Table. 2: Feasibility Phase

Sr. No.	Risk Event
1	Conflict of laws related to one of contract clauses (laws are not consistent)
2	Inconsistency of contact clauses
3	Delay in contract issue by owner of the project
4	Type of contract between owner and contractor is not allowed by laws regarding special type of the project
5	Inappropriate form or type of the contract
6	Allocation of risks to the parties is not mentioned or is not clear in the contract
7	Changing of mind of bank before finalizing the contract

Table. 3: Contract Phase

Sr. No.	Risk Event
1	Defective design (incorrect)
2	Awarding the design to unqualified designers
3	Inappropriate method used by designer for design risk assessment
4	Lack of consistency between bill of quantities, drawings and specifications
5	Inaccurate quantities
6	Rush design
7	Design process doesn't include sensitivity study to assess the impact of natural hazards
8	Poor or defective design due to using inappropriate design parameters
9	Not coordinated design (structural, mechanical, electrical, etc.)
10	Poor design check by consultant regarding the level of risks for project works and/or third party
11	Mistake of designer in remedial action planning and design
12	Change of design because of poor understanding of customer needs

Table. 4: Design Phase

Sr. No.	Risk Event
1	Inadequate storage, transport and use of explosives (inexperience contractor)

IX. BENEFITS WITH RISK MANAGEMENT

- 1) To maximize the efficiency of risk management, the RMP should be continuously developed during the entire project. In this way, risks will be discovered and managed throughout all the phases.
- 2) The benefits from RM are not only reserved for the project itself, but also for the actors involved.
- 3) The main incentives are clear understanding and awareness of potential risks in the project.
- 4) Risk management contributes to a better view of possible consequences resulting from unmanaged risks and how to avoid them.
- 5) Another benefit of working with risk management is increased level of control over the whole project and more efficient problem solving processes which can be supported on a more genuine basis.
- 6) It results from an analysis of project conditions already in the beginning of the project.
- 7) The risk management also provides a procedure which can reduce possible and sudden surprises.
- 8) Different attitudes towards risk can be explained as cultural differences between organizations, where the approach depends on the company's policy and their internal procedures (Webb, 2003). Within the RM, three company’s approaches can be distinguished.
- 9) Achievement of objectives
- 10) Shareholders reliability
- 11) Reduction of capital cost
- 12) Less uncertainty
- 13) Creation of value

X. LIMITATIONS OF RISK MANAGEMENT

- 1) In the event of improper assessment of risks, important time can be wasted in dealing with risk losses which are unlikely to occur.
- 2) If too much time is spent on the assessment and management of unlikely risks, then important resources can be diverted which otherwise could have been very profitable.

2	Disregarding to sequential and staged activities of remedial action by contractor
3	Disregard to different warning signs (excessive deformation, crack...) by contractor
4	Irregular or inadequacy of site inspection by consultant
5	Strike during implementation phase
6	Lower work quality in presence of time constraints
7	Accident due to falling objects
8	Gaps between the Implementation and the specifications
9	Design changes
10	misunderstanding of drawings and specifications
11	Actual quantities differ from the contract quantities
12	Rush bidding
13	Technical mistakes during construction stage by contractor
14	Consultant is not informed about the changes in project

Table. 5: Construction Phase

Sr. No.	Risk Event
1	Complexity of project time management due to complex nature of the project
2	Imposed unrealistic time planning for project due to insufficient or incorrect information
3	Poor time Management due to change of manager or management strategies of the project
4	Public concerns related to health and safety of the project due to poor communication
5	Skill deficiency in cost management of the project
6	Skill deficiency of project manager(s) in environmental protection

Table. 6: Management Phase

## XII. CONCLUSIONS

A building project is a complex process where each phase should be carefully planned and discussed. First of all a good understanding of the project's objectives and good relations and communication between the participants form the basis of a successful cooperation during the project progress.

The project participants, depending on the contract form, take their responsibilities for risk consequences in their project tasks. The strategy of risk management and the time schedule should always be prepared for potential changes and the additional time for completion of the project under unexpected circumstances should be planned. Budget control and technical inspections during the project's duration allow identification of critical events connected with economical and technical situations on site.

Identification and handling of potential risks in the building project is an issue, which should be considered carefully and controlled during the whole project life cycle. However, the decisive point to analyze the risks in the building project and minimize its impact on its different phases is in the conceptual design phase. It is not an easy task for the project manager and the assignment manager. The risk identification and analysis require adequate knowledge about risk management and the awareness of risks of all the project members during the whole period of building project realization.

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