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Risk Management Frameworks

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***Abstract* - Risk management is a rapidly developing discipline and there are many and varied views and descriptions of what risk management involves, how it should be. Risk management can also differ with the context of the project. In this paper, first we discuss the fundamentals of risk management and the risk pricing method. Then we present the general framework of risk management. Finally, we look an example framework for seismic risk management.**

Keywords- Risk management, types of risks, framework of risk management.

I. INTRODUCTION

A risk any factor that may potentially interfere with the successful completion of the project. A risk is a potential that may or may not occur and if occur will lead to potential loss. Sometimes it is essential to take risks for the beneficial of the project and organisation. It is always not possible to avoid risks, so we look for ways to reduce the risk or the impact of the risk. But even with careful planning and preparation, risks cannot be completely eliminated because they cannot all be identified beforehand. Even so, risk is essential to progress.

The opportunity to succeed also carries the opportunity to fail. It is necessary to learn to balance the possible negative consequences of risk with the potential benefits of its associated opportunity.

Risk may be defined as the possibility to suffer damage or loss. The possibility is characterized by three factors:

1. The probability or likelihood that loss or damage will occur.
2. The expected time of occurrence.
3. The magnitude of the negative impact that can result from its occurrence.

The seriousness of a risk can be determined by multiplying the probability of the event actually occurring by the potential negative impact to the cost, schedule, or performance of the project:

Risk Value = Probability of Occurrence Potential Negative Impact

Thus, risks where probability is high and potential impact is very low, or vice versa, are not considered as serious as risks where both probability and potential impact are medium to high. In other words, risk value is generally defined as the product of the impact (or effect) of a risk event and the probability of the event occurring, i.e.

$$V(A) = P(A) * C(A)$$

where P(A) is the probability that event A will occur, C(A) is the cost/impact or risk effect, and V(A) is the risk value for event A. The risk value is interpreted to be the average expected loss (in some measure) of the event occurring. This is also referred to as utility loss.

People's understanding of certain matter with risk mainly contains three aspects, what may occur within a given time, the possibility of occurrence and the consequences.

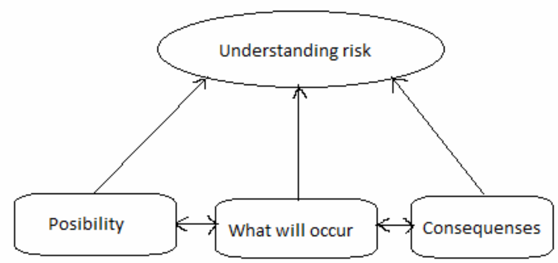

Figure 1 Basic element for developing an understanding of risk

Risk cycle engages in three interlinked cycles: a relevance cycle, a design cycle, and a rigor cycle. These cycles mean that project faces more elaborate kinds of risks. As shown in figure people, organization, technology is external resources which interact with risk cycle. Also from this diagram it is clear that risk cannot be eliminated but it can be minimized.

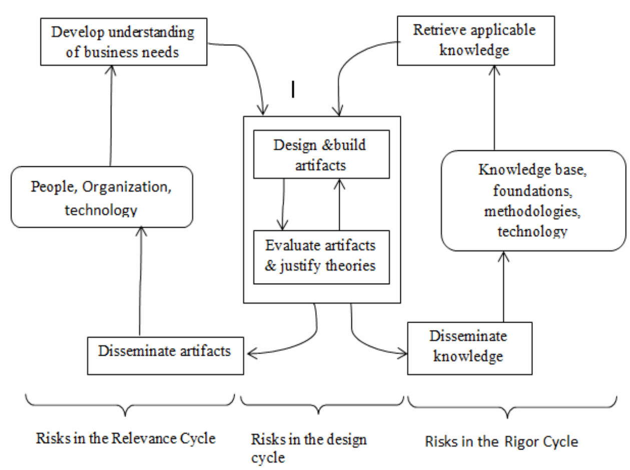

Figure 2 Risk cycle

The different types of risks and their description is shown in Table I:

Table I
Types of Risks

Types of risks	Definition
Total Risk	The sum of identified and unidentified risks.
Identified Risk	Risk that has been determined through various analysis techniques. The first task of system safety is to identify, within practical limitations, all possible risks.
Unidentified Risk	Risk not yet identified. Some unidentified risks are subsequently identified when a mishap occurs. Some risk is never known.
Unacceptable Risk	Risk that cannot be tolerated by the managing activity. It is a subset of identified risk that must be eliminated or controlled.
Acceptable Risk	Acceptable risk is the part of identified risk that is allowed to persist without further engineering or management action. Making this decision is a difficult yet necessary responsibility of the managing activity. This decision is made with full knowledge that it is the user who is exposed to this risk.
Residual Risk	Residual risk is the risk remaining after system safety efforts have been fully employed. It is not necessarily the same as acceptable risk. Residual risk is the sum of acceptable risk and unidentified risk. This is the total risk passed on to the user.

Risk-Pricing Method

This method uses information about variability in risk factors to explain variability in project cost. A cost estimator such as COCOMO expresses the expected project cost *CE* as a function of the risk factors' expected values. If the risk factors' actual values deviate from the expected values, the actual project cost *CA* will also deviate from *CE*. The difference between actual and expected project cost (*CA* – *CE*) is primarily due to risk factor deviations from their expected values and to a cost estimator statistical error. However, the effect of the former element dominates. The *relative cost deviation ci* = (*CA* – *CE*)/*CE* can therefore be termed the *risk-adjusted cost premium* percentage for a project.

Approach to Risk Management

1) Reactive Risk Management:

In this approach, project team reacts to risks when they occur. Project team Mitigate the risks by planning for additional resources in anticipation of fire fighting. Fix on failure—resource are found and applied when the risk strikes. Crisis management—failure does not respond to applied resources and project is in jeopardy. Thus, this approach is not or rarely used.

2) Reactive Risk Management:

Risk analysis and management is a core requirement of most project management tasks, especially in those situations where well-laid plans do not always come with fruitful output.

Risk management is a central part of any organization's strategic management. It is the process whereby organizations methodically address the risks attaching to their activities with the goal of achieving sustained benefit within each activity and across the portfolio of all activities.

The focus of good risk management is the identification and treatment of these risks. Its objective is to add maximum sustainable value to all the activities of the organization. It marshals the understanding of the potential upside and downside of all those factors which can affect the organization. It increases the probability of success, and reduces both the probability of failure and the uncertainty of achieving the organization's overall objectives. Risk management should be a continuous and developing process which runs throughout the organization's strategy and the implementation of that strategy. It should address methodically all the risks surrounding the organization's activities past, present and in particular, future.

II. RISK MANAGEMENT FRAMEWORK

The benefits of risk management in projects are huge. A lot of money can be gained if you deal with uncertain project events in a proactive manner. The result will be that we minimize the impact of project threats and seize the opportunities that occur. This allows us to deliver the project on time, on budget and with the quality results that project sponsor demands. Risk management must be an integrated part of the project management framework if it is to be effective. The steps shown in Figure 3 must be wrapped in a process that appropriately identifies roles and responsibilities within the organization and the project team. The ProRisk Management Framework follows these steps with operational extensions. The goals of these extensions are intended to provide:

1) A set of guidelines to assist in the analysis of a project for risk elements.

2) A process by which these risk elements can be organized into groups of \related risk factors and ultimately into risk perspectives that match stakeholder views.

3) A model representation that enables formal risk analysis to be performed using a quantitative approach while keeping the data requirements to a minimum,

4) A process of analysis that assists in the identification of key risk factors, outcomes and reactions, and the creation of action plans to mitigate these risks, i.e. to target resources where the payoffs are expected to be the greatest.

5) An ongoing re-assessment to ensure continuous monitoring and review of the risk elements as the project proceeds towards completion. This framework focuses attention on primary project components, i.e. the business domain in which the project is created, and the operational domain when the project is actually carried out.

The business domain is a necessary part of the risk management process as it provides opportunities to:

1) Identify the economic environment in which the project is being undertaken, and the susceptibility of the organization to the performance of the project team and the exposure to external risk factors.

2) Estimate the knowledge and experience of the organization for the project, and the level of confidence that the project can be successfully concluded. These two factors define the components of the framework that allow a formal model of the risks to be described.

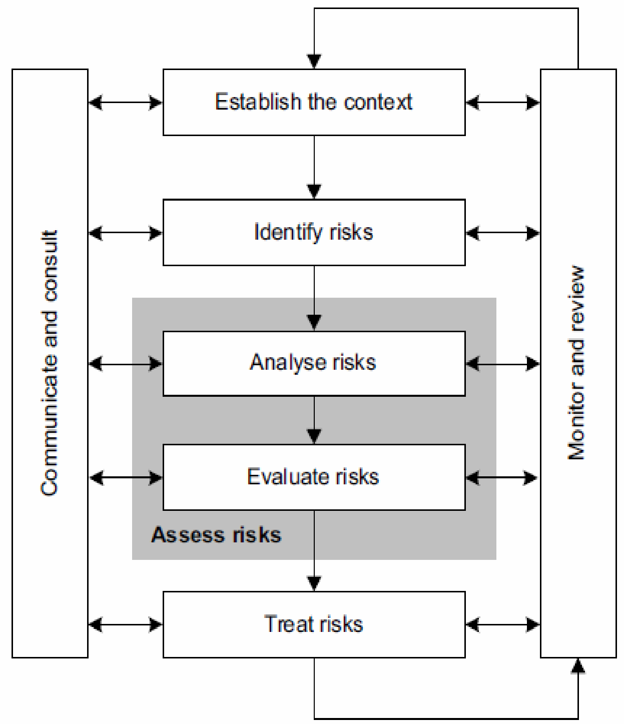

Figure 3 General Framework of Project Risk Management

The operational domain contains the formal modeling that allows a formal model of the risks to be described. The operational domain contains the formal modeling aspects of the project:

1) Undertake the necessary measurement of risk values as guided by organizational views and policies.

2) Complete detailed assessments to identify the key risk factors within the assumed modeling framework.

3) Identify and describe the action plans aimed at reducing key risk values.

4) Implement these plans and then re-assess the effected risk factors.

5) Wrap these steps in a continuous cyclic process that must be applied for the duration of the project.

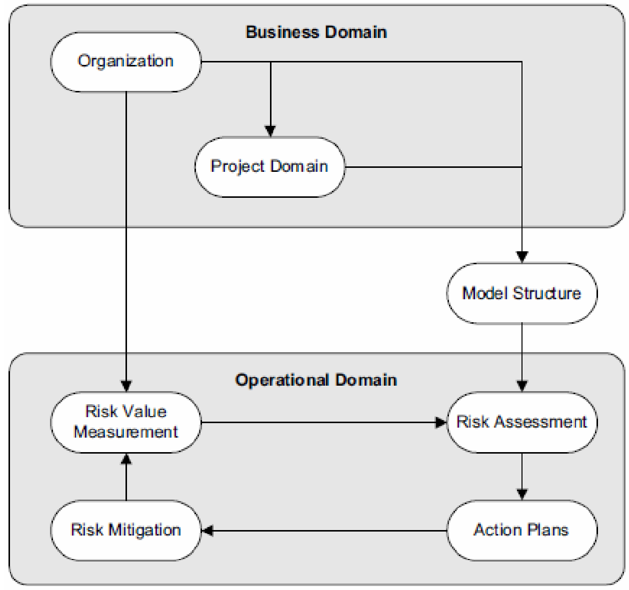

Figure 4. The ProRisk Management Framework

III. AN EXAMPLE FRAMEWORK: SEISMIC RISK MANAGEMENT FRAMEWORK

Bridge engineering plays an important role in the field of traffic transport and contributes to steady development of society. When severe earthquakes happen, the seismic capacity of bridge structures becomes the main symbol of a region resisting disaster. The damage of the major bridges affects the society by cutting off the lifeline supplies and denying the access of rescue forces to the area, generating an even larger impact to the society. The difficulties in repairing or retrofitting these structures lengthen the rescue process to such an extent that the wounded lost their lives due to the lack of necessary medical care. How to guarantee the safety, function of bridges or easy repair after earthquakes is the key for preventing and mitigating disaster. Now the risk evaluation and management of earthquakes to these important engineering projects are becoming a hot issue. Figure 3 shows the framework for seismic risk management.

A. Seismic Risk Degree

Risk degree is the quantitative description of risk. Risk degree can be written as various expressions. Risk degree expression proposed by UNDHA (1992) used the form of expression as:

Risk degree = Hazard degree × Vulnerability degree… (1)

This expression can clearly reflect the essential character of natural disasters and separate hazard from vulnerability, so the risk degree expression has been accepted by most researchers in the world. The same expression was used to describe quantitatively seismic risks of bridges.

B. Seismic Risk Management of Bridge Structures

Earthquakes are natural phenomena, which are impossible to be get rid of completely. What we can do is to try our best to reduce and avoid the losses of the disaster. The concept of seismic risk management was put forward accordingly. Seismic risk management is a discipline for dealing with the possibility that future events may cause harm, which is a continuous, circular and dynamic process. Ideal risk management minimizes the expense and maximizes the reduction of negative influences of risks. As one of forms in risk management, seismic risk management of bridge engineering includes four steps: seismic risk identification, seismic risk analysis, seismic risk assessment and seismic risk control.

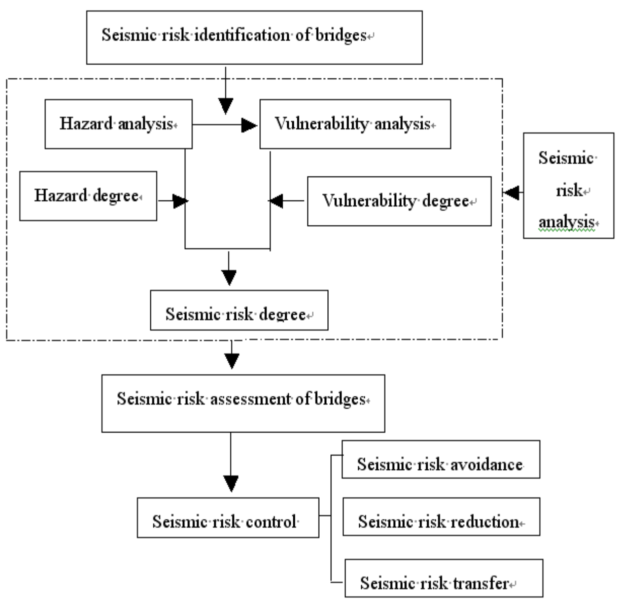

Figure 5 Theoretic framework of seismic risk management of bridges.

C. Seismic Risk Identification

Seismic risk identification is the first step in risk management and is the precondition of risk management system. It is to identify and classify systemically and continuously all sorts of seismic damages of bridges, and find out the causes of seismic damages. It includes two aspects: one is the investigation on seismic damages of bridges, and the other is the analysis on causes of seismic damages of bridges. Investigations on seismic damages in existence can help to collect the information on seismic damages of bridges, understand and summarize the rules of seismic damages. As for the analysis on causes of seismic damages, it can reveal all kinds of risk factors on seismic damages. By seismic risk identification of bridges, it can be seen that circumstances and structures responses are main factors. Circumstance factors include landslide, sand liquefaction, and ground surface collapse etc., while structures responses factors include span collapse, bearing displacement, shear key failure, destruction of expansion joins, pounding of adjacent girders and cracking of abutments etc.

D. Seismic Risk Analysis

Seismic risk analysis is the main part of risk management and two important problems should be solved in this step. One is seismic hazard evaluation, and the other is seismic vulnerability analysis. The evaluation of the seismic hazard for a particular site involves the estimation of ground motions associated with potentially damaging earthquakes. The seismic hazard may be evaluated by deterministic and probabilistic procedures. In a deterministic analysis a particular earthquake scenario is assumed by specifying an earthquake size and location. A probabilistic analysis includes the uncertainties in earthquake intensity level, location, and time of occurrence, and with the use of attenuation relationships it provides estimates of the likelihood of earthquake ground motion at a given site. Typically the seismic hazard is first computed at the bedrock level either by performing a site-specific seismic hazard analysis or by using regional seismic hazard maps. Bridges vulnerability associated with various states of damage is usually shown as the form of fragility curves. In principle, the development of rigidity curves of bridges will require synergistic use of the following methods: (1) professional judgments, (2) quasi-static and design code consistent analysis, (3) utilization of damage data associated with past earthquakes, and (4) numerical simulation of bridge seismic response based on structural dynamics.

E. Seismic Risk Assessment

Seismic risk assessment is one important part in risk management, and it will help to make appropriate mitigation plans and measures. Seismic risk assessment can be done as the following procedures: Firstly seismic risk degree assessment level is determined at the basis of seismic hazard and vulnerability level; Secondly seismic risk degree is calculated as Equation (1). Finally, give risk assessment with comparison between theoretical seismic risk degree and managers' experiences. The statistical risk assessment methodology was applied to analyze hazards based on recorded or historic damage information. The risk assessment needs to consider the potential losses to identify vulnerable bridges structures located in the hazard regions. The fundamental difficulty in risk assessment is that the rate of occurrence should be determined under the conditions that statistical information is not available on all kinds of past incidents. With the increasing uncertainty, it is necessary to analyze the components of risk in a more systematic way such as risk evaluation methodologies.

F. Seismic Risk Control:

At present, seismic risk cannot be eliminated entirely, so how to reduce the losses of the disaster is the main task. Once risks have been identified, analyzed and assessed all techniques to manage the risk fall into avoidance, reduction and transfer. Avoidance seems to be the answer to all risk. Hazard prevention is the process of preventing risks. Prevention itself means to stop or cancel hazard before it goes further. Earthquake prediction, monitor and alarm are the main measures to seismic risk avoidance. But now there are many difficulties in these technology fields. Along with an increasing awareness of the risks to property posed by earthquakes, the idea on the likelihood of seismic damage comes out, particularly considering the rising economy development in seismic regions. Since seismic disasters can't be avoided, our tasks are to reduce the losses. As for bridges, in the engineering technologies, there are many measures that can be taken to reduce the influences of earthquake. Careful selection on the location where a bridge is built, reasonable layouts, strong connections between superstructures and substructures, design based on ductility and performance, and high quality construction etc, all measures above can do well to seismic behaviors of bridges. The improvement of seismic behaviors of bridges may reduce the effects of earthquakes, decrease the disaster losses and rescue costs. Feasible measures of engineering technologies to mitigate seismic losses are generally concerned with investment. High investment may lead to low losses. So a certain extent of increasing investment can result in seismic losses reduction.

Additional spending to new-built or existing bridges for better seismic performance is more economical and effective than post-disaster remedy. The cost of improving construction quality should also be included in it. The process that seismic risk is transferred to capital market is called seismic risk transfer. Seismic risk can be managed if it can be identified prior to a loss. Insurance is an important tool available for that purpose. The insurance agents can benefit from those measures to strengthen new-built or existing bridge structures. However, the benefits of hazard mitigation are often long term. Considering the uncertainty and\ volatility, many insurants may be reluctant to commit expenditure to such long-term mitigation strategies. This is the reason that it isn't very easy to transfer seismic risk.

IV CONCLUSION

The framework discussed above can be readily applied to both small scale and quite large complex projects, with manageable levels of data requirements. The ProRisk Management Framework requires a detailed analysis of the organization and project domains. The framework covers the complete life cycle of the project and provides support to allow the risk analysis to run in parallel with the conventional project management activities. As we know that in ProRisk Management framework, the Action Plan provides support for the documentation, management and re-evaluation of risk events during the progress of the project. So it is mainly require concentrating on action plan for better output. Also to minimize the risk degree we have to take lots of affords on risk control. The groups of risks can help us to deal with risk in same group consequentially and it also minimize time and afford.

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