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An Analysis on Usability of Risk Management Processes in the Construction Projects: A Review

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Abstract – Risk management is a concept which becomes very popular in a number of businesses. Many companies often establish a risk management procedure in their projects for improving the performance and increase the profits. Projects undertaken in the construction sector are widely complex and have often significant budgets, and thus reducing risks associated should be a priority for each project manager. This master thesis presents an application of risk management in the early stage of a project life cycle of a construction project. In order to examine how risk and risk management process is perceived a case study of a school project was chosen. Moreover, based on the conducted interviews, the research presents how risks change during a project life cycle. All analyses are based on a theoretical background regarding risk, risk management process and project life cycle approach in the construction sector.

Construction projects are characterized as very complex projects, where uncertainty comes from various sources. Construction projects gather together hundreds of stakeholders, which makes it difficult to study a network as a whole. But at the same time, these projects offer an ideal environment for network and risk management research. Additionally, construction projects are frequently used in management research, and several different tools and techniques have already been developed and especially for this type of project. However, there is a gap between risk management techniques and their practical application by construction contractor. This paper deals with the identification of risk by different methods, types of risks associated with construction project and different risk mitigation techniques.

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INTRODUCTION

Project management is the science which applies skills, tools and techniques to fulfill project activities in a way that the expectations and requirements of stakeholders are fulfilled or exceeded. Project 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. It is believed generally that risk in an environment is a choice rather than fate, and the inherent uncertainty in the plans can affect the desired outcome of achieving project and business goals. Risk is present in all the activities in a project; it is only the amount which varies from one activity to another.

Risks and uncertainties inherent in the construction industry are more than other industries. The process of planning, executing and maintaining all project activities is complex and time-consuming. The whole process requires a myriad of people with diverse skill sets and the coordination of a vast amount of complex and interrelated activities. The situation is made complex by many external factors. The track record of construction industry is very poor in terms of coping with risks, resulting in the failure of many projects to meet time schedules, targets of budget and sometimes even the scope of work. As a result, a lot of suffering is inflicted to the clients and contractors of such projects and also to the general public. Risk in the construction industry is perceived to be a combination of activities, which adversely affect the project objectives of time, cost, scope and quality. Some risks in construction processes can be

easily predicted or readily identified; still some can be totally unforeseen.

Construction risks can be related to technical, management, logistical, or sociopolitical aspects or can be related to natural disasters. In the domain of project management, 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.

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) (2004), 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).

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.

Many industries have become more proactive and aware of using analyses in projects. Likewise, RM has become a timely issue widely discussed across industries. However, with regard to the construction industry, risk management is not commonly used (Klemetti, 2006). More construction companies are starting to become aware of the RMP, but are still not using models and techniques aimed for managing risks. This contradicts the fact that the industry is trying to be more cost and time efficient as well as have more control over projects. Risk is associated to any project regardless the industry and thus RM should be of interest to any project manager. Risks differ between projects due to the fact that every project is unique, especially in the construction industry (Gould and Joyce, 2002). However there are still many practitioners that have not realized the importance of including risk management in the process of delivering the project (Smith et al., 2006). Even though there is an awareness of risks and their consequences, some organizations do not approach them with established RM methods.

The construction industry operates in a very uncertain environment where conditions can change due to the complexity of each project (Sanvido et al., 1992). 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.

Many previous studies (Klemetti, 2006; Lyons and Skitmore, 2002; Zou et al. 2006) have been conducted within the field of RM but each presents a different approach to this concept. The research in this master thesis focuses on the construction industry and how the subject is practiced in the everyday operation. The concept of RM is presented in a systematized project life cycle (PLC) approach to show differences between elements of RMP in different project phases.

The research for this study was conducted together with a consultancy company working with construction project management, which consults a variety of construction projects. This organization works with risks in a way that they are aware of risks, but do not use any specific structured methods to handle them. However, they believe that a project's performance can be improved by implementing risk management methods. At the time when research was conducted, the company was working on a school project in the western part of Gothenburg, which is the case study in this thesis. The project was chosen in order to investigate the practices of risk management across project organization.

CONCEPTS OF RISK ANALYSIS AND MANAGEMENT

The concept of risk is multi-dimensional. In the context of construction industry, the probability that a definite factor detrimental to the overall project occurs is always present. A lack of predictability related to the consequences of a planning situation and the associated uncertainty of estimated outcomes leads to the consequence that results can either be better than expected or can be worse. In addition to the different definitions of risks, risks can be categorized for different purposes as well. The broad categories of construction risks are external risks and internal risks; while some other categories curtail risks as political, social and safety risk etc.

1) **Project Risk:** Risk management in a project encompasses the identification of influencing factors which could negatively impact the cost schedule or quality objectives of the project, quantification of the associated impact of the potential risk and implementation of measures to mitigate the potential impact of the risk. 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 justification

of costly measures to reduce the level of risk. It can also help to decide if sharing the risk with an insurance company is justified. Some risks such as natural disasters are virtually unavoidable and effect many people. In fact, all choices in life involve risks. Risks cannot be totally avoided but with proper management these can be minimized.

2) **Determination of Risk:** There are two methods to determine risks in a project, namely the qualitative and quantitative approach. The quantitative analysis relies on statistics to calculate the probability of occurrence of risk and the impact of the risk on the project. The most common way of employing quantitative analysis is to use decision tree analysis, which involves the application of probabilities to two or more outcomes. Another method is Monte Carlo simulation, which generates value from a probability distribution and other factors.

The qualitative approach relies on judgments and it uses criteria to determine outcome. A common qualitative approach is the precedence diagramming method, which uses ordinal numbers to determine priorities and outcomes.

Another way of employing qualitative approach is to make a list of the processes of a project in descending order, calculate the risks associated with each process and list the controls that may exist for each risk.

3) **Factors affecting Risk:** Several factors expose projects to normal than higher risk.

a) **History:** Newer projects pose more risk because the process has not been refined with the passage of time. If a project of similar nature has been done many times before, then the likelihood of success with the current project is also enhanced.

b) **Management Stability:** Management stability means that the whole management team shares the same vision and direction, thereby leading successful achievement of goals. If the management is unstable then it can lead to unrealistic and impractical schedules for the project and inefficient use of resources.

c) **Staff expertise and experience:** In the event that the members of a project team lack the direct working knowledge and experience of the area, there is a likelihood of time delays, estimated cost upsets and poor quality.

d) **Team Size:** In case of large teams, the probability of problem occurrence increases due to the team size. One of the reasons can be the difficulty of communication due to the large team size.

e) **Resource Availability:** If the availability of resources is easy, the probability of responding to problems in real time also increases. For example, easy availability of money makes securing human, material and equipment resources easy on as needed basis. However, an abundance of resources does not provide guarantee against risks, all it does is to equip the project team with the tactics to respond to risks.

f) **Time Compression:** In case of highly compressed time schedule, the risks are magnified in the project. When more time is available, more flexibility is present in the project and there is an opportunity to mitigate and reduce the impact of occurring risks.

g) **Complexity:** In case of a highly complex or sophisticated project, the opportunity of a mistake or a problem is also enhanced.

4) **Types of risks:** Risks can be associated to technical, operational or business aspects of projects. A technical risk is the inability to build a product that complies with the customer's requirement. An operational risk arises when the project team members are unable to work cohesively with the customer.

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 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.

Risks can also 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.

Finally, 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. Whereas, an external risk has origin in sources

external to the project scope, such as cost cuts by senior management.

Risks associated with the construction industry can be broadly categorized into:

a) Technical risks:

- Inadequate site investigation
- Incomplete design
- Appropriateness of specifications
- Uncertainty over the source and availability of materials

b) Logistical risks:

- Availability of sufficient transportation facilities
- Availability of resources-particularly construction equipment spare parts, fuel and labor

c) Management related risks:

- Uncertain productivity of resources
- Industrial relations problems

d) Environmental risks:

- Weather and seasonal implications
- Natural disasters

e) Financial risks:

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

f) Socio-political risks:

- 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

5) Common sources of risk in construction projects:

The common sources of risks in construction industry are listed below:

- Changes in project scope and requirements
- Design errors and omissions
- Inadequately defined roles and responsibilities
- Insufficiently skilled staff
- Subcontractors
- Inadequate contractor experience
- Uncertainty about the fundamental relationships between project participants
- New technology
- Unfamiliarity with local conditions
- Force majeure

6) Major processes of project rish management: Risk management involves four processes namely:

a) Risk Identification: Determination of most likely risks affecting the project and documentation of characteristics of each risk

b) Risk quantification: Assessment of risks and the possible interactions of risks with project activities to evaluate the possible outcomes of the project

c) Risk response development: Definition of response steps for opportunities and threats associated with risks

d) Risk response control: Response to the changes implemented to remove risks throughout the project duration

7) Response to risk: There are five categories of classic risk response strategies: accepting, avoiding, monitoring, transferring and mitigating the risk.

a) Accepting the risk: This category implies to understand the risk, its consequences and probability of occurrence, and not doing anything about it. The project team will react to the risk in case of occurrence. This

strategy is commonly used in cases when the probability of a problem occurrence is minimal. This strategy makes sense for cases when consequences are cheaper than the cure.

b) **Risk quantification:** Risk can be avoided by not doing part of the project which contains risk. Scope of the project is changed in this manner, which might change the business case as well, since a scaled down product could lead to lesser revenue or cost saving opportunities. More risk is involved with high return on an investment. Avoiding risks on projects can have same effect on low risk, low return projects.

c) **Monitor the risk and prepare contingency plans:** Risk can be monitored by employing a predictive indicator to watch the project as it approaches a risky point. The risk strategy is to monitor the risk by being part of the test team. Contingency plans are the alternative courses of action prepared before the risk event occurs. The most common contingency plan is to set aside extra money, a contingency fund, to draw on in the event of unforeseen cost overruns. Contingency plans can be looked on as a kind of insurance and, like insurance policies, they can be expensive.

d) **Transfer the risk:** In order to transfer the risk in a project, many large scale projects purchase insurance for risks ranging from theft to fire. By doing so, the risk is effectively transferred to the insurance company in such a way that if a disaster occurs, the insurance company would be liable to pay the costs associated with the disaster. Insurance certainly is the most direct method of transferring risk; however, there are other methods as well. For example, a fixed price contract with a contractor states that work will be done for a pre-specified amount. Fixed schedule can also be added to such a contract, and penalties are imposes in case of overruns. Thus these measures effectively transfer cost and schedule risks from the project to the subcontracting firm and any overruns will be the responsibility of the sub contractor. The only drawback in this case is that the sub contractor knowingly makes a higher bid to make up for the risk he is assuming. Risk can also be transferred by hiring an expert. Transferring risk to another party has advantages, but it also introduces new risks.

e) **Mitigate the risk:** Mitigation is process of response to the risk after it has affected the project. Mitigation covers all actions the project team can take to overcome risks from the project environment.

8) **Advantages of risk management:** Following are advantages of risk management:

a) Achievement of objectives

b) Shareholders reliability

c) Reduction of capital cost

d) Less uncertainty

e) Creation of value

9) **Limitations of risk management:** In the event of improper assessment of risks, important time can be wasted in dealing with risk losses which are unlikely to occur. 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. 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.

RISKS AT VARIOUS STAGES OF PROJECT

The following is a listing of many construction industry risks and exposures.

Financial risks This risk is the totality of all risks that relate to financial developments external to the project that are not in the control of the project developer. This results from consequences that may have adverse economic effects. Financial risks fall into these categories: Exchange rate risk relates to the possibility that changes in foreign exchange rates alter the exchange value of cash flows from the project. This risk may be considerable, since exchange rates are particularly unstable in many developing countries or countries whose economies are in transition. In addition to exchange rate fluctuations, the project company may face the risk that foreign exchange control or lowering reserves of foreign exchange may limit the availability in the local market of foreign currency needed by the project company to service its debt or repay the original investment. Interest rate risk forces the project to bear additional financing costs. This risk may be significant in infrastructure projects given the usually large sums borrowed and the long duration of projects, with some loans extending over a period of several years.

Political risk The project company and the lenders face the risk that the project execution may be negatively affected by acts of the contracting authority (Government), another agency of the government or the host country's legislature. Such risks are often referred to as political risks. Political risk faced by firms can be defined as "the risk of a strategic, financial, or personnel loss for a firm because of such nonmarket factors as macroeconomic and social policies. Political risk includes risk such as change in law, payment failure by government, increase in taxes and change in government.

Legal risks It is the risk of non-compliance with legal or regulatory requirements. Much of the law is general and will apply to all organizations e.g. employment law, health and safety, environmental legislation, etc. Others may be industry specific e.g. covering specific transport services such as railways or airlines. Some of the legal risks that a construction projects can face are related to lease of property, ownership of asset and breach of financial documents.

ENVIRONMENT RISK

These are risks relating to occurrence of environmental incidents during the course of implementation of the project. These risks are generally within the control of the construction and the operation and maintenance consortium. This risk has increased due to the presence of strict legal liability in relation to such environmental incidents, which can result not only in adverse affects on the financials of a project but may also cause a closure of any work or operations of and in relation to the facility. The main environmental risks associated with hydro power projects are –

- Loss of flora and fauna
- Loss of fertile lands
- Rehabilitation and resettlement problems

Force majeure risks These risks are regarding the events that are outside the control of any party and cannot be reasonably prevented by the concerned party. These risks generally arise due to causes extraneous to the project. The defining of force majeure events, these include natural force majeure events, direct or indirect political force majeure events. Natural force majeure events comprise of all events that can be attributed to natural conditions or acts of god such as earthquakes, floods, cyclones and typhoons. These risks should be shared equally among the parties. Direct political force majeure events are events attributable to political events that are specific to the project itself such as exploration, nationalization. Indirect political force majeure events are events that have their origins in political events but are not project specific such as war, riots etc.

Operating risks Some of the risks that may face in a construction project apply during operations and maintenance (O&M) type services. More specifically, operational risk can be defined as the risk of loss resulting from inadequate or failed internal processes, people and systems, or from external events22. Some of the risks and actions available to the concession company include:

1. **Performance risk-** The completed facility cannot be effectively operated or maintained to produce the expected capacity, output or efficiency.

2. **Operation cost overrun-** The operating costs exceed the original estimates.

3. **Operating contractor default-** The concession company may terminate the operations and maintenance contract and appoint a new O&M contractor.

4. **Default-** The default may be caused by the actions of a third party, in which case the concession company could make claims of damages against that party.

RISK IDENTIFICATION PROCESS

Risks exist from the very outset of a project. Therefore we need to identify what they are, ascertain when they might arise, what effect they may and what measures need to be taken to prevent their occurrence or mitigate their potential impact. The identification of risks may be considered as the most important stage in Risk Management, if only in terms of bringing considerable benefit to all parties in the greater understanding of the project, irrespective of whether further action is taken or not. When identifying risks, it is important to appreciate not merely the risk itself but the source, the event that may lead to the risk materializing and the effect of the risk if it does materialize.

RISK IDENTIFICATION METHODS

Questionnaires or Checklists:- Questionnaires are usually drawn up from a combination of previous experience and specific project criteria. There are two forms of questionnaire, one is a very general form with non-specific prompts or questions and the other can be detailed as is required by the particular project. Questionnaires also facilitate consistently presented answers from different team members which allow less time consuming and more

meaningful comparisons. Therefore the risk manager can ascertain more readily any apparent consensus.

Interviews:- This is technique that has been used historically by personnel departments and other consultants to extract information. It has also been used by risk managers to identify possible risk in a development. The interviews may take place on a one to one basis or on a many to one basis. The many to one basis should consist of projects members from different disciplines so that the subjects raised can be viewed from different perspectives. The problem with this method is that it is time consuming not only to carry out the interviewing but also record the risks arrived at there from.

Expert system:- A lot of research is being done on artificial intelligence and expert systems. Specifically, one of the most sophisticated models that can be developed for risk management is by making use of knowledge-based systems or human-computer cooperative systems. This system is designed to assist the project managers in achieving more effective control over risks by providing them with appropriate knowledge, gathered from many project managers and compiled into a knowledge-base. It is designed to warn project managers of risks that may follow etc. While doing this, the logical thinking and the intuitive thinking of the managers is accounted for in the system

The Delphe technique:- The Delphe technique attempts to produce objective results from subjective discussions. It is a systematic, interactive forecasting method which relies on a panel of independent experts. This method may be applicable to the identification of risks but it is more suited to attaching likelihood of occurrence and potential impacts of previously identified risk events. This method basically involves the following sequence of events:

1. A questionnaire is forwarded to all the appropriate members of the project team by the appointed risk manager.

2. The members of project teams gives their objective views in response to the questionnaire and returns them to the risk manager.

3. The risk manager then collects these results and redistributes them. Each project participant now receives a different set of views and is requested to reconsider their original answers and resubmit them to the risk manager.

4. These revised results are again collected by the risk manager and redistributed again in the same manner as above.

5. This iterative process is continued until the risk manager is satisfied that a consensus o opinion has been reached.

RISK ASSESMENT

Risk assessment is the process of estimating and communicating workplace safety risk, and deciding whether this risk is acceptable. Conducting a risk assessment involves making a value judgement based on this information and any available evidence within the workplace and industry. This may include numbers of current and past incidents, severity of injuries from the identified hazard, lost work time from injuries and number of people involved in incidents. Specific information such as environmental measurements of hazards, eg noise levels, dust levels, and comparisons made between the workplace measurement and the legally required measurement can also assist in the risk assessment process**.** Widely used method is risk matrix**.** The risk matrix records the level of risk which is determined by the relationship between the likelihood of an incident occurring from the hazard, and the consequence caused by the hazard. This is recorded as either a numerical or alphabetical code. The relationship between likelihood and consequence determines how dangerous the hazard is. The level of risk or code that is determined is referred to as a risk priority rating. This priority rating allows employers to priorities the hazards identified to ensure that the hazards with high potential of creating an incident are eliminated or controlled first. Controlling a hazard may involve inspections, investigations and/or monitoring control activities with managers, supervisors and work teams involved as appropriate depending on the circumstances.

CONCLUSION

Formal risk analysis and management techniques are rarely employed by Pakistani construction industry owing to the lack of experience and knowledge in the area. The industry also holds disbelief that these techniques are suitable to be employed in construction projects, much in the same manner as employed in other industries. The perception of risk by contractors and consultants is mostly based on their intuition and experience. The most utilized risk response measures are risk elimination and risk transfer. However, the respondents have revealed that these practices cause the problems of delays, low quality and low productivity in projects.

It may be stated that risk Management is the core of project management. The success of every project depends on how efficiently and effectively the. Risk avoidance may include a review of the overall project objectives leading to a reappraisal of the project as a

whole. depends on how efficiently and effectively the uncertainties are handled. Every project is unlike the earlier one, the problems are distinctive and their solutions are also different. Risk management will not remove all risks from the projects. Its main objective is to ensure that risks are managed most effectively. The formal risk analysis and management techniques are rarely used by construction industry due to lack of knowledge and expertise. The industry is also unknown about the suitability of these techniques to construction industry. The control and risk transfer is most useful method in construction industry. Joint venture widely used as a tool for risk transfer.

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