CONSTRUCTION INSURANCE AND RISK MANAGEMENT

Submitted By

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ABSTRACT

Construction industry all over the world is infested with innumerable uncertainties and risks. Contractors have to deal with and manage risk on daily basis. Time and cost overruns are the ultimate consequences of this peril. However, in order to ensure profits and client satisfaction, this predicament must be dealt with efficiently and effectively.

There are three basic ways of risk handling. A contractor can mitigate, transfer or own the risk. The conventional practice is to own it by defining a contingency amount for the project. This may be a temporary solution but does not provide comprehensive coverage for all the risks involved. Contingencies are often miscalculated and misused by the contractors especially in this part of the world.

Another technique to handle the risks associated with construction is to employ insurance. General observation reveals that construction insurance in Pakistan is not being successfully adopted by the contractors Insurance has the potential to tackle uncertainties and risks in a profound manner. By employing insurance the contractor can transfer certain risks to a third party i.e. The Insurance Company which is better suited to deal with it. Against this guarantee of compensation, the insurance companies charge a certain premium amount. The premium value corresponds to the extent of coverage and the number of risks involved in a particular project.

Before we started the project we had assumed that insurance was not being successfully employed in Pakistan due to high premium rates and lack of company's providing construction insurance. In order to better understand the mechanism involved in calculating insurance premiums we have developed our own insurance model and compared the results with data obtained through our industry surveys. This has enabled us to gain an insight in to the problems and shortcomings afflicting the industry in general.

DEDICATION

We would like to dedicate this project to our parents. It is only through their consistent and unwavering support that we have been able to come this far not only in our academics but also as responsible members of the society. We cannot even begin to imagine the sacrifices that they have made in order for us to follow our dreams and aspirations. Although we can never repay what they have done for us, we hope to one day be able to live up to their expectations and make them proud.

ACKNOWLEDGEMENTS

First of all we would like to show our gratitude to Allah Almighty (The Most Gracious The Most Merciful) for helping us to get back on track whenever we lost our way. There were many hurdles along the way and without the help of The Almighty we could never have overcome them.

Also, we would like to thank NUST administration for providing us with the best infrastructure and facilities in the country to carry out our endeavors.

We would like to take this opportunity to acknowledge some people who have been instrumental in the successful completion of this project. To that effect, firstly we thank our project supervisor Dr. Muhammad Jamaluddin Thaheem who has been a major source of inspiration for us. It was in his lectures that we first started to appreciate the importance of risk management and mitigation in construction projects, which eventually led to us choosing this topic for our final year project. Throughout the duration of the project, he provided us with whatever support we needed and always made himself available in spite of his demanding schedule. We would also like to extend our gratitude towards the other faculty members with a special mention for Lecturer Bilal Ayub and Lecturer Fahim Ullah Khan for providing us with industrial contacts and for going through our tedious survey sheets.

Lastly we would like to acknowledge the efforts of the people who helped us in our data collection both within NUST and in the industry.

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CHAPTER 1

1 INTRODUCTION

1.1 General

Construction taking place throughout the world is prone to countless uncertainties and risks. No matter how thoroughly you plan a project there is always a probability of encountering the unforeseen. Primarily, contractors reserve a contingent amount to cater for these unforeseen factors. However, the contingency amount can never be precisely calculated as uncertainty is supposed to be unpredictable itself. The international market has shifted towards construction insurance as a means to tackle uncertainties (Odeyinka, 2000; Smith and Bohn, 1999).

However, before employing construction insurance, an effective risk identification and management process should be set in place. Although the main focus of this study is to signify the importance of construction insurance and ways to use it more effectively, the significance of risk reduction and management from within the means of the project can't be stressed enough. Before transferring risks to third parties, it is highly important to see if there are other ways of dealing effectively with those risks and if the contractor himself is in a better position to tackle said risks. This requires great skill and knowledge on the part of project managers and supervisors. They need to make sure that project risks are reduced to a minimum and then to decide which risk management tools are best applicable (Palmer et al., 1996; Ahmed et al., 2007).

In the case of insurance for example, it is imperative for the project manager to know what risks should be transferred to the insurance companies and he should be able to accurately quantify those risks in order to make an in-house estimation of the premium rates, deductibles and related quantities. The most common contractual requirement is to obtain Contractor's All-Risk Insurance (CAR). Now let's suppose that a PM has been given the task of selecting and employing a suitable CAR policy for the project that has been assigned to him. First and foremost he will study with detail the risks that can be covered under the CAR policy. Out of those risks, he will select the risks that cannot be tackled by methods other than insurance. After that, the PM will need to quantify those risks in order to come up with the expected loss that can

be incurred due to those risks and the chance of their occurrence. Using all of this information, he will be able to select suitable premium rates and deductibles. If he is not able to do any of this, he will have to rely upon the estimations of the insurance companies who may not be working for the best interests of the project. This may result in highly unsuitable CAR policies, which will practically mean that the contractor will have to deal with the insured risks himself eventually (Raviv, 1979).

1.2 Problem Statement

The construction industry of Pakistan is lagging behind the international market in the adaptation of construction insurance as an effective tool of dealing with the Risk in construction Projects.

1.3 Objective

- To study sources of construction risks and uncertainties.
- To study various risk management techniques with a special focus on insurance.
- To study construction insurance practices in Pakistan.
- To quantify the risk perception for proposing a industry-friendly insurance regime.

1.4 Reason for selection of Construction Insurance as research area

As per contractual requirements, a huge number of projects need to employ insurance in one form or another. Although insurance can be a very useful instrument in dealing with risks and uncertainties of a particular project, in Pakistan it is not being used as effectively as it should be. There are several reasons for this, one of them being lack of awareness and understanding among even the major contractors who are currently working in the construction industry. This is so, partly because there hasn't been a lot of research that has been carried out in this field in our country and partly because industry professionals are reluctant to make use of new and innovative ways of carrying out construction projects and tend to stick towards the more conventional methods. There is also a false notion among contractors that insurance cannot be used as an effective tool for risk management and that it is a waste of money. We selected this research area to see for ourselves whether there is any truth to these preconceived notions. We see great potential in insurance as an effective tool for risk management and aim to create awareness as to how it can be effectively utilized.

1.5 Industrial Application

By use of the methods that we have suggested in this project, project managers of even the most complex and demanding projects can better identify and quantify the risks associated with their respective projects. This will enable them to pinpoint the party best equipped to deal with the identified risks and the risks can then be transferred to them. This research will also help them in understanding the significance of insurance and how it can be helpful in risk management. We have created a universal insurance model, which can be applied to any construction project to calculate the insurance premiums with deductibles as the variable. Previously, project managers in Pakistan have been relying on insurance companies to do this for them. Through the utilization of our model, managers can now decide for themselves what premium rates and what deductibles are more suitable for their projects.

CHAPTER 2

2 LITERATURE REVIEW

2.1 Uncertainty and Risk

Uncertainty and risk can be best expressed by the famous words of former US Secretary of Defense Donald Rumsfeld:

"There are known knowns. These are things we know that we know. There are known unknowns. That is to say, there are things that we know we don't know. But there are also unknown unknowns. These are things we don't know we don't know."

Uncertainty can be defined as unknown unknowns while risk can be defined as known unknowns.

2.1.1 Factors influencing Risk and Uncertainty

Risk in construction industry rise due to a number of factors. These factors are enlisted and explained briefly below (Abbasi et al., 2005).

2.1.1.1 The duration of the project is large

Unlike many other fields civil engineering projects usually have large durations associated with them this results in the rise of many uncertainties in the project e.g. varying weather conditions all over the year, escalation and many others which can result in overruns in time and cost (Shen and Cheung, 1996).

2.1.1.2 Human resource requirement is great and changes over time

Similarly large human resource requirements in civil engineering projects also increase the number of risks and uncertainties associated with them. Certain large-scale projects may have thousands of workers working in difficult terrain and harsh conditions and hence the probability for injury and other damages is proportionately high.

2.1.1.3 Projects are geographically diverse and often located in different terrains

Civil engineering projects are often located at remote areas where unsuitable working conditions prevail. It is difficult for the manpower and the machinery to operate in these areas thus increasing the associated uncertainty and risk.

2.1.1.4 A large variety and quantity of materials is required

Civil engineering projects often involve use of large quantities of expensive materials. Sometimes they involve working with new and untested materials and to the uncertainty and risk in the project.

2.1.1.5 Many parties are involved in the project leading to various disputes

Most civil engineering projects have a large number of stakeholders which results in the rise of many different disputes in the project. The resulting disputes cause disruptions and result in cost and time overruns. Apart from above mentioned risks many other factors influence the risks and uncertainties in construction projects.

2.1.2 Risk Management

Risk management is a structured process to reduce the impact of risk on the project. Uncertainties surround the construction projects and as a result the risk needs to be managed and treated efficiently. Risk management plays a vital role in the success of a project (Ward, 1999).

The construction project includes many stakeholders including client, consultant, contractor etc. and all of them have different perspectives towards the risk. Therefore, the risk is best placed with the party who is in the best position to deal with the factor that gives rise to that risk (Royer, 2000).

Risk management process given by Flanagan and Norman is shown below:

2.1.2.1 Risk Identification

In risk management, identification of various risks plays a vital role. Once the risk is identified it can be dealt efficiently. Risk identification involves finding the source of the risk and the type of risk that occur in the project. It is imperative that the management team identifies most of the risks in the project (Tadayon et al., 2012; Al-Bahar and Crandall, 1990).

2.1.2.2 Risk Classification

The next step after identification of risk identification is its classification. This step involves what type of risk is involved and to which parts of organization it will effect. The risk is classified in various classes e.g. material damage, political risks etc.

2.1.2.3 Risk Analysis

After the classification of risk, analysis of risk is performed. In the analysis phase we observe fields like occurrence of risks, its impact, its consequences, its effects on other risks, its impact when combined with other risks etc. Different measurement techniques are used to analyze risks.

2.1.2.4 Risk Attitude

Risk attitude refers to the attitude of the organization or the management in dealing with the risk. Their attitude will affect the decisions regarding the risk and that in turn will have an impact on the possible consequences of the risk.

2.1.2.5 Risk Response

The last step of the process is risk response. Risk response refers to the steps taken to deal with the risk.

2.1.3 Risk Response Techniques

Various approaches can be taken to deal with any particular risk. One of the methods to deal with risk is Risk Process (Boussabaine and Kirkham, 2008; Ezeldin, and Orabi, 2006).

It comprises of following steps:

2.1.3.1 Risk retention

Risk retention means that the risk can be retained or owned by a party due to reasons like little impact, low cost, low chance of occurrence etc. of the risk. Retention is usually practiced when the party can see the impact and effect of the risk. If the risk is such that party is not affected greatly it accepts its effects.

2.1.3.2 Risk reduction

Risk reduction is another method to deal with risk; in this approach risk is reduced by various methods. For example by employing safety measures on the site, different workshops for the laborers, inserting clauses in the contractual document to safeguard from risks or to reduce it, by proper planning and supervision of the site etc. Risk reduction is applied when the risk can be greatly reduced by employing simple and effective management.

2.1.3.3 Risk transfer

Risk transfer is an approach whereby the risk is transferred to a third party. This technique is applied when the risk impact and probability of occurrence are high cannot be reduced. The risk is transferred to a third party that is best suited to handle it i.e. Insurance Company. Against a certain monetary value (premium) the risk is transferred to the insurance company in case of damage occurring as a result of that risk the insurance company is liable to compensate the contractor. Nowadays many large projects are insured because the probability of occurrence and potential impact of risk is extremely high.

2.1.3.4 Risk avoidance

Risk avoidance occurs when a party can control risk, i.e. it can either eliminate it or it can avoid it. Risk can be avoided by different techniques. Risk can be avoided by using up to date equipment that can work efficiently etc. One of the basic methods to avoid risk is sub-contracting the project. All the risk from the contractor can be shifted to the sub-contracting firm. In this way the main contractor avoids the risk.

2.1.4 Benefits of Risk management

Although risk management is a process that may be difficult and costly to employ at first, one a well-defined risk management process is in place, there are numerous benefits that emanate from it (Wang et al., 2004).

2.1.4.1 More realistic project planning

Once an effective risk management system has been adopted, project planning, although still a very complicated and multifaceted job becomes relatively easy. The PM can use a more realistic approach in carrying out the planning process, as he will have a better view of the risks involved and their consequences and implications. Major processes like procurement, workforce management, and resource allocation can be undertaken in a better way. There is more control over each phase of the project from initiation to closeout.

2.1.4.2 Improved loss control

Effective risk management can help better control and minimize the losses that can be incurred in a project. Once risks have been allocated to the parties best suited to deal with them, the chances of those risks causing losses are greatly reduced. This leads to much greater control over the overall expected loss of the project which ensures that the project is carried out under a healthy environment and is profitable for the contractor while also fully meeting the needs of the client.

2.1.4.3 Control of project cost

Improved control over the losses automatically results in greater control over the project cost. It is in the best interest of all parties to keep the project cost to a minimum while not compromising on the contractual requirements regarding the scope and the quality of the construction. This is only possible through good risk management and allocation. If a proper risk management process is not in place, an increase in project cost becomes inevitable.

2.1.4.4 Greater certainty

One of the goals of effective project management is to increase the certainty of a project so that planning and management becomes easy. If there are too many risks and uncertainties in a project, project management seems like a rather insurmountable task. The project manager is never well equipped to carry out his duties in case of great uncertainty. However, if these uncertainties are reduced through effective risk management, the manager will have much greater control over both the cost and time schedules of the project.

2.1.4.5 Lesser delays and timely completion

Another benefit of systematic risk management is that due to greater certainty in the project, fewer changes will be needed to make in the project schedule and it will be more likely that the project will be able to finish on time. This can be of great use where an imposed finish date is set or where fast tracking is being employed. Lesser project duration also means lesser overhead costs and lesser direct costs, which increases the profitability of the project and increase the motivation level of the contractors and subcontractors.

2.1.4.6 Lesser disputes

It is the poor allocation of risk that is a major cause of disputes that arise among major stakeholders. If there is a proper risk management system, risks will be allotted in a much better way than usual leading to a more streamlined relationship between different parties that are involved in a project. Also, the liabilities of each party are well defined which makes it easier to resolve disputes even if they do arise in the first place.

2.1.4.7 Increased flexibility

With better risk management funds can be better appropriated and time delays avoided. This provides for an increased flexibility in the allotment of time and capital resources to the various tasks in the project. This eases the pressure on the management team and allows it to better deal with conditions arising from various risks.

When all the risks in a project are known a better plan and schedule can be developed. As the probability of any uncertain events occurring go lower due to a greater certainty in planning the project, cost can be properly managed and risk of loss also goes down. There are lesser delays in the project leading to timely completion and lesser disputes among stakeholders.

2.1.5 Risk Management through Insurance

Insurance is a tool to transfer risk to a third party (construction insurance company) in lieu of a payment called the premium. Many companies offer a number of different policies dealing with various aspects of construction. However before going through with insurance certain factors need to be considered (Baartz et al., 2003).

These are:

- Insurability of the risk
- Premium
- Deductibles
- Insurance Period
- Probability of occurrence
- Probable damage

Before going for any insurance policy the above-mentioned factors have to be considered. After identifying and analyzing the risks the first step is to determine its insurability i.e. whether any policy is available to cover that risk. It is also imperative that we determine the pros and cons of insuring that particular risk before making any decision.

The next step is to consider whether the premium rates the insurance company is charging are reasonable and within the limits the contractor is willing to pay. Deductibles also need to be considered most policies have a deductible amount. The policy does not cover any losses below this amount.so the contractor needs to consider whether the deductibles are reasonable (Liu et al. , 2004).

Insurance period refers to the time period for which the policy will remain valid. Insurance company does not deal any loss after that particular time period. Like deductibles it is also an important factor, because if the project duration exceeds the insurance period than the insurance is useless for the remaining time period.

Risks that occur have a certain probability of their occurrence. If the probability of a certain risk is very high and its impact on the project is also large then it is important that any policy the contractor takes must cover that risk. Other risks which have low impact and low probability may be excluded from the policy (Ross et al., 1986).

2.1.6 Risk Quantification

To increase the effectiveness of risk management, a carefully drafted risk management system should be developed and employed. For this purpose, it is usually advised to form a risk quantification team of no more than 3-5 members with representation of each stakeholder. This is important because understanding and perception of risks is fairly subjective. If all stakeholders are not on the same page throughout the risk quantification process, it can lead to disputes between them, which will adversely affect the proceedings of the project.

2.1.6.1 What is Risk Quantification?

Risk quantification is the process of assigning probabilities to the occurrence of certain negative events that are foreseeable in the project. The main aim of quantification is to develop a system with which risks can be arranged according to their importance. Not all risks are equally important. Some pose a greater threat to the project than other. The magnitude of this threat is a function of both the probability of occurrence of the risk and its impact. It is this magnitude that risk quantification aims to compute. The probability of the risk can be a decimal figure from 0 to 1 or in the form of a percentage. On the other hand, impact is estimated in monetary terms or in terms of time delays (Walke et al. 2011).

2.1.6.2 The need for Risk Quantification

Most construction projects don't have enough resources both in terms of money and in terms of time to deal with each and every risk that has been identified. Due to this reason, risks need to be ordered in accordance with their significance with regard to the project. This is only possible through the process of risk quantification. The larger the size of the project, the more important this process becomes as larger projects are usually more complex and can go out of hand fairly quickly if not managed effectively and efficiently. The stakes associated with these projects are very high and as it is generally observed that risks can account for about 12-20% of the project costs, a great amount of loss can be incurred if they are not dealt with in an effective way.

2.1.6.3 Qualitative Techniques:

The qualitative method of risk quantification is used to roughly rank risks in order of importance. It is not a detail oriented process and cannot provide precise values but is fairly useful when both time and money set aside for risk evaluation are limited. One qualitative technique is to rank risks from low to high both in terms of probability and impact. Another technique is to rank them

on a scale of 1 to 10. Qualitative analysis however, can only assist in prioritizing risk. It does not provide a very definitive guideline. For that, the quantitative methods of quantifying risks need to be employed.

2.1.6.4 Quantitative Techniques:

To assign specific numerical values to risks, quantitative techniques need to be used. These values are assigned to both the probabilities and the impacts of the risks. The techniques that are used for this are statistical in nature. Examples of statistical methods for quantifying risk are enlisted below:

- Pert
- Sensitivity analysis
- Monte Carlo Analysis
- Decision Tree Analysis
- Critical Chain Scheduling
- Expected Monetary Value Analysis

2.1.6.5 Risk quantification and Insurance

Once all the risk have been ranked and quantified, the total risk of the project in terms of the percentage of the total project cost can be calculated. This value usually comes out to be around 12 to 20 percent of the total cost. This risk can usually be directly translated to expected loss if we just focus on insurance as the sole risk management tool and ignore other techniques for the time being just for the sake of better understanding the relationship between the quantified risk and insurance premium rates. Once we have this value for expected loss, we can use it to calculate the premiums. Premiums are a function of both the expected loss value and the deductible amounts that have been agreed upon.

2.2 Insurance

Now lets take a look what insurance in and what is its role in the construction industry and its use as a tool for risk management.

2.2.1 What is insurance?

"Insurance is the equitable transfer of the risk of a loss from one entity to another in exchange for a payment."

Insurance is a safeguard from the potential consequences of various risks. Against a certain monetary sum the risk is transferred to the insurance company. In case of any loss originating in that risk the insurance company is liable to pay compensation. Many different types of insurance policies exist today and it is a huge industry in itself. Different types of common insurance policies are Health insurance, life insurance, vehicle insurance, construction insurance and many others.

2.2.2 What is insurance in construction?

Construction industry contains a large amount of risks and contractors are not suited to deal with all of that risk .so there is a need to transfer that risk to a third party which can suitable deal with it. That is where the insurance company comes in the contractors pay a certain monetary value (premium) against which the risk is transferred to the company In case of damage occurring as a result of that risk the insurance company is liable to compensate the contractor. Nowadays many large projects are insured because the probability of occurrence and potential impact of risk is extremely high. There are different policies that are practiced worldwide e.g. General Liability Insurance, Environmental impairment Liability Insurance, Contractors All Risk Insurance (Zaki, 1992; Bunni, 2003).

2.2.3 Premium

Premium refers to the monetary amount that the contractor pays to the insurance company in order to transfer the risks to the company.

2.2.3.1 Factors affecting premiums

Premiums are dependent upon various factors:

- Scope of the project
- Duration of the project
- Location
- Capabilities and reputation of the contractor
- Political
- Weather
- Deductibles
- Competition

Scope of the project holds a large sway over the premium amounts. Larger more complex projects result in higher premium rates, as the potential for something to go wrong is higher. On the other hand smaller less complex projects have lower premium rates associated with them.

Longer projects inevitably have more risks associated with them. The longer duration gives rise to various problems that are not normally encountered in shorter duration projects e.g. inflation. As a result the premiums are higher for projects with longer durations (Cunningham and Fischer, 1998).

Premiums directly depend upon the risks involved. Civil engineering projects are often located in remote areas where the terrain is difficult and conditions harsh. The risk in these projects is proportionately greater and as a result the premiums of these projects are also higher. Other factors related to location also impact the premiums e.g. earthquake zoning and climatic zoning.

The political conditions of one area can affect the premium rates because there is a chance of political disturbance in the area that can affect the project. Capabilities of contractor represent the amount and scope of work that he can easily handle. It depends upon his available resources i.e. equipment, and experienced workforce work force also important is the amount of experience

the contractor has in similar projects. Reputation in the market is indicator of how reliable a contractor is. Insurance companies will charge lower premiums to contractors with good reputations.

Weather conditions are another factor that affects the premium rates. Risks are larger in areas prone to bad weather conditions and as a result. Projects in these areas will be charged with higher premiums.

If the contractor agrees to higher deductibles then the premium amounts are automatically lower. Similarly high level of competition in the market may force the insurance company to quote lower premiums.

2.2.4 Deductibles

Deductible is the minimum amount below which the insurance company is not liable to pay any damages i.e. for any loss below the amount specified as deductible, the contractor has to bear the cost of any damage. Deductibles are invariable included in most of the policies. This is usually done to reduce the number of claims and to protect the insurance company from paying to many compensations

2.2.4.1 Factors that affect deductibles:

- Cost of the project
- Scope of the project
- Willingness to pay higher premiums

Cost of the project directly impacts the deductible amount. For larger more expensive projects the deductible amount are mostly higher. Same is the case for complex long duration projects.

The major factor in determining the deductible amount is the willingness of the contractor to pay high premiums. If the contractor agrees to pay higher premiums the deductibles can be lowered if the contactor is unwilling to pay high premiums then inevitably the deductible amounts quoted by the insurance company would be higher.

2.2.5 Insurance Policies

Before deciding on any particular policy certain factors should be considered;

- Flexibility in insurance policy
- Limitations of insurance policy
- Insurance gaps and overlaps
- Quality of service
- Reputation
- Extent of coverage

Insurance policies should be flexible in nature as contractors prefer to buy one policy that covers many aspects. Careful consideration should be given to the limitations and gaps of insurance policies thorough knowledge of what is covered and what is not covered in the policy is essential. Similarly the quality of service provided by the company and its reputation in the market hold considerable sway in the mind of the client when going for any construction policy. With time many policies have been introduced in to the market. These policies provide coverage for different types of risks each has its own exclusions and limitations.

Some of these policies are:

- Contractors All Risk Insurance
- Public Liability Insurance
- Employer Liability Insurance
- Personal Accident Insurance
- DSU (Delay in Start-up) or ALOP (Advance loss of Profit) are designed to cover business interruptions.
- Wrap-up Insurance Policy
- CGL (Comprehensive General Liability) Insurance Policy

- EIL (Environment Impairment Liability) Insurance Policy

A general overview of the above-mentioned traditional and contemporary insurance policies has been given below. Although now there are various new types of insurance policies that are tailor-made for the ever-varying types of construction projects, these policies are a few of the most commonly used ones.

2.2.5.1 Public liability insurance

Public liability insurance is a general insurance to be possessed by any business, which involves interaction with the customers, or people in general. Public liability insurance as part of construction insurance helps the businesses in case employees or the tools cause any damage to third party property or individuals used in construction.

2.2.5.2 Employers liability Insurance

As the construction industry involves lot of risks, any worker can get injured or die at any point of time, due to the faulty equipment or negligence of supervisors or co-workers. Employers are responsible for the health and safety of their employees at construction site. Moreover, the employees will have every right to sue the owner and claim for compensation. In case of such unexpected events, the employer or the owner can benefit from the construction liability insurance, as the insurance company pays the medical costs or the compensation associated with the claims.

2.2.5.3 Personal Accident Insurance

This insurance is specifically designed for managers, sole proprietors or business partners. This is useful in the cases, where the person injured can't blame any other person for the injury caused to him. This is helpful in providing assistance for the time during which the injured person cannot get income.

2.2.5.4 CGL (Comprehensive General Liability) Insurance policy

CGL provides coverage for any bodily injury, products and complicated operations. It is so broad that it can provide insurance for owners, contractors, personal injury, medical payments, property damage as well as "Contingent Employers Liability" (Weimer et al., 2011).

2.2.5.5 EIL (Environment Impairment Liability)

It provides coverage for the "Pollution Liability" placed on the owners and contractors for the environment hazards occurred due to construction. The EIL policy provides coverage for the following cases:

- Sudden and Accidental pollution, occurring on the site.
- On-site third party bodily injury and property damage
- Off-site third party bodily injury and property damage

2.2.5.6 Contractors all risks insurance (CAR)

Contractors all risks insurance is customized for construction businesses. It provides assistance for contract works of new structures, theft of materials or tools, damage to the materials or tools due to unexpected events, sudden stoppage of on-going works of new structures, owned or hired plants, etc. This insurance acts as a perfect help for the most commonly incurred accidents in the construction process (Musundire and Aigbavboa 2015).

Through our research we found that CAR policy is the most widely employed insurance policy in construction. As a result most of our work is based on CAR

"Contractors' All Risks insurance (CAR) (also referred to as Contract Works or Construction Insurance) typically provides cover for the cost of physical loss or damage to building works, advanced loss of revenue/income, public liability, installation and constructional plant/machinery including hired-in plant and tools." (Estate Insurance Group website)

Contractors all risks insurance is customized for construction businesses. It provides assistance for contract works of new structures, theft of materials or tools, damage to the materials or tools due to unexpected events, sudden stoppage of on-going works of new structures, owned or hired plants, etc. This insurance acts as a perfect cover for the most commonly incurred accidents in the construction process (Perera et al., 2010).

Contractors All Risk is used worldwide in the construction industry. CAR is comprehensive policy which covers most of the commonly found sources of risk in construction projects as a result there is seldom any need for the contractor to buy any other policy. Furthermore in many countries where FIDIC rules are followed it is often a contractual requirement for the project so

contractors are obliged to buy CAR. CAR policy can be cover all the projects at the same time or it can be applied to each single project one at a time.

2.2.5.6.1 Exclusions in CAR

Exclusions are a part of almost all the insurance policies. It is the part of risk that is not included in the policy. These risks are not included because of their unpredictable nature or the severity of their consequences. Another reason for these exclusions is that these are often included to reduce the number of claims.

Some of the common exclusions in CAR policy:

- War
- Act of Terrorism
- Rebellion
- Military or usurped power
- Other exclusions specific to the project

.If we analyze the above scenarios, we can see that they are unpredictable and their effect on the project can be large so because of their nature they are excluded from the policy.

2.2.5.6.2 General Conditions

All insurance policies have some conditions specified by the insurance company and any person availing these policies has to adhere with these regulations. These are generally included by the insurance companies to reduce the number of claims and as protection against fraudulent claims. Each insurance contract includes these condition some of these conditions are generic and there are others which are specific to the project

2.2.5.6.3 Sections

The sections included in the CAR policy are:

1. Material Damage

Material damage section can be further subdivided in to:

- Contract Work
- Construction Plant and Equipment
- Construction Machinery
- Clearance of Debris

Material damage comprises of the contractual work i.e. problems and issues which hinder the completion of the contract. Materials that are supplied by the principals are also included in it. The damage to the material equipment and plant are also covered. Along with it clearance of debris is also the part of material damage but the coverage for these is usually limited up to smaller amounts.

2. Acts of God

- Earthquake
- Volcanism
- Storm
- Cyclone
- Flood

Acts of God section provides cover against the damage arising from natural forces including but not limited to earthquake, cyclones etc.

3. Third Party Liability

- Body Injury
- Property Damage

Third party liability includes injury of any person on the site and also includes damage to third party property damage that may occur on the field (Imriyas et al., 2007).

CHAPTER 3

3 Methodology

3.1 Methodology

Three basic phases of proceeding with the project:

- Research phase
- Data collection phase
- Data analysis and conclusion phase

3.1.1 Research phase

This phase mainly comprises of going through research papers and work that has already been carried out by other specialists on the subject in question. The ultimate purpose of doing so is to build a knowledge bank as well as get acquainted with the field so as to develop significant and meaningful questions for the surveys that we carried out in the data collection phase. The questions act as guide path for the study as it approaches conclusion. The list of research papers and contract documents that we have gone through are provided in the reference section.

3.1.2 Data collection phase

There are three basic concerned entities to the field of study:

- Insurance firm
- Contractor
- Client

The tools employed for carrying out this phase are:

- Questionnaires
- Interviews
- Archives

Our data collection phase began with meeting the representatives of four basic AA+ category insurance providers in Pakistan namely:

- Jubilee Insurance Company Limited
- EFU General Insurance Limited
- IGI Insurance Limited
- Adamjee Insurance Company Limited

The meetings included specific set of questions that we asked the representatives in order to get first-hand information pertaining to insurance policies and practices. However, these sessions were not as fruitful as we had expected because of the hesitance of the representatives in disclosing information. They claim that some information was part of the 'trade secret' while some was classified on the basis of client privacy privilege.

Next up, we met with different contractors and clients to hear their side of the story. We asked them questions about why they didn't consider insurance as an effective tool for risk management and what could be done to change the way that insurance is currently being employed in the country. We also asked them if they had developed a system for efficient management of risks and what protocols were set to prioritize certain risks over others. This led us to identify the major insurable risks that are involved in almost every project.

Once we had a list of risks that were insurable, we made sure that they were applicable to most projects and that they made up more than 80% of the total risk value of the project. We set 80% as a criterion because each project is unique in itself and has some risks involved that are only project specific and cannot be applied to other projects.

In the next step, we developed survey sheets, which aimed to obtain the probabilities of occurrence of each of these risks and their impacts on both cost and duration of the project and the probabilities of loss from one event to exceed different values, which we compared with the deductibles specified in the insurance data. We distributed these sheets among only a handful of experienced professionals who have been working in the industry for more than 10 years at least. The reason for this was that it is imperative for quantitative data to be highly credible and this

was only possible if it came from credible sources. It is said that risk quantification using bad data can produce more negative effects than doing no quantification at all so this is one area in which we took special care.

To see if the results we came up with were correct and precise, we needed actual insurance data with which we could compare them. Now this was not an easy thing to do. Both the contractors and insurance companies were fairly hesitant in providing us with any insurance data related to actual projects. This forced us to use underground channels to obtain this data. We used our sources, which we cannot name, to get insurance data pertaining to gross premiums and deductibles for 5 projects of different sizes ranging from Rs. 50 million to Rs. 1 billion. Because we cannot name these projects, we will refer to them as project A, project B, project C, project D and project E.

After obtaining all this data, we gathered it, organized it and prioritized it in order of importance. This took us about 5 days in all. Once we had all the data in an organized form, we met with our project supervisor to get ideas regarding the approach with which the data needed to be tackled. He advised us to adopt one of the different statistical techniques used in quantification of risk and to learn software, which would assist us in our calculations. We learned to effectively use three different project management computer programs, which are enlisted below:

- Primavera P6
- Risky Project Professional
- MS Project

A list of the questions we asked during the interviews and images of all the survey sheets and questionnaires have been attached below to give an idea as to how we conducted the data collection phase:

3.1.2.1 Interview Questions:

Following is a list of the questions that we asked in the interviews that we conducted in the preliminary survey phase.

3.1.2.1.1 Contractors who are insured

- Which aspects of the project does your company generally insure?
- Do you feel that the premiums are attractive?
- What are the benefits of construction insurance?
- In how many projects insurance helped you?
- Why did you decide to get insurance
- What is the difference in projects that are insured and not insured?
- What improvements are required in the insurance industry?
- With which insurance company are you working with and why
- What criteria's do the insurance companies set before insuring the project?
- Why do you feel insurance is not widely used in the construction industry?
- What percentage of projects encounters cost and time overrun?

3.1.2.1.2 Contractors who are not insured

- Why you are not insured?
- Have you done any studies regarding insurance?
- On what basis you have rejected the idea of insurance?
- What percentage of projects encounters cost and time overrun?
- How do you deal with the overruns in the project?
- What do you think is lacking in insurance?
- Will you get the insurance if any feasible solution is available?
- Will insurance be a viable solution in the future?

3.1.2.1.3 Insurance Companies

- Does your company offer insurance in construction?
- If yes than how many projects you are dealing with?
- Which construction aspects you are dealing for insurance?
- Why are you not insuring the other aspects?
- What is the industry response towards insurance?
- It is the common thinking that premiums are high, why is that?

Table 3-1 Survey Sheet 1 (Risk Quantification)

Risk		Probability of Occurrence					
Consequences		Impact on total project duration cost and time					
		0-1%	1-3%	3-5%	5-10%	10-30%	30-50%
	Cost						
	Schedule						
	Cost						
	Schedule						
	Cost						
	Schedule						
	Cost						
	Schedule						
	Cost						
	Schedule						
	Cost						
	Schedule						
	Cost						
	Schedule						
	Cost						
	Schedule						
	Cost						
	Schedule						

Table 3-2 Survey Sheet 2 (Insurance Deductibles)

Project Cost				
	Deductible Value			
Risk	4 lac	10 lac	20 lac	60 lac
Material Damage				
Machinery Damage				
Environmental				
Political				
Organizational				
Weather				
Location and Site				

3.1.3 Data analysis and conclusion phase

The data that we needed to analyze was in two parts. First, there was qualitative data that we obtained from initial interviews with insurance firms and contractors and from questionnaires that we had floated. This data was significant because we needed it to identify why different stakeholders were not on the same page regarding the employment and the effectiveness of insurance as a risk management tool. Identification of these problems was highly important, as we would never have been able to suggest measures with which these problems could be rectified without some sort of knowledge about what the problems were and what were their causes. The end result of analysis of qualitative data was a set of suggestions and recommendations that can help close the gap between clients, contractors and insurance companies.

The other part of our analysis was related with the quantitative data we got from industry professionals and engineers. This was the most demanding and challenging phase of our project as it dealt with tedious probability calculations and use of different computer programs.

Firstly, we used Expected Monetary Value Analysis to bring the identified risks into monetary terms. For this we used values of the data that we obtained through survey sheet 1. Through the EMV analysis we found out the total risk in terms of percentage of the total cost of a general

construction project. Then, we combined this data with the average deductible values we obtained from survey sheet 2 and came up with different values of premiums in terms of percentage of the total cost of the project. Then we applied these values to project A, project B, project C, project D and project E. By varying the deductible values we got varying insurance premium rates for these projects. At the end we compared these results with the actual insurance data that we had at our disposal and came up with a conclusion as to how deductibles and insurance premiums affect each other in construction projects and how a suitable policy can be tailor made for any project.

Also, we used computer programs to run Monte Carlo Simulations and Sensitivity Analysis on cost loaded sample schedules to better understand the consequences that risks can have on a construction project. This led us to appreciate the significance of using other risk management techniques in combination with employing a suitable CAR insurance policy.

CHAPTER 4

4 ANALYSIS AND RESULTS

The first survey was aimed towards getting a basic understanding of the market conditions. We visited different insurance companies to get the information about the insurance practices being done in Pakistan. Our initial assumption was that the insurance is not as widely practiced in our construction industry as it should be, but through these surveys we realized that many large construction firms are incorporating insurance in their projects. We learned that these firms follow FIDIC (International Federation of Consulting Engineers) rules and regulations as a result insurance is essentially a requirement the contractor has to fulfill. Also we observed that there are many companies that are providing insurance but that four insurance companies hold the majority of the market share. These companies are:

- Adamjee Insurance
- Jubilee insurance
- EFU
- IGI

Due to the privacy policy of the company and clients confidentiality the companies were reluctant to give us any data about specific projects or the number of clients as well as data about the number of construction projects being insured by the company but we were able to get a vague estimate which suggested that about 20% of large scale projects where the contractors are required to get bid and performance bonds also require insurance coverage. But it became clear that any contractors who do get insurance coverage do so not because they think it is necessary and will be helpful but because it is one of the requirements of the client. We also came to know about the risks that are insured under the policies. One remarkable piece of information we came across was that in case of any time and cost overrun occurring the contractors had to pay extra money to extend their coverage instead of the insurance company compensating the contractor.

4.1 Contractor's Survey

Our project next phase was to visit contractors. After getting general idea from insurance companies we went to different contractors having different expertise in the field. We asked them different questions regarding insurance in construction. After getting plentiful information from the contractors we reached on a conclusion that sadly there was a severe lack of knowledge about insurance among the contractors. Though some of them had bought insurance in the past it had only been due to contractual requirements and not due to their own initiative.

Our survey helped us uncover several reasons for this

1) Prevail in notion that there is no need of insurance on small scale projects like building a house or construction of a grocery shop etc.
2) Contractors are using the conservative practices and they don't want to change their perspective and move forward.
3) Prevailing notion that it is just a waste of money and has no real application
4) Potential 'benefits' of contingency.
5) Lack of knowledge about insurance and its potential benefits.
6) Belief that premiums are unreasonably high.

These findings from the surveys made us realized that these reason are the cause of contractor's ill will to practice insurance. We observed the notion of rigidity among the contractors. They didn't want to change themselves and they were happy in their negligence.

4.2 Probability Calculations

The insurance companies were reluctant in divulging the details of the models they used to compute insurance premiums. So for the purpose of better understanding the process we decided to formulate our own model to enable us to study insurance premiums and to determine whether the premium rates prevalent in the market were justified or not. The purpose of any insurance policy is to cover the risk involved in the project so as the very first step we were required to do was to come up with some framework for the quantification of the risks involved.

For this purpose we decided to do a survey to determine the common risks in the market, the probabilities of their occurrence and the probable impact of their consequences on the cost of the project. The following risks were identified.

- Weather
- Environmental
- Political
- Material damage
- Machinery damage
- Location/site related
- Organizational.

We then developed a survey table (table 3-1) to get data regarding these risks from experienced people in the field. Following is the table for weather and its consequences.

Table 4-1 Probability Calculation (Weather)

Risk	Weather	Probability of Occurrence			0.3		
Consequences		Impact on total project cost					
		0-1%	1-3%	3-5%	5-10%	10-30%	30-50%
Re- Scheduling	Cost	0.486	0.3	0.18	0.03	0.01	0.006
Injuries	Cost	0.48	0.32	0.16	0.03	0.016	0.005
Material Damage	Cost	0.47	0.33	0.15	0.04	0.006	0.006
Machinery Damage	Cost	0.5	0.33	0.11	0.04	0.011	0.011
Ovehead Increase	Cost	0.5	0.33	0.11	0.027	0.011	0.011
Total Impact (% of project cost)		3.126					

As can be seen in the table the probability of occurrence of weather related risks is about 30 %. Several consequences of the occurrence of weather related risks have been identified. We asked the experts to provide probabilistic values for the % impact these consequences could have on the total cost. The probable impact was divided in 6 ranges and the experts provided us with the probability of the damage falling within that range. For example there is a 48.6 % chance that the cost impact of re scheduling resulting from the occurrence of weather related risks would fall

within 0-1 % of the total project cost. To calculate the total impact of a particular risk each probability is multiplied with the midpoint of its range all these answers are then added together and the final result is multiplied with the probability of occurrence of the risk itself. The total impact of weather related risks was calculated to be 3.126.

Similar tables were prepared for the other identified risks as well. These tables are all shown below

Table 3-2 Probability Calculation (Location/ Site)

Risk	Location/Site	Probability of Occurrence			0.1		
Consequences		Impact on total project cost					
		0-1%	1-3%	3-5%	5-10%	10-30%	30-50%
Location/Site	Cost	0.36	0.27	0.18	0.13	0.04	0.02
Total Impact (% of project cost)		0.4					

Table 4-3 Probability Calculation (Political)

Risk	Political	Probability of Occurrence			0.2		
Consequences		Impact on total project cost					
		0-1%	1-3%	3-5%	5-10%	10-30%	30-50%
Delays	Cost	0.367	0.286	0.204	0.082	0.041	0.02
Re-Scheduling	Cost	0.43	0.362	0.181	0.045	0.023	0.0045
Corruption	Cost	0.638	0.213	0.071	0.035	0.035	0.007
Increased Overhead	Cost	0.536	0.357	0.06	0.03	0.012	0.006
Total Impact (% of project cost)		2					

Table 4-4 Probability Calculation (Environmental)

Risk	Enviornmental	Probability of Occurrence			0.15		
Consequences		Impact on total project duration cost					
		0-1%	1-3%	3-5%	5-10%	10-30%	30-50%
Licensing	Cost	0.45	0.31	0.15	0.05	0.02	0.005
Claims	Cost	0.51	0.23	0.17	0.05	0.03	0.006
Penalties	Cost	0.5	0.26	0.16	0.05	0.03	0.005
Delays	Cost	0.46	0.3	0.15	0.08	0.005	0.005
Total Impact (% of project cost)		1.49					

Table 4-5 Probability Calculation (Organizational)

Risk	Organiztional	Probability of Occurrence			0.15		
Consequences		Impact on total project cost					
		0-1%	1-3%	3-5%	5-10%	10-30%	30-50%
Re- Scheduling	Cost	0.48	0.32	0.16	0.03	0.01	0.005
Disputes	Cost	0.41	0.3	0.22	0.06	0.004	0.004
Corruption	Cost	0.57	0.32	0.06	0.03	0.013	0.006
Increased Overhead	Cost	0.44	0.28	0.17	0.05	0.03	0.03
Mismanagement	Cost	0.41	0.26	0.1	0.1	0.1	0.02
Total Impact (% of project cost)		2.211					

Table 4-6 Probability Calculation (Material Damage)

Risk	Material Damage	Probability of Occurrence			0.15		
Consequences		Impact on total project cost					
		0-1%	1-3%	3-5%	5-10%	10-30%	30-50%
Disposal	Cost	0.467	0.32	0.147	0.049	0.0098	0.00492
Re- Scheduling	Cost	0.47	0.31	0.13	0.052	0.026	0.00523
Increased Overhead	Cost	0.44	0.28	0.16	0.055	0.027	0.027
Re- Purchasing	Cost	0.44	0.28	0.16	0.055	0.027	0.027
Defective Work	Cost	0.33	0.25	0.21	0.125	0.0625	0.02
Total Impact (% of project cost)		2.41					

Table 4-7 Probability Calculation (Machinery Damage)

Risk	Machinery Damage	Probability of Occurrence			0.1		
Consequences		Impact on total project cost					
		0-1%	1-3%	3-5%	5-10%	10-30%	30-50%
Re-purchase	Cost	0.54	0.41	0.2	0.033	0.0135	0.00675
Re-rent	Cost	0.495	0.27	0.137	0.055	0.027	0.0109
Repair	Cost	0.428	0.347	0.16	0.0267	0.0267	0.01
Increased Overhead	Cost	0.437	0.29	0.17	0.049	0.049	0.0049
Re- Scheduling	Cost	0.45	0.284	0.17	0.057	0.028	0.057
Total Impact (% of project cost)		1.39					

The values shown in the above tables are normalized average values which we arrived at after analyzing the various responses. The total impact of all these risks was calculated to be about 13 % of the total project cost. Here it is important to note that this is just a vague estimate and not a detailed estimate of the impact of risk on any particular project. If this method is to be used to analyze a particular project in detail then proper risk identification of that project needs to be done and after that the consequences of these risks should be studied. Experts who are both experienced and have intimate knowledge of that particular project should then fill in the required values.

However since the objective of this project is not the risk analysis and quantification of any specific project but the development of a framework for analyzing insurance premiums this value is considered to be an accurate estimate. Nevertheless general observations show that almost all projects have about 12 – 20 % risks so the value obtained is reasonable enough to proceed towards further calculations.

4.3 Incorporating deductibles

The next step is to incorporate the deductibles and to give a final value for the insurance premiums. Higher deductible values mean that the insurance premiums will be lower. To gain an insight about the impact of deductibles another survey was done.

For this purpose we proposed different values of deductibles and asked the experts to give us the probabilities for the damage to exceed that value. Deductibles are the amount below which the insurance company is not liable to pay compensation for any loss. Here it is important to note

that this refers to the loss occurring as a result of any single event as opposed to the total loss incurred in the duration of the project. For example, The total loss occurring as a result of material damage may indeed be very large but the loss occurring as a direct result of any one event may not exceed the value of the deductible as a result the insurance company may not even have to deal with any claims.

Table 4 Deductibles (15 Crore)

Project Cost	15 Crore				
	Deductible Value				Impact(% of project cost)
Risk	2 lac	4 lac	7 lac	10 lac	
Material Damage	0.25	0.15	0.1	0.05	2.41
Machinery Damage	0.1	0.05	0.05	0.03	1.39
Environmental	0.1	0.01	0.005	0.003	1.49
Political	0.1	0.03	0.02	0.015	2
Organizational	0.15	0.05	0.03	0.02	2.21
Weather	0.15	0.01	0.005	0.004	3.126
Location and Site	0.1	0.05	0.03	0.03	0.4
Total Impact(% of project cost)	1.9309	0.66766	0.45188	0.265374	
Premium Amount	2896350	1001490	677820	398061	

Table 4-9 Deductibles (100 Crore)

Project Cost	100 Crore				
	Deductible Value				Impact(% of project cost)
Risk	4 lac	10 lac	20 lac	50 lac	
Material Damage	0.3	0.15	0.04	0.025	2.41
Machinery Damage	0.1	0.08	0.05	0.01	1.39
Environmental	0.05	0.03	0.02	0.005	1.49
Political	0.05	0.08	0.01	0.01	2
Organizational	0.1	0.05	0.02	0.02	2.21
Weather	0.05	0.02	0.01	0.008	3.126
Location and Site	0.1	0.07	0.03	0.02	0.4
Total Impact(% of project cost)	1.4538	0.87842	0.30316	0.178808	
Premium Amount	14538000	8784200	3031600	1788080	

The above tables were used to gain data regarding the deductibles. The values represent the probability that the damage occurring as a direct result of any event will exceed the specified deductible value. For example there is a 30 % probability that damage of any one event of material damage will exceed 4 lac rupees in a project where the total cost is around 100 crore. The impact is calculated by multiplying the probability value with the percentage impact of that risk on the total project cost. The results of all risks are added to gain the value for total impact on the project. This value represents the expected amount of loss as a percentage of total project cost if only those risk events are considered where the damage exceeds the deductible value. For a deductible amount of 4 lac, impact is 1.4538 % of the total cost.

So the premium amount if the deductible is 4 lack should be around 1.4538 % of total cost + profits and taxes.

We had three sample projects there summary is given below:

Table 5 Insurance Comparison

Project	Project Cost (Rs.)	Premium before tax (Rs.)	Premium after adding tax (Rs.)	Premium Calculated By us (Rs.)	Deductibles (Rs.)
A	139,978,451	357,074	417,797	398,061	1,000,000
B	154,833,401	351,667	411,471	398,061	1,000,000
C	1,037,294,986	1,965,795	2,300,000	1,788,080	5,000,000

One thing that is important to mention is that the value of deductible does not remain same it depends upon the scope of the project and by scope we mean all aspects (Cost, Quality, Time etc.)

From above calculation we saw that as we increase the deductible the value of the premiums started to get low and vice versa. Deductibles play a vital role in the insurance because it sets the mark line to which insurance company will not pay for losses.

The difference in the values of our calculations are can be explained by following reasons:

- We have not incorporated all the risks, we just took the general risks due to which there is difference in the values.
- The second reason is that we haven't incorporated the profits of the insurance companies, their overheads etc.

4.4 Analysis using Monte Carlo Analysis

Time overruns are usually not being incorporated in the insurance calculations and are somewhat acceptable in the industry. None of the stakeholders understand their significance even though they can affect the project greatly. We have run schedule risk analysis through Monte Carlo Technique to highlight the importance of time overruns.

4.4.1 Monte Carlo Analysis:

Monte Carlo method is a statistical technique employed to better understand the impact of different risks and uncertainties in a project. When you develop a schedule, there are a few assumptions that you make. These assumptions might be related to the total cost of the project or its duration. Since these assumptions are about future events, you can never be too sure about them and the best you can do is to estimate the results that you expect. These estimations are made on the base of skill, knowledge and field experience. Although these estimates are helpful in creating cost and time schedules, they still contain some risks and uncertainties because after all they are estimates of values that are not known at the time. The usual approach to estimate the costs and duration is not to make a single guess but to make a range of estimates. The range includes a most likely value, a value for the worst-case scenario and a value for the best possible case.

In a Monte Carlo simulation, random values are selected for each of the tasks, according to the range of estimates. The model is calculated based on this value. The result of the model is recorded, and the process is repeated. A typical Monte Carlo simulation calculates the model hundreds or thousands of times, each time using different randomly selected values.

When the simulation is complete, we have a large number of results from the model, each based on random input values. These results are used to describe the likelihood, or probability, of reaching various results in the model.

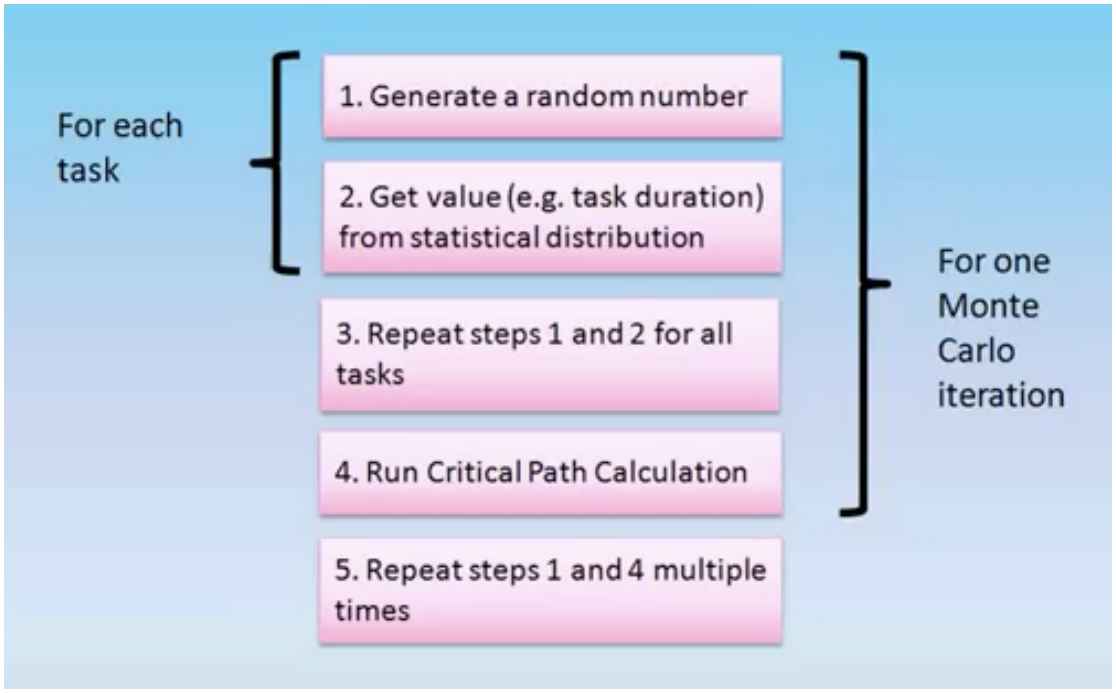

Figure 4-1 Monte Carlo Analysis

We used Monte Carlo analysis to carry out schedule risk analysis of a sample power plant construction project, which we cannot name due to confidentiality reasons. The estimated duration for the project was 583 days with an original estimated cost of 26,940,000 Euros. The start date was 1st September 2011 and the estimated finish date after accounting for all public holidays and vacations was 26th November 2013. We used a slightly right-skewed triangular distribution to carry out the simulations on the project. The reason for using a right skewed distribution is that in a construction project there is a greater chance that the duration of a task will go over the most likely value than the chance that it will finish earlier than the most likely value. Keeping that in mind we assigned a low duration factor of 0.8 and a high duration factor of 1.5 to all the tasks. After doing that we ran the simulation for 5000 different values within the range of estimates that we had.

Now let's have a look at the results:

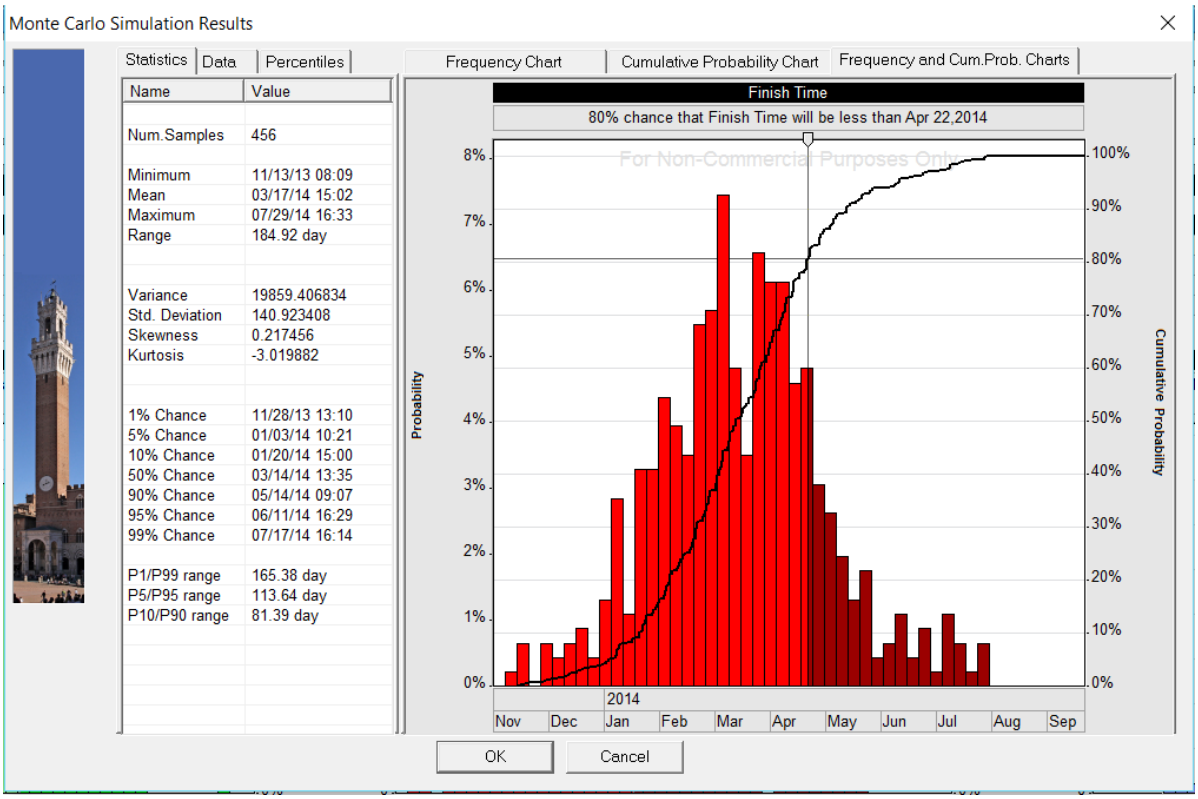

Figure 4-2 Simulation Results

This first chart is based on the finish date of the project. For all our results we used an 80% confidence interval, which is a common industry practice. After running all simulations, the resultant chart shows that there is an 80% chance that the project will finish before April 22, 2014. From the results, we can see that there is only a 1% chance that the project will finish on the date that was estimated before carrying out the simulations. Using these results, the project manager can see a much more realistic picture of the proceedings of the project and this well help greatly in the planning process and financial forecasting.

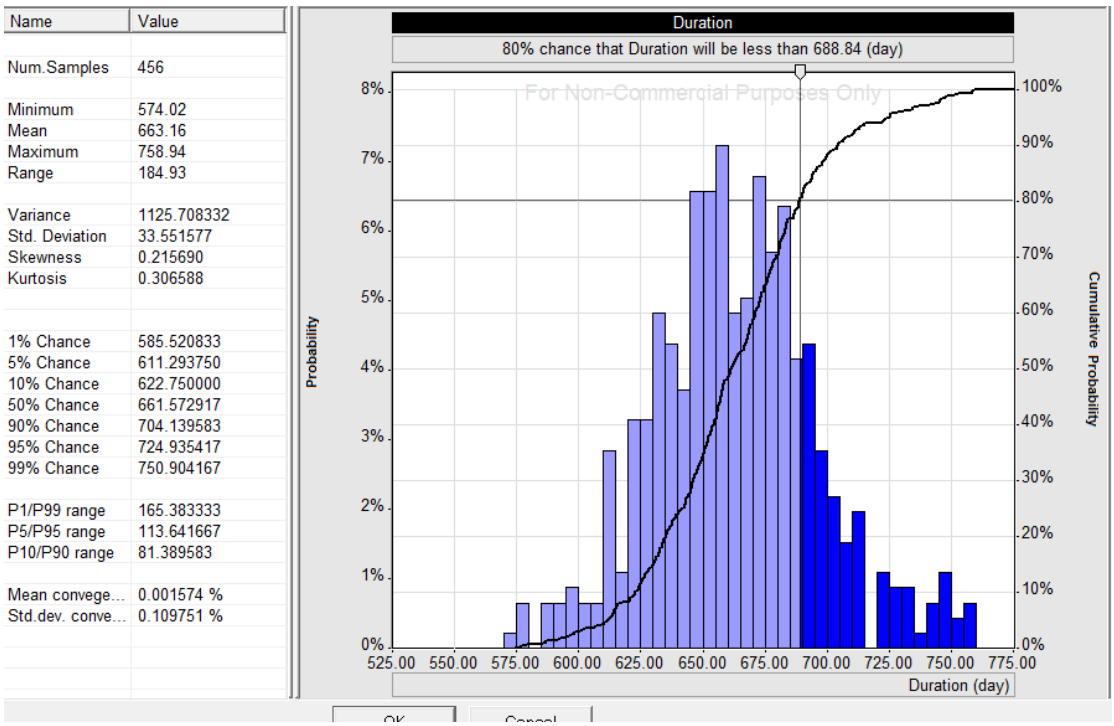

Figure 4-3 Simulation Results

This figure gives us the total worknig days of the project with 80% confidence level. This means that there is an 80 percent chance that the project will finish within 689 days. This again is way more than the estimate that was originally made by the project management team. These results mean that the most likely duration is much greater than the duration that was estimated before accounting for the risks and uncertainties that affect the duration of a project. This information can be very useful in the panning stages of the project which deal with labour recruitment, financing and resource allocation. However, one thing that must be remembered is that these results are only as accurate as the estimated range of values so special care should be taken while making those estimates.

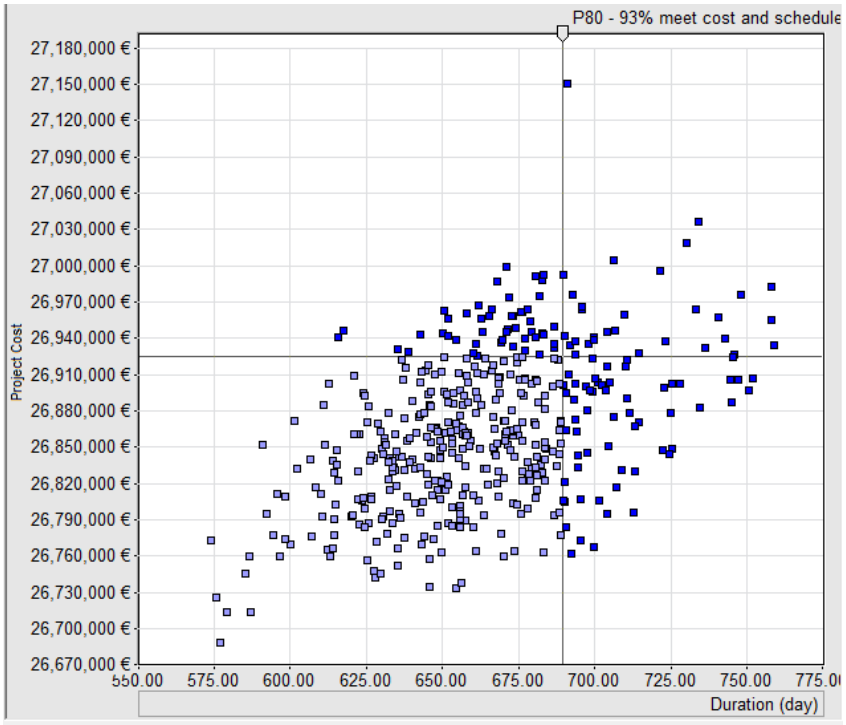

Figure 4-4 Simulation Results

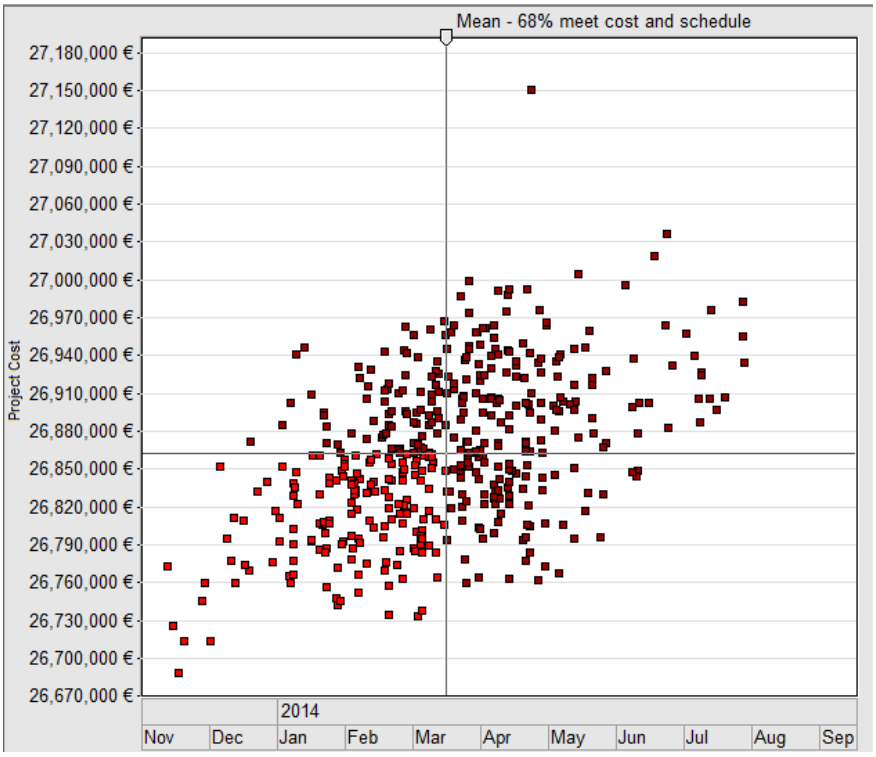

Figure 4-5 Simulation Results

The above figures are scatter plots of total project cost plotted against duration one in terms of days and again in terms of the finish date. These plots show that there is a positive correlation between duration and cost. As the duration of the project increases, the total project cost also increases. These graphs can be highly effective in studying in depth, the relationship that exists between the cost of the project and its total duration. Project managers can use it to observe the consequences of an increase in duration due to the risks and uncertainties in the project.

4.5 Sensitivity Analysis:

Sensitivity analysis is a method to rank activities in order of their impact on the parameters of the project such as the total cost or the duration. In other words, it is a way to identify and rank activities in a schedule in order of the adverse effects that they can produce with regard to the total duration or the total cost of the project.

We ran variance based sensitivity analysis on the sample power plant project and the results can be seen in the figure below:

Task Duration, Task Start Time, Task Cost, Lags, Risks affected project: Duration

	Name	Task ID	Type	Risk Assigned To	Sensitivity Chart	Ranking
1	Task: Finish	86	Start Time			1.000
2	Task: Commissioning Project Management	84	Start Time			0.986
3	Task: Commissioning Site Management	85	Start Time			0.986
4	Task: Commissioning and testing	83	Start Time			0.986
5	Task: Generator and Gear Box Set Erection	72	Start Time			0.704
6	Task: Gas Treatment and Compression Station E	70	Start Time			0.629
7	Task: Steam Condenser Erection	79	Start Time			0.629
8	Task: Transformer Erection	73	Start Time			0.590
9	Task: Steam Boiler Erection	78	Start Time			0.570
10	Task: HRSG and Diffuser Erection	75	Start Time			0.566
11	Task: Start of Erection Process	68	Start Time			0.563
12	Task: Stack Erection	76	Start Time			0.563
13	Task: Plant Erection Project Management	80	Start Time			0.563
14	Task: Plant Erection Site Management	81	Start Time			0.563
15	Task: Generator and Gear Box Set Erection	72	Duration			0.551
16	Task: Construction control room and office buildin	64	Start Time			0.523
17	Task: Civil Works Project Management	65	Start Time			0.523
18	Task: Civil Works Site Management	66	Start Time			0.523
19	Task: Start of Civil Works Process	61	Start Time			0.523
20	Task: Site installation	62	Start Time			0.523
21	Task: Plant civil works	63	Start Time			0.523
22	Task: Lot 6	55	Start Time			0.474
23	Task: Pre-test of Generator and Gearbox	23	Start Time			0.472
24	Task: Order GC	20	Start Time			0.454
25	Task: Competitive proposal analysis GC	19	Start Time			0.454
26	Task: Fabrication of Generator and Gear Box Set	40	Start Time			0.451
27	Task: Fabrication of Transformer	41	Start Time			0.451
28	Task: Fabrication of Gas Turbine	39	Start Time			0.451
29	Task: Basic Design	4	Duration			0.442
30	Task: Detailed Engineering Building	6	Start Time			0.442
31	Task: Detailed Engineering Civil Works	7	Start Time			0.442
32	Task: Detailed Engineering Gas Cycle System	8	Start Time			0.442
33	Task: Detailed Engineering Steam Cycle System	9	Start Time			0.442
34	Task: Permit and authorizations based on basic d	11	Start Time			0.442
35	Task: Gathering of proposals GC	18	Start Time			0.443
36	Task: B.O.M. and take-offs	15	Start Time			0.441

Figure 4-6 Sensitivity Analysis

This figure shows the results of sensitivity analysis. It ranks activities in order of the effects that their duration, cost, lags, and associated risks have on the total duration of the project. The greater the value of the ranking of an individual task, the greater impact it has on the duration of the project. The manager can use this data to analyze which activities and which need a more careful approach when developing a risk management system. This method is highly effective when used in combination with critical path method since it can also analyze what chance an activity that is not critical to begin with, has of becoming critical because of the involved risks.

CHAPTER 5

5 CONCLUSION

5.1 Conclusions:

The conclusions that we reached after our study are enlisted and explained below.

5.1.1 Risk Management in Pakistan:

Although risk management techniques are being widely practiced all over the world to make construction works more economical and efficient than ever before, the application of these techniques in Pakistan is rather limited. Through our surveys and field visits it has become clear that the most common way in which risk is being dealt in our country is by retaining and owning the risk. This is done through setting aside a contingency for the whole project. No focus is being given to risk reduction, avoidance or transfer. There are people out there who have the required knowledge and skill to propose risk management systems for all kinds of projects but due to the conventional and old-fashioned approach of the higher ups and most of the contractors, these people remain hindered from providing their services and making the construction process in the country better. Even the clients focus on getting their projects built in as little an amount as possible. This leads to them hiring contractors who try to save money by eliminating the expense of project risk management and even project management as a whole in some cases. Little do they understand that this does not reduce costs and they end up paying way more than they initially plan to.

5.1.2 Employment of Insurance but lack of effectiveness:

Before the start of our research, we had assumed that insurance was almost non-existent in the construction projects here in Pakistan. This assumption of ours, however, turned out to be false. We have observed that a large percentage of projects are employing insurance in one form or another but it is only due to contractual requirements. If the contractors were not bound by the contract to get their work insured, they would never have it done. This has reduced the use of insurance as an effective risk mitigation tool to a mere formality. No contractors are doing any sort of in house calculations with regard to insurance policies. They just go to insurance companies and ask for the bare minimum that would fulfill their contractual obligations. They

prefer to manage risk through contingencies. This approach of the construction industry has led to a one-way cash flow system that is explained through the figure below:

Figure 5-1 One-Way cash flow

5.1.3 Premium Rates:

Another assumption that we made at the beginning was that contractors do not employ insurance because the premium rates are too high. This however is not the case. After developing a model of our own and studying the calculation of premium rates in detail, we have come to the conclusion that the premium rates that are being charged are justified completely. It is the contractors themselves who play a role in deciding the premium rates and the deductible values. More often than not, they choose unreasonably high deductible values, which in turn lowers the value of the premium rates.

5.1.4 Lack of competition among insurance companies:

By studying the construction insurance market, we have observed that essentially, there are only four insurance companies that are currently dealing with construction insurance. This means that when a contractor goes policy shopping, there are not a lot of options that he has to choose from. This is in no way an excuse to take the blame away from the poor understanding of risk management by contractors, but it does play a role in making insurance companies a little rigid in their stance and they don not show a lot of flexibility as a result.

5.1.5 Deductible values:

Because contractors go to insurance companies looking for the lowest possible premium rates that the can get, the deductible values that are chosen as a result, turn out to be unreasonably

high. This means that the contractors have to pay greater amounts out of their own pockets before getting compensation from the insurance companies in case of loss or damages. This has resulted in a very few number of claims being registered by the contractors.

5.2 Recommendations and Suggestions:

After studying the impact of insurance in the construction industry and in light of the conclusions that we have made above, we have devised a set of recommendations and suggestions, which are explained below.

5.2.1 Special focus should be given to risk management:

Awareness needs to be created among all stakeholders involved in the construction industry regarding the importance of an effective risk management system. It is imperative to bring to the attention of contractors that risk management does bot increase project costs, but creates a framework which can be used to lower the impact of risks and uncertainties in the project and ultimately help in saving both time and cost. Contractors should hire skilled project managers who know how to analyze each risk that is present in the project and know what approach should be taken to deal with those risks.

5.2.2 In house calculation of insurance parameters:

With a thorough understanding of project risks and a little mathematical and statistical knowledge, it is possible to quantify the total risk specific to a project. In our opinion, this carries a lot of significance since it's the risks and their severity that play a vital role in determining whether a project is successful or not. Once risks have been quantified it becomes fairly easy to develop an intuition with regard to what premium rates and deductible values would be most suitable for a project. This knowledge can greatly help contractors in getting an effective insurance policy for their projects.

5.2.3 Lower Deductibles:

We have examined in depth the relationship between premium rates and deductible values. It is our suggestion that when contractors shop for insurance policies, they should opt for lower deductible values. This will result in premium values being higher but it will most definitely also

increase the number of claims and the overall effectiveness of the policy. We suggest that to pay these higher premium values while also not disturbing the cash flow of the project, the contractors should lower the amount of contingencies that they have set aside. This is because a well thought out insurance policy can cover the complete cost of the project while a contingency only covers loss up to the total amount of the contingency.

5.2.4 Liquidated Damages:

The current situation in Pakistan is that time overrun of the project is considered as a norm and to a great extent it has become acceptable. There are very few projects that finish on time. This attitude towards time overruns is very unhealthy and produces adverse effects on the total cost of the project. To deal with this problem, liquidated damages should be incorporated into contracts which will bind contractors to pay penalties in case the project duration exceeds the initially agreed upon duration. However, there might be some cases where time overruns occur due to factors that are unforeseeable and/or uncontrollable. In these cases the contractors should get suitable insurance policies to deal with the liability that lies on them even though it is not their own fault.

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