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RISK AND COST OPTIMIZATION OF A COMMERSIAL BUILDING

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Abstract — *Risks are very common in construction sector. Risk is the Possibility of suffering loss and the impact on the involved parties. Risk is identified and then risk assessment and analysis is done. Then risk management and risk mitigation is carried out. Risk affect construction sector negatively and focusing on risk reduction measure it important. The purpose of this study is to assess the use and method of risk identification techniques in the construction industry. They are classified in specialized industrial construction, infrastructure and heavy construction. The risk identification techniques more frequently applied in construction are checklist, flowchart, Brain storming etc.*

Keywords- *Risk and cost optimization, risk optimization, cost optimization, simulation of cost and risk, @Risk*

I. INTRODUCTION

There are many risks encountered in the projects, particularly construction project. The possibility of encountering loss and its impact is known as risk. Risk is a negative term referring to loss and the impact of loss, but there is also a positive risk involving favorable results and their impact is also may be positive. The recovering of the construction area is very important to the engineering service sector. Faced with this increase in demand, we verify that it is necessary to include risk management in project planning and management so as to identify, assess, manage and control the risks that would be adverse to the project goals. This theme is relatively new, though, since this methodology was elaborated in the last decade and the companies have been adopting it in their projects in the lasting years. The risk identification phase was considered by many studies in this area as the most important phase in the risk management process. During this phase, there is a lot of identification techniques that could help the identification process. The aim of this project is to assess the degree of knowledge and utilization of risk identification techniques in the construction projects.

1.1 WHAT IS RISK?

- The exposure to loss/gain.
- The probability that unfavorable outcome will occur.
- Uncertainty and the result of uncertainty.
- The probability of occurrence of some uncertain, unpredictable and even undesirable event(s) that would change the prospects for the profitability on a given investment.
- In relation to construction; risk is described as “an exposure to economic loss or gain arising from involvement in the construction process”, and “a consideration in the process of a construction project whose variation results in uncertainty in the final cost, duration and quality of the project.”

1.2 WHAT IS RISK ANALYSIS?

Risk Analysis (RA) is an investigation (usually forensic) into what has caused the project to run late and who is responsible for the risk. Risk analysis is performed in three steps:

- Investigation
- Description (Analysis of facts)
- Presentation the case one is seeking to prove

Investigation is aimed to identify all risks. In starts with data basing relevant project records, then analyzing collected data, linking facts, aggregating, filtering, etc. Results are graphed using bar charts, tables, histograms, etc.
Second step consists description and analysis collected information in order to identify the responsible party, draw final conclusions and prepare a presentation of the case.

1.3 EFFECT OF RISK

A. Delay in Project

Contractor related factors and client related factors such as inadequate contractor experience and owner interference have an impact on time overrun. It is identified that time overrun as one of the major effect of Risk.

B. Cost Overrun

There are three main causes that were contractor related problems, material-related problems, and owner’s financial constraints, and the most critical factors which affect the cost overrun problem includes: high inflation/increased material price; design change by the client; defective design; weather conditions; delayed payment on contracts and defective construction work.

C. Total Abandonment

The most critical adverse effect of risk in construction projects is an abandonment that could be temporary or in worse condition for permanent duration. The major causes of client related, consultant related, contractor related and external related may lead to project abandonment that will lead to delays or abandonment in construction projects.

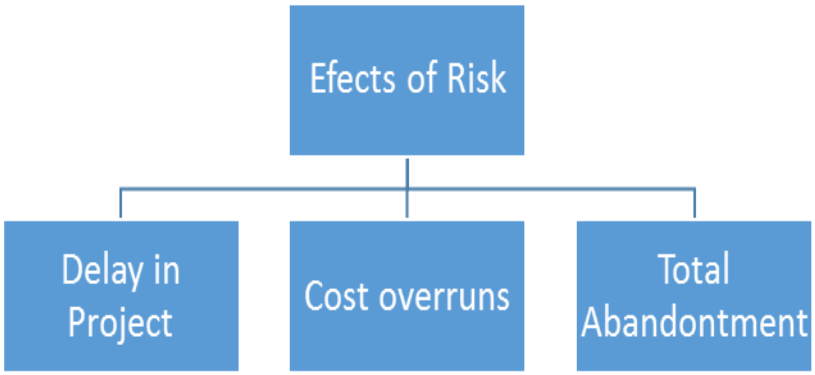

Figure 1. Effect of Risk

II. EXECUTION OF WORK

2.1. BUILDING DATA

This project contains the Construction site at Surat City as a case study. This construction will result in the Industrial Building with Installation of Machinery. Details of this structure are as given below:

Table 1. Building Data

Type of Site	Industrial/Commercial Building
Address of Site	K.K. Road, Surat
Area of Project Site	75 m X 35 m
Client	Sarin Technology
Contractor	Albatross Project Pvt. Ltd.
Type of Contract	Turn Key Contract
Total Cost of Work	84,184,848
Start Date	December, 2015
End Date	November, 2016
Time of Completion of Project	11 Months

Table 2. Work Data

Activity ID	Activity Description	Actual Duration
G1	Excavation in Foundation	7
G2	PCC in Foundation	4
G3	Construction of Footings	4
G4	Construction of Columns	7
G5	Masonary upto plinth level	8
G6	DPC at Plinth Level	7
G7	Earth-filling and Preparation of Flooring (LC Flooring)	3
G8	Preparation of Column & Beam at GF	7
G9	Brickwork upto Sill Level (GF)	4
G10	Preparation of Sill (GF)	4
G11	Brickwork upto Lintel Level (GF)	6
G12	Preparation of Lintel & Chhajja (GF)	4
G13	Brickwork upto Slab Level (GF)	4
G14	Preparation of Slab (GF)	7

G15	Electric & Sanitation Piping Work (GF)	5
G16	Plastering work at Ground Floor (GF)	8
G17	Preparation of Column & Beam at FF	7
G18	Brickwork upto Sill Level (FF)	4
G19	Preparation of Sill (FF)	4
G20	Brickwork upto Lintel Level (FF)	6
G21	Preparation of Lintel & Chhajja (FF)	4
G22	Brickwork upto Slab Level (FF)	4
G23	Preparation of Slab (FF)	7
G24	Electric & Sanitation Piping Work (FF)	5
G25	Plastering work at First Floor	8
G26	Preparation of Column & Beam at SF	7
G27	Brickwork upto Sill Level (SF)	4
G28	Preparation of Sill (SF)	4
G29	Brickwork upto Lintel Level (SF)	6
G30	Preparation of Lintel & Chhajja (SF)	4
G31	Brickwork upto Slab Level (SF)	4
G32	Preparation of Slab (SF)	7
G33	Electric & Sanitation Piping Work (SF)	5
G34	Plastering work at Second Floor	8
G35	Preparation of Column & Beam at TF	7
G36	Brickwork upto Sill Level (TF)	4
G37	Preparation of Sill (TF)	4
G38	Brickwork upto Lintel Level (TF)	6
G39	Preparation of Lintel & Chhajja (TF)	4
G40	Brickwork upto Slab Level (TF)	4
G41	Preparation of Slab (TF)	7
G42	Electric & Sanitation Piping Work (TF)	5
G43	Plastering work at Third Floor	8
G44	Preparation of Column & Beam at FF	7
G45	Brickwork upto Sill Level (FF)	4
G46	Preparation of Sill (FF)	4
G47	Brickwork upto Lintel Level (FF)	6
G48	Preparation of Lintel & Chhajja (FF)	4
G49	Brickwork upto Slab Level (FF)	4
G50	Preparation of Slab (FF)	7
G51	Electric & Sanitation Piping Work (FF)	5
G52	Plastering work at Forth Floor	8
G53	Brickwork upto Parapet Level	2
G54	Plastering work in Outer Side of Building	11
G55	Waterproofing work at Roof Level	2
G56	Tiles Flooring	22
G57	Fixing of Doors & Windows	18
G58	Painting Work	23
G59	Installation of Electrical Appliances	14
G60	Installation of Mechanical Instrument at GF	9
G61	Site Clean-up and Handover to Client	3

Table 3. List of Group of Activity with cost

Sr. No.	Item description	Cost	Activity	Time of work	Dead-line of work in days	Actual Total days of work
A	**CIVIL WORKS**					
I	Earth work and water proofing	5,238,533	G1 G3 G4 G6 G7 G55	7 4 7 7 3 2	26	30
I	Preparation work, roofing work,plain and reinforced cement concrete work	52,309,392	G2 G8 G10 G12 G14 G17 G19 G21 G23 G26 G28 G30 G32 G35 G37 G39 G41 G44 G46 G48 G50	4 7 4 4 7 7 4 4 7 7 4 4 7 7 4 4 7 7 4 4 7	94	114
III	Masonry work	10,989,056	G5 G9 G11 G13 G18 G20 G22 G27 G29 G31 G36 G38 G40 G45 G47 G49 G53	8 4 6 4 4 6 4 4 6 4 4 6 4 4 6 4 2	66	80
IV	Finishing	5,831,541	G16 G25 G34 G43 G52 G54 G56 G57 G58	8 8 8 8 8 11 22 18 23	94	114
V	Miscellaneous work	316,234	G61	3	3	3
B	**PLUMBING WORK**					

I	All type of plumbing work with sanitary and water supply	5,573,874	G15 G24 G33 G42 G51 G60 G61	5 5 5 5 5 9 3	30	37

2.2 COMPUTATION OF COST AND TIME BY @RISK

This project contains the Construction site at Surat City as a case study. This construction will result in the Industrial Building with Installation of Machinery. All data of cost and time of all activities are described in table 1 & 2. These all activities are divided in group on the basis of its type which is shown in table 3. We can compute the cost for these group of activities with the help of @RISK software. This software is working with MS Excel simulation. The computation of cost and time for earthwork and water proofing activities is described below by the screenshot of this software.

A. Computation of activities of earthwork and water proofing

Here in Figure 2 which is screenshot of software, there is a cost increase multiple. The value of this software is cost slope, which depends upon the cost and time of any activity. The cost is inversely proportional to the time. If we increase the cost for any activity, the time will be decreased at certain level. So the cost increase multiple gives us the best of minimum of time.
Figure 2, 3 and 4 are the screenshots of RISK software for the calculation of all the activities which can be taken under earth work and water proofing.

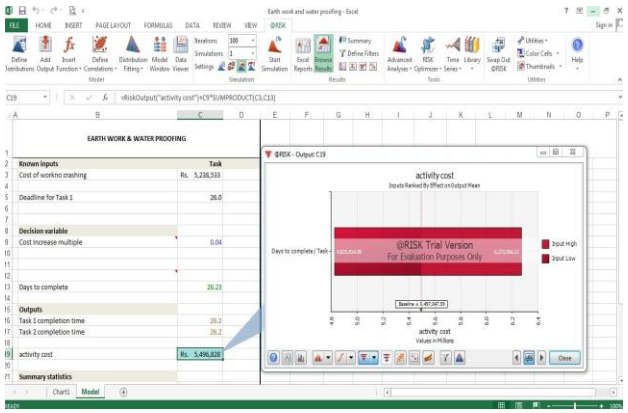

Figure 2. Screenshot of earthwork and water proofing

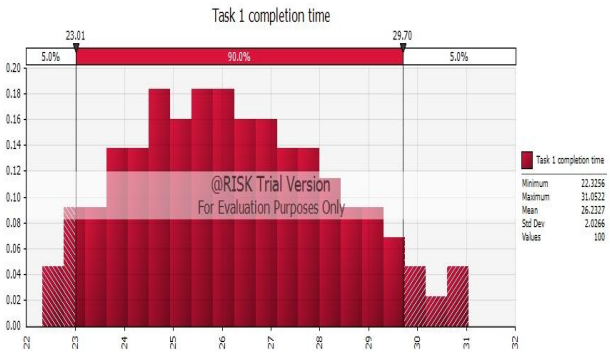

Figure 3. Graph of simulation of time

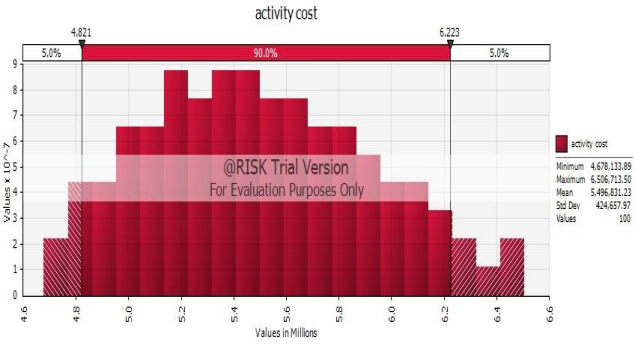

Figure 4. Graph of simulation of cost

Likewise computation of all group of activities from table 3 can be done and the results of those activities are as below.

Table 4. Comparision of cost and time

Sr. No	Item description	Actual cost (Rs.)	Cost using simulation in RISK (soft) (Rs.)	Deadline of work (day)	Possible duration (days) by simulation	Actual completion of work (Day)
A	**CIVIL WORKS**					
I	Earth work and water proofing	5,238,533	5,496,828	26	26.2	30
II	Preparation work, roofing work, plain and reinforced cement concrete work	52,309,392	53,000,225	94	101.04	114
III	Masonry work	10,989,056	11,249,064	66	68.2	80

IV	Finishing	5,831,541	5,561,200	94	95.4	114
V	Miscellaneous work	316,234	316,234	3	3	3
B	**Plumbing work**					
I	All type of plumbing work with sanitary and water supply	5,573,874	4,154,457	30	37.3	37
	TOTAL	**80,258,630**	**79,778,008**	**313 (+1 Mon-th)**	**331.14**	**378 (1 mth. due to currency)**
	Variation	**480622**			**46.86**	

III. RESULT AND DISCUSSION

A. Result

By considering these various risks in the different activities, there was a greater change in the scheduled time of the project. These risk factors are directly connected with the time and cost of the project, so if the risk takes place in activity the overall time and cost of the project may be increased. As we know that if the actual time duration of any work is predefined then we can divide the work in the best way. Here the deadline of work was 313 days and the possible duration of the simulation is 331.41 days, it means we have total 331 days to complete our task and by this time line, we can divide the total work in days, so that proper work division is possible.

Table 5. Cost Comparison of time and cost after risk simulation

	Actual cost (Rs.)	**Cost using simulation in RISK (software) (Rs.)**	**Deadline (Days) of work**	**Possible duration (days) by simulation**	**Actual completion of work (Days)**
TOTAL	**80,258,630**	**79,778,008**	**313 (+1month)**	**331.14**	**378 (1month delay due to currency)**
Variation	**480622 Rs.**			**46.86 Days**	

B. Discussion

- For any kind of work, if we know the accurate deadline for it then the planning can be properly done and the work also can be divided.
- It gives the smooth working condition for ongoing project.
- For this project if we could get accurate deadline of whole project then the work could be devided in proper way and 4,80,622 Rs. can be saved.

FUTURE SCOPE OF WORK

- For any ongoing project the simulation with the help of @RISK can be done.
- By using MS Project the critical path can be found out and only computation of critical activities can also give the accurate result.

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