

# Construction Project Risk Management for Residential Building by using P6- EPPM

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**Abstract**— The construction industry works in a very uncertain environment where conditions can change due to complexity of each project. Therefore number of risks occurred due to this complexity. Risk management is a concept which is used in all industries. The main objective of risk analysis is to evaluate the impact of risk from the activity and to prepare the risk management plan. This project deals with 'Risk management of a residential building by using Primavera'. G +7 storeyed residential building has been selected as a project case study. Risk analysis is done using Probability Impact Matrix method. As per the results risks are categorized as per high to low. And risk response plan is prepared to mitigate the risk by using Primavera web.

**Keywords:** Risk Management, Probability Impact Matrix

## I. INTRODUCTION

Construction industry has more risk as compared to any other industries, because of complexity in coordinating various activities. Each construction project is unique and consist of various methods and procedures. Time, Cost and Quality are the main constraints of any project. However risk raises from different sources results in cost over-run, poor quality and delay in project. So in order to overcome this, risk management should be implemented as it is one of the important area in a project management. Project Management Institute (PMI) includes the risk management in their Project Management Body of Knowledge as one of the nine knowledge areas of project management. It is nothing but the systematic approach to control the level of risk to mitigate its effects. Risk management consist of some steps such as, Risk identification, Risk estimation, Risk evaluation, Risk response, Risk monitoring and Risk control.

### A. About Primavera Web Software:

Primavera launched in 1983 by the Primavera Systems. It was acquired by the Oracle Corporation in 2008. Primavera P6 Web a Project Management tool that as a web browser interface. It requires internet access and a web browser in order to plan, schedule and manage the project which allows the project teams to have anytime, anywhere access to project information through the flexible web based user interface facility. By utilizing the Oracle Primavera Web tool to plan tasks, keep up time in the mission, for keeping up cost and tracking of activities in industry. Development, vitality, aviation, data innovation. The tool may seem overwhelming in extent of its capacities. Incorporates undertaking asset arranging framework, content management framework, announcing framework, and application servers and innovation, to describe only a couple. With a specific end goal to guarantee that they likewise possessed the best of breed in project scheduling software. The range of a project may be overwhelming. Oracle Primavera Web allows projects into smaller, attainable projects, tasks and activities.

Enhanced communication especially if project spans for large geographic areas, requires hundreds of workers and involves many different parties. Primavera Web offers many complex analysis and processes. However accessing and managing the schedule remains simple. It helps in categorize & mitigate risks in track of planning, supervision and finishing a project there by reducing expenses in project. Some of the benefits of primavera are,

- Easy to Use Software
- Optimized Resources.
- Enhanced Visibility.
- Forecasting of Project Activities
- Tracking Features.
- Enhanced Communication
- Improved Collaboration
- Gives Employees Responsibility in Schedule Creation
- Breakdown Complex Projects
- Ease of Access.

### B. Literature Survey:

Divya Gupta, et al. 2015, For analyzing the level of various risk factors in construction industry, questionnaire survey were used to collect the data. Based on the assessment of likelihood of occurrence of various risks and their impact on the project objectives, they identified twenty major risk factors. These risks are mainly related to contractors, clients and designers. 'Financial risk' is the major factor in their research. The research result shows that our construction companies significantly differ from foreign construction companies in the adoption of risk management practices. To manage the risk effectively and efficiently, the contractor must understand risk responsibilities, risk event condition, risk preference and risk management capabilities. The lack of experience makes it difficult to change contractor's attitude towards risk management.

Krantikumar V. Mhetre, et al. 2017, This paper covers the use and benefits of computer software i.e. Primavera Risk Analysis in Risk Management Process of construction projects to analyse the risks involved in a construction project. It includes the preparation of schedule, assigning the 3-time estimate durations and performing iterations using primavera risk analysis. Preparation of schedule is the input to the Primavera Risk Analysis software after which the risk analysis is performed and we get output in the form of distribution graphs. And the conclusion was that for small scale projects, the need of risk management is not compulsory as the risks are managed at the qualitative level through meetings and discussions only. In case of large and huge projects, the quantitative risk analysis is very useful and the analysis is made easy for analysts by the use of software's available in the industry.

Dr. Nadeem Ehsan, 2010, This research focused on concepts of risk management and development of a survey questionnaire and suggestions related to risk management practices in construction industry of Pakistan. Questions were prepared on the basis of information available on construction risks. He discussed with personnel working for construction industry in Pakistan to identify and assess, the risk factors relating to construction industry in Pakistan. The conclusion was that Formal risk analysis and management techniques are rarely employed by Pakistani construction industry owing to the lack of experience and knowledge in the area. The perception of risk by contractors and consultants is mostly based on their intuition and experience.

Dr. R. K. Kansal, et al. 2012, The purpose of this study is to assess the use and method of risk identification techniques in the construction industry. Techniques are classified as specialised industrial construction, infrastructure heavy construction. They conducted the questionnaire survey in construction industry. The collected data was grouped into risk categories and its magnitude of consequence on project objective in term of cost, quality, time, environment and safety. And they concluded that the currently used methods for risk assessment are brain storming, checklist, flowchart Delphi method, risk significant index method. And it was observed that currently used risk assessment method can be integrated into new approach, which will help the decision makers for applying risk assessment methods effectively.

X. Regina Mary and V. Rathinakumar, 2015, This study deals with the ways that decreases time and cost constraints and resource management. Residential building has been taken for case study which was undergoing the time and cost overrun. They have reduced the constraints by using techniques such as connecting activities properly and increasing the resources, schedules are prepared by means of Primavera software. The cost constraints can also be reduced by managing labour resources of different categories. They concluded that, schedule made by the technique interconnecting activities properly gives a time difference for the completion of the project of about 5 months from the base schedule of the project. Thereby increase the profit outcome from the project. Further, with the management on the labour resource of skilled, unskilled male worker and unskilled female worker in the construction activities, the cost spent on the labour resources reduces by 5% of the actual cost spent on the labour resources. Using a software helps to manage the work easily and it reduces the information constraints between the management and the site members which greatly contribute to the project success.

Zakari Tsiga, et al. 2017, This research aims at the attitude and personality of people who deliver construction projects. The research was carried out by using an online questionnaire which includes the aspects of risk decision and personality questions. Total 50 responses have been collected and analyzed. The conclusion of this study shows that people having experience are aware about risks in construction projects and prefer not to take risk in most of the cases. In the aspect of personality, the results were compared to the Carl Jung personality theory and shows that the participants are extroverts, judging, more intuitive than sensing, and are equally thinkers and feelers.

## II. MATERIAL AND METHODS

In this project work, questionnaire is prepared on the basis of expert judgement and by going through some literature for the purpose of risk identification. Residential building from Pune is selected for case study. The methodology for the project is given below.

### A. Step 1: Plan risk management

In this process we will plan the risk management process. Means how we are going to identify the risks, process of risk analysis whether it is quantitative or qualitative risk analysis. Also we have to plan the risk response methods like risk avoidance, risk transfer, risk retention etc. and also monitoring the process.

### B. Step 2: Risk identification

There are various methods of risk identification. Such as questionnaire survey, documentation review, brainstorming, Delphi technique, interviewing, root cause identification, checklist analysis etc. Appropriate method should be selected on the basis of requirements or scope of project.

### C. Step 3: Qualitative risk analysis (Probability Impact Matrix)

In this analysis probability will be taken as per the responses and expert judgement. Impact will be taken from the cost. From probability and impact calculation probability score will be identified. By using probability score average of each risk category will be find out. After finding the average, risk categories will be ranked as per high, medium and low.

### D. Step 4: Plan Risk Response

Once risks have been identified and evaluated they have to be responded to in some way. There are seven basic responses on identified risks:

- 1) Recognized but no action taken (absorbed as a matter of policy)
- 2) Avoided (by taking appropriate steps)
- 3) Reduced (by an alternative approach)
- 4) Shared (with others, e.g., by joint venture)
- 5) Transferred (to others through contract or insurance)
- 6) Retained and absorbed (by prudent allowances)
- 7) Handled by a combination of the above.

### E. Step 5: Manage Risk

Risk management tools can be applied on the basis of nature of the project, organization's policy, project management strategy, risk attitude of the project team members, and availability of the resources. Your overall risk mitigation strategy should be simple, clear and manageable with the resources available. Risk mitigations plan should be ready before risk occurs. Risk mitigations techniques should be accepted by every stakeholder. Mostly if possible risk manager should be there and risks should be identified while planning the project.

### F. Step 6: Control Risk

Not a single project is free from risk. But we should try to control the risk because risks and uncertainties, involved in construction projects, cause cost overrun, schedule delay and lack of quality during the progression of the projects and at

their end. By continuously tracking the project periodically we can control the risk.

### III. RESULTS AND ANALYSIS

In this project risks are divided in various categories such as time, quality, project management, contract, people, market, environment, cost etc.

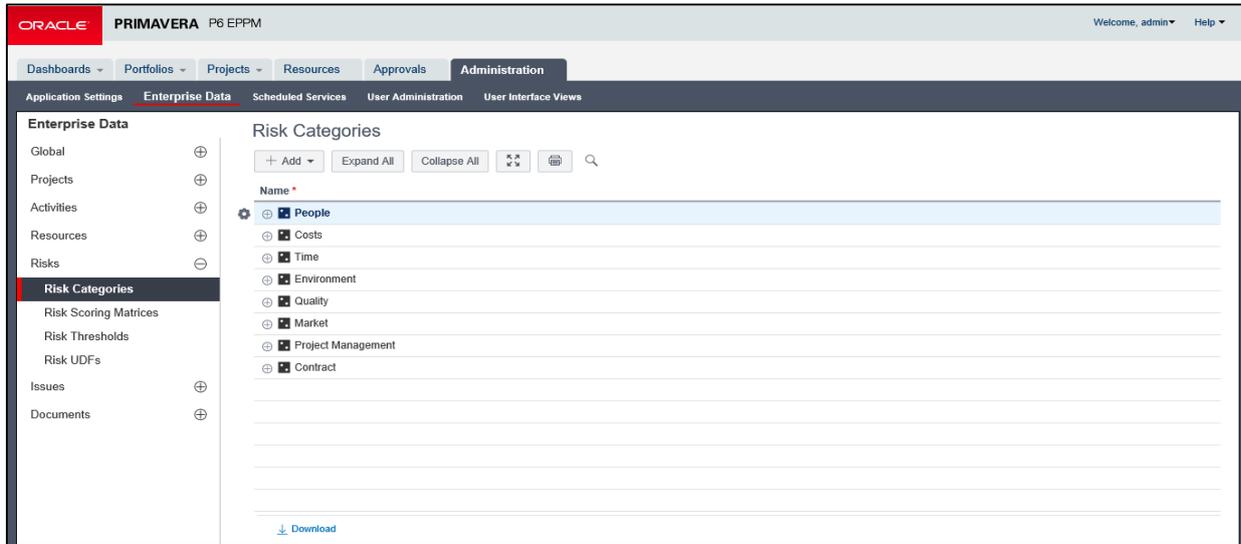


Fig. 1: Risk categories in primavera web software

By using questionnaire survey and by referring to expert judgement various risks are identified in this project. There may be number of risks involved in project but we have

to decide or we have to prioritized the risk as per the responses. In this project total 38 risks are considered. And risk analysis is done in primavera web software.

ID	Name	Category	Probability	Schedule	Cost	Score	Exposure	Response Total Cost	Type
RISK41	Change of contractors demand	Contract	H (50% to 70%)	H (3 to 5)	H (D100,000.00 to D250,000.00)	28	D105,000.00	07,884,052.81	Threat
RISK40	Constraint of availability of concrete	Market	H (50% to 70%)	H (3 to 5)	M (D50,000.00 to D100,000.00)	28	D45,000.00	01,851,856.16	Threat
RISK39	Unskilled labours doing electrical work	People	H (50% to 70%)	H (3 to 5)	H (D100,000.00 to D250,000.00)	28	D105,000.00	02,047,990.00	Threat
RISK38	Line out of blocks is improper	People	H (50% to 70%)	H (3 to 5)	M (D50,000.00 to D100,000.00)	28	D45,000.00	01,595,747.42	Threat
RISK36	Different soil conditions	Costs	H (50% to 70%)	M (1 to 3)	L (D10,000.00 to D50,000.00)	14	D18,000.00	00.00	Threat
RISK35	Change in rates of material	Market	H (50% to 70%)	M (1 to 3)	M (D50,000.00 to D100,000.00)	14	D45,000.00	05,891,495.49	Threat
RISK34	Uneven or undulating surface of ground	Environment	M (30% to 50%)	M (1 to 3)	L (D10,000.00 to D50,000.00)	10	D12,000.00	00.00	Threat
RISK33	Delay from steel supplier for material	Time	H (50% to 70%)	M (1 to 3)	M (D50,000.00 to D100,000.00)	14	D45,000.00	03,884,583.02	Threat
RISK32	Health and safety of labours	People	H (50% to 70%)	H (3 to 5)	H (D100,000.00 to D250,000.00)	28	D105,000.00	07,100,255.20	Threat
RISK31	Check for column plum	Quality	H (50% to 70%)	H (3 to 5)	H (D100,000.00 to D250,000.00)	28	D105,000.00	0420,300.89	Threat
RISK29	Availability of resources	Costs	H (50% to 70%)	H (3 to 5)	H (D100,000.00 to D250,000.00)	28	D105,000.00	011,557,002.51	Threat
RISK27	Extra cost required for injection grouting OHMT	Costs	M (30% to 50%)	L (1 to 1)	L (D10,000.00 to D50,000.00)	5	D12,000.00	068,755.05	Threat
RISK26	Breaking of sliding doors and windows	Time	M (30% to 50%)	M (1 to 3)	M (D50,000.00 to D100,000.00)	10	D30,000.00	02,086,081.18	Threat
RISK24	Strike of labours	People	H (50% to 70%)	H (3 to 5)	H (D100,000.00 to D250,000.00)	28	D105,000.00	05,793,861.37	Threat
RISK23	Issues with payment	Contract	H (50% to 70%)	VH (5 or higher)	M (D50,000.00 to D100,000.00)	56	D45,000.00	01,940,840.96	Threat

Fig. 2: Risk analysis in primavera web

After risk analysis, risk categorization has been carried out by using probability impact matrix. In this analysis probability is taken as per the response filled in the survey report and impact is considered from the higher impact value of cost and schedule. Probability score has been obtained from the probability and impact calculation. With the help of this score average of each risk category has been calculated. And by considering this average risk categories are ranked as high, medium and low. (0-10%) in low, (10-15%) in medium and more than 15% in high category.

For example-

Risk category- Contract

Risk score- 56 and 28

Therefore average =  $(56 + 28) / 2 = 42$ .

Risk category	Average	Percentage	Results
Time	19.67	10.70%	M
Quality	17.86	9.72%	L
Project Management	28	15.23%	H
Contract	42	22.85%	H
People	28	15.23%	H
Market	21	11.43%	M
Environment	12.67	6.89%	L
Cost	14.56	7.92%	L
Total =	183.76	100%	

Table 1: Average of risk categories

Probability and Impact matrix generated in the software as follows.

Probability and Impact Diagram						
Probability	Severity 1	Severity 2	Severity 3	Severity 4	Severity 5	
Very High	6	12	18	56	72	
High	4	7	14	28	56	
Medium	3	5	10	20	40	
Low	2	3	6	12	24	
Very Low	1	1	2	4	8	

Fig. 3: Probability impact diagram

The risks having probability very high and high indicated by red colour requires a detailed risk response plan to mitigate those risks. Risks having probability of medium requires indicated by yellow colour requires a defined mitigation action. And risks having probability very low and low, indicated by green colour will not going to impact the cost much more. So it does not required the detailed mitigation plan.

To mitigate the risks, we have to prepare a risk response plan. By using risk response plan we can reduce or we can totally avoid that risks from our project. To overcome the negative risks (Threat) we have 4 response type such as avoid, accept, reduce and transfer.

Following table indicates the reduction in cost before and after risk management plan.

Risk category	Cost before Risk Management	Cost after Risk Management
Time	2,83,750.00	1,85,000.00
Quality	4,33,000.00	2,77,000.00
Project Management	2,10,000.00	1,75,000.00
Contract	1,50,000.00	1,00,000.00
People	6,15,000.00	4,10,000.00
Market	90,000.00	48,000.00
Environment	75,000.00	75,000.00
Cost	3,81,750.00	2,56,000.00
Total =	22,38,500	15,26,000

Table 2: Category wise Cost reduction

#### IV. CONCLUSIONS

- Risk is a crucial part of any construction project. Therefore construction companies must include risk management process in there project management. The risk identification and risk assessment of project risks are the critical procedures for any successful project.
- In this case study risk categories such as project management, contract and people comes under high risk causing factor. Medium risk categories are time and market. Whereas low risk categories are quality, environment and cost.
- Risks are more in the beginning of the project. It will get reduced towards the closure of the project. Therefore risk should be identified throughout the project and risk register should be maintained.
- Some risks that we cannot avoid or transfer, so we have to accept those risks.
- Probability and impacts for various risks may change in another project. Therefore Probability Impact Matrix will also change for another project.
- If possible risk manager should be appointed.
- Therefore after adopting risk management process we can save Rs. 7, 12,500 in this project.
- Financial savings by using risk management can increase the productivity of an organization and also it improves the success rate of new project and improves decision making process of an organization.

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