

Construction projects risk management by risk allocation approach using PMBOK standard

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ABSTRACT

Projects' managers in plenty of construction projects which are assumed that are under control, are facing risk as an unknown occurrences and they are attempting to control it and are suffering more costs. Though, by a comprehensible effort and applying risk management, risks are identified and controlled before happening or a plan is provided in order to deal with these occurrences and time and cost are saved. Construction projects are encountering uncertainties in regard with achieving their goals. Thus, they have to be controlled and appropriately responded by risk management methods. In this regard, risk management process in PMBOK standard can be a suitable approach to solve this problem. Due to necessity of resource optimal spending, this process has a considerable importance. In this project, 11 important risks in Mehr housing project in Hashtgerd city have been identified. All of objectives of risk management have been brought in the table entitled "Risk Register" and it has been practically given to project management.

KEYWORDS: Risk Management, Uncertainty, Risk Tracking, Preventive Activities

1. INTRODUCTION

One of important areas in project risk standard is project risk management. Project environment is influenced by uncertainty and this condition will be more acute [1]. Uncertainty has different origins that are technical, management, commercial and internal and external issues related to the plan. Risk value reflects severity of uncertainty in achieving respective domain and subsequently, by increasing risk, expected domain has to be higher for an investment in order to have an efficient and acceptable investment [2]. Also, this matter is quite important that identification and successful management of uncertainties is eventually connected to projects' success [3]. Contracts are explaining procedures and obligations and powers of the parties (employer and contractor) which have a special importance in terms of considering and dividing predictable risks.

Project Management Body of Knowledge (PMBOK) is one of the most reliable references in the context of project control. This standard is derived from researches and efforts done by Project Management Institute (PMI). From 1969, this institute has presented elegant facilities and attempts in the context of project management knowledge development. In the context of project risk analysis, PMBOK standard is able to provide very efficient and applicable process which has facilitated assessment and analysis of project directors.

2. Problem statement

In implementing projects risk management process, there are 2 main priorities. First, studying critical risks which are influencing project time and cost and ultimately, proper response and accurate plan have to be determined in order to control risks occurred in regard with project implementation. In fact, harmful impacts of risks can be eliminated or at least minimized. In this query, to investigate and analyze project risks and respond research questions, applicable model of standard risk management process, PMBOK has been employed.

Questions proposed in this research are:

1. What are the risks which might happen in Mehr housing project in Hashtgerd city?
2. What are critical risks of Mehr housing project in Hashtgerd city?
3. Which factors are influenced by project's important risks?
4. How much project's important risks do have impact on project's time and cost?
5. What are the proper solutions and responses to each critical risk?

3. Risk management

Risk management is considered as one of most important project management processes, because it is directly connected to 4 chief goals of each project that is cost, time, quality and span. Project risk management is a systematic process to identify, analyze and react toward project risk. Its main objectives are to increase possibility and consequences of positive occurrences and reduce possibility and consequences of negative occurrences in regard with project's goals.

4. Risk definition

Decision making processes which include estimates, assumptions and anticipating occurrences will be happening in the future along with risk. There are various definitions for risk. Some of them have been pointed in the following:

Defining project risk based on PMBOK standard, uncertain occurrences or conditions which if they are happening, they will have positive or negative impact on at least one of project's objectives such as time, cost or quality [4].

The Concise Oxford Dictionary of Art [5] describes risk as a danger opportunity of bad consequences.

Risk term is applied when the probability of occurring phenomenon can be assessed. In another word, risk can be estimated. To calculate risk, following logic equation can be used:

Risk rate= probability * impact

Uncertainty: It is a condition of an event which its result is probable and uncertain. Results obtained from this risk can produce risk or opportunity.

Probability: It is the likelihood of pleasant or unpleasant consequences which is expressed by percentage or in more comprehensible way as probability distribution chart.

PMBOK standard is summarizing risk management in 5 following steps:

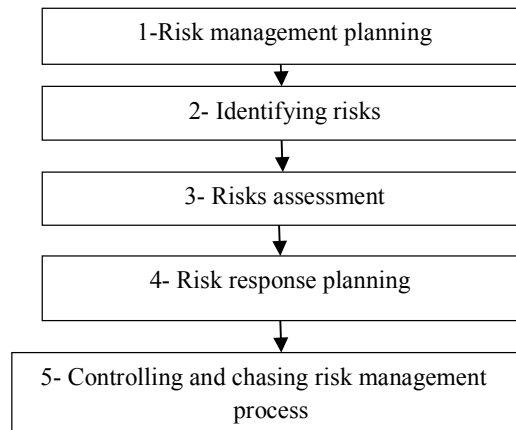


Figure 1: PMBOK standard

4-1- Definitions of PMBOK

Risk management planning: Decision making about how to record and plan risk management activities

Risk identification: determining risks which might influence on project and documenting their impacts.

Qualitative risk analysis: It is a qualitative analysis of risks and conditions in order to prioritize their impacts on project goals

Quantitative risk analysis: It is measuring risks consequences and probability and estimating their impacts on project objectives

Risk response planning: providing procedures and techniques for increasing opportunities and reducing threats in projects objectives

Risk monitoring and control: Monitoring residual risks; identifying new risks; implementing risk reduction plans and evaluating their effectiveness in all of project lifetime cycle.

5. Risk management planning

It elaborates how to structure and identify; qualitative and quantitative analysis, response planning, risk monitoring and control along project lifetime cycle. Project management is not a discrete and independent process, but also, it is integrated with other duties of project management. Doing project risk management is a duty of all of project stakeholders and they have to participate in this process actively. Project risk management activities are started from the beginning of project and it is continuing along project lifetime cycle and its programs are developed. Risk management must systematically consider all of risks derived from past, now and especially future objectives of organization.

5-1- Risk plan management method

This part consists of identifying risks, risk analysis including qualitative analysis, risk quantitative analysis and risk response methods.

5-1-1- Risk identification

Risk identification requires risk management and planning. Risk management is determined through identifying risks and their probability [6]. To identify risks, Information Gathering Techniques and Standard List of Risk methods have been used. Then, risks have been classified and ultimately the output of this step is Risk Register which has been brought in table 4.

5-1-2- Risks classification

Risks are classified based on their nature into the following groups: technical, work conditions, constructions, economic, weather and financial which have been exhibited in table 1.

5-1-3- Risk assessment and analysis

Analysis of identified risks related to project production and process is being done in assessment stage in order to meet impacts of risks. In another word, risk analysis is to estimate impact of each risk in project faith. The main goal of risk analysis is to describe risk as a quantitative value for estimating probability and impact of each risk [1].

For quantitative and qualitative analysis of risks, we are simultaneously acting and risk matrix has been used and each risk based on probability and impact is ranked and accordingly, tables 2 and 3 have been employed.

Table 1: Risk classification

Risk root	Risk kinds	Code
1.1. Lack of accessibility to materials 1.2. Lack of consistency between design and information in order to estimate cost and planning	Technical	1
2.1. Lack of resources such as worker, material, land 2.2. Human risks like experts' low job experience	Work condition	2
3.1 Performance risks like safety	Construction	3
4.1. Uncontrollable condition of weather and other atmospheric factors	Weather	4
5.1. Inflation (short-term)	Economic	5
6.1. Lack of index for activities' costs 6.2. Payment inappropriate scheduling (bank as aN investor) 6.3. Workers strike 6.4. Employer's financial shortage	Financial	6

Table 2: Guideline for risks impact rate

Impact	Delay	Cost	Quality	Span
9	Very High	The possibility of failure to complete the project	Inability to estimate performance	It creates human casualties
7	High	Overall delay more than determined limitation of delay fine	Lower than employer expectation	It will lead to physical injuries
5	Medium	Project's delay more than the contract estimation	Lower than industry medium	There is safety danger
3	Low	Initiated delay with increase in non-compensable costs and resources	Higher than industry medium	The need for embedding systems to increase security
1	Very Low	There is delay in ratio with time initial estimation.	Cases of employer complaint	There are not any considerations for security

Table 3: Guideline to quantify risks probability

Probability	
Very high	>80%
High	60- 80%
medium	40-60%
low	20-40%
Very low	<20%

Then, this matrix is calculated for each one of these risks:

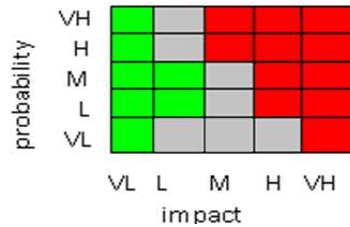


Figure 2: Impact and probability of risk occurrence

5-1-4- Strategies to deal with risk

Risk response methods are determined based on project condition, appropriate kind and method. Then, based on matrix priority, risks are classified.

1. Risk transfer: Finding another adventurous person or institute which owns better ability in risk management. This action is preventive kind. Different risks can be transferred to the third party in the form of insurance policies, warranties and different contracts [1].
2. Risk reduction: Reducing risk is in regard with its acceptance for project [4].
3. Risk acceptance
4. Active acceptance: Dealing with venturesome phenomena intelligently
5. Passive acceptance: Retreating and accepting to change in budget, time and quality of project implementation
6. Risk hesitation: It will be achieved through changes in project plans.

5- risk management process control

The main goal of the last step of risk management process is to monitor condition of identified risks, new risks, ensure proper implementation of responses and review their effectiveness and also monitoring risk changes in all of project enhancement steps [4]. Of course, effectiveness of risk management process must be reviewed to ensure that its needs are met.

6. research mythology

Project in this study is Mehr housing project in Hashtgerd city. Mehr housing projects is government mass projects. Indeed, it is the use of state land under 99-year lease and house ownership by eligible applicants of Mehr housing. Mehr housing plan was firstly started mentioned in paragraph D, note 6, budget law in 2007 (sectors related to rehabilitation and reconstruction of old urban areas and informal settlements of country) and then, based on law of organizing and supporting the housing production and supply, it was continuously put in agenda. Of course, mentioning this issue is necessary that this plan in fact includes long-term land lease to build a house. The main foundation of Mehr housing is based on this issue that land price has been allocated a considerable part of net housing cost, so by reducing or eliminating land price from net housing cost, house price can be largely decreased. In this dissertation, methods which have caused initiating risk appropriate management to achieve project's goals and also increase impacts of opportunities and decrease threats impacts in contractual term have been investigated. These methods have been used during implementation of Mehr housing project in Hashtgerd city located in Alborz province. In this query, performance report of one block with 16 apartments out of 160 apartments of Hashtgerd Mehr housing has been evaluated.

In this research, library references, internet and also documents existed in project's achieve have been employed which indeed, it has been written by field-descriptive method. Identifying critical risks have been done through brain storming technique and also after studying and holding meetings with project management team and professional experts which ultimately, applicable and appropriate responses have been proposed for all of risks.

Table 4: Risk Register

Code	Risk classification	Risk	Which element is influenced?	Probability	Impact	Risk matrix	Response method	Response
1	Technical	Lack of accessibility to materials	Time, cost	Medium	High		Reduction	Identifying reliable suppliers and making contract
2	Technical	Lack of proper design and information to meet cost and programing	Time, cost, span	Low	High		Prevention	Dividing project into 2 or 3 phase in order to facilitate and make this work better.
3	Work condition	Lack of resources like material and worker	Time, cost	Medium	High		Reduction	Human force education using subcontractor
4	Work condition	Human risk like experts' low job experience	Time, quality, cost	Low	Medium		Elimination	Choosing appropriate employment method (studying experts 'work records in similar past projects)
5	Construction	Performance risks like safety	Time, cost	Medium	High		Reduction	Creating safer condition using new technologies

6	Construction	Uncontrollable condition of weather and other atmospheric factors	Time, cost	High	High		Acceptance	Statistics of Meteorological Organization give us useful information which has been accumulated in figures and charts. Return period and duration of its occurrence can be guessed. By forecasting days which these events might be happened, damages derived from them are estimated. So, in these damages, the rate of human force cost, capital cost and other indirect costs can be considered.
7	Financial	Inflation rate	Cost, quality	High	High		Acceptance	Studying government's performance in previous years and local condition can help us with estimating this rate
8	Financial	Lack of index for activities' costs	Cost	Low			Elimination	Collecting information by different methods like brain storming, experienced people's and experts' opinions
9	Financial	Payment incorrect scheduling	Time, cost	High	High		Reduction	Using managerial resources to compensate budget shortage
10	Financial	Workers' strike	Time	Medium	High		Reduction	Creating better work condition and giving reward and timely payment of wages
11	Financial	Employer's financial shortage	Time	Low	Very high		Elimination	By negotiation and using technical and financial ability of insurance companies and also by following previous works that other contractors have had with these employers, their payment method can be evaluated

7. Conclusion

The main goal to propose this paper is to identify and analyze risks which are influencing one construction project. This work has been done to codify an initial pattern and it is a very limited work. It can be generalized in other massive projects. The advantages of this work are to specify ways to make profit and security for contractor and employer. For this purpose, it is suggested to attach risk allocation matrix to contract documents in order to provide a context for contractors to estimate their recommended sum to implement more real projects based on risks allocation. The ultimate objective of risk management process and instruments such as risk allocation matrix is to initiate optimal condition in terms of risk balance and efficiency to achieve objectives. Of course, such process requires spending time, holding several meetings, interfering all of units related to identifying risks in meetings; having adequate knowledge about modern economic and political issues and also providing and codifying software for risk analysis. In the recent years, plenty of efforts have been done in the world such as software like Pert Master software. Due to inquiries conducted in Risk Register, risk such as weather uncontrollable condition and other factors like atmosphere factors, inflation rate and payment inappropriate scheduling because of their high probability and impact have an especial place compared with other risks. These risks have to be more addressed. According to results, out of 11 identified risks based on risks classification, 2 risks have been allocated to technical cases; 2 risks to work condition; 1 risk to weather and 5 risks to financial cases. As it was determined, the largest number of risks is related to project costs which are the most challengeable index in construction projects.

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