A MODEL TO EVALUATE THE RISK MANAGEMENT APPROACH TO VALUE ENGINEERING IN CONSTRUCTION PROJECTS (DESIGN OF THE EXTERIOR OF THE BUILDING)

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Abstract-The creation of the risk management approach and value engineering goes back to the 19th century,and their effectiveness in implementation of projects have been proved.This research aims to offer a simpler and more functional model than previous ones and it emphasis on construction phase of project which is done by integration of risk and value. Because of the similarities of objectives and structures of these two techniques which is the increase in value and optimum opportunities to use them in projects the integration of risk management and value is implemented.The approach selected in this study gives the readers a comprehensive view of the model andthey will be familiar with the evolution of this process.The results of this research help theexpertise engineers to provide efficient models in future.

Keywords- value engineering, risk management, project management, integrated model

I. INTRODUCTION

The risk management process is a method by which the project's risks during project implementation will be rated and managed.This process consists of activities to reduce the likelihood and severity of each risk event determined.In construction projects,achievement of goals is faced with threats and opportunities in relation to key elements of the project including time, cost and quality. The roots of these threats and opportunities can be found in a series of conditions of uncertainty. [1]

Value engineering is a successful value methodology to solve problems, reduce costs and improve performance. Thefunctionalist approach of value engineering is the reason of high speed to wrap up and deliver solutions in the early stages of the process and that is its difference compared with other techniques. [2]So the combination of risk management and value engineering techniqueswill create a balance between risk and value engineering. This is a realistic approach to optimize costs rather than incremental approach of risk management and decline approach of value engineering.

1.1 The risk management process:

Enterpriserisk management process has a significant role in improving the project performance and getting predetermined goals with reduction or deletion of risk consequences.In fact,risk management is a multi-step process which is done to maximize the results of positive events and to minimize the possible negative consequences. [3] [4]Risk management processes introduced by the Project Management Institute of America also includes six stages as following: [5]Risk management planning, risk identification, qualitative risk analysis, quantitative risk analysis, risk response planning, risk monitoring and control

1.2 Value Engineering: The nature of value in standard EN 2000 and in concept of value engineering is the required performanceat the lowest cost. Miles,the father of value engineering, says that:"A product / service has a good value when its performance and costs is appropriate and proportionate."International Association of value engineering (SAVE) has defined thevalue engineering as following:[7]

1.3 The systematic use of specific and innovative methods based on teamwork,which aims to identify and remove unnecessary costs and improve the quality and efficiency of a product / service throughout its entire life.Engineering work plan reflects the array of approaches and practices for obtaining answer of issues.This program consists of three phases:

- Pre-study
- Study:It includes six successive phases:Information phase,function analysis phase,creativity phase,Evaluation phase,Development and Presentation Phases.
- Post-study

1.4 Models ofintegrated risk and value management

Researchers have offered many reasons for combining the two approaches. The main reasons are:

- Value and risk are complementary.
- There is a consistency between risk and value. [8] [10] [11] [12]

-Developments from the beginning to present

Integration of risk and value management in 1995,stated first in the international conference of SAVE.Articles with the topic of "challenging paradigm of Project Management"and"Integratedriskmanagement and value management" presentedin this conferenceand created a comparable positionfor value and risk

management, and showed the conflicts of project management. [13]Inrecent years a lot of studies and articles on the combination of these two approaches have been developed by researchers and experts andpresented in scientific community, especially the international conference of value engineering.Prominent scholars such as Koga, MutanahVedjmarkhave presented about the combination of these two techniques. [9]

II. INTEGRATED METHODOLOGY OF RISK MANAGEMENT AND VALUE ENGINEERING

The first step: It includes the pre-study activities that are carried forward from value engineering study.In determining the team members should be noted that an expert who has knowledge of risk and risk management tools and its processes being added to them.

Second step: The study activities included the **following steps:**

Information phase:In this phase, a variety of information about the project can gather human resourcesor other resources, including documentation and instructions.At this stage, at the same time,Information about the risk will be collected then the identified risks will be ordered into order to facilitate the study. Function analysis and risk assessment phase:This phase is the most important and perhaps most difficult part of the risk management process and the value engineering phase.In this phase activities such as building a functional model for the project,record of risks associated with each function, cost and risk estimation and selection of functions with differences in value and risk will be done. Creativity phase:In this step, different ideas for projects with the aim of minimizing the risk to a minimum and also bring down the value gap is will be generated. This is a great opportunity to reduce the risk to occur. Evaluation phase:This phase is done to select the best ideas (with minimum risk and maximum value) for switching to transition to the development phase with the purpose of doing more analysis. Presentation phase:In this phase the final details, including details of the risk and cost options will be provided for the decision-makers.Also all the risks associated with the suggested options with strategies for maximizing assess their control will be included. Step Three: Post study phase is done to prepare the final report of value engineering program, and alsoto determine the results of execution of risk and value management. The risks are dynamic and we might face new risks by time which should be identified too.

III. CASE STUDY: THE BEST DESIGN OF EXTERIOR OF RESIDENTIAL BUILDINGS

The steps presented in research method with the case study (exterior design) were done in a district of Tehran city according to three types of stone and brick, composite materials separately.

According to the standard method of value engineering, the workflow process included three stages of pre-study, study and post studies. The pre-study phase was done with the primary data collection with the help of human resources, documentation and presenting the preliminary studies and numerous meetings with experts. The value engineering study stage was done in the right environment and with the participation of 14 specialists with over 10 year experience in construction management building.

Information Phase: First of all the members and tasks of value engineering team was determined. Following the completion of information phase, to determine the scope of the study, project goals, objectives of value engineering and risk management workshops, decision criteria and risk identification were examined. At this point, the prospect of work was to access o thebest projects with high quality in less time and cost.

Function analysis and risk assessment phase:At this stage, the performance targets of different parts of the project were reviewed and defined. Finally, after analyzing the performances and identified risks, areas of improvement which meet the employee's needs are analyzed to be discussed in creativity phase. Then, those parts of the review to be done in creativity phase were selected.

Creativity phase:In creativity phase, the multitude of different ideas in the scope of value engineering was offered. The output of this work after individual and teamwork creativity resulted in 45, 43 and 20 new for each of the shots in stone, brick and composite, respectively.

Options evaluation phase:This phase is done in 5 steps:Step 1: Many of the ideas generated in this phase are clearly useless,so the first step in the evaluation phase is to put away these ideas and adopt ideas with better prospects.

Step 2: In this step the remaining ideas will be evaluated by Tables 1 to 3 based on the type of function.Theideas are as following:Exterior stone: 1-parallel with the joinery, 2 in the facade design with depressions and protrusions along with the hard work is carried out, 3-run with combination of brick or composite, 4 - strict execution of hard work facade work to prevent repeat,5. The expert team increase, 6. use of machinery in transportation of materials in the evacuation, 7. The use of modern equipment, such as laser plummet, laser meters, depot 8. Depots of materials are needed to fulfill each class of floors of the building, 9. Consideration of the construction joints in facade design, 10.Performancesof primary actions of project while performing the hard working

Table 1-step evaluation (stone facades)

Rating feasibility	Scheduling: executive					
Overall Rating	The potential for cost reduction	Time employment	Risks	Price development	The development	Idea
	Cost reduction = 10	Quite short = 10	No risk = 100	No cost = 10	Fully developed = 10	
	No reduction = 0	Quite a lot = 0	Risk = 0	High cost = 0	Undeveloped = 0	
37	5	10	4	10	8	1
37	8	10	4	10	5	2
33	7	10	6	10	5	3
28	10	5	5	10	8	4

Table 2-step evaluation (stone facades)

Rating feasibility	Scheduling: Initial actions					
Overall Rating	The potential for cost reduction	Time employment	Risks	Price development	The development	Idea
	Cost reduction = 10	Quite short = 10	No risk = 100	No cost = 10	Fully developed = 10	
	No reduction = 0	Quite a lot = 0	Risk = 0	High cost = 0	Undeveloped = 0	
28	0	10	6	5	7	5
34	5	7	7	5	10	6
25	2	5	8	2	8	7
30	5	8	7	5	5	8
21	1	5	6	0	9	10

Table 3-step evaluation (stone facades)

Rating feasibility	Scheduling:Design					
Overall Rating	The potential for cost reduction	Time employment	Risks	Price development	The development	Idea
	Cost reduction = 10	Quite short = 10	No risk = 100	No cost = 10	Fully developed = 10	
	No reduction = 0	Quite a lot = 0	Risk = 0	High cost = 0	Undeveloped = 0	
28	3	10	8	2	5	13

Brick: 1. Purchase from the factory without intermediaries, 2.parallel working hard to do when you run, 3.Using other materials such as brick and wooden in combination, 4. Increasing the expert team, 5. Use of machineries in the evacuation and transportation of materials ,6. Using new tools 7.Depot of materials to execute the façade of each floor 8.Considering the performance gaps in design of facades, 9.Execution of preliminary actions in hard work stage of project

Table 4-step evaluation (brick)

Rating feasibility	Scheduling: executive					
Overall Rating	The potential for cost reduction	Time employment	Risks	Price development	The development	Idea
	Cost reduction = 10	Quite short = 10	No risk = 100	No cost = 10	Fully developed = 10	
	No reduction = 0	Quite a lot = 0	Risk = 0	High cost = 0	Undeveloped = 0	
28	5	10	4	1	8	2
27	0	10	3	9	5	3

Table 5-step evaluation (brick)

Rating feasibility	Scheduling: Initial actions					
Overall Rating	The potential for cost reduction	Time employment	Risks	Price development	The development	Idea
	Cost reduction = 10	Quite short = 10	No risk = 100	No cost = 10	Fully developed = 10	
	No reduction = 0	Quite a lot = 0	Risk = 0	High cost = 0	Undeveloped = 0	
32	8	3	9	4	8	1
28	0	10	6	5	7	4
34	5	7	7	5	10	5
25	2	5	8	2	8	6
30	5	8	7	5	5	7
21	1	5	6	0	9	9

Table 6-step evaluation (brick)

Rating feasibility	Scheduling: Design					
Overall Rating	The potential for cost reduction	Time employment	Risks	Price development	The development	Idea
	Cost reduction = 10	Quite short = 10	No risk = 100	No cost = 10	Fully developed = 10	
	No reduction = 0	Quite a lot = 0	Risk = 0	High cost = 0	Undeveloped = 0	
28	3	10	8	2	5	8

Composite:1- Expert team Increase, 2- Use of machinery to transport and evacuation of materials, 3- use of modernequipment, 4- Depot of materials required for each class of floors of the building facades, 5- Considering the gaps of execution in design view, 6-Execution of primary actions in hard work stage of project.

Table 7-step evaluation (facades)

Rating feasibility	Scheduling: Initial actions					
Overall Rating	The potential for cost reduction	Time employment	Risks	Price development	The development	Idea
	Cost reduction = 10	Quite short = 10	No risk = 100	No cost = 10	Fully developed = 10	
	No reduction = 0	Quite a lot = 0	Risk = 0	High cost = 0	Undeveloped = 0	
28	0	10	6	5	10	1
34	5	7	7	5	10	2
25	2	5	8	2	8	3
30	5	8	7	5	5	4
21	1	5	6	0	9	5

Step 3: The advantages and disadvantages of each of the top ideas which are resulted from previous stageswill be entered in tables 4 which it shows the comparison of ideas.

Table 8-step evaluation (stone facades)

Ideas and combinations of ideas as possible are more select in the following list down the advantages and disadvantages of each type of ideas between +1 to +5 score benefits and disadvantages score between -1 to -5 we give			
	Ideas	**Advantages**	**Disadvantages**
3	Parallel with joinery	5	2-
4	Strict implementation of hard work	5	1-
2	Increased expert team	3	1-
3	Use of machinery for handling and unloading	4	1-
3	Depo working materials required for each class of floors of the building facade	4	1-
1	By considering construction joints in facade design	2	1-
3	Early work conducted in the project implementation firm	4	1-

Table 9-step evaluation (brick)

Ideas and combinations of ideas as possible are more select in the following list down the advantages and disadvantages of each type of ideas between +1 to +5 score benefits and disadvantages score			
	Ideas	**Advantages**	**Disadvantages**
2	Buy Direct from factory	3	1-
3	Parallel with joinery	4	1-
1-	The use of combination products	1	2-
1	Increased expert team	3	2-
3	Use of machinery for handling and unloading	4	1-
3	Depo working materials required for each class of floors of the building facade	4	1-
1	By considering construction joints in facade design	2	1-
3	Early work conducted in the project implementation firm	4	1-

Table 10-step evaluation (facades)

Ideas and combinations of ideas as possible are more select in the following list down the advantages and disadvantages of each type of ideas between +1 to +5 score benefits and disadvantages score			
	Ideas	**Advantages**	**Disadvantages**
2	Increased expert team	3	1-
3	Use of machinery for handling and unloading	4	1-
1-	Early work conducted in the project implementation firm	1	2-

Step 4: The important functions from the previous step should be listed as the AHP paired comparison to clarify their relative importance.

Table 11. The fourth step evaluation

Criteria	**A**	**B**	**C**	**The relative importance**	**ranking**	**Intensity difference:**
						The difference is very minor .1
A	-	3	4	3	1	narrowly .2
B	1/3	-	2	2	2	The average difference .3
C	1/4	1/2	-	1	1	The gap .4
						The great difference .5

Step 5: In this step, the relative importance of each criterion obtained from previous table will be determined to get the top ideas to be used. The idea with the top pick will be selected and will be transferred to the development phase.

Table 12. The fifth step evaluation (stone facades)

Overall Rating	C	B	A	Desired criteria
-	1	2	3	Weight
15	1 / 1	1 / 2	3 / 12	Parallel with joinery
19	1 / 1	1 / 2	4 / 16	Strict implementation of hard work
17	1 / 1	2 / 4	3 / 12	Depo working materials required for each class of floors of the building facade
20	2 / 2	3 / 6	3 /	Use of machinery for handling and unloading
19	1 / 1	3 / 6	12 / 3	Early work conducted in the project implementation firm

Table 13. The fifth step evaluation (brick)

Overall Rating	C	B	A	Desired criteria
-	1	2	4	Weight
19	1 / 1	1 / 2	4 / 16	Parallel with joinery
23	1 / 1	4 / 8	4 / 16	Use of machinery for handling and unloading
19	1 / 1	1 / 2	4 / 16	Depo working materials required for each class of floors of the building facade
22	4 / 4	2 / 4	3 / 12	By considering construction joints in facade design
21	1 / 1	4 / 8	3 / 12	Early work conducted in the project implementation firm

Table 14. The fifth step evaluation (facades)

Overall Rating	C	B	A	Desired criteria
-	1	2	4	Weight
17	1 / 1	2 / 4	3 / 12	Increased expert team
23	1 / 1	3 / 6	4 / 16	Use of machinery for handling and unloading

PRESENTATION PHASE

The development and execution phase respect to subject matter and program of value engineering requires the execution proposed by experts and also providing the statement by them.

The post study:During the process of execution of top ideas a comparison between the planned and ongoing projects is done to determine the type of planned progress on the project according to schedule of project. With the assessment done according to the ideas implemented in this project, the use of machines can help reductionof cost and time of project. For other options the depot of materials option to run each class of floors of the building facade or increase ofteam experts will be used to improve working conditions.

CONCLUSION

Due to the simplicity of the proposed method by integration approach of value and risk, this method can be used widely. Also, the index value calculated in this way is closer to reality and has effective role in decision-making for the project team plays.

As the value engineering is an index in any value management approach and risk assessment is an index for risk management, the integration of these two methods can be considered as a worthy criterion. The present study tries to say that with descriptions and explanations found in the risk management process, itcan be run in value engineering workshop simultaneously. The main task of value engineering is to make a balance between cost, performance and quality that are referred to as the components of value engineering. So it creates better conditions for studying risk as the value engineering study provides valuable additional information for risk study. Thenthe value and risk management program phase will be determined and the instructions, tools and goals of each phase will be explained.

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