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Risk Assessment of Time and Cost Overrun Factors throughout Construction Project Lifecycle

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Abstract: The construction industry has a reputation for delivering projects over budget. This research identifies actual project examples illustrating the problem of cost overruns. Results of a questionnaire survey present perceptions of the main reasons why building construction projects sometimes exceed the initial budget estimate. The paper reviews how the construction industry is responding to the challenge of accurate budgeting. In the domain of facility capital cost budgets and risk management, two key conclusions are made. Firstly, that complete design information leads to more accurate budget estimates. Secondly, that client driven design change is the greatest risk. Clients are the key drivers of change and they must therefore take a look at themselves before blaming the industry for being inefficient.

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1. Introduction

Construction industry is suffering from cost overruns; cost overrun is a major problem in project development and is a regular feature in construction industry. The situation of a construction project in which budgetary estimate exceeds estimation, budget exceeds budgetary estimate, and settlement exceeds budget is a universal phenomenon. Construction cost which is out of control adds investment pressure, increases construction cost and affects investment decision-making. Besides, the increasing in cost of project can reduce the feasibility of the project, its contribution to the development and the renaissance of community.

Cost control will be explained from the view of risk management, as uncertainty and risks linked with construction industry as it threats achieving the project success. In addition, it's clarified that cost overrun is considered as a risk. Consequently, this paper discusses cost overrun as a risk and deal with it by risk management process. Once factors causing cost overrun are determined, it will be easy to deal with them. Als**o,** it's clarified that *Risk management* is considered as "a control technique that can help in achieving project success".

The avoidance of the risks' occurrence in construction projects can be achieved in the presence of a good management in attempt to reach the supposed approach helps who are responsible for those risks. So, it has become crucial for contractors to understand their risk of cost overburden in advance and manage it effectively. This requires utilization of a systematic approach to the management of project risks and uncertainties in the cost estimation stage to minimize their effects for identifying the factors that contribute to cost overrun avoiding. So, the main objective of this research paper is to find an approach to providing early warning devices to reduce these problems. So, understanding these factors allows for appropriate actions to mitigate factor impacts. Project participants can take action to curtail or control the effects of these identified cost escalation factors throughout the life of the project. So, both of theoretical and practical studies aimed at:

- Ranking the causing factors of cost overrun in Egypt, in particular, prioritize the cost overrun factors regarding their risk index.
- Determining a response plan for cost overrun risks in construction projects in Egypt.

2. Cost Control in Construction Projects

Successful project management requires the identification of the factors impacting project scope definition, cost, schedule, contracting strategy and work execution plan. However, much of the research related to risk identification, assessment and management for constructed facilities is focused on specifics such as location, categories of risks aspects, or types of projects. Consequently, lists of relevant construction project risks have been developed. Hence, the accuracy of planning costs leads to reduce these costs as it is the most appropriate chance to avoid any mistakes that would happen later in cost estimating, budgeting, and control. Also, the best time to make changes without bearing burden of cost in

other words the appropriate period to control the costs of projects. As shown in Figure 1. Consequently, the best tool used within this period is risk management process.

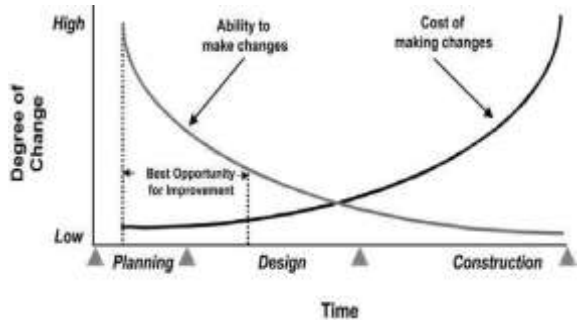

Figure 1: The best time to make changes without bearing burden of cost

So, it's preferred to use an aiding tool to guarantee achieving the goal of cost reduction within preparing lists of potential risks that affecting cost overrun occurrence in addition, creating a suitable response plan for them. The suggested approach is an attempt to reduce the occurrence of cost overrun in construction projects is depending on project management knowledge as shown in figure2 using three steps to achieve the desired goal; first, focusing on defining the objectives regarding the project cost. second, discussing the cost management, the phase of cost control in particular. Moreover, risk management had been selected as a tool of cost control in a new approach to deal with the cost overrun in projects.

3. The Proposed Approach t Control Project Costs

It is recognized that cost management is responsible for controlling project costs but it's necessary to integrate between cost management and risk management as the first concerns with all issues of project costs from planning to control and monitor, and the second concerns with evaluation and response of potential factors affecting on achievement of the project objectives.

Moreover, the researcher will be able to conduct a response plan by qualitative analysis for the cost overrun risks. The model steps are shown in the following figure.

4. Risk Management Methodology

It was improved by the PMI, adding details based on users" experience. Consequently, the process of risk management includes many phases**.** These phases of proposed approach risk management process are proper to achieve the researcher's target in getting a final risk matrix to deal with project construction risks.

Figure 2: The idea of suggested approach

- **First step** is **"risks identification"** which was conducted by determining and classifying them into groups and categories.
- **Second step** is **"risk assessment"** which leads to risk analysis based on probabilities and impacts. The researcher preferred using the qualitative method.
- **Third step** is "**risk response"** which leads to create a response plan for determined risks. This plan contains the high-priority risks and the suitable response strategies for each one. The used strategies are mitigation, avoidance, transference, acceptance and watch.
- **Fourth step** is "**monitor and control**" which is considered the last category of Risk management process; it can be in controlling all the former categories as it is used from the earlier steps in dealing with cost overrun risks.

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Figure 3: A proposed approach to manage risks

4.1. Risk Identification

Risk identification is considered the first step of risk management process, in which potential risks

associated with a construction project are identified. As an integrative part of risk identification, risk classification attempts to structure the diverse risks affecting a construction project. Many approaches have been suggested in the literature for classifying risks. Also, it is defined as "*The purpose of identifying risks is to obtain a list with potential risks to be managed in a project*".

In addition, this step is usually informal and can be performed in various ways, depending on the organization and the project team. It means that the identification of risks relies mostly on past experience that should be used in upcoming projects. In order to find the potential risks, an allocation needs to be done. This can be decided and arranged by the organization. In this case, no method is better than another, since the only purpose is to establish the possible risks in a project. This process would highlight risks that may be considered, by project management, to be more significant and selected for further analysis. As, through this stage the potential risks affecting construction projects can be identified. However, the careless way in which this process is undertaken in many construction companies is one of the causes of failure of construction projects.

4.1.1. Risk Classification

It is an integrative part of risk identification; its main objective is to structure the diverse risks affecting a construction project.

Many sources can cause and identify risks. Some sources can be easily identified and risks can be analyzed, but other sources are not obvious. Risks can be predictable before projects start or appear during the construction process suddenly. Some risks are related to project itself that is under the control of project decision makers, while others are related to external factors that are out of control. Project managers identify risks by documenting their characteristics after determining the risks that are likely to affect the project. Moreover, the nature of risks could be internal or external. Consequently, the identification process should be carried out by a professional with enough experience.

4.2. Risk Assessment and Analysis

Risk assessment and management are important as identified risks on construction projects are typically financial in nature. Early in the project, an assessment of risk is crucial to establish the budget parameters within which the project must be completed. The calculation of project contingencies should be based on an assessment of the risk surrounding the project. Also, it is defined the risk analysis as estimating the probabilities needed as input data to evaluate the alternative decisions.

After the identification of risks, they must be evaluated in terms of the probability of occurrence and impact. An understanding of the possible effects on project objectives is needed. Since most projects have only a limited amount of resources to use for risk management, concentration on only the major risks is essential.

In addition, that the common problem in project risk management processes is the need to determine the relative significance of different sources of risk so as to guide subsequent risk management effort and ensure it remains cost effective.

4.2.1. Risk Assessment

It is a process where the occurrence probability and the impact of risk are determined. This process consists of analyzing the causes of risk that might occur and the effects of risk that are the potential impacts on a project. The risk assessment process consists of two stages as shown in figure 4:

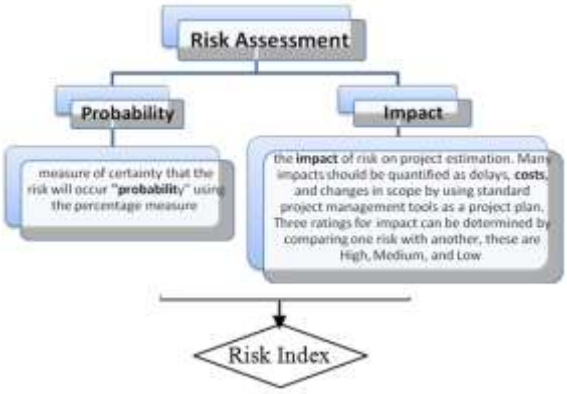


Figure 4: Risk assessment phases

According to risk matrix, the three variables; risk (R), probability (P) and impact (I) are all measured numerically. The project manager judged the probability of occurrence using the five-level judgment scale of: very high, high, medium, low and very low. The same scale was also applied to the degree of impact of the risk.

$$R = P \times I$$

The previous step determined the probability of occurrence and the impact level for calculating the risk index. Moreover, the approach seeks to rank risks involves the use of probability-impact grid to allocate the risks on risk matrix in order to understand the severity of risks better. Typically, such grids require individual sources of risk to be characterized as risk events with a roughly assessed probability of occurrence and degree of impact. This allows each risk to be characterized by a single `risk rating.

4.2.2. Qualitative Risk Analysis

Qualitative assessment is concerned with the qualities and subjective elements of the risk by assessing the impact and likelihood of the identified risks and developing the prioritized lists of these risks

for further analysis or direct mitigation. Also, the identified risks can be assessed qualitatively to determine both probability and potential effect on project objectives, allowing risks to be prioritized for further attention.

The primary technique for this approach is mainly based on the Probability–Impact Matrix, where the probability and impacts of each risk are assessed against defined scales, and plotted on a two dimensional grid. Hence, it uses expert opinion to evaluate the probability and consequence of interaction within a system. This approach can be used to assess the cost overrun risks as one of the project's threats.

In addition, qualitative assessment techniques have many actions like risk definition, risk details, and risk categorization and prioritization. In addition, *qualitative technique* has several methods as direct judgment, ranking options, comparing options and descriptive analysis. In fact, identifying, describing, and assessing project risks allow the team to have decision to move on project construction. Besides, project teams may elicit assistance from subject matter experts or functional units to assess the risks in their respective fields.

4.2.3. Steps of Qualitative Analysis

Once a risk is identified, including a thorough description of the risk, it can be characterized in terms of probability of occurrence and the consequence if it does occur as follow:

1- Gather the project team and appropriate persons to discuss project risk. Determine which of the qualitative risk matrixes you intend to use and define the terms you plan to use (Very High, High, Medium, Low…. etc.).

2- Review the risk information from the risk identification step.

3- Discuss the risk with the group.

4- Evaluate the likelihood of the risk occurring by asking the group "How likely will this risk occur?" Record the result that the group agrees on.

5- Evaluate the consequences if the risk does occur by asking the group "What will be the impacts if this risk occurred?" Record the results that the group agrees on.

6- Prioritize the risks based on the results of the qualitative analysis. If it is desirable, the risks can also be grouped by category and ranked within each category.

Finally, the risk matrix consists of five levels (very low, low, moderate, high and very high) for impact and (rare, occasional, somewhat frequent, frequent, and very frequent) for probability of occurrence. Besides, high- priority risks locate on (Very High- Very Frequent); (Very High- Frequent); (Very High- somewhat Frequent); (High- Very Frequent); (High- Frequent); (Moderate- Very Frequent) and (Moderate- Frequent) cells. So it differs from PMI's matrix in evaluating the high-priority risks. Moreover, it is more focusing on the deserved risks to near- term response plan. As shown in table (1) as follows:

Table 1: Risks matrix

Very high					
High					
Moderate					
Low					
Very low					
Impact/ likelihood	Rare	Occasional	Somewhat frequent	Frequent	Very frequent

	Take action now
	Put measures in place
	Watch

5. Risk Response plan

A Risk response plan includes answers to the threats that are identified in the risk assessment phase. There are a number of ways to address these threats.

In other words, the control plan is a series of course adjustments within the project's main objectives. These adjustments include scheduling and tracing the advance of risk situations. The control plan defines indicators that provide warnings regarding the realization of specific risks.

When as, the distribution of risks between the client and contractor make them tending to overshadow the effective management strategies. Also, investigations show that contactors and owners give minimal consideration to risks outside the realm of their own concerns.

Table 2: Response strategies of threat risks

	Strategy type	Description
Threat risks responses	Acceptance	Accept risk impacts on cost, schedule, scope and quality.
	Avoidance	When scope could be changed.
	Mitigation	Reduction of risk impact or probability.
	Transference	Shifting responsibility of risk to another part.
	Watch	Delay response action to a later time.

6. Practical study

This study follows a certain methodology depending on some approaches as field study (pilot, guide and field studies) and analytical study. In addition, there are many types of survey tools that were used in survey process hence, they can answer the research questions, and these answers will determine the most influencing factors in cost overrun occurrence and create a database for the risks which frequently occur in construction projects in Egypt, the establishing of an approach to control it. The methods used to collect data in this research are as follow:

- **Previous Studies:** Theoretical and practical.
- **Meeting with experts:** By conducting few interviews.

Questionnaires: Delivered by hand ore-mailed.

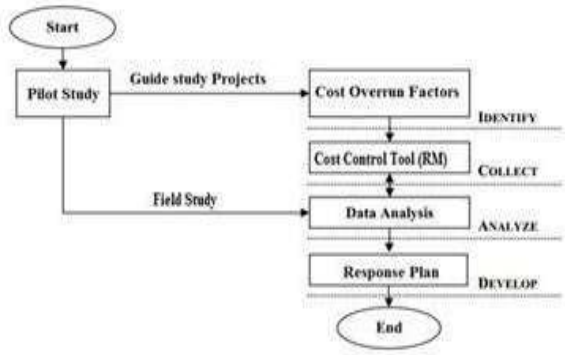


Figure 5: Structure of practical study methodology

The used questionnaires aim to obtain respondents' (expert and specialists) opinions on cost overrun problem in construction projects (tourist in particular) in Egypt at their life cycle. Hence, filling this questionnaire will help in identifying major factors that because cost overrun and their level of impact on projects; this will help in developing an approach to control and minimize this problem. The purpose of these questionnaires is to investigate project parties' and specialists' in construction field viewpoints about factors causing cost overrun in construction projects, Egypt. The applied questionnaire that was reformulated tends as base the questionnaires used by some scholars After reformulation, the questionnaire kept the possibility of multiple choices, arranged in a total of 102 questions, subdivided in three parts as shown in appendix A.

In general, data was analyzed using (SPSS 20) Version 20 as follows:

Descriptive Statistic: mean, standard deviation

- That was used to summary and describes the data.
- **Cronbach' alpha test**: estimating the reliability coefficients of the three variables of the current study.
- **Qualitative assessment:** for both impact and probability of each factor because cost overrun.

6.1. Survey of Results and Data Analysis

The questionnaires were distributed by several forms as personally (delivered by hand) or via e–mail to 75 respondents of the contracting companies and consultation firms. But, only 64 forms were filled and were returned (85.3% over all response rate) while, three forms were excluded for incomplete answers and missing data. Sample's size has been determined based on the participants in the designing and executing of the guide projects.

In this questionnaire, cost overrun risks COR are grouped with reference to the literature review and interviews with experts classified risks into **6** main groups technical, economic and financial, political and regulation, management, project resources and environment, the questionnaire was the main used tool to evaluate and rank those factors. These groups are divided into **20** categories. Those categories that contain **95** risks were deemed to be able to influence the project costs and cause of cost overrun occurrence. They affect construction project cost during the project life cycle.

First, the analysis of demographic results concerned with the characteristics of participated respondents in the questionnaires survey as shown in the following table will present these demographic results.

Table 3: Respondents' profile

Category	Respondent	
	Number	%
Years of respondents' experience		
Group < 10	10	15.6%
Group 10 – 20	24	37.5%
Group 20-30	22	34.4%
Group > 30	8	12.5%
Years of companies' experience		
Group 10 – 20	14	21.9%
Group 20-30	32	50%
Group > 30	18	28.1%
Position		
Consultant	8	12.5%
Project manager	14	21.9%
Site engineer	8	12.5%
Technical office engineer	12	18.8%
Contractor	22	34.4%
Project counts		
<5	6	9.4%
5 – 10	10	15.6%
10 – 20	22	34.4%
>20	26	40.6%

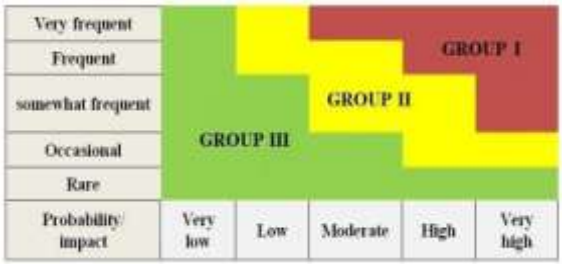
The sample properties show that the respondents are highly experienced in implementing the construction projects in Egypt.

Second, Cronbach Alpha test is concerned with the reliability and validity of the gathered data.

Table 4: Cronbach's alpha value for groups

Group	Technical	Economic & financial	Political & regulation	Management	Project resources	Environment
Alpha Cronbach α Values	**0.795**	**0.844**	**0.756**	**0.9**	**0.863**	**0.9**

Table 5: Matrix of risk factors (Main zones' classification)



Cronbach's alpha α coefficient is greater than 0.7 and is considered highly reliable. Consequently, the collected data is considered highly reliable as it is ranged between (**0.756**) and (**0.9**).

The survey feedback includes two groups of data, the likelihood of occurrence of each risk and its severity impact on project objectives in terms of cost. The five- point scales for the likelihood a (very highly likely, highly likely, moderate, likely, and less likely) need to be converted into numerical scales as the researcher put for them in sequence 0.1, 0.3, 0.5, 0.7 and 0.9. The matrix presented in Table 6 shows the converted numerical values and the calculation of the risk significance index which will be explained in detail later.

Table 6: Risk indexes of risk matrix zones

Very frequent (0.9)	0.09 (J)	0.27 (E)	0.45 (C)	0.63 (A)	0.81 (A)
Frequent (0.7)	0.07 (J)	0.21 (G)	0.35 (D)	0.49 (B)	0.63 (A)
somewhat frequent (0.5)	0.05 (K)	0.15 (H)	0.25 (F)	0.35 (D)	0.45 (C)
Occasional (0.3)	0.03 (L)	0.09 (J)	0.15 (H)	0.21 (G)	0.27 (E)
Rare (0.1)	0.01 (M)	0.03 (L)	0.05 (K)	0.07 (J)	0.09 (J)
Probability/ impact	Very low (0.1)	Low (0.3)	Moderate (0.5)	High (0.7)	Very high (0.9)

Table 7: Key risks as per their significance on individual project objective

Factors of cost overrun risk	Risk index
1. Design changes	0.441
2. Modified to standard drawings during construction stage	0.331
3. Lack of experience of technical consultants.	0.176
4. Poor review of drawings	0.213
5. Deficient documentation for specification	0.340
6. Delay in project completion time	0.704
7. Inappropriate contractor policies	0.014
8. Obsolete or unsuitable construction methods	0.061
9. Changes in material specification and type	0.451
10. Mistakes during construction	0.140
11. Lake of experience in contracts	0.178
12. Technology changes	0.039
13. Poor organizational structure	0.061
14. Lack of experience of project type	0.378
15. Absence of managerial programs and poor decision-making process	0.107
16. Poor performance of subcontractor	0.548
17. Poor technical structure of construction companies	0.617
18. Incompetent subcontractors and nominated suppliers	0.404
19. Inadequate pre-construction of site study	0.398
20. Far storages from the site.	0.177
21. Unexpected site conditions	0.094
22. Additional work due to owner's request.	0.723
23. Change orders	0.278
24. Complexity of project.	0.371
25. The gap between the construction plan and the reality.	0.714
26. Lack review of contract.	0.013
27. Contractual claims such as extension of time and cost claims.	0.260
28. Poor financing / contract management.	0.178
29. Donor policy in bidding to the lowest price one.	0.709
30. Poor contract documentation	0.168
31. Bureaucracy and political interference in tendering method	0.247
32. Insufficient number of competitors	0.208
33. Inefficient use of resources	0.051
34. Lack of incentives	0.212
35. Improper mode of financing and payment for completing work	0.209
36. Cash flow and financial difficulties faced by contractors	0.608
37. Contractors undertaking projects beyond their capacity	0.617
38. Problems in license' extraction	0.315
39. Fluctuation in money exchange rate	0.437
40. High interest rates charged by bankers on loans received by contractors	0.371
41. Financial difficulties of client	0.369
42. Domination of construction industry by local organizations	0.288
43. High transportation costs	0.042
44. High insurance cost.	0.041
45. Long period between design and bidding	0.370
46. Delay in payment to supplier/subcontractor	0.395
47. Work suspension because of litigation/disputes within the parties involved in the project	0.067
48. Economic instability/Political insecurity	0.626
49. Change in the scope of the project according to government policies	0.243
50. Lack of experience of local regulation	0.066
51. Delays in decisions making by Government.	0.242

Factors of cost overrun risk	Risk index
52. Change in government regulation.	0.067
53. Inappropriate government policies.	0.183
54. Inaccurate estimation of original cost.	0.464
55. Wrong method of cost estimation.	0.392
56. Risk and uncertainty associated with projects.	0.459
57. Lack of cost planning/monitoring during pre-and post-bidding stage.	0.613
58. Inadequate project preparation, planning and implementation.	0.549
59. Poor managerial structure of construction companies.	0.399
60. Improper planning and scheduling	0.216
61. Absence of construction cost data/ lake of reports.	0.216
62. Fraudulent practices, kickbacks and corruption.	0.641
63. Number of projects going on at same time/work load	0.101
64. Stealing and waste on site	0.168
65. Delay in inspection and approval of completed works	0.613
66. Inadequate monitoring and control	0.245
67. A poor site management/ Poor cost control	0.400
68. Poor relationships between management and labor	0.041
69. Poor coordination among the project participants	0.180
70. Subcontractors' passive attitude toward project	0.284
71. Disputes/Strikes/Accidents on site	0.160
72. The project manager's poor capability	0.268
73. Limited skilled labor	0.520
74. High cost of skilled labor	0.270
75. Shortage of labor in site.	0.389
76. Labor unrest.	0.393
77. Poor performance of labor.	0.067
78. Lack of labor productivity.	0.398
79. Fluctuations in the cost of building materials.	0.709
80. Late in the delivery.	0.180
81. Limited stocks.	0.064
82. Inadequate production of raw materials in the country.	0.183
83. Project materials monopoly by some suppliers.	0.065
84. Shortage of material.	0.513
85. Omissions and errors in the bills of quantities.	0.233
86. High cost of machineries.	0.076
87. High machineries' maintenance costs.	0.185
88. Delay in Equipment supply.	0.182
89. Insufficient numbers of equipment	0.183
90. Inadequate site investigation /unexpected ground conditions.	0.284
91. Wrong / inappropriate choice of location.	0.021
92. Social condition.	0.094
93. The project located in the middle of public facilities.	0.221
94. Unpredictable weather conditions.	0.021
95. The impact of bad weather on production's rate.	0.051

6.1.1. Risks Of Technical Group

This group contains **5** categories and consists of **25** factors affecting cost overrun in construction projects, it is shown that **6** out of **25** factors in this group are considered as strongly casual factors of cost overrun in building construction projects. In this group," **Additional works at owner's request**" is the most influencing factor of cost overrun in building construction projects followed by "**Delay in project completion time**", "**Poor technical structure of construction companies**", "**The gap between the construction plan and the reality**", "**Poor performance of subcontractor**" and "**Design changes**". Besides, the "**Additional work at owner's**

request" factor has the most significant impact and the greatest value of probability occurrence in technical group too.

6.1.2. Risks of Economic and Financial Group

This group contains 5 categories and consists of 22 factors affecting cost overrun in construction projects, it is shown that 3 out of 22 factors in this group are considered as strongly casual factors of cost overrun in building construction projects. In this group, "Donor policy in bidding to the lowest price" is the most influencing factor of cost overrun in building construction projects follows by "Contractors undertaking projects beyond their capacity" and "Cash flow and financial difficulties faced by contractors". Besides, the "Donor policy in bidding to the lowest price one" factor has the most significant impact; the "Contractors undertaking projects beyond their capacity" factor has the greatest value of probability occurrence in economic group.

6.1.3. Risks of Political Group

This group contains 2 categories and consists of 6 factors affecting cost overrun in construction projects, it is shown that 1 out of 6 factors in this group are considered as a strongly casual factor of cost overrun is in building construction projects. In this group, "Economic instability/Political insecurity" is the most influencing factor of cost overrun in building construction projects. Besides, the "Change in the scope of the project according to government policies" factor has the most significant impact, the "Economic instability/ political insecurity" factor has the greatest value of probability occurrence in political group.

6.1.4. Risks of Managerial Group

This group contains 4 categories and consists of 19 factors affecting cost overrun in construction factors of cost overrun in building construction projects. In this group, is the most influencing factor of cost overrun in building construction projects, it is shown that 6 out of 19 factors in this group are considered as strongly casual projects followed by "Delay in inspection and approval of completed works", "Inadequate project preparation, planning and implementation", "Inaccurate Estimation of Original Cost" and "Risk and uncertainty associated with projects". Besides, the "Fraudulent practices, kickbacks, corruption" factor has the most significant impact, in addition, the "Risk and uncertainty associated with projects" factor has the greatest value of probability of occurrence in management group.

6.1.5. Risks of Project Resources Group

This group contains 3 categories and consists of 17 factors affecting cost overrun in construction projects, it is shown that 4 out of 17 factors in this group are considered as strongly casual factors of cost overrun in building construction projects. In this group, "Fluctuations in the cost of building materials" is the most influencing factor of cost overrun in building construction projects follows by "Limited skilled labor", and "Shortage of material". Besides, the "Fluctuations in the cost of building materials" factor has the most of significant impact and the greatest value of probability occurrence in project resources group too.

6.1.6. Risks of Environmental Group

This group has 2 categories and consists of 6 factors affecting cost overrun in construction projects, it is shown that none of the 6 factors in this group is considered as a strongly casual factor of cost overrun in building construction projects. Besides, the "Inadequate site investigation /unexpected ground conditions" factor has the most significant impact and the greatest value of probability occurrence in environment group too.

These 19 factors of cost overrun risk are high-priority located in group I (red zone) which consist of three zones; zone A (additional works at owner's request, donor policy in bidding to the lowest price, fluctuations in the cost of building materials, delay in project completion time, fraudulent practices, kickbacks, corruption, economic instability/Political insecurity, contractors undertaking projects beyond their capacity and poor technical structure of construction companies), zone B (delay in inspection and approval of completed works, cash flow and financial difficulties faced by contractors, the gap between the construction plan and the reality, limited skilled labor, Poor performance of subcontractor, poor managerial structure of construction companies, inadequate project preparation, planning and implementation), and zone C.

Table 8: Research risk model:

Risks Model	Contractor (RI)	Owner (RI)
Bribes on projects delivery	16.4	24.2
Cronyism and corruption in awarding tenders	16.3	23.4
Awarding tenders to lowest prices	15.4	23.4
Ease of sector entry		22.6
Burn bid prices during tenders	15	22.6
Courts length during contracts parties litigations		21.8
Poor projects distribution between large and small firms	15.4	21.8

Risks Model	Contractor (RI)	Owner (RI)
Current economic situation	17.6	21
Lack of management thought		20.9
Government impact on litigations		20.2
Contractors falsification in classifications documents		20.2
Cheating material specifications		20.1
Egyptian arbitration chamber is not activated		19.5
Lack of specialized courts		19.5
Authority relationship with construction sector	14.9	19.5
Difficulty in issuing permits		19.4
Weakness of Data base		18.8
Conflict in design drawings		18.8
Poor in project risks allocations (responsibilities)	15.2	18.8
Lack of scientific management	15	18.8
Lack of governmental oriented policy to develop construction sector	14.5	18.8
Political uncertainty	16.4	
Lack of safety systems	16.2	
Criminal behavior	16	
Execution mistakes	15.8	
Tolerance quality on delivery	15.4	
The absence of technical department	15.2	
contractual problems	14.7	
Drawings delay	14.7	
Lack of site data	14.7	
Inflation impact on material prices	14.6	

Table 9: Research measures (Response Plans) framework

Measurement framework	Contractor	Owner
Consultant delivers the drawings on time.	4.08	4.83
Pay dues to contractor on time		4.68
Rely on contractor with high administrative skills.	4.08	4.68
Improve legislative system		4.60
Enact legislation requires refused tenders less than the estimation value with 25%.	4.06	4.52
The government fix exchange rate		4.52
Prepare and submit all necessary documents and feasibility on timely manner	4.09	4.52
Unite the prime minister and the finance ministry to facilitate the projects capital		4.52
Prepare and submit all necessary documents and feasibility		4.47
Secure a standby cash flow		4.47
Define clearly the objectives of all project		4.47
Employ the professional project management team		4.47
Create legal and reasonable measures to reduce taxes		4.44
Project team must be aware of the		4.44
Rely on distinct contractors in the technical		4.39
Contractor obliged to Project specifications, schedule to reduce conflicts		4.39
Add clauses of disputes settlements in the contract		4.39
Add clauses in the contract relating to additional expenses, inflation		4.39
Obtain approvals and permits in a timely manner to avoid the workflow obstruction	4.14	4.39
Keep good relations with relevant officials and senior officials	4.07	
Enforce fines by the competent authorities in case the owner delay in dues payment	4.10	
The design team must be cautious to carry out soil tests and all site tests	4.14	
Rely on the experienced managers to take out a good schedule	4.15	
Set clauses in the contract including inflation and delay rates	4.16	
Cooperation design team and the consultant engineer to minimize the change in the Design	4.16	
A scientific skilled project team should be set at the initiating of the project	4.16	

Measurement framework	Contractor	Owner
Add risks to the schedule	4.19	
Owner must prepare a practical schedule	4.32	
Measure BOQ properly during tender	4.33	
Rely on distinct contractors in the technical Field	4.37	
Transfer and sharing risk with a third-party	4.40	

7. Results and Discussion

In Egypt, the concept of risk management is unfamiliar and there is a misunderstanding the concepts risk management plan and safety procedures used in construction sites. This proves a weakness in the process of project risk management that identifies, analyzes, and deals with risks that may affect projects cost. While, being the cost control process in earlier phases of the project ensures that there is no deviation from the planned cost and the project would be completed according to its budget. The project's owner is considered the responsible part for controlling project costs and reducing any probabilities of cost overrun risks. Consequently, the proposed model of cost overrun's reduction has several steps based on RM as shown in the Figure 6:

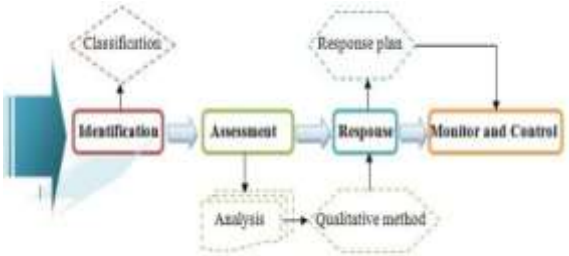


Figure 6: Proposed approach of cost overrun control & reduction

The proposed approach gives possibility to detect the identified risks that has the most influencing impact on cost. Hence, it provides a suitable response plan for them.

Table 10: Ranking of groups

Group	Risk index values	Risk index rank
Technical	0.295	2
Economic & Financial	0.265	3
Political and regulation	0.222	5
Management	0.314	1
Project resources	0.257	4
Environment	0.104	6

It's noticed that the managerial group has the maximum risk index at the level of groups. On the contrary the scope category (belonged to the technical group) has the maximum risk index at the level of categories.

Table 11: Ranking of categories

Category	Risk index value	Risk index rank
Design	0.295	10
Construction	0.172	15
Experience	0.296	9
Site	0.223	13
Scope	0.477	1
Financial contracts	0.232	12
Financial policy	0.312	8
External factors	0.374	5
Internal factors	0.161	16
Political situation	0.435	3
Regulatory Environment	0.134	19
Estimation process	0.450	2
Planning	0.424	4
Monitor and control	0.324	7

Category	Risk index value	Risk index rank
Communication	0.182	14
Labor	0.333	6
Materials	0.253	11
Equipment's	0.160	17
Location	0.140	18
Weather conditions	0.036	20

Table 12: Summary of significance levels of risk ranking according to risk matrix

Significance Level	High Risks	Moderate Risks	Low Risks
Groups	**I**	**II**	**III**
Zones	**A-B-C**	**D – E – F– G**	**H - I – J – K – L – M**
Factors Count	**19**	**37**	**39**
Maximum Risk Index	**(T.SC1)**	**(M.MC7)**	**(PR.E2)**
Minimum Risk Index	**(T.D1)**	**(E.FC7)**	**(E.FC1)**
Range Values	**0.759: 0.455**	**0.435: 0.223**	**0.195: 0.018**

The (high-priority) risks belong to group A (located on red zone) are ranked according to the main groups of risks (six groups) based on the highest to the lowest impact on project costs and more probable to happen in construction projects. It proves that the management risk group has the strongest impact on cost overrun, then economic and financial risks affect cost overrun. Less impact on cost overrun comes from environmental risks. Management risks are more frequent in construction projects of touristic projects and other risks like environmental risks are less frequent in projects.

Figure 7: Top ranked factors in groups

The researcher clarified the FCCO related to the group I that consists of 3 zones (A-B-C), hence, it consists of only 19 cost overrun factors. A response plan was proposed for those risk factors and noticed that the mitigation actions is the most used as it was 78.9% then the avoidance actions at value of36.8%.

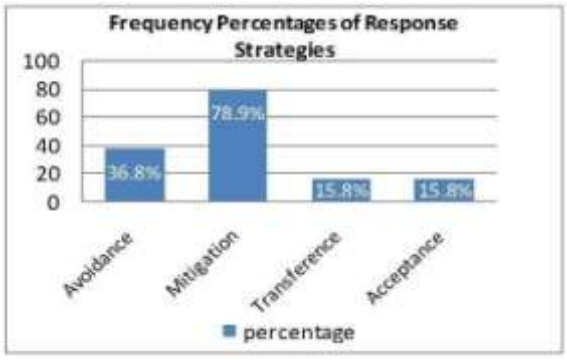


Figure 8: Frequency percentage of response strategies

Avoiding the potential FCCO in construction projects leads to make increased number of projects, and provide sufficient employment for youth in tourism sector, consequently, working on revitalizing the tourism industry in Egypt.

Figure 9: Cost overrun risks in zone (A) of risk matrix

It's noticed that almost of top Factors causing cost overrun located on zone A (red zone) of risk matrix is related to the poor efficiency of contractor. So, it's recommended to create an evaluation model for the contractor to improve the donor policy in bidding process.

Recommendations

1. Consultants should have clear understanding about project background information collected by either clients or consultant**.**
2. Feasibility report should be high quality as this report usually includes such items as purpose of study, requirements, and needs of project. The results of studies and investigations are usually submitted in written report. The quality of consultant investigation will inevitably be reflected in their reports.
3. Clients should clarify their project requirements to the consultant. Consultants should be sure that the project design includes all of those requirements to avoid the additional works as possible and observe the client's requirements, but also make every endeavor to assist the client in identifying and developing other crucial objective for the project. Also, the additional work at owner's request is the most significant factor in cost overrun in that survey.
4. Cost estimating process is preferred to be done by value estimator to obtain a more accurate cost based on the function.
5. Change the donor policy in bidding to the lowest price to assess bidders based on the technical, managerial, economic, project resources and political aspects.
6. Consultants should demonstrate their abilities in handling the claims and controlling the project costs properly in order to avoid the contractual claims, such a sex tension of time and cost claims (over budgeting).

Conclusion

The objective of this paper was to explore the most affecting factors in project costs and the main causes of cost overrun occurrence in the planned budget. Consequently, the better understanding of project's risks helps the project parties in identifying these factors that may cause cost overrun. So, determination the most effective factors enable them to determine the stage per which the cost overrun takes an action, and then the proposed corrective actions will take place as shown in the following figure.

Managing risks in construction projects has been recognized as a very important process in order to achieve project objectives in term of cost. This paper presents the research results obtained through past researches, meeting with experts and questionnaire surveys conducted in Egypt. A total of 95 factors of cost overrun risks were ascertained based on a comprehensive assessment of their likelihood of occurrence and magnitude of consequence on project objectives. The unique risks included only 19 risks are high- priority in influencing on project cost, so a near response plan must be found to deal with these risks in order to mitigate their impacts on project costs.

Figure 10: Inputs and outputs of practical study

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