



Cost Overruns and Delay in Municipal Construction Projects in Developing Countries

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ABSTRACT: Cost overruns and delay are common issues in the construction industry of developing and developed countries. In this article, compared with construction projects in other developing countries, the common causes of the cost overruns and delay in delivering municipal construction projects are discussed. This case study considers municipal construction projects in the city of Karaj, as one of the fastest developing cities in Iran. To meet the objectives of this research, 72 different types of urban roads and building projects are considered. This study shows that small-budget and short-term municipal projects, generally, experience higher cost and time performance. This paper contributes to the construction project management body of knowledge by a comprehensive analysis of cost overruns and delays in delivering municipal construction projects in developing countries. The findings of this study may be used by municipalities, for the realistic strategic planning of their construction projects, especially in developing countries.

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1- Introduction

Cost overruns and delay are common issues in the construction industry of developing countries [1,2,3], and large number of Iranian municipal construction projects, which have used huge amounts of the budget [4], encounter cost overruns and delay. Delay may negatively affect the scope of projects which leads to serious cost overruns [5]. Thus, it is necessary to evaluate these issues in relation to each other.

The purpose of this research is to study how the cost overruns and delay in delivering municipal construction projects are dependent on projects' predicted cost and predicted duration. Moreover, compared with construction projects in other developing countries, the common causes of cost overruns and delay in delivering the projects are discussed. Furthermore, mitigation measures for cost overruns and delay in the municipal construction projects are studied. This paper looks at the municipal construction projects in the city of Karaj as one of the fastest developing cities in Iran. This paper is a pioneer to present a comprehensive analysis of cost overruns and delay in delivering municipal construction projects in the developing country of Iran.

2- Literature Review

About 20 years ago, Kaming et al. [6] illustrated that more than 90% of Indonesian building constructions suffered from cost overruns. Investigation of delay occurrence in UAE by Faridi and El-Sayegh [7] concluded that 50% of construction projects were not completed in time. At the same time, Assaf and Al-Hejji [8] revealed an average delay of 10% to 30% in

construction projects in Saudi Arabia. Also recently, Shehu et al. [2] have reported that in Malaysia, 55% of construction projects have experienced cost overruns. This trend shows that construction projects in developing countries have suffered from cost overruns and delay for quite a long time. In this regard, many researchers have investigated the causes of cost overruns or delay in delivering construction projects in developing countries. Among them are: Aibinu and Jagbore [9], highlighted 43 factors of delay in Nigerian projects and described increasing rate of delay in Nigeria as "a major criticism". In a study, which is a backbone for many other studies, Sambasivan and Soon [10] found 10 most important causes of delay as well as six main effects of it in Malaysian construction projects. In Egypt with the same methodology, Aziz [11] identified and ranked factors which might have an effect on time extension of projects based on a survey containing 99 delay factors. This study was grounded on a research of Abd El-Razek et al. [12], who, earlier, had identified the main causes of delay in Egyptian construction industry and concluded that different groups of construction participants do not agree on the significance of various factors of delay. Later, Doloi et al. [13] revealed seven most critical causes of delay in India. Gardezi et al. [14] studied causes of delay in Pakistani construction industry; they monitored time extension data of 50 projects and identified 27 factors with a significant influence on delay. Like other studies, they carried out a survey among professionals working in the construction industry and as a result "domestic issues of the country" was evaluated as the major factor causing delay in projects. Research on the main causes of delay in construction projects in Bangladesh, which was conducted by Rahman et al. [15], divided the causing factors into seven

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groups of related to materials, manpower, owner, consultant, contractor, construction and external problems.

As an attempt to find the factors that cause a delay in Iranian construction projects, Khoshgoftar et al. [16] distributed a questionnaire to clients, consultants, and contractors. Financial problems, in their study, were reported to be the most significant factor affecting projects delay. With the same methodology, in a study conducted by Alavifar and Motamedi [17], owners, consultants, and contractors asserted that the most important causes of delay are “insufficient data collection”, “inflation rate” and “rework”, respectively. Delay and cost overruns in Iranian construction industry have been the subject of other research such as Ghoddousi and Hosseini [18]; Khalafizadeh et al. [19]; Pourrostam and Ismail [20]. There are many factors, potentially causing serious projects’ delay and cost overruns which were highlighted in the previous studies, among them are improper planning, poor site management, lack of communication, financial problems, delay in payments, and subcontractors’ problems. Identification of common key factors from a variety of references, regardless of differences in their country of origin, indicates that construction industry is affected by, almost, the same factors in all those nations. The conduction of literary review in this field; e.g., Akinci and Fischer [21], Bhargava et al. [22], Doloi [23], Enshassi et al. [24], Frimpong et al. [25], Jahren and Ashe [26] and Sweis et al. [3]; brings about the same conclusion that there are some communal delays and cost overruns occurring in construction industry of all developing countries.

In this case, review of the literature shows that construction projects in developing countries have suffered from cost overruns and delay for quite a long time. In this regard, many researchers have investigated the causes of cost overruns or delay in delivering construction projects in developing countries, but limited research has been focused on municipal construction projects. The results of such research can be used by municipalities in developing countries, such as Iran, to foresee realistic expected cost and time for their under-construction projects.

3- Municipal Projects in Iran

Iranian municipal construction projects are mostly financed by municipalities, which are governmental organizations. According to the latest budget bill of Iran; Mar. 2013 to Mar. 2014; municipal construction projects have been the most important sectors of Iranian construction industry. Compared with national construction projects, in terms of time and cost, municipal projects are usually short-term and small size. Limited job site, restriction about the kinds of equipment that can be used, and constraints about working time are among the common challenges faced by municipal construction projects. Also, because citizens are the final users of these projects, contractors are under pressure to deliver the projects as fast as possible. Urban constructions in Iran usually are conducted by contractors that are not well-structured and do not have sufficient resources to handle projects.

The city of Karaj, which is immediately adjacent to the capital of Iran (Tehran), has been one of the most rapidly growing cities of Iran in recent years, from 2006 to 2011. Karaj municipality is the major client for urban area constructions of this growing city. This specialized organization has a very long hierarchy and is highly formalized. Karaj municipality

receives a major amount of its budget from the government. Last year about 70 percent of the budget of this organization was dedicated to public projects. In the mentioned year, urban roads and buildings, as the major part of municipal construction projects, were almost 60% and 35% of the municipal projects, respectively.

4- Research Method

This research is conducted through the following five main stages:

1. Reviewing the literature relevant to cost overruns and delay in construction projects in developing countries.
2. The arrangement of the necessary information required for statistical analysis.
3. Data collection through reviewing the documents of selected projects.
4. Statistical analysis of collected data.
 - Regression analysis of the relationship between predicted cost/time and actual cost/time of projects.
 - Class range analysis of cost overruns/delay versus predicted cost/time of projects.
5. Discussion to interpret the results.
 - Class range analysis of cost overruns versus delay in projects.
 - Studying main conditions that cause cost overruns and delay in projects, comparing with other research.

5- Data Collection

To meet the objectives of this research, 72 different types of urban roads and building projects are considered. Two third of projects were new-build, which reflects the country’s tendency toward new projects and facilities. In addition to new-build projects, there were renovation projects, including municipal infrastructures such as road rehabilitation and maintenance projects (Table 1).

The tendering method for all of the selected projects was open tender. Projects were selected in the time span of four years from 2011-2014. Planned start date; predicted duration and cost; actual expenditure and finish date; type (new build or renovation); and nature (road or building) of the selected projects were extracted through projects’ document.

Table 1. Project Characteristics

Characteristics	Number	Percent	Type
New build	41	56.9	
Renovation	31	43.1	
Nature of Project			
Road	48	66.7	
Building	24	33.3	
Start Date			
2011	12	16.7	
2012	21	29.2	
2013	20	27.8	
2014	19	26.4	

6- Data Analysis

6- 1- Cost Overruns and Delay Versus the Predicted Cost of Projects

Class range analysis of predicted cost for collected data (Table 2), provides a reliable understanding about the cost performance of projects.

Table 2. Predicted Cost of Projects

Category	Class Range (Billion IRR*)	Predicted Cost		
		Frequency	Percent	Cumulative cost*
Small	Under 3	37	51.4	66.1
Medium	3 - 9	19	26.4	97.9
Large	Over 9**	16	22.3	876.0
Totals		72	100	1040

* Cumulative cost of projects in each class range (billion IRR)

**Maximum size project is 300 Billion IR

As predicted in Table 2, the predicted cost of projects mainly fell in 'Small' category ($n = 37$). Two categories of Small

and Medium together constituted 78 percent of the sample data. This could be due to the fact that urban projects are usually characteristically small. Other reason may be the preference of officials toward subdividing big budget projects into smaller ones, because of their financial or managerial constraints.

Figure 1 indicates the graphical result of a regression analysis to assess the correlation between predicted cost and actual final cost of projects. The high value of $R^2 = 0.99$ implies a minimal amount of discrepancy between the subsets.

In the next step, cost overruns and delay were evaluated in each predicted cost's range. More details about the percentage of projects that encountered either cost overruns or delay in each category of predicted cost are depicted in Table 3.

Table 3 shows that all projects with predicted cost of nine billion IR or higher, have encountered cost overruns and delay. This finding emphasizes that large municipal projects are prone to higher risk of cost overruns and delay; although the studied projects had a little bit better performance in terms of delay compared with cost overruns. This illustrates that the big projects divided into the smaller ones had a better cost performance.

Table 3. Cost Overruns and Delay Versus the Predicted Cost of Projects

Category	Class Range (Billion IR)	Cost Overruns (Percent)			Delay (Percent)		
		No	0-25	Over 25	No	0-25	Over 25
Small	Under 3	11	43	46	5	43	51
Medium	3 - 9	5	37	58	21	47	32
Large	Over 9	0	56	44	0	75	25
Total		6.9	44.4	48.6	8.3	48.6	43.1

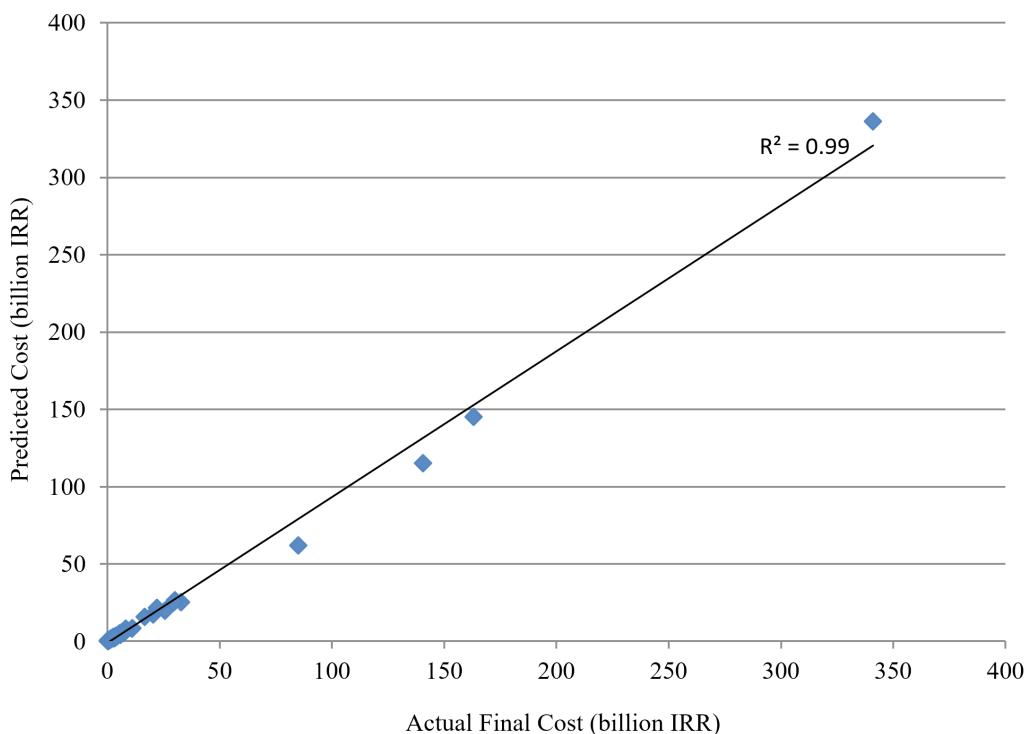


Fig. 1. Predicted cost versus actual cost of projects

6- 2- Cost Overruns and Delay Versus the Predicted Duration of Projects

In Table 4, based on the predicted duration, the projects are categorized into three groups of Short, Medium and Long terms. As shown in Table 4, 75% of projects are scheduled to be completed by six months or less. On the other side of the spectrum, only 10% of projects were predicted to have longer durations than a year.

Table 4. Predicted Duration of Projects

Category	Class Range (Month)	Predicted Duration	
		Freq.	Percent
Short Term	Less than 6	54	75.0
Medium Term	6 - 12	11	15.3
Long Term	Over 9**	22.3	876.0
Total		72	100

Usually, municipal construction projects have a limited scope, thus they take a shorter time to complete (the challenges facing municipal projects forces clients toward defining shorter projects or broken down the long term or large projects into several short terms or small ones). The minimum discrepancy was indicated by regression analysis; $R^2 = 0.95$; between predicted and actual durations in Figure 2. Distribution of positive and negative variances was not

distinctively different, suggesting a trend between predicted and actual duration of projects in the sample data disregarding the relative time class range. Figure 2 also reflected a high probability of 22% delay in projects. Table 5 illustrates the delay and cost overruns of projects and their distribution in each class range.

As shown in Table 5, all projects with a longer duration than six months have encountered delay and cost overruns. This result confirms that the small projects had a better performance in terms of time and cost. The important factor causing a delay in the sample data projects was improper prior planning and scheduling. This is in line with the findings of Khoshgoftar et al. [16]

who selected improper planning as the second most important factor of delay in Iranian construction.

7- Discussion

Table 6 shows the cost overruns versus the delay of understudied municipal projects.

As illustrated in Table 6, 93% of the sample projects have encountered cost overruns, and 91% of them have experienced a delay. Moreover, 24% of the projects have encountered more than 25% cost overruns and delay, simultaneously. It reveals a poor performance of municipal projects and proves a direct correlation between the cost overruns and delay. The major reasons for the cost overruns and delay in construction

Table 5. Cost Overruns and Delay Versus the Predicted Cost of Projects

Category	Class Range (Months)	Cost Overruns (Percent)			Delay (Percent)		
		No	0-25	Over 25	No	0-25	Over 25
Short Term	Less than 6	9	41	50	11	43	46
Medium Term	6 - 12	0	45	55	0	64	36
Long Term	over 12	0	71	29	0	71	29
Total		6.9	44.4	48.6	8.3	48.6	43.1

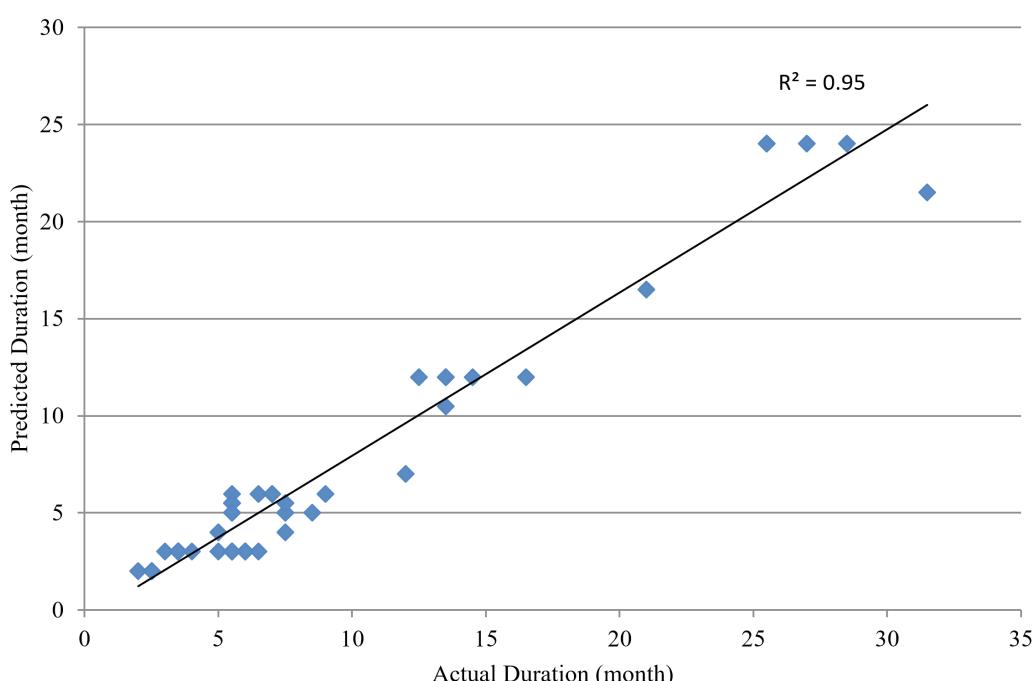


Fig. 1. Predicted Duration Versus Actual Duration of Projects

Table 6. Cost Overruns Versus Delay of Projects

Performance			Delay					
Cost Overruns	Class Range (Percent)	No	0 - 25		Over 25		Total	
		Freq.	Percent	Freq.	Percent	Freq.	Percent	
	No	2	3	3	4	0	0	5 7
	0 - 25	1	1	17	24	14	19	32 44
	Over 25	3	4	15	21	17	24	35 49
	Total	6	8	35	49	31	43	72 100

projects may be categorized in three categories of client related, consultant related, and contractor related, as follows:

- **Client related:** It was illustrated that small and medium municipal projects can achieve a better performance in terms of cost. One of the main reasons is that the municipality prefers to allocate its limited budget to small projects rather than big projects. The explanation is that officials prefer to complete several small projects to benefit several parts of the city rather than a single big project. In conclusion, it can be inferred that a good solution to decrease the cost overruns is breaking big projects into smaller parts. The same conclusion had been verified in previous research by Shehu et al. [2] who illustrated that almost 50% of Malaysian small construction projects were completed within budget.
 - **Consultant related:** In municipality projects, consultants are the parties that estimate the amount of work and budget of projects using governmental price lists, as a contractual base for tender. A change order is a main problem in this stage. If consultants make any misjudgment about the scope of the projects and/or the amount of work, the actual final cost of the projects may be higher than their predicted cost. Also since, cost and time underestimating of construction projects is a common practice in tendering, cost overruns and delay is prevalent.
 - **Contractor related:** It was illustrated that Small and Medium municipal projects can achieve a better performance in terms of cost. One main reason is that the smaller projects attract a wide range of contractors thus the client can choose the contractor with the least plus rate to do the job. Also, because the Small and Medium municipal projects' contractors are small firms, thus their overhead costs are low and they can perform the job with the least cost possible. Another reason is that carrying out big projects with the least cost overruns and delay needs a detailed plan, both financially and time-wise, which many companies are unable to organize.
- Compared with construction projects in other developing countries (Table 7), there are the following four common causes of delay and cost overruns in Iranian municipal construction projects:
- **Poor prior planning:** Improper prior planning has been proved to have detrimental effects on construction projects' time and cost performance. As highlighted before, inaccurate planning has a major role in cost overruns and the delay of projects, especially, with longer duration or a bigger budget. In some cases, decomposing the long-term or big budget projects to smaller subprojects, as several independent projects, may mitigate this issue.

- **Owner's financial problem:** Building projects suffer the most from this problem. These projects do not receive the proper amount of budget, in comparison to road projects, and as a result, they face more cost overruns and delay. This problem could be avoided by making some changes in the strategy toward allocating budget between projects with a different nature.
- **The slowness of decision making:** Slowness of decision-making process is a result of the formalized and long hierarchy structure of municipalities in Iran. Restructuring municipalities to matrix structures may be a solution for this issue. Matrix structures provide the formalization and hierarchy [27], which are the internal characteristics of municipalities as the governmental organization. At the same time, they provide key characteristics of project management.
- **Interferes with unforeseen situations:** Urban area projects have their own unique challenges, some of which are unforeseen situations and interfere with existing utilities. Road projects, as mentioned previously, suffer the most from these issues. No absolute solution can be found for these problems unless the owner, contractors, and consultants come to the consensus to mitigate the outcomes, they should develop the contingency plans for projects. This confirms the findings by Reyers and Mansfield [28] and Shehu et al. [2] which emphasized the bigger contingency reserves requirement for renovation projects.

8- Conclusion

This research studied how the cost overruns and delay in delivering municipal construction projects are dependent on projects' predicted cost, predicted the duration, type, and nature. The findings of this study provide statistical information about the significance of cost overruns and delay in construction projects. Cost overruns and delay of 72 urban roads and building projects in the city of Karaj, as one of the fastest developing cities in Iran, were investigated in this case study. Only 7 and 8.5 percent of the studied projects were completed in their budget and time, respectively. The major findings of this paper were as follows: (a) Small and short-term projects, generally, experienced higher cost and time performance; and (b) Reviewing the data of projects and comparing that with other research in developing countries explained the major reasons for cost overruns and delay in municipal construction projects as follows: poor prior planning, owner's financial problem, slowness of decision making, and interferes with unforeseen situations.

This case study contributed to the construction project management body of knowledge by a comprehensive analysis of cost overruns and delay in delivering municipal

Table 7. Main Conditions that Cause Delay and Cost Overruns in Construction Projects in Developing Countries

Country	References	Main Conditions	Relevant
Kuwait	Koushki et al. [29]	Owners' lack of experience Owners' financial constraints Changing orders	*
UAE	Faridi and El-Sayegh [7]	Slow preparation and approval of drawings Inadequate early planning of the project Slowness of owners' decision-making Shortage of manpower Poor site management and supervision	*
Saudi Arabia	Assaf and Al-Hejji [8]	Change in orders by the owner during construction Delay in progress payment Ineffective planning and scheduling Shortage of labor	*
Hong Kong	Lo et al. [30]	Difficulties in financing on the part of the contractor Inadequate resources due to contractor/lack of capital Unforeseen ground conditions Exceptionally low bids Inexperienced contractor Works in conflict with existing utilities	*
Malaysia	Sambasivan and Soon [10]	Contractor's improper planning Contractor's poor site management Inadequate contractor's experience Inadequate client's finance and payments for completed work Problems with subcontractors	*
Iran	Khoshgoftar et al. [16]	Finance and payments of completed work Improper planning Site management Contract management Lack of communication between the parties	*

construction projects in developing countries. The findings of this study may be used by municipalities for the realistic strategic planning of their construction projects, especially in developing countries.

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