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Time and Cost Overrun in Public Construction Projects in Qatar

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Abstract

This paper investigate time delays and cost overruns in public construction projects in the State of Qatar using statistical relationships between project contracted costs or durations and other variables. An extensive review of regional and international case studies was conducted to get a better understanding of the phenomena and of the various methodologies used to analyze it. The data of the study, which was collected from Qatar public work authority ASHGHAL, covered 122 public roads, buildings, and drainage projects. The Analysis Of Variance (ANOVA) statistical technique was used for the data analysis and inference. Several models were developed based on project type, duration, and cost. However, the models were limited in scope. Therefore, future work will involve adding more variables into the current models.

Keywords: Cost Overrun, Construction Delays, Qatar Public Projects, Statistical Analysis

1. Introduction

Changes are facts of the construction process. They are issued to respond to newly developed circumstances. Large and poorly managed changes may have tremendous negative impacts on project time and cost performances. One of the major problems facing the construction industry is project frequent delays and cost overruns. In today's economic boom times and highly competitive business environment, the need for completing construction projects within the stipulated cost, time frame and performance expectations is becoming increasingly important. Delays and cost overruns extend the duration of a project, inflate the budget, reduce revenues, and degrade productivity.

In the state of Qatar, the public projects, which were performed during the period between 2000 and 2013, had a 54% cost overrun and a 72% time delay of 72%. On the other hand, the maintenance projects during the same period had both 50% cost overrun and time delay. Thus, there is a real need to investigate time delays and cost overruns in Qatar public construction projects because of their criticality and the limited number of published studies in this area.

2. Objectives ad Methodology

2.1. *Objectives*

The main objective of the study is determine and analyze the time delays and cost overruns commonly found in Qatar public projects. The scope of the study is limited to public construction projects whose data were obtained from public work authority (ASHGHAL).

2.2. *Methodology*

The methodology consisted of data collecting, data mining, performing statistical analysis and building conclusions based on statistical findings. The data was requested from the Public Work Authority ASHGHAL. A total of 122 projects were studied with a focus on the construction phase only. All the construction projects were

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completed between the years 2000 and 2013 and all claims settled by 2013. All construction projects were lump sum contracts and had the traditional delivery method of design-bid-build.

The collected data included project category, project type, contract cost, contract duration, duration and cost at completion at completion. Time and cost overrun percentages had been calculated, using this data.

The data was studied using the Analysis of Variance (ANOVA).

3. Literature Review

Cost overruns, deadline delays, delivery delays, poor quality of materials, poor workmanship, and low productivity, are inevitable in the construction industry. Time delays and cost overruns usually lead to adverse effects on the growth of national economies, contribute to major financial losses, and hold back the development of the industry. A long-term study of a number public works projects, which was conducted in the state of Nevada in the United States showed the negative and costly impacts of such time delays. It investigated several design-bid-build state projects from 1991 to 2008 and concluded that large and long-duration projects had significantly higher cost and schedule overruns than smaller and short-duration projects [1]. The project aspects such as scope definition, coordination of roles and responsibilities among involved parties, initial estimation and contingency planning, and monitoring and control systems are the main factors for time delays and cost overruns [2]. Most construction projects in developing countries are characterized by time delays [3]. The projects with extensive delays may end up losing their economic justification, which in turn may result in the termination of the project [4]. The following complications due to delays increase in governmental projects were identified: 1) confusion regarding public development plans, 2) disturbance of the budget execution plan, and 3) public inconvenience resulting from project delays [5].

The following major causes of construction/delivery delays were reported: 1) insufficient data collection and survey before design, 2) higher than expected increase in costs due to inflation, and 3) repair/reconstruction work due to errors during construction [4]. The three most important causes for construction delay were improper planning, poor site management, and inadequate and/or limited experience [6].

The majority of cost overruns are encountered in lump sum contracts, fewer occur in unit-price contracts and even less in reimbursement contracts [7]. They reported the following causes of cost overruns: 1) awarding contracts to the lowest bidder; 2) site conditions; 3) incompetent subcontractors and poor site management; and 4) inaccurate estimates and client-led change orders. The following major cause of cost overruns were identified: 1) market conditions, 2) personal experience in the contract work, 3) insufficient estimated time for construction items, 4) material fluctuation, and 4) political situations [8].

Qatar is one of the fastest growing GDP in the world. Moreover, Qatar has the highest saving rate in the world, with a saving percentage of 60.8% of GDP. The construction industry showed the second largest growth in 2013 by contributing 2.7% to the non-hydrocarbon GDP growth. The construction activities have been expanding rapidly to be completed ahead of FIFA World Cup in 2022. Qatar is currently constructing major infrastructure projects such as Doha metro, a network of expressways, Sharq crossing, several tunnels and bridges, crossing Doha bay. Moreover, several real estate projects are underway in Lusail city, to the north of Doha. The Qatari construction sector is suffering delay and cost overruns. New projects are experiencing 54% cost overrun and 72% delay. On the other hand, the maintenance projects are experiencing 50% for both cost overrun and delay.

The $1.7 billion project, which aimed to convert a jammed traffic road into a new layout of junctions, underpasses and bridges was a nightmare for vehicle movement and shops running along since construction began in 2010. The initial target was due to the end of 2012. However, the date was pushed to the third quarter of 2013.

The long-awaited Hamad International airport, $15.5 billion planned investment $15.5bn was delayed four years. It was partially opened in April 2014, with a later phase expected to finish by year 2017-2018.

Possible justifications to project delays were reported as poor management and control systems, manpower low quality, construction material and equipment shortage, inappropriate estimation of massive scale of projects, harsh summers, and funding constraints of private projects. Public projects are also suffering from imposed changes and unclear work scope and objectives.

4. Data Collection and Analysis Methods

4.1. *Data Collection*

Several meetings were conducted with head of departments to discuss the project and get needed approvals. Several other meetings were conducted with project managers and planning engineers to discuss the topic and get more clarifications through discussing some cases and followed procedures at ASHGHAL. Once the approval was gained, proposed data had been sent to the student.

Qatari public projects are classified in to roads, buildings and drainage projects, and being categorized as new construction or maintenance projects. Road projects include the design, construction, delivery, and maintenance of all expressways, major and minor roads all over the country. The same role applies to public buildings for a number of government entities, including schools, hospitals, parks and cultural centers. Drainage projects represent storm and rain water, waste water and sewerage drainage and treatment projects across Qatar.

The data for 122 projects was received from ASHGHAL. The collected projects started in or after the year 2000 and were completed before or on the year 2013. Their contract were lump sum and their delivery method were design-bid-build.

The collected data included the project category, project type, contract cost, contract duration as well as the duration and cost at completion. The durations were measured in calendar days and costs in Qatari Riyals. Road projects represented 67% of total received data, 21% of building projects, and 12% drainage projects. All drainage projects were new construction.

4.2. *Analysis Methods*

Statistical analysis was used to compare samples. ANOVA was used to determine if differences were statistically significant. The confidence level selected for the analysis was set to 95%.

ANOVA assumed a null hypothesis, assuming that the means of compared samples are to be statistically equal. For the null hypothesis to be false, the p-value must be less than or equal to 0.05. Given that the null hypothesis is true, the p-value represents the probability of observing a random sample that is at least as large as the observed sample.

If the p-value is below 0.05, the difference in means is considered to be statistically significant (Weinstein, 2007).

This study covered the three projects types, road, building and drainage construction projects, in which, cost and time overrun percentages were compared based on five categories as follows:

- Project Type: road, building, drainage
- Project Category: new construction, maintenance construction
- Project Size: final cost less than or equal QR10 million; final cost between QR10–QR100 million; final cost between QR100–QR1000 million, final cost greater than QR1 billion.
- Project Duration: duration less than or equal 1 year; duration between 1 and 2 years; duration between 2 and 3 years; duration between 3 and 4 years; duration greater than 4 years)
- Project Year of Completion: completed between 2000 and 2006; completed between 2007 and 2013.

When the multiple groups were identified, a single factor ANOVA test was carried between the groups of highest and lowest means.

5. Result Analysis

Statistical tests were used to determine the descriptive statistics of the dependent variables. The first test was to investigate whether the sample means of various groups were statistically different or of equal variances. For this goal, MS-Excel 2007 ANOVA tool had been used.

The statistical differences between project cost and time overrun percentages as per different classification methods are tabulated in this section.

5.1. *Project Type*

Table 1 shows the ANOVA analysis of the construction cost and time overruns for the different project types. The means of the cost and time overruns of building, road, and drainage projects were not statistically significant at a significant level of 0.05, as the P value of both metrics are larger than 0.05 (0.05<0.233 and 0.05<0.316). Therefore, the sample means were not statistically different.

Table 1. ANOVA project type

Metrics	Building	Road	Drainage	F Value	P Value	F Critical
Cost Overrun (%)	0.703	0.182	0.108	1.493	0.233	3.153
Number of Projects	14	40	8	Not Significant		
Time Overrun (%)	2.616	0.815	0.782	1.170	0.316	3.120
Number of Projects	18	51	8	Not Significant		

5.2. *Project Category*

Table 2 shows the ANOVA analysis of the construction cost and time overruns for the different projects categories. Although the cost overrun and time overruns were higher in new projects than in maintenance projects, the means were not statistically different. In another expression, new and maintenance projects were not statistically significant at a significant level of 0.05 (0.05 <0.473 and 0.05<0.363).

Table 2. ANOVA project category

Metrics	New	Maintenance	F Value	P Value	F Critical
Cost Overrun (%)	0.365	0.170	0.521	0.473	4.001
Number of Projects	38	24	Not Significant		
Time Overrun (%)	1.560	0.590	0.837	0.363	3.968
Number of Projects	51	26	Not Significant		

5.3. *Project Category*

Table 3 shows the ANOVA analysis of the construction cost and time overruns for the different building project categories. The cost overrun mean for new projects was higher than in maintenance projects. On the other hand, the time overrun mean for maintenance projects was higher than that for new projects. However, in both cases, new and maintenance projects were not statistically different at a significance level (0.05 <0.515 and 0.05<0.658).

Table 3. ANOVA building project category

Metrics	New	Maintenance	F Value	P Value	F Critical
Cost Overrun (%)	0.953	0.078	0.451	0.515	4.747
Number of Projects	10	4	Not Significant		
Time Overrun (%)	0.412	3.057	0.204	0.658	4.494
Number of Projects	3	15	Not Significant		

5.4. *Road Project Category*

Table 4 shows the ANOVA analysis of the construction cost and time overruns for the different road project categories. The maintenance road projects had higher cost and time overrun means. However the new and maintenance projects were not statistically significant at a significance level of 0.05. (0.05 <0.805 and 0.05<0.099)

Table 4. ANOVA road project category

Metrics	New	Maintenance	F Value	P Value	F Critical
Cost Overrun (%)	0.953	0.078	0.451	0.515	4.747
Number of Projects	10	4	Not Significant		
Time Overrun (%)	0.412	3.057	0.204	0.658	4.494
Number of Projects	3	15	Not Significant		

5.5. *Project Size Category*

Table 5.5 shows the ANOVA analysis of the construction cost and time overruns for the different projects sizes. The cost and time overruns for project size ranges between QR10 million to QR100 million were the highest. However, the mean differences were not statistically significant at a significance level of 0.05 (0.05< 0.883 and 0.05<0.896).

Table 5.5. ANOVA project size

Metrics	Less than 1 million QRs	10 to 100 Million QRs	100 to 1000 Million QRs	Larger than 1 billion QRs	F Value	P Value	F Critical
Cost Overrun (%)	0.148	0.387	0.193	0.120	0.219	0.883	2.764
Number of Projects	10	34	16	2	Not Significant		
Time Overrun (%)	0.778	1.591	0.845	0.659	0.200	0.896	2.730
Number of Projects	14	42	18	3	Not Significant		

5.6. *Project Duration Category*

Table 5.6 shows the ANOVA analysis of the construction cost and time overruns for the different projects durations.
The construction cost and overrun means for projects with 1 to 2 years durations were the highest, with a noticeable difference to cost overrun percentages of other durations. All were not statistically significant at a significance level of 0.05 (0.05<0.797 and 0.05<0.946).

Table 5.6. ANOVA project duration

Metrics	Less than 1 year	1 to 2 years	2 to 3 years	3 to 4 years	Larger than 4 years	F Value	P Value	F Critical
Cost Overrun (%)	0.140	0.518	0.143	0.238	0.150	0.416	0.797	2.534
Number of Projects	12	22	13	9	6	Not Significant		
Time Overrun (%)	0.554	1.648	0.907	0.902	1.662	0.183	0.946	2.499
Number of Projects	11	32	17	10	7	Not Significant		

5.7. *Project Year of Completion Category*

Table 5.7 shows the ANOVA analysis of the construction cost and time overruns for the different project completion years. The cost overrun mean of the projects that were completed between 2007 and 2013 were lower than those of the projects that were completed between 2000 and 2006. The P value was less than the significance level (0.05>0.021). This shows that the sample means were statically different at a significance level of 0.05. On the other hand, the time overrun mean of the projects that were completed between 2007 and 2013 were higher than those of the projects that were completed between 2000 and 2006. However, the means were not statistically different at a significance level of 0.05 (0.05<0.099).

Table 7. ANOVA project year of completion category

Metrics	2000 to 2006	2007 to 2013	F Value	P Value	F Critical
Cost Overrun (%)	0.900	0.143	5.606	0.021	4.001
Number of Projects	12	50	Not Significant		
Time Overrun (%)	2.677	0.759	2.792	0.099	3.968
Number of Projects	19	58	Not Significant		

6. Conclusions

This present study investigated time and cost overruns in Qatari construction projects. An extensive literature review was conducted to regional and international case studies, to achieve a better understanding of the phenomena while inspecting various methodologies performed for different goals. Extensive data was collected from 122 construction projects that were from the Public work authority ASHGHAL. The ANOVA statistical analysis method was used for the data analysis and inference. The statistical analysis results show that the cost and time overrun means were not significant at a significance level of 0.05 with respect to the project type (i.e., building, road, and drainage). The results also show that the new and maintenance projects were not statistically significant at a significant level of 0.05. Moreover, they show that the cost and time overruns were not significant at a significance level of 0.05 with respect to the project size and project duration. Finally, the ANOVA statistical results show that the construction project cost overruns were statistically significant at a significance level of 0.05 with respect to their year of completion. In other words, the construction project cost overruns for the project completed between 2007 and 2013 are lower than those completed between 2000 and 2007.

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