Investigating Main Causes for Schedule Delay in Construction Projects in Bangladesh

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Abstract: Delay is the most common problem in the construction industry. It has many negative effects on project's success in terms of time, cost, quality, and safety. From the literature review, a total of thirty-five factors of delay were selected. These factors were divided into seven groups related to materials, manpower, owner, consultant, contractor, construction, and external problems. This study was carried out to identify the main causes of delay for a construction project through their importance level. The importance level was determined based on the frequency of occurrence and severity of impact. The structured questionnaire has distributed to the respondents who have much experience in construction management in Bangladesh. The results of analysis indicated that top five factors of construction delay according to their level of importance are: (1) price of construction materials increased very rapidly, (2) political situation (revolution/ public strikes), (3) shortages of skilled workers, (4) poor site management and supervision by contractor, (5) incompetent/ immature subcontractors. These findings of this study are expected to be significant contributions to Bangladesh construction industry in controlling current performance of project on time overrun.

Keywords: Delay, Cause, Construction project, Bangladesh

I. INTRODUCTION

The construction industry is the key sector that provides important elements for the development of a country's economy. In Bangladesh, it has been growing fast in recent years. However, it is affected in its performance due to a lot of problems. In such problems, Hasan [5] identified many drawbacks in construction projects such as mismanagement on project planning, construction materials, quality control, worker, worker safety, and equipment and tools were remarkable in Sylhet city, Bangladesh. Furthermore, Shaon [23] identified delay in construction and cost overrun is one of most important problem in Bangladesh. Delays in construction are very costly for most parts and completing project on time is beneficiary to all project parties [12]. In recent years, schedule delay has been identified as the most common problems in Bangladesh, and it has caused a multitude of negative effects on construction projects. Schedule delay is a term in construction industry which refers to a difference between estimated time and actual time of project completion. It can be caused by the actions and/or inactions of the parties (i.e., owner, consultant, contractor, subcontractor, vendor, etc.) or circumstances (i.e., weather, strikes, etc.) beyond their control. This leads to the significant reduction of the efficiency of project performance. Therefore, finding the actual reasons of delay and its management practice in the early stage of construction is needed.

Based on above discussion, the purpose of this study is to identify the main causes of delay for construction industry through their importance level. The comparison of most delay causes between some selected countries is then made to gain the comprehensive view about delay problems.

II. LITERATURE REVIEW

A number of studies have been carried out to investigate the causes of delay in construction projects around the world. However, it is quite hard to find any research conducted related to causes of delay in Bangladesh. Among these studies, Baldwin and Manthei [9] investigated the fundamental causes of delay in building construction projects in the United States. They concluded that there was substantial agreement on the causes of delay among three project parties, i.e., engineers, architects, and contractors, and they also revealed that weather, labor supply, and subcontractors were the major causes of delay. In addition, Assaf et al. [7] conducted a survey research in large building construction projects. They pointed out 56 main causes of delay that were separated into nine major groups: materials, manpower, equipment, financing, environment, changes, government relations, contractual relationships, and scheduling. It showed that the financing group was ranked as the highest and the environment group was ranked as the lowest by all project parties. Furthermore, Kaming et al. [17] studied influencing factors on 31 high-rise projects in Indonesia. Regarding problem of time overrun, the most important factors causing delays were found as design changes, poor labor productivity, inadequate planning, and resource shortages.

Chan and Kumaraswamy [10] carried out a survey to evaluate the relative importance of 83 potential delay factors in Hong Kong construction projects. They found five most

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TABLE I
SOURCE OF FACTORS SELECTION OF CONSTRUCTION DELAY

No.	Description of Factors and References	Category
F1	Slow/ late delivery and shortages of construction materials [4,8, 11, 12, 16, 21]	Materials
F2	Price of construction materials increased very rapidly [4, 11]	Materials
F3	Damage of materials in storage [8, 11]	Materials
F4	Shortages of skilled workers [4, 8, 12, 16, 21]	Manpower and equipment
F5	Poor labor productivity [8, 11, 12, 16, 21]	Manpower and equipment
F6	Shortage of equipment [8, 12]	Manpower and equipment
F7	Low equipment efficiency and unskilled operators [4, 8, 11, 16]	Manpower and equipment
F8	Frequent break down of equipment [8, 12, 21]	Manpower and equipment
F9	Poor communication by owner with other construction parties [8, 11, 12, 16, 21]	Owner
F10	Delays in decision making by owner [4, 8, 11, 12, 16, 21]	Owner
F11	Late issue of approval documents and sample materials by owner [4, 8, 11, 12, 16, 21]	Owner
F12	Delay in running bill payments to contractor and financial difficulties of owner [4, 8, 11, 12, 16, 21]	Owner
F13	Conflict between owners and other parties [8, 11]	Owner
F14	Rework due to change of design or deviation order by owner or his agent during construction [4, 12]	Owner
F15	Poor/ deficient planning and estimate [4, 21]	Consultant
F16	Slow examination/ inspection of completed works by consultant [4, 8, 12, 16]	Consultant
F17	Delay in design works [8, 16]	Consultant
F18	Inappropriate design or mistake in design made by designers [4, 8, 12, 16, 21]	Consultant
F19	Delay in material procurement (action by the contractor) [4, 8, 11]	Contractor
F20	Difficulties in financing project by contractor [8, 11, 12, 16, 21]	Contractor
F21	Poor site management and supervision by contractor [4, 8, 11, 16, 21]	Contractor
F22	Inadequate experience of contractor [8, 11, 12, 16, 21]	Contractor
F23	Incompetent/ immature subcontractor [4]	Contractor
F24	Frequent change of subcontractor [8, 11]	Contractor
F25	Changes in types and specifications during construction [8, 11, 12, 16, 21]	Construction
F26	Change orders during construction [4, 8, 16, 21]	Construction
F27	Addition/ increase in quantity of works [4, 11, 16]	Construction
F28	Unrealistic project time estimation and imposed in contract [11, 12, 16, 21]	Construction
F29	Fault/ mistake in soil investigation report [11, 12]	Construction
F30	Rework because of errors during construction [4, 8, 11, 12, 16, 21]	Construction
F31	Excessive bureaucracy in owner operation [4, 8, 11, 12, 16, 21]	External cause
F32	Take long time to get permissions from local authorities [4, 8, 11, 12, 16, 21]	External cause
F33	Political situation (revolution/ public strikes) [4, 8, 11, 21]	External cause
F34	Government/ public interruptions [4, 8, 11, 16, 21]	External cause
F35	Natural disaster [4, 8, 11, 12, 16, 21]	External cause

TABLE II
SUMMARY OF CHARACTERISTICES OF RESPONDENTS AND THEIR PROJECTS

Project party	Project type	Project involvement	Working experience	Project size
Owner = 33.90%	Building = 42.37%	>4 projects = 57.63%	>12 years = 30.51%	Small = 42.37%
Consultant = 33.98	Civil = 35.59%	4 projects = 8.48%	8~12 years = 30.51%	Medium = 30.51%
Contractor = 11.86%	Industrial = 8.48%	3 projects = 11.86%	4~8 years = 22.03%	Large = 27.12%
Others = 15.25%	Others = 13.56%	2 projects = 18.64%	<4 years = 16.95%	-
Total N = 59	-	1 project = 3.39%	-	-

important factors: poor risk management and supervision, unforeseen site conditions, slow decision making, client-initiated variations, and work variations. Similarly, Al-Momani [6] investigated causes of delay in 130 public projects in Jordan. The main causes of delay were related to designer, user changes, weather, site conditions, late deliveries, economic conditions, and increase in quantity. That study also suggested that paying much attention to factors of delay could help practitioners minimize the contract disputes. Assaf and Hejji [8] stressed that delays have strong relationship with failure and ineffective performance of contractors.

Akogbe et al. [4] analyzed several sources, which cause the delay in construction completion in Benin. They identified top ten important delay factors that involve: (1) financial capability by contractor, (2) financial difficulties by owner, (3) poor subcontractor performance, (4) materials procurement of contractor, (5) changes in drawings of architect, (6) inadequate planning and scheduling of contractor, (7)

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TABLE III
STATISTICAL SIGNIFICANCE TEST RESULTS FOR FREQUENCY

No.	Description	ANOVA test results		
		Project parties	Project types	Project Size
F1	Slow/ late delivery and shortages of construction materials	0.141	0.085	0.196
F2	Price of construction materials increased very rapidly	0.541	0.126	0.516
F3	Damage of materials in storage	0.818	0.132	0.162
F4	Shortages of skilled workers	0.451	0.473	0.293
F5	Poor labor productivity	0.872	0.860	0.344
F6	Shortage of equipment	0.860	0.571	0.666
F7	Low equipment efficiency and unskilled operators	0.173	0.582	0.045[a]
F8	Frequent break down of equipment	0.712	0.596	0.536
F9	Poor communication by owner with other construction parties	0.958	0.935	0.088
F10	Delays in decision making by owner	0.044[a]	0.236	0.565
F11	Late issue of approval documents and sample materials by owner	0.143	0.134	0.806
F12	Delay in running bill payments to contractor and financial difficulties of owner	0.670	0.655	0.154
F13	Conflict between owners and other parties	0.399	0.704	0.639
F14	Rework due to change of design or deviation order by owner or his agent during construction	0.452	0.652	0.861
F15	Poor/ deficient planning and estimate	0.574	0.276	0.630
F16	Slow examination/ inspection of completed works by consultant	0.673	0.950	0.257
F17	Delay in design works	0.954	0.956	0.858
F18	Inappropriate design or mistake in design made by designers	0.986	0.464	0.209
F19	Delay in material procurement (action by the contractor)	0.392	0.129	0.651
F20	Difficulties in financing project by contractor	0.674	0.001[a]	0.818
F21	Poor site management and supervision by contractor	0.416	0.079	0.320
F22	Inadequate experience of contractor	0.980	0.411	0.341
F23	Incompetent/ immature subcontractor	0.926	0.058	0.863
F24	Frequent change of subcontractor	0.375	0.408	0.316
F25	Changes in types and specifications during construction	0.148	0.999	0.362
F26	Change orders during construction	0.604	0.225	0.069
F27	Addition/ increase in quantity of works	0.488	0.002[a]	0.800
F28	Unrealistic project time estimation and imposed in contract	0.947	0.476	0.762
F29	Fault/ mistake in soil investigation report	0.670	0.544	0.321
F30	Rework because of errors during construction	0.254	0.491	0.126
F31	Excessive bureaucracy in owner operation	0.288	0.799	0.265
F32	Take long time to get permissions from local authorities	0.046[a]	0.205	0.254
F33	Political situation (revolution/ public strikes)	0.451	0.513	0.616
F34	Government/ public interruptions	0.955	0.888	0.763
F35	Natural disaster	0.491	0.173	0.518

slow inspection of completed works by the consultant, (8) equipment availability of contractor, (9) preparation and approval of drawings of consultant, and (10) acceptance of inadequate design drawings by consultant. In addition, Doloi et al. [11] in India indicated that main causes of delay are (1) lack of commitment, (2) insufficient of site management (3) poor site coordination (4) improper planning, and (5) lake of clarity in project scope. Moreover, Ezeldin et al. [13] in Middle-East Egypt showed that they are (1) low speed of decision making by employer, (2) lack of construction coordination & supervision, (3) productivity, (4) economic problems, and (5) lack of resources. In addition, El-Razek et al. [12] in Egypt also indicated that they are (1) financing by contractor during construction, (2) delays in contractor's payment by owner, (3) design changes by owner or his agent during construction, (4) partial payments during construction, and (5) slow delivery of materials for building construction projects. Furthermore, Long et al. [19] in Vietnam found that they are (1) poor site management and supervision, (2) poor project management assistance, (3) financial difficulties of owner, (4) financial difficulties of contractor, and (5) design changes for large construction projects. Ibrahim et al. [16] in Palestine stated that factors caused delays are different with location and type of construction project. They also indicated the major causes are (1) political situation, (2) limited working area, (3) award project to lowest bid price, (4) progress payment delay by owner, (5) delays in decision making by owner for road construction projects.

Through the literature review, some factors of delay were adopted, and some were merged in this study. Finally, 35 delay factors were selected to meet the objectives of the study as shown in Table I. These factors are classified into seven categories: (1) materials, (2) manpower and equipment, (3) owner, (4) consultant, (5) contractor, (6) construction, and (7) external cause.

TABLE IV
STATISTICAL SIGNIFICANCE TEST RESULTS FOR SEVERITY

No.	Description	ANOVA test results		
		Project parties	Project types	Project Size
F1	Slow/ late delivery and shortages of construction materials	0.534	0.238	0.719
F2	Price of construction materials increased very rapidly	0.710	0.065	0.165
F3	Damage of materials in storage	0.872	0.527	0.182
F4	Shortages of skilled workers	0.697	0.447	0.379
F5	Poor labor productivity	0.563	0.854	0.142
F6	Shortage of equipment	0.595	0.643	0.464
F7	Low equipment efficiency and unskilled operators	0.680	0.647	0.999
F8	Frequent break down of equipment	0.055	0.835	0.095
F9	Poor communication by owner with other construction parties	0.843	0.638	0.395
F10	Delays in decision making by owner	0.360	0.368	0.775
F11	Late issue of approval documents and sample materials by owner	0.065	0.024[a]	0.437
F12	Delay in running bill payments to contractor and financial difficulties of owner	0.760	0.320	0.922
F13	Conflict between owners and other parties	0.189	0.298	0.404
F14	Rework due to change of design or deviation order by owner or his agent during construction	0.564	0.833	0.879
F15	Poor/ deficient planning and estimate	0.482	0.238	0.763
F16	Slow examination/ inspection of completed works by consultant	0.823	0.678	0.827
F17	Delay in design works	0.055	0.918	0.359
F18	Inappropriate design or mistake in design made by designers	0.993	0.497	0.585
F19	Delay in material procurement (action by the contractor)	0.939	0.259	0.711
F20	Difficulties in financing project by contractor	0.667	0.131	0.650
F21	Poor site management and supervision by contractor	0.392	0.788	0.183
F22	Inadequate experience of contractor	0.733	0.308	0.431
F23	Incompetent/ immature subcontractor	0.755	0.184	0.906
F24	Frequent change of subcontractor	0.929	0.949	0.745
F25	Changes in types and specifications during construction	0.342	0.740	0.999
F26	Change orders during construction	0.364	0.659	0.117
F27	Addition/ increase in quantity of works	0.907	0.136	0.359
F28	Unrealistic project time estimation and imposed in contract	0.176	0.703	0.620
F29	Fault/ mistake in soil investigation report	0.456	0.611	0.771
F30	Rework because of errors during construction	0.337	0.903	0.310
F31	Excessive bureaucracy in owner operation	0.527	0.720	0.703
F32	Take long time to get permissions from local authorities	0.598	0.323	0.119
F33	Political situation (revolution/ public strikes)	0.322	0.712	0.766
F34	Government/ public interruptions	0.999	0.795	0.882
F35	Natural disaster	0.548	0.439	0.781

III. RESEARCH METHODOLOGY

A. Questionnaire Design

Data related to causes of delay were gathered through a questionnaire. The questionnaire was divided into two main parts: (1) evaluation of effect of causes of delay to construction project based on frequency and severity, and (2) personal information. In the first part, the respondents were requested to answer the questions that are originated from thirty-five factors mentioned in Table I. In this situation, the five-point Likert scale with value ranging from 0 to 4 was used as the followings: '0 = no; 1 = rarely; 2 = sometimes; 3 = often; and 4 = always' for frequency; and '0 = no; 1 = little; 2 = moderate; 3 = very; and 4 = extremely' for severity. For each factor, two questions composed to ask the respondents are "what is the frequency of occurrence for this cause?" and "how is the degree of severity of this cause on schedule delay?". In the second part, the characteristics of

respondents and their projects were asked to gain the general view about surveyed population.

B. Data Collection

The structured questionnaire has distributed to the respondents who have much experience in construction management in Bangladesh. The electronic mail was mainly used to collect data regarding frequency and severity of each delay cause. The method of sampling used in this study was non-probability sampling because of some certain limitations and difficulties. The respondents were selected from the catalogue of REHAB (The Real Estate and Housing Association of Bangladesh), IEB (Institution of Engineers, Bangladesh) and other sources. After eliminating the uncompleted questionnaires, 59 data sets were found to be usable in this study. Detailed information related to respondents and their project characteristics in terms of project party, project type, project involvement, working experience, and proj

ect size is provided in Table II.

C. Analysis Tools

One way analysis of variance (ANOVA) is used to analyse the mean differences between groups. If the p-value of ANOVA test is greater than significance level of 0.05, the variances are equal. It shows that mean differences are not statistically significant. In this context, all data need to be considered in the analysis as a whole.

Pearson's coefficient of rank correlation is then used to demonstrate whether there is the agreement or disagreement among each pair of parties. The correlation coefficient varies between +1 and -1, where +1 implies a perfect positive relationship (agreement), while -1 results from a perfect negative relationship (disagreement). The estimate of correlation coefficient close to unity in magnitude implies good correlation, while values near zero indicate little or no correlation.

As mentioned early, there are three indices used in this study as follows:

Frequency index (FI): is the number of times it happens during a particular period. This index expresses occurrence frequency of factor responsible for delay. It was computed as the following equation.

$$FI = \frac{\sum_0^4 a_i n_i}{4N}$$

where: a = constant expressing the weight assigned to each responses (ranges from 0 for 'No happen' to 4 for 'Always'), n =frequency of each response, N = total number of responses.

Severity index (SI): is the degree of influence of a cause to the performance. This index expresses severity of factor that caused delay. It was computed as the following equation.

TABLE V
FREQUENCY INDEX, SEVERITY INDEX, IMPORTANCE INDEX AND RANKING BY OVERALL

No.	Description	Overall			
		FI	SI	IMP. I	Rank
F1	Slow/ late delivery and shortages of construction materials	0.572	0.555	0.318	9
F2	Price of construction materials increased very rapidly	0.648	0.657	0.426	1
F3	Damage of materials in storage	0.419	0.470	0.197	34
F4	Shortages of skilled workers	0.597	0.597	0.357	3
F5	Poor labor productivity	0.564	0.547	0.308	12
F6	Shortage of equipment	0.568	0.555	0.315	10
F7	Low equipment efficiency and unskilled operators	0.525	0.572	0.301	16
F8	Frequent break down of equipment, F8	0.500	0.500	0.250	28
F9	Poor communication by owner with other construction parties	0.534	0.542	0.290	17
F10	Delays in decision making by owner	0.547	0.572	0.313	11
F11	Late issue of approval documents and sample materials by owner	0.547	0.530	0.290	18
F12	Delay in running bill payments to contractor and financial difficulties of owner	0.589	0.589	0.347	6
F13	Conflict between owners and other parties	0.534	0.513	0.274	22
F14	Rework due to change of design or deviation order by owner or his agent during construction	0.508	0.517	0.263	25
F15	Poor/ deficient planning and estimate	0.479	0.513	0.245	29
F16	Slow examination/ inspection of completed works by consultant	0.462	0.449	0.207	32
F17	Delay in design works	0.470	0.428	0.201	33
F18	Inappropriate design or mistake in design made by designers	0.411	0.466	0.192	35
F19	Delay in material procurement (action by the contractor)	0.542	0.568	0.308	13
F20	Difficulties in financing project by contractor	0.551	0.619	0.341	7
F21	Poor site management and supervision by contractor	0.597	0.597	0.357	4
F22	Inadequate experience of contractor	0.564	0.572	0.322	8
F23	Incompetent/ immature subcontractor	0.572	0.614	0.351	5
F24	Frequent change of subcontractor	0.500	0.568	0.284	19
F25	Changes in types and specifications during construction	0.483	0.525	0.254	26
F26	Change orders during construction	0.500	0.487	0.244	30
F27	Addition/ increase in quantity of works	0.525	0.483	0.254	27
F28	Unrealistic project time estimation and imposed in contract	0.534	0.525	0.281	20
F29	Fault/ mistake in soil investigation report	0.534	0.517	0.276	21
F30	Rework because of errors during construction	0.441	0.487	0.215	31
F31	Excessive bureaucracy in owner operation	0.530	0.500	0.265	24
F32	Take long time to get permissions from local authorities	0.555	0.551	0.306	15
F33	Political situation (revolution/ public strikes)	0.610	0.589	0.359	2
F34	Government/ public interruptions	0.542	0.568	0.308	14
F35	Natural disaster	0.487	0.547	0.266	23

$$SI = \frac{\sum\limits_{0}^{4} a_i n_i}{4N}$$

where: a = constant expressing the weight assigned to each responses (ranges from 0 for 'No Severe' to 4 for 'Extremely'), n = frequency of each response, N = total number of responses.

Importance index *(IMP.I):* This index expresses the overview of factor based on both their frequency and severity. It was computed as the following equation.

$$IMP.I = FI \times SI$$

IV. RESULT OF ANALYSIS

A. ANOVA Results

The In order to accept with the test of consistency with respect to three categories, namely project party, project type, and project size, this study employed ANOVA test at 0.05 level. These three categories of project characteristics were selected because they are the principal items in any type of construction projects. The ANOVA test results are shown in the Table III and Table IV for frequency and severity respectively. Among the 35 delay factors, most the factors are not statically significant because p-value is greater than 0.05 except F7, F10, F20, F27 and F32 for frequency, and F11 for severity. Therefore, the diffidence in mean between categories can be ignored. It means that the 35 factors mentioned in Table I can be considered as possible causes of delay for further analysis.

B. Ranking According to Overall

The factors of delay were ranked according to their overall importance index. The importance index was determined based on the frequency of occurrence and severity of impact. The results of frequency, severity and importance indices are shown in Table V. In addition, the importance level of factors of delay was graphically presented in the Fig. I.

The five top causes of delay identified based on overall results are: (1) F2 'price of construction materials increased very rapidly', (2) F33 'political situation (revolution/ public strikes)', (3) F4 'shortages of skilled workers', (4) F21 'poor site management and supervision by contractor', and (5) F23 'incompetent/ immature subcontractors' as shown in Table X. Among these five factors of delay, there is one common factor of delay relating all parties, i.e., F2 'price of construction materials increased very rapidly'. Moreover, there are two more common causes between consultant and other party, i.e., F12 'delay in running bill payments to contractor and financial difficulties of owner' and F21 'poor site management and supervision by contractor'. In addition, there is another common cause between owner and contractor, i.e., F4 'shortages of skilled workers'.

In order to find out how to mitigate schedule delay, it is important to identify the responsibility of each party for causes of delay. The results of overall analysis have shown that among the five most influential causes, two of the causes belong to the contractor, one cause belongs to materials, one cause belongs to manpower and equipment, and one cause belongs to external category. Based on this finding, it can be concluded that no single party is responsible for the construction delay. It means that any step to prevent or mitigate delay has to be a joint attempt and based upon teamwork. This conclusion can be also found from the study of El Razek et al. [12] in Egypt and Abdul-Rahman et al. [1] in Malaysia.
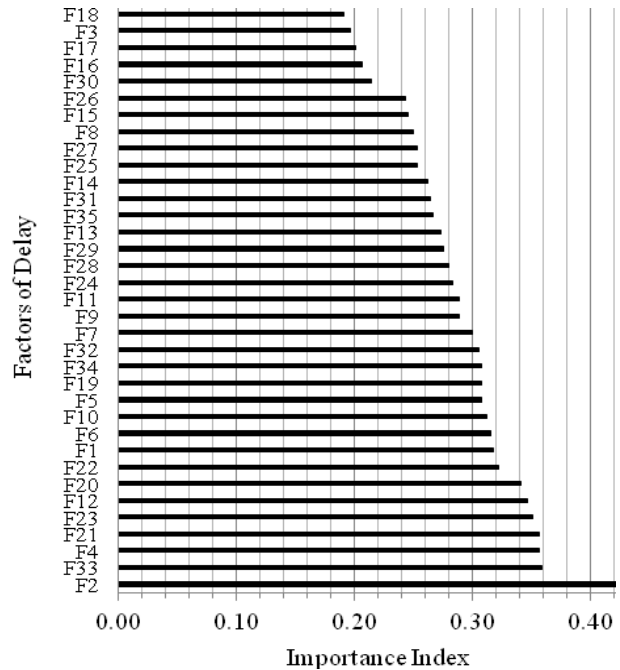
FIGURE I
IMPORTANCE INDEX OF ALL CAUSES OF DELAY

C. Ranking According to Project Parties

In order to define the delay causes for each party independently, data were separated and analysed according to the owner, consultant, contractor and others. The factors of delay were also ranked according to their importance index as presented in Table VII. The top five factors of delay organized by project party were then extracted and shown in Table X. F2 'price of construction materials increased very rapidly' was identified as the first ranking among five top influential causes of delay both owner and consultant party. This factor was also identified as the first ranked delay cause by the overall results. Moreover, the results of analysis also indicated that this factor is the second in contractor's ranking, and it is the third in other party's ranking. Furthermore, contractor identified F4 'shortages of skilled workers' as the first ranking among five top influential delay causes. It is ranked as the third by the owner, and the second by other party, but it is not listed within the top five important causes in the consultant's result. In addition, the other party identified the first ranked factor of delay as F21 'poor site management and supervision by contractor'

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TABLE VI
FREQUENCY INDEX, SEVERITY INDEX, IMPORTANCE INDEX AND RANKING BY PROJECT PARTIES

No.	Owner				Consultant				Contractor				Others			
	FI	SI	IMP. I	Rank	FI	SI	IMP. I	Rank	FI	SI	IMP. I	Rank	FI	SI	IMP. I	Rank
F1	0.525	0.575	0.302	16	0.576	0.511	0.294	13	0.607	0.500	0.304	3	0.667	0.667	0.444	12
F2	0.650	0.725	0.471	1	0.630	0.620	0.391	1	0.536	0.571	0.306	2	0.778	0.667	0.519	3
F3	0.463	0.488	0.225	31	0.402	0.457	0.184	34	0.393	0.500	0.196	16	0.417	0.472	0.197	34
F4	0.588	0.663	0.389	3	0.554	0.522	0.289	15	0.607	0.536	0.325	1	0.722	0.722	0.522	2
F5	0.563	0.538	0.302	15	0.554	0.554	0.307	9	0.500	0.429	0.214	12	0.639	0.639	0.408	14
F6	0.575	0.575	0.331	10	0.609	0.576	0.351	4	0.393	0.464	0.182	21	0.611	0.556	0.340	27
F7	0.500	0.588	0.294	18	0.543	0.565	0.307	10	0.464	0.500	0.232	9	0.583	0.639	0.373	19
F8	0.525	0.488	0.256	22	0.500	0.522	0.261	26	0.429	0.429	0.184	18	0.500	0.556	0.278	31
F9	0.575	0.550	0.316	13	0.478	0.533	0.255	28	0.536	0.536	0.287	4	0.583	0.583	0.340	25
F10	0.475	0.588	0.279	20	0.565	0.543	0.307	11	0.500	0.571	0.286	5	0.722	0.611	0.441	13
F11	0.475	0.488	0.232	28	0.598	0.554	0.331	8	0.464	0.429	0.199	14	0.639	0.639	0.408	15
F12	0.563	0.563	0.316	12	0.598	0.598	0.357	3	0.500	0.500	0.250	7	0.722	0.694	0.502	5
F13	0.475	0.500	0.238	27	0.576	0.500	0.288	16	0.500	0.393	0.196	17	0.583	0.667	0.389	17
F14	0.475	0.563	0.267	21	0.500	0.467	0.234	31	0.500	0.464	0.232	10	0.611	0.583	0.356	21
F15	0.488	0.513	0.250	23	0.500	0.565	0.283	19	0.286	0.321	0.092	34	0.556	0.556	0.309	30
F16	0.450	0.463	0.208	34	0.467	0.413	0.193	33	0.357	0.357	0.128	27	0.583	0.583	0.340	26
F17	0.488	0.463	0.225	32	0.457	0.359	0.164	35	0.429	0.500	0.214	13	0.528	0.500	0.264	33
F18	0.400	0.500	0.200	35	0.446	0.478	0.213	32	0.250	0.214	0.054	35	0.472	0.583	0.275	32
F19	0.525	0.688	0.361	7	0.565	0.457	0.258	27	0.393	0.393	0.154	23	0.639	0.722	0.461	9
F20	0.588	0.650	0.382	4	0.576	0.598	0.344	6	0.321	0.429	0.138	25	0.611	0.778	0.475	8
F21	0.650	0.600	0.390	2	0.609	0.576	0.351	5	0.321	0.429	0.138	26	0.694	0.778	0.540	1
F22	0.563	0.663	0.373	6	0.587	0.467	0.274	22	0.429	0.429	0.184	19	0.611	0.750	0.458	11
F23	0.600	0.600	0.360	8	0.576	0.641	0.369	2	0.357	0.393	0.140	24	0.667	0.778	0.519	4
F24	0.500	0.563	0.281	19	0.489	0.565	0.276	21	0.464	0.536	0.249	8	0.556	0.639	0.355	24
F25	0.488	0.500	0.244	24	0.489	0.576	0.282	20	0.321	0.321	0.103	30	0.583	0.611	0.356	22
F26	0.488	0.475	0.232	29	0.533	0.511	0.272	23	0.286	0.357	0.102	32	0.611	0.583	0.356	23
F27	0.525	0.438	0.230	30	0.543	0.522	0.284	17	0.321	0.393	0.126	28	0.667	0.556	0.370	20
F28	0.513	0.475	0.243	25	0.554	0.511	0.283	18	0.357	0.464	0.166	22	0.667	0.750	0.500	6
F29	0.538	0.450	0.242	26	0.565	0.543	0.307	12	0.321	0.321	0.103	31	0.639	0.750	0.479	7
F30	0.450	0.488	0.219	33	0.489	0.489	0.239	30	0.429	0.429	0.184	20	0.306	0.528	0.161	35
F31	0.575	0.563	0.323	11	0.533	0.467	0.249	29	0.357	0.321	0.115	29	0.556	0.611	0.340	28
F32	0.513	0.600	0.308	14	0.587	0.500	0.293	14	0.464	0.464	0.216	11	0.639	0.639	0.408	16
F33	0.650	0.588	0.382	5	0.587	0.565	0.332	7	0.536	0.500	0.268	6	0.639	0.722	0.461	10
F34	0.588	0.613	0.360	9	0.511	0.533	0.272	24	0.464	0.429	0.199	15	0.583	0.667	0.389	18
F35	0.525	0.575	0.302	17	0.489	0.554	0.271	25	0.357	0.286	0.102	33	0.500	0.667	0.333	29

FI = frequency index, SI = severity index, IMP. I = important index

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It is also ranked as the second by owner and the fifth by consultant, but it is not listed within the top five important causes in the contractor's result. F12 'delay in running bill payments to contractor and financial difficulties of owner' is ranked as the third according to consultant's result and the fifth according to other party's result. As a consequence, F33 'political situation (revolution/ public strikes)' is the fifth ranked by the owner but it is the second most influential factor in overall result.

TABLE VII

FREQUENCY INDEX, SEVERITY INDEX, IMPORTANCE INDEX AND RANKING BY PROJECT TYPES

No.	Building				Civil				Industrial				Others			
	FI	SI	IMP.I	Rank	FI	SI	IMP.I	Rank	FI	SI	IMP.I	Rank	FI	SI	IMP.I	Rank
F1	0.650	0.550	0.358	13	0.548	0.619	0.339	7	0.450	0.500	0.225	24	0.469	0.438	0.205	26
F2	0.700	0.640	0.448	1	0.631	0.726	0.458	1	0.550	0.600	0.330	8	0.594	0.563	0.334	3
F3	0.390	0.410	0.160	35	0.464	0.488	0.227	30	0.500	0.650	0.325	9	0.344	0.500	0.172	30
F4	0.630	0.660	0.416	3	0.595	0.548	0.326	9	0.500	0.550	0.275	12	0.563	0.563	0.316	4
F5	0.590	0.490	0.289	23	0.536	0.583	0.313	11	0.500	0.750	0.375	3	0.594	0.500	0.297	9
F6	0.620	0.580	0.360	12	0.536	0.560	0.300	13	0.550	0.650	0.358	5	0.500	0.406	0.203	27
F7	0.590	0.570	0.336	15	0.476	0.583	0.278	16	0.450	0.600	0.270	16	0.500	0.531	0.266	11
F8	0.540	0.500	0.270	30	0.488	0.488	0.238	24	0.400	0.550	0.220	25	0.469	0.500	0.234	19
F9	0.560	0.490	0.274	29	0.476	0.560	0.266	17	0.550	0.650	0.358	6	0.594	0.594	0.353	1
F10	0.590	0.620	0.366	10	0.488	0.500	0.244	21	0.550	0.650	0.358	7	0.563	0.563	0.316	5
F11	0.610	0.590	0.360	11	0.536	0.524	0.281	15	0.500	0.500	0.250	18	0.406	0.375	0.152	32
F12	0.610	0.630	0.384	6	0.619	0.595	0.368	3	0.450	0.550	0.248	20	0.531	0.469	0.249	15
F13	0.610	0.560	0.342	14	0.464	0.476	0.221	31	0.450	0.550	0.248	21	0.531	0.438	0.232	22
F14	0.530	0.540	0.286	24	0.488	0.512	0.250	20	0.500	0.400	0.200	28	0.500	0.531	0.266	12
F15	0.540	0.560	0.302	20	0.476	0.512	0.244	23	0.400	0.550	0.220	26	0.344	0.344	0.118	34
F16	0.470	0.490	0.230	31	0.464	0.393	0.182	34	0.400	0.400	0.160	35	0.469	0.500	0.234	20
F17	0.490	0.410	0.201	34	0.440	0.393	0.173	35	0.600	0.650	0.390	2	0.406	0.438	0.178	28
F18	0.440	0.480	0.211	32	0.405	0.476	0.193	33	0.350	0.500	0.175	32	0.375	0.375	0.141	33
F19	0.630	0.590	0.372	8	0.488	0.619	0.302	12	0.450	0.400	0.180	30	0.469	0.469	0.220	23
F20	0.650	0.590	0.384	7	0.524	0.690	0.362	4	0.400	0.500	0.200	29	0.406	0.594	0.241	18
F21	0.710	0.630	0.447	2	0.536	0.619	0.332	8	0.400	0.450	0.180	31	0.531	0.531	0.282	10
F22	0.610	0.600	0.366	9	0.560	0.607	0.340	6	0.500	0.350	0.175	33	0.469	0.531	0.249	16
F23	0.630	0.620	0.391	5	0.571	0.679	0.388	2	0.500	0.500	0.250	19	0.438	0.500	0.219	24
F24	0.510	0.580	0.296	21	0.500	0.524	0.262	18	0.450	0.600	0.270	17	0.500	0.625	0.313	7
F25	0.510	0.540	0.275	28	0.440	0.536	0.236	26	0.500	0.550	0.275	13	0.500	0.438	0.219	25
F26	0.530	0.520	0.276	26	0.488	0.452	0.221	32	0.550	0.550	0.303	10	0.406	0.438	0.178	29
F27	0.600	0.540	0.324	17	0.488	0.476	0.232	28	0.500	0.350	0.175	34	0.406	0.406	0.165	31
F28	0.610	0.550	0.336	16	0.464	0.500	0.232	29	0.550	0.450	0.248	22	0.469	0.563	0.264	13
F29	0.580	0.550	0.319	19	0.488	0.500	0.244	22	0.550	0.500	0.275	14	0.500	0.469	0.234	21
F30	0.460	0.450	0.207	33	0.429	0.548	0.235	27	0.650	0.650	0.423	1	0.281	0.344	0.097	35
F31	0.570	0.510	0.291	22	0.500	0.476	0.238	25	0.550	0.450	0.248	23	0.469	0.563	0.264	14
F32	0.600	0.540	0.324	18	0.536	0.548	0.293	14	0.450	0.450	0.203	27	0.531	0.656	0.349	2
F33	0.660	0.610	0.403	4	0.607	0.571	0.347	5	0.500	0.600	0.300	11	0.531	0.563	0.299	8
F34	0.530	0.530	0.281	25	0.536	0.607	0.325	10	0.600	0.600	0.360	4	0.563	0.563	0.316	6
F35	0.530	0.520	0.276	27	0.440	0.583	0.257	19	0.550	0.500	0.275	15	0.438	0.563	0.246	17

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Furthermore, F20 'difficulties in financing project by contractor' is identified as the fourth factor by the owner. Finally, F23 'incompetent/ immature subcontractors' is ranked as the second and the fourth ranked by the consultant and other party respectively, while it is not listed within the five important causes in the owners' and contractors' results.

Pearson's rank correlation analysis was then adopted to assess the level of agreement between parties. The results are shown in Table VIII. A conclusion can be inferred from these results that there is strong positive agreement between parties because all correlation coefficients are greater than 0.9 with significance level less than 0.05. In detail, the lowest degree of agreement appears between contractor and other party with importance level of 0.926, and highest degree of agreement appears between owner and other party with importance level of 0.958. It indicates that the overall results of ranking for all parties are acceptable.

TABLE VIII
PEARSON'S CORRELATION COEFFICIENT BETWEEN PARTIES

Parties	Frequency		Severity		Importance level	
	Coefficient	Sig. level	Coefficient	Sig. level	Coefficient	Sig. level
Owner-Consultant	0.971	0.000	0.981	0.000	0.942	0.000
Owner-Contractor	0.949	0.001	0.911	0.004	0.944	0.001
Owner-Others	0.907	0.001	0.905	0.001	0.958	0.000
Consultant- Contractor	0.927	0.003	0.861	0.013	0.946	0.001
Consultant-Others	0.958	0.000	0.980	0.000	0.972	0.000
Contractor-Others	0.958	0.001	0.891	0.007	0.926	0.003

TABLE IX
FREQUENCY INDEX, SEVERITY INDEX, IMPORTANCE INDEX AND RANKING BY PROJECT SIZES

No.	Small				Medium				Large			
	FI	SI	IMP. I	Rank	FI	SI	IMP. I	Rank	FI	SI	IMP. I	Rank
F1	0.580	0.540	0.313	17	0.597	0.583	0.348	3	0.531	0.547	0.291	24
F2	0.700	0.590	0.413	4	0.611	0.708	0.433	1	0.609	0.703	0.428	1
F3	0.400	0.420	0.168	35	0.431	0.472	0.203	28	0.438	0.547	0.239	34
F4	0.660	0.630	0.416	3	0.569	0.597	0.340	4	0.531	0.547	0.291	25
F5	0.620	0.520	0.322	14	0.500	0.528	0.264	11	0.547	0.609	0.333	11
F6	0.620	0.590	0.366	6	0.542	0.528	0.286	9	0.516	0.531	0.274	28
F7	0.600	0.590	0.354	8	0.500	0.528	0.264	12	0.438	0.594	0.260	30
F8	0.540	0.560	0.302	18	0.458	0.403	0.185	30	0.484	0.516	0.250	33
F9	0.610	0.570	0.348	10	0.444	0.528	0.235	21	0.516	0.516	0.266	29
F10	0.580	0.620	0.360	7	0.486	0.472	0.230	24	0.563	0.609	0.343	8
F11	0.580	0.580	0.336	12	0.542	0.472	0.256	14	0.500	0.516	0.258	31
F12	0.590	0.580	0.342	11	0.611	0.583	0.356	2	0.563	0.609	0.343	9
F13	0.550	0.510	0.281	21	0.528	0.444	0.235	22	0.516	0.594	0.306	22
F14	0.490	0.530	0.260	28	0.542	0.444	0.241	17	0.500	0.578	0.289	26
F15	0.480	0.560	0.269	24	0.431	0.403	0.173	32	0.531	0.563	0.299	23
F16	0.420	0.460	0.193	32	0.444	0.319	0.142	33	0.547	0.578	0.316	17
F17	0.510	0.440	0.224	31	0.389	0.347	0.135	34	0.500	0.500	0.250	32
F18	0.360	0.470	0.169	34	0.375	0.347	0.130	35	0.531	0.594	0.315	18
F19	0.580	0.550	0.319	16	0.500	0.528	0.264	13	0.531	0.641	0.340	10
F20	0.600	0.590	0.354	9	0.514	0.597	0.307	6	0.516	0.688	0.354	5
F21	0.670	0.660	0.442	1	0.542	0.542	0.293	8	0.547	0.563	0.308	19
F22	0.570	0.590	0.336	13	0.583	0.514	0.300	7	0.531	0.609	0.324	15
F23	0.580	0.650	0.377	5	0.556	0.583	0.324	5	0.578	0.594	0.343	6
F24	0.460	0.580	0.267	25	0.444	0.514	0.228	25	0.625	0.609	0.381	3
F25	0.470	0.550	0.259	29	0.444	0.458	0.204	27	0.547	0.563	0.308	20
F26	0.530	0.470	0.249	30	0.403	0.444	0.179	31	0.563	0.563	0.316	16
F27	0.540	0.490	0.265	26	0.542	0.472	0.256	15	0.484	0.484	0.235	35
F28	0.530	0.540	0.286	20	0.486	0.486	0.236	19	0.594	0.547	0.325	14
F29	0.500	0.540	0.270	22	0.542	0.444	0.241	18	0.578	0.563	0.325	13
F30	0.380	0.480	0.182	33	0.472	0.431	0.203	29	0.500	0.563	0.281	27
F31	0.520	0.500	0.260	27	0.528	0.444	0.235	23	0.547	0.563	0.308	21
F32	0.570	0.560	0.319	15	0.500	0.472	0.236	20	0.594	0.625	0.371	4
F33	0.650	0.650	0.423	2	0.500	0.486	0.243	16	0.672	0.609	0.409	2
F34	0.520	0.580	0.302	19	0.528	0.542	0.286	10	0.594	0.578	0.343	7
F35	0.500	0.540	0.270	23	0.417	0.500	0.208	26	0.547	0.609	0.333	12

FI = frequency index, SI = severity index, IMP. I = important index

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TABLE X
TOP FIVE MOST IMPORTANT CAUSES OF DELAY

Items		Top five influential factors of delay				
		Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Overall	-	price of construction materials increased very rapidly	political situation (revolution/ public strikes)	shortages of skilled workers	poor site management and supervision by contractor	incompetent/ immature subcontractors
Project party	Owner	price of construction materials increased very rapidly	poor site management and supervision by contractor	shortages of skilled workers	difficulties in financing project by contractor	political situation (revolution/ public strikes)
Project party	Consultant	price of construction materials increased very rapidly	incompetent/ immature subcontractors	delay in running bill payments to contractor and financial difficulties of owner	shortage of equipment	poor site management and supervision by contractor
Project party	Contractor	shortages of skilled workers	price of construction materials increased very rapidly	slow/ lately delivery and shortages of construction materials	poor communication among the construction parties	delays in decision making by owner
Project party	Others	poor site management and supervision by contractor	shortages of skilled workers	price of construction materials increased very rapidly	incompetent/ immature subcontractors	delay in running bill payments to contractor and financial difficulties of owner
Project type	Building	price of construction materials increased very rapidly	poor site management and supervision by contractor	shortages of skilled workers	political situation (revolution/ public strikes)	incompetent/ immature subcontractors
Project type	Civil	price of construction materials increased very rapidly	incompetent/ immature subcontractor	delay in running bill payments to contractor and financial difficulties of owner	difficulties in financing project by contractor	political situation (revolution/ public strikes),
Project type	Industrial	rework because of errors during construction	delay in design works	poor labor productivity	government/ public interruptions	shortage of equipment
Project type	Others	poor communication by owner with other construction parties	take long time to get permissions from local authorities	price of construction materials increased very rapidly	shortages of skilled workers	delays in decision making by owner
Project size	Small	poor site management and supervision by contractor	political situation (revolution/ public strikes)	shortages of skilled workers	price of construction materials increased very rapidly	incompetent/ immature subcontractors
Project size	Medium	price of construction materials increased very rapidly	delay in running bill payments to contractor and financial difficulties of owner	slow/ lately delivery and shortages of construction materials	shortages of skilled workers	incompetent/ immature subcontractors
Project size	Large	price of construction materials increased very rapidly	political situation (revolution/ public strikes)	frequent change of sub contractors	take long time to get permissions from local authorities	difficulties in financing project by contractor

D. Ranking According to Project Type

In order to explore delay causes under the category of project type, the data were divided and then analysed according to building, civil, industrial and others. The results of analysis are shown in Table VII. The five most important causes according to project type are also extracted and shown in Table X. The five most important factors in the building projects, in order, are: F2 'price of construction materials increased very rapidly', F21 'poor site management and supervision by contractor', F4 'shortages of skilled workers', F33 'political situation (revolution/ public strikes)', and F23 'incompetent/ immature subcontractor'. The civil projects indicated two similar causes with the building projects are F2 'price of construction materials increased very rapidly' and F33 'political situation (revolution/ public strikes)', as the first and fifth ranking; whereas, F23 'incompetent/ immature subcontractor', F12 'delay in running bill payments to contractor and financial difficulties of owner', and F20 'difficulties in financing project by contractor' are as the second, third, and fourth ranking respectively. In industrial projects, there are distinct in five most important causes of delay, in order, being: F30 'rework because of errors during construction', F17 'delay in design works', F5 'poor labor productivity', F34 'government/ public interruptions', and F6 'shortage of equipment'. The other projects have two similar causes with building projects are: F2 'price of construction materials increased very rapidly' as the third ranking and F4 'shortages of skilled workers' as the fourth ranking, and other three delay causes, in order, are: F9 'poor communication by owner with other construction parties', F32 'take long time to get permissions from local authorities', and F10 'delays in decision making by owner' as the first, second, and fifth ranking respectively.

E. Ranking According to Project Size

Finally, in order to assess the factors that are responsible for delay by project size, the data were separated and analyzed according to small, medium, and large projects. The results of analysis are shown in Table IX. The five most important causes according to project size are also extracted and shown in Table X. The most important five causes in small projects, in order, are F21 'poor site management and supervision by contractor', F33 'political situation (revolution/ public strikes)', F4 'shortages of skilled workers', F2 'price of construction materials increased very rapidly', and F23 'incompetent/ immature subcontractors'. F2 'price of construction materials increased very rapidly', F12 'delay in running bill payments to contractor and financial difficulties of owner', F1 'slow/ late delivery and shortages of construction materials', F4 'shortages of skilled workers', and F23 'incompetent/ immature subcontractors' are the top five influential delay causes in the medium projects. The most important causes in large projects, in order, are F2 'price of construction materials increased very rapidly', F33 'political situation (revolution/ public strikes)', F24 'frequent change of sub contractors', F32 'take long time to get permissions from local authorities ', and F20 'difficulties in financing project by contractor'. In this case of analysis, several findings can be observed from the above results. Among top five important factors of delay, there is one most influential common cause in the all project sizes: F2 'price of construction materials increased very rapidly'. It is as the first ranking in the medium and large projects, and as the fourth ranking in the small projects. Moreover, there are two common causes between small and medium projects: F4 'shortages of skilled workers' and F23 'incompetent/ immature subcontractors'. In addition, there is one common delay cause between small and large projects: F33 'political situation (revolution/ public strikes)'.

V. COMPARISON WITH OTHER COUNTRIES

The purpose of this section is to observe a comprehensive general view of top five factors of delay in different countries. Thirteen studies from thirteen countries have been selected to make the comparison such as: Ghana, Kuwait, South Korea, Hong Kong, UAE, Nigeria, Malaysia, Vietnam, Palestine, India, Egypt, Benin, and Bangladesh. The top five influential delay causes of these selected studies are shown in Table XI. In this table, delay causes are organized according to their level of importance. This study identified F21 'poor site management and supervision by contractor' as the fourth ranking among five top influential causes. This finding is very similar with Long et al. [19] in Vietnam (rank 1) and Faradi [14] in UAE (rank 5). Furthermore, F33 'political situation (revolution/ public strikes)' is indicated as the second ranking. This result is similar with Ibrahim et al. [16] in Palestine and Acharya et al. [2] in South Korea as the first and fifth ranking among the five influential delay causes respectively. Moreover, F2 'price of construction materials increased very rapidly' is identified as the first ranking. This finding is similar with Doloi et al. [11] and Frimpong [15] in India and Ghana. Doloi et al. [11] identified 'delay in material delivery by vendors' as the first ranking, and Frimpong [15] indicated 'material procurement' as the third ranking. Finally, this study identified F23 'incompetent/ immature subcontractors' as the fifth ranking; whereas, it is the fifth ranking according to Sambasivan [22] in Malaysia.

In general, the comparison of delay causes between countries gives the results that 'financial difficulties' is a common factor of delay causes for most developing countries including Ghana, Nigeria, Benin, Egypt, Kuwait, and India. 'Political situation' is one of the most influential construction delay cause for Bangladesh and Palestine. Therefore construction delay is much related to the economic and political stability of a country as well as management implementation of its construction industry.

VI. CONCLUSIONS AND GENERAL RECOMMENDATIONS

This study has identified the main causes of delay that affect construction industry in Bangladesh. Based on the literature review, 35 factors of delay were selected and examined. Among them, this study indicated to extract five most influence delay causes, in order, are: F2 'price of construction materials increased very rapidly', F33 'political situation', F4 'shortages of skilled workers', F21 'poor site management and supervision by contractor', and F23

TABLE XI

COMPARISON OF FIVE MOST INFLUENTIAL CAUSES OF DELAY AMONG SOME SELECTED COUNTRIES

Top five influential factors of delay in construction

Country and study	Rank 1	Rank 2	Rank 3	Rank 4	Rank 5
Ghana, (Frimpong, 2003)	monthly payment difficulties	poor contract management	material procurement	inflation	contractor's financial difficulties
Kuwait, (Koushki, 2005)	change orders	financial constraints	owner's lack of experience	materials	weather
South Korea, (Acharya et al., 2006)	public interruptions	changed site conditions	failure to provide site	unrealistic time estimation	design errors
Hong Kong, (Lo, 2006)	inadequate resources due to contractor/lack of capital	unforeseen ground conditions	exceptionally low bids	inexperienced contractor	works in conflict with existing utilities
UAE, (Faridi, 2006)	preparation and approval of drawings	inadequate early planning of the project	slowness of the owner's decision-making process	shortage of manpower	poor supervision and poor site management
Nigeria, (Aibinu, 2006)	contractors financial difficulties	clients cash flow problem	architects incomplete drawing	subcontractor's slow mobilization	equipment break-down and maintenance problem
Malaysia, (Sambasivan, 2007)	improper planning	site management	inadequate contractor experience	finance and payments of completed work	subcontractors
Vietnam, (Long et al., 2008)	poor site management and supervision	poor project management assistance	financial difficulties of owner	financial difficulties of contractor	design changes
Palestine, (Ibrahim et al., 2012)	political situation	segmentation of the west bank and limited movement between areas	award project to lowest bid price	progress payments delay by owner	shortage of equipment
India, (Doloi et al., 2012)	delay in material delivery by vendors	non availability of drawing/design on time	financial constraints of contractor	increase in scope of work	obtaining permissions from local authorities
Egypt, (Marzouk and El-Rasas, 2013)	finance and payments of completed work by owner	variation orders/changes of scope by owner during construction	effects of subsurface conditions	low productivity level of labors	ineffective planning and scheduling of project
Benin, (Akogbe et al., 2013)	financial capability of contractor	financial difficulties of owner	poor subcontractor performance	materials procurement	changes in drawings
Bangladesh, (This study, 2013)	price of construction materials increased very rapidly	political situation (revolution/ public strikes)	shortages of skilled workers	poor site management and supervision by contractor	incompetent/ immature subcontractors

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'incompetent/ immature subcontractors' in construction industry. In addition, Pearson's rank correlation coefficients indicate that the overall results of ranking for all parties are acceptable because its' values are greater than 0.9 with significance level less than 0.05. Hoverer, the results of analysis according to project parties show good agreement and also disagreement few cases regarding most important delay causes. For example, the contractor and other party identified "shortages of

skilled workers" and "poor site management and supervision by contractor" as the first ranking. However, the owner and consultant gave these factors of delay as a lesser ranking. It is also mentioned that the factor 'shortages of skilled workers' is not enlisted in the five most important causes of delay by consultant's result. Therefore, the analysis of responsible for delay causes suggests that a joint effort based on teamwork is required to mitigate delays.

According to project sectors, the five most important delay cases of build, civil, and others (port, harbor etc.) projects are indicated some similarity between project sectors. However, the result for industrial project identified distinct five delay causes. Therefore, it can be concluded that the industrial sectors can have more difference in the work items and design.

In the results of project sizes, large and medium projects are more affected by schedule delay due to cause of 'price of construction materials increased very rapidly' than small sizes project.

Finally, the comparison of delay causes between countries indicated that delay in construction is much related to the economic and political stability of a country.

After analysing these entire problems, the following points can be recommended for controlling and to mitigate delays in construction:

Owner should give extra attention to the following factors:

▪ Pay running bill payment to the contractor timely, because it debilitates the contractor capability to finance the work.
▪ Establish smooth communication with other parties, otherwise it will make projects delay.
▪ Check for work experience, resources and capabilities, before contract with the lowest bidder.

Consultant should emphasis the following factors:

▪ Slow examination/ inspection of completed works by consultant: management of consulting firm should be monitored technical staffs who are engaged for inspection of contractors' work, reviewing and approving the design submittals prior to construction phase.
▪ 'Delay in design works': design/ architects engineer should be completed design documents as per schedule.
▪ 'Error in design and specification': it takes a long time to make necessary corrections. Therefore, architects/ design engineer give special careful to mitigate this type's problem.

Contractor should focus on the following factors:

▪ 'Price of construction materials increased very rapidly': regarding this problem, site administration should maintain strong communication corporate office and procurement have to complete within time frame as possible.
▪ 'Shortage of skill workers': sufficient labor should be appointed and be increased productivity with skill site supervision.
▪ 'Poor site management and supervision by contractor': engaged with proficient administration and technical staff, handled to achieve completion within time and estimated project cost.
▪ 'Difficulties in financing project by contractor': contractor should maintain target cash flow and financial resources using work running bill payment.
▪ 'Incompetent/ immature subcontractors': before selection of lowest rate proposed subcontractor, should be check working experience and other logistic support for construction work.

REFERENCES

[1] H. A. Rahman, M. A. Berawi, A.R. Berawi, O. Mohamed, M. Othman, I.A. Yahya, "Delay mitigation in the Malaysian construction industry." Journal of *Construction Engineering Management*, vol. 132, no. 2, pp.125–133, 2006.
[2] N.K. Acharya, Y.D. Lee, H.M. Im, "Investigating Delay Factors in Construction Industry: A Korean perspective." *Korean Journal of Construction Engineering and Management,* vol. 10, no. 6, pp. 177-190, 2006.
[3] A.A. Aibinu, A. Odeyinka, "Construction Delays and their Causative Factors in Nigeria." *Journal of Construction Engineering Management*, ASCE, vol. 132, no. 7, pp. 667-677, 2006.
[4] R.T.M. Akogbe, X. Feng, J. Zhou, "Importance and Ranking Evaluation of Delay Factors for Development Construction Projects in Benin." *KSCE Journal of Civil Engineering,* vol. 17, no. 6, pp. 1213-1222, 2013.
[5] MD. A. Hasan, "Evaluation of Building Construction Management in Sylhet City, Bangladesh" *KICEM Journal of Construction Engineering and Project Management,* vol. 2, no.2, pp. 40-47, 2012.
[6] A.H. Al-Momani, "Construction Delay: A Quantitative Analysis." *International Journal of Project Management*, vol. 18, no. 1, pp. 51–59, 2000.
[7] S.A. Asaaf, M. Al-Khalil, "Causes of Delay in Large Building Construction Projects." *International Journal of Project Management,* vol. 11, no. 2, pp. 45-50, 1995.
[8] S.A. Asaaf, S. Al Hejji, "Causes of Delay in Large Construction Projects." *International Journal of Project Management*, vol. 24, pp. 349–357, 2006.
[9] J.R. Baldwin, J.M. Manthei, "Causes of Delay in the Construction Industry." *Journal of Construction Division*, ASCE, vol. 97, no. 2, pp. 177-187, 1971.
[10] D.W. Chan, M.M. Kumaraswamy, "A Comparative Study of Causes of Time Overruns in Hong Kong Construction Projects". *International Journal of Project Management*, vol. 15, no. 1, pp. 55–63, 1997.
[11] H. Doloi, A. Sawhney, K.C. Iyer, S. Rentala, "Analyzing Factors Affecting Delays in Indian Construction Projects." *International Journal of Project Management,* Vol. 30, 479–489, 2012.
[12] M.E. El-Razek, H.A. Bassioni, A.M. Mobarak, "Causes of Delay in Building Construction Projects in Egypt." *Journal of Construction*

Engineering and Management, ASCE, vol. 134, no. 11, pp. 831-841, 2008.

[13] A.S. Ezeldin, M. Abdel-Ghany, "Causes of Construction Delays for Engineering Projects in the Middle-East: An Egyptian Perspective." *AEI*, ASCE, pp. 53-62, 2013.

[14] A.S. Faridi, S.M. Sayegh, "Significant Factors Causing Delay in the UAE Construction Industry." *Construction Management and Economics,* vol. 24, no. 11, pp. 1167-1176, 2006.

[15] Y. Frimpong, J. Oluwoye, L. Crawford, "Causes of Delay and Cost Overruns in Construction of Groundwater Projects in a Developing Countries; Ghana as a Case Study." *International Journal Project Management,* vol. 21, pp. 321-326, 2003.

[16] M. Ibrahim, A. Bruland, N. Dmaidi, "Causes of Delay in Road Construction Projects." *Journal of Management in Engineering*, ASCE, vol. 28, no. 3, pp. 300-310, 2012.

[17] P. Kaming, P. Olomolaiye, G. Holt, F. Harris, "Factors Influencing Construction Time and Cost Overruns on High-Rise Projects in Indonesia." *Construct Management and Economics*, vol. 15, pp. 83–94, 1997.

[18] P.A. Koushki, K. Al-Rashid, N. Kartam, "Delays and Cost Increases in the Construction of Private Residential Projects in Kuwait." *Construction Management and Economics*, Vol. 23, no. 3, pp. 285-294, 2005.

[19] L. Le-Hoai, Y.D. Lee, J.Y. Lee, "Delay and Cost Overruns in Vietnam Large Construction Projects: A Comparison with other Selected Countries." *KSCE Journal of Civil Engineering*, Vol. 12, no. 6, pp. 367-377, 2008

[20] T.Y. Lo, I.W.H. Fung, K.C.F. Tung, "Construction Delays in Hong Kong Civil Engineering Projects." Journal of Construction Engineering Management, ASCE, vol. 132, no. 6, pp. 636-649, 2006.

[21] M.M. Marzouk, T.I. El-Rasas, "Analyzing Delay Causes in Egyptian Construction Projects." *Journal of Advanced Research*, 2013.

[22] M. Sambasivan, Y.W. Soon, "Causes and Effects of Delays in Malaysian Construction Industry." *International Journal of Project Management,* vol. 25, pp. 517-526, 2007.

[23] MD.R.R. Shaon, "Investigation of Construction Delay of Real Estate Companies in Dhaka City", Bachelor of Science thesis, *Bangladesh University of Engineering and Technology*, Dhaka, Bangladesh, 2012.