CRITICAL SUCCESS FACTORS AFFECTING BRIDGE CONSTRUCTIN IN THAILAND

INTRODUCTION

General

Researchers and practitioners generally accept that the major concerns in today's construction are budget, schedule, and quality. However, the varieties of factors determine the success and failure of projects. Among these projects, the critical factors for these objectives are project participant factors, project characteristic factors, interactive process factors, and external factors. Further details will be discussed in methodology.

In the past 10 years, many mega projects, such as bridge constructions have been built across the country. New and modern architectural shapes of bridges have been introduced. Also innovative construction techniques and machines are used in the construction projects. Bridge construction projects are different from other types of projects in that, large and modern architectural design requires complex construction techniques, the use of effective instruments, and the use of heavy machines. There are many factors that influence the success of the projects including the use of skilled human resources, quality materials, and effective construction techniques so that projects finishes on time, within the cost, and with quality. Moreover, some projects are performed in urban areas, where traffic jams and site limitation issues become critical concern and more serious. Some contractors are forced to work at night.

Several researchers introduced the definition of success criteria in construction projects. Anthony D. Songer and Keith R. Molenaar (1997) defined success projects as those which are on budget, on schedule, meet specification, conform to user's expectations, high quality of workmanship and minimize construction aggravation.

D.K.H Chua, Y.C. Kog, and K.P. Loh (1997) presented critical success factors for different project objectives in terms of budget, schedule, and quality.

Problem Statement

Researchers in the past have identified various factors that lead to project success, although their works are area specified on building construction and mostly for the developed countries. However, none of them has identified success factors that can affect bridge construction projects in developing countries like Thailand. These projects are unique in design, geology, and the people who work for a project. Less experience in coordinating between managers and other participants might cause project failure. The construction problems can be classified into:

A. Project participant factors, such as (1) project owner, (2) project designer, (3) project manager, (4) contractors, and (5) sub-contractor.

B. Project characteristic factors, such as (1) contract document, (2) project site, and (3) the uniqueness of the project.

C. Interactive process factors such as: (1) project planning, (2) project managing, (3) project monitoring and controlling, (4) communication and relationship, and (5) safety and health of participants in the project.

D. External factors such, as (1) social environmental, (2) economic and political, and (3) natural environment.

OBJECTIVES

The main objectives of this research are as follows:

1. To identify a list of critical success factors affecting bridge construction in Thailand.
2. To determine the level of importance of these critical success factors by using scoring method.

Scope and Limitation of research

This study concentrates in concrete bridge construction projects in Thailand. The study is conducted through structured questionnaires surveying the engineers who work for bridge construction projects. The participant parties consist of owners, consultants, and contractors, who have minimum 5 years experience in bridge construction.

Advantage of this study

In this study, critical success factors for bridge construction in Thailand will provide useful information for further research and help preventing project delay, cost overrun, and provide warranty quality of bridge construction in Thailand.

LITERATURE REVIEW

Definition of project success

The investigation on project success is very attractive to many of researchers and practitioners. D.K.H Chua, Y.C. Kog, and P.K Loh (1999) had defined success construction projects as those that finished under the budget, within schedule, and with high quality. The analytic hierarchy process is adopted to determine the relative importance factors, sixty seven success factors are considered and grouped in to four main factors as shown below:

A. Project characteristics include: (1) Political risks, (2) economic risks, (3) impacts on public, (4) technical approval authorities, (5) adequacy of funding, (6) site limitation and location, (7) construction ability, (8) pioneering status, (9) project size.

B. Contractual arrangements include: (10) realistic obligations/clear objectives, (11) risk identification and allocation, (12) adequacy of plans and specifications, (13) formal dispute resolution process, (14) motivation/ incentives.

C. Project participants contain: (15) project competency, (16) project management authority, (17) project management commitment and involvement, (18) capability of client key personnel, (19) competency of client level of service, (20) client team turnover rate; (21) client top management, (22) client track record, (23) client level of service, (24) capability of contractor key personnel contractor track record, (25) competency of contractor proposed team, (26) contractor team turnover rate, (27) contractor top management support, (28) contractor track record, (29) contractor level of service, (30) capability of consultant key personnel, (31) competency of consultant proposed team, (32) consultant team turnover rate, (33) consultant top management support, (34) consultant track record, (35) consultant level of service, (36) capability of subcontractor key personnel, (37) competency of subcontractors proposed team, (38) subcontractors team turnover rate, (39) subcontractors top management support, (40) subcontractors track record, (41) subcontractors level of service, (42) capability of suppliers key personnel, (43)

competency of suppliers proposed team, (44) supplier team turnover rate, (45) supplier tip management support, (46) suppliers track record, (47) suppliers level of service.

D. Interactive processes consist of: (48) formal design communication, (49) informal design communication, (50) formal construction communication, (51) informal construction, (52) functional plans, (53) design complete at construction start, (54) constructability program, (55) level of modularization, (56) level of automation, (57) level of skilled labors required, (58) report updates, (59) budget updates, (60) schedule updates, (61) design control meetings, (62) construction control meetings, (63) site inspections, (64) work organization chart, (65) common goal, (66) motivational factor, (67) relationships.

The conclusion shows that project characteristics and contractual arrangements cannot be left out of the success equation; in other words, project success is not determined exclusively by the project manager, monitoring and control efforts.

Factors influencing project success or failure

The following literature reviews are the studies that identified factors affecting project success or failure. Where as a number of papers are prepared by local researchers, some of them are conducted by international researchers:

Wongpattananikorn (2005) presented causes of delay in a large infrastructure project (Suvannaphumi airport). The study was conducted by interviewing the owners, consultants, and contactors. Twelve groups of factors which lead to project delay were identified as: (1) drawing, (2) material and equipment inspection, (3) project planning, (4) project biding and contract arrangement, (5) materials, (6) machines, (7) labor, (8) project management, (9) communication, (10) financial, (11) construction implementations, and (12) other factors. Finally the study concluded from survey result of effect and frequency that drawing work is the most critical factor of project delay.

Abert P.C. Chan, Davod Scott, and Ada P.L. Chan (2004) presented factors affecting the success of a construction project. This is the theoretical study to understand the project success by reviewing seven journals of construction management namely: Construction Management and Economic Journal (UK), International Journal of Project Management (UK), Journal of Construction Procurement (UK), Journal of Construction Engineering and Management (US), Engineering Construction and Architectural Management Journal (UK), Journal of Management in Engineering (US), and Project Management Journal (US). The study can be grouped the success factors under five main categories. These include human related factors, project related factors, project procedures, project management actions, and external environment.

Songer and Molenaar (1997) introduced project characteristics for successful public sector design build. This paper discusses the results from a survey of 88 public sector design build personnel and structured interviews of federal agency representatives. They recognize the critical success of public sector design build into fifteen factors as follows: (1) well defined scope, (2) shared understanding of scope, (3) owner's construction sophistication, (4) adequate owner staffing, (5) established budget, (6) established completion date, (7) availability of design builders, (8) willingness to forego, (9) design input, (10) owner's risk aversion, (11) standard design specifications, (12) technologically advanced, (13) type of contract, (13) size of project, and (15) current state of the market, alternative financing option. In wrapping up, the first five project characteristics of public sector have the most impact on project success.

Iyer and Jha (2005) presented factors affecting cost performance: evidence from Indian construction project. The authors identified the project success criteria into 55 factors. The questionnaire of a five point scale was used to assess the attributes influence on cost performance. In this scale, 1 represents adversely affecting the cost of the project, 2 represents significantly affecting the cost, 3 represents marginally affecting the cost, 4 represents no effect on the cost, 5 represents help in saving in the cost of the project. Questionnaires were mailed to top Indian

construction industry professionals covering about 50 top and medium size organizations by selecting randomly from across the county. The research extracted seven factors. Critical success factors by the analyses of relative importance index (RII) are (1) project manager's competence, (2) top management support, (3) project manager's coordinating and leadership skill, (4) monitoring and feedback by the participants, (5) coordination among project participants, (6) owners competence and (7) favorable climatic condition.

Intaraphrom (2005) studied factors affecting the quality of building projects in the construction phase. The author suggested that the quality of project is the one factor of project success. There are numerous factors which play a major influence on the quality of building. This paper presents factors that could significantly affect the quality of building in construction phase. The structural questionnaires survey from Thai experienced engineers in building projects were sent. The researcher classified the success factors into four groups (causes related to project participants, causes by construction team, causes from the construction processes and the external causes). These four main factors consist of 39 sub factors. The questionnaires were sent to interviewer by mail and face interviews. By using the Relative Important Index method (RII), the study reveals the six most impacted factors such as: management skill of project manager, designer's knowledge in construction technique and process, coordinating ability of project manager, and care and responsibility of engineers and foremen.

Puagsopa (2005) presented the causes of contractor's delays in large building construction projects. The author identified the following delay factors (1) cause from materials, (2) cause from labor, (3) cause from equipment and machine, (4) cause from planning and management, (5) cause from finance, (6) cause of site engineers, (7) cause from subcontractors, (8) cause of coordination and communication. The paper studied 30 large buildings in Bangkok metropolitan area. In conclusion, the first three ranks of delay factors are problem of finance, problems due to subcontractors, and problems related to coordination and communication.

Chovichien (2001) presented the factors affecting the construction operations of the mass transit electrical train projects in Bangkok metropolis. The researcher analyzed factors affecting the construction operation of Bangkok mass transit system project (BTS) and metropolitan rapid transit authority (MRTA). The study was performed by analyzing frequencies of factors and cause effect diagram to come up with factors affecting the duration of projects. This paper classifies factors affecting performance into five groups as follow: (1) resource, (2) cooperation, (3) environmental and site of project, (4) government and state enterprise, (5) uncertain governmental and administration factors. In conclusion, the most critical factors effecting performance factors are (1) the experience and skill of personal and (2) the coordination factors.

Type of bridge

There are 4 types of bridge separated by the shape, loading, and the supports

1. Beam - The beam type is the simplest type of bridge. The beam bridge could be anything as simple as a plank of wood to a complex structure. It is made of two or more supports which hold up a beam.

2. Arch - In the arch type of bridge, weight is carried outward along two paths, curving toward the ground.

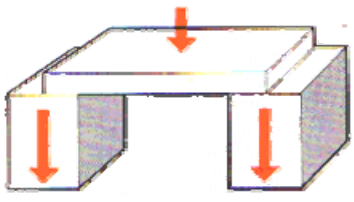

Figure 1 Beam Type Bridge

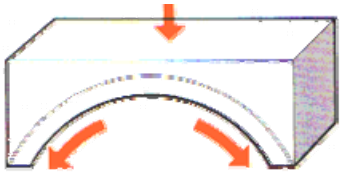

Figure 2 Arch Type Bridge

3. Suspension/Cable-stayed - The deck (traffic way) of a suspension bridge is hung by cables which hang from towers. The cables transfer the weight to the towers, which transfer the weight to the ground. Cable-stayed bridges have towers, but cables from the towers go directly to the road deck, instead of spanning from tower to tower

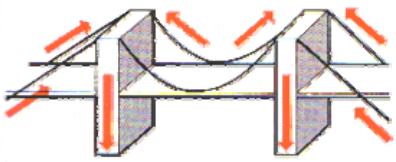

Figure 3 Suspension bridge

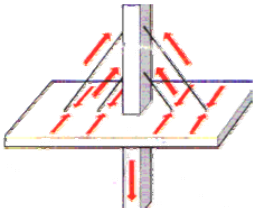

Figure 4 Cable stayed bridge

4. Cantilever - In the cantilever type of bridge, two beams support another beam, which is where the deck or traffic way is. The two beams must be anchored, and this must be done well.

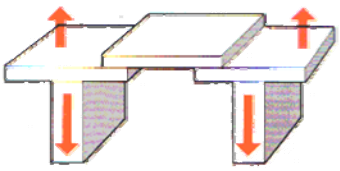

Figure 5 Cantilever bridge

MATERIALS AND METHODS

Project success is an abstract concept, and determining whether a project is a success or a failure is far more complex. However, the concept of project success can be evaluated through performance measures that can be developed from research literature where various success criteria can be identified.

Materials

The study tools consist of 4 items as follows:

1. A personal computer
2. A printer
3. A calculator
4. A questionnaire form

Methods

The basic element of the methodology consists of six major parts: (1) literature review, (2) questionnaire development, (3) pilot test, (4) data collection, (5) results, and (6) conclusions as the flow chart below:

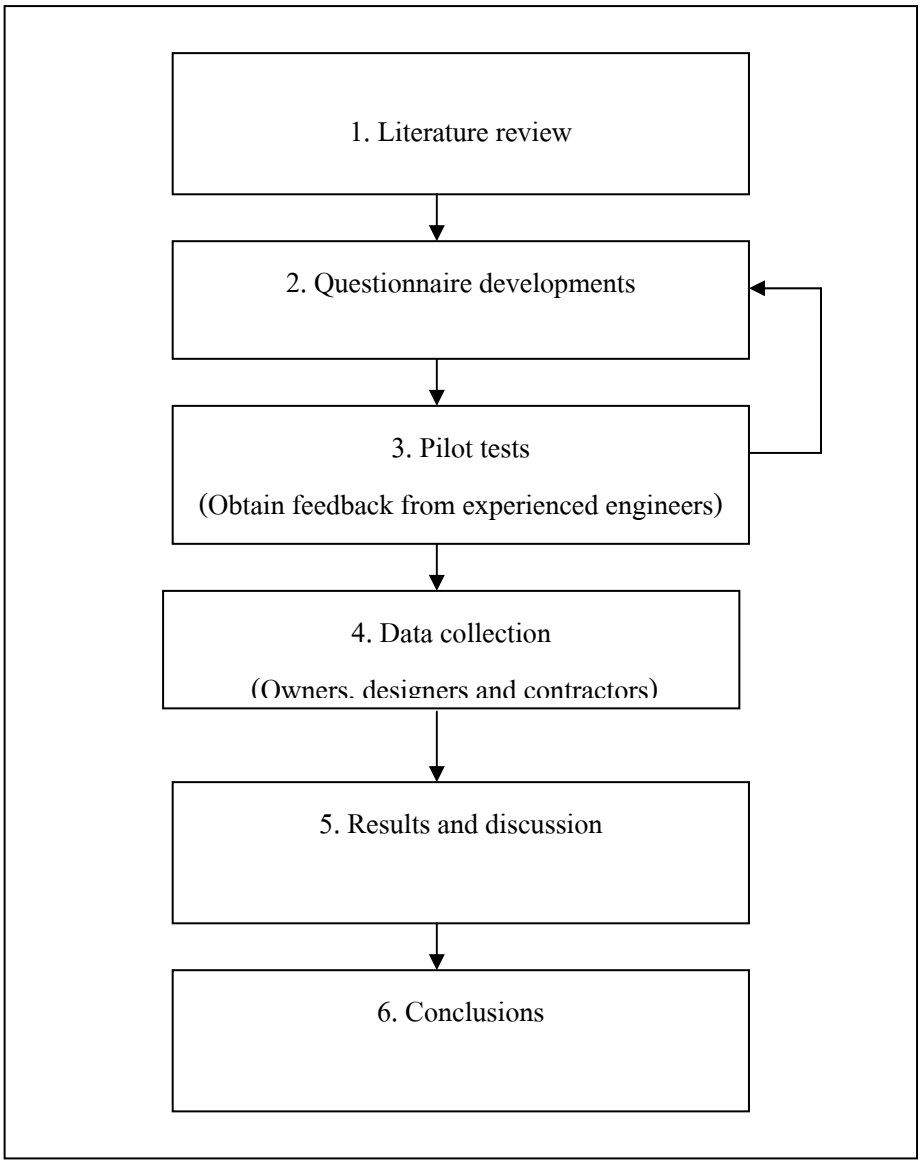

Figure 6 Research framework

Step 1 Literature review

1. Study on the papers, books and interview experienced individuals to find out success factors on bridge construction project
2. Study on the statistics theories to develop the questionnaire

Step 2 Questionnaire development

Developing questionnaire according to research objectives, the purposive sampling is applied for collecting data (BOUNSOM SRYSAAD, 2532). The target groups are engineers with at least 5 years of experience who are working as owners, designers, and contractors.

There are two parts in the questionnaire: (1) general information and (2) level of importance for each success factor.

The first part gathers general information of the respondents. The information includes names, parties, function in the projects, and working experience.

The second part of questionnaire is accessed level of importance of each of forty nine success factors (Dr. UTOUMPHON CHAMRAMAD, 2531), the five levels of importance rating score are

1= Lowest importance
2= Low importance
3= Moderate importance
4= High importance
5= Highest importance

The questionnaire was constructed in Thai language (Appendix D) to enhance the respondents' exercise of sound judgment.

Critical success factors

The major objectives in the construction project are budget, schedule, and quality, although there are other more specific objectives such as safety consideration and market entry, depending of the nature of the project and company. This paper presented four group factors: project participant, project characteristic, interactive process, and external factors.

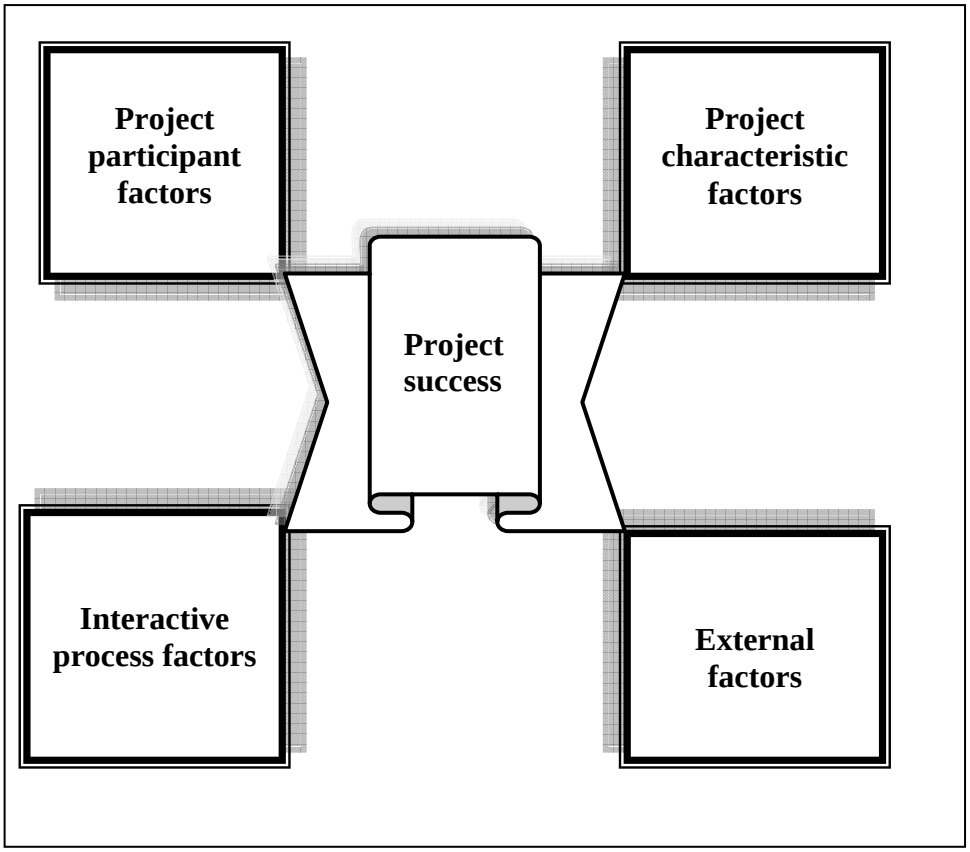

Figure 7 Framework of bridge construction success

Description of the factor in framework

This framework consists of four groups of factors as follow:

A. Project participant factors

Project participant factors are one of the most significant factors affecting project success, including owner, designer, manager, contactor, and subcontractor.

Owner

1: Knowledge and experience of the owner (PP1)

Designer

2: Skills and experience of designer (PP2)
3: Constructability of drawing (PP3)
4: Responsibilities of designers on dealing construction phase (PP4)

Manager

5: Managerial skills of project manager (PP5)
6: Experience in managing of similar projects (PP6)
7: Leadership of project manager (PP7)

Contractor

8: Cash flow of contractors (PP8)
9: Experience of contractor in bridge construction projects (PP9)
10: Workable machines and instruments at site of contractor (PP10)
11: Number of jobs in hand (PP11)
12: The coordination between contractors and sub-contractors (PP12)
13: Safety performance and safety policy of contractors (PP13)
14: Relationship between contractors and suppliers (PP14)

Sub-Contractor

15: Experience in bridge construction of sub-contractors (PP15)
16: Sufficiency of skilled labor and machine of sub-contractors (PP16)

B. Project characteristic factors

Project characteristics factors cover the contract document, project site, and the uniqueness of project.

Contract document

17: Using an appropriate contract type (PC1)

18: Well defined scope of works in the contract (PC2)

19: Clarity of contract documents (PC3)

20: Clarity of conflict resolution method specified in the contract documents (PC4)

21: Clarity of terms of payment in contract documents (PC5)

Project site

22: Density of traffic that interrupts construction activities (PC6)

23: The limitation of project site access (PC7)

24: Availability of utilities (PC8)

Uniqueness of project

25: Size, scope, and cost of project (PC9)

26: The uniqueness of project which requires advanced technical know-how (PC10)

C. Interactive process factors

Interactive process means the coordination among the organizations, proper communication, management and monitoring.

Planning

27: Appropriate and reasonable planning (IP1)

28: Usage of appropriate construction technique (IP2)

29: On site planning is integrated to other plan (IP3)

30: Reasonable project duration (IP4)

31: Availability of resources throughout the project period (IP5)

Organization

32: Effective organization chart (IP6)

33: Good document system (IP7)

Managing

34: Using efficient construction management techniques such as: critical path method, time cost tradeoff, resource allocation (IP8)

35: Using effective software in project managing such as: Microsoft project and Primavera (IP9)

36: Effective conflicts resolving method (IP10)

Monitoring and controlling

37: Effectiveness of monitoring and feedback systems (IP11)

38: Regular plan updating (IP12)

39: Good quality control system (IP13)

Communication and relationship

40: Use of informal communication among project teams (IP14)

41: Using formal communication such as: daily and weekly meeting (IP15)

Safety and health

42: Safety system and safety training program to project members (IP16)

D. External factors

Bridge construction projects are long term mission, and involve many organizations of government, state enterprise and private sectors. Many projects can be affected by external and uncontrolled factors such as social environment and culture factors, government policy and regulation factors, economic factors and natural environment.

Social environment

43: Conflicts caused by people who live nearby project (EF1)

Economic and political environment

44: Effects of inflation and exchange rates (EF2)
45: Economic tendency (EF3)
46: Fluctuation of material, machine, and labor costs (EF4)
47: Government policies which can affect construction industries (EF5)

Natural environment

48: Risk from natural disasters such as heavy rain, flooding, and storm (EF6)
49: Geological conditions of project site (EF7)

The four groups of factors: project participant factors, project characteristic factors, interactive process factors, and external factors are referenced to these documents as shown in Table 1

Table 1 Literature cite of forty nine factors

No	Factors	Literature cite
1	PP1	Suphachai Songsra (2002)
2	PP2	Suphachai Songsra (2002)
3	PP3	Suphachai Songsra (2002)
4	PP4	Puagsopa (2005)
5	PP5	Suphachai Songsra (2002)
6	PP6	Chovichien (2001)
7	PP7	Suphachai Songsra (2002)
8	PP8	Chovichien (2001)
9	PP9	Suphachai Songsra (2002)
10	PP10	Wongpattananikorn (2005)
11	PP11	Suphachai Songsra (2002)
12	PP12	D Songer, R Molenaar (1997)
13	PP13	D Songer, R Molenaar (1997)
14	PP14	Suphachai Songsra (2002)
15	PP15	Suphachai Songsra (2002)
16	PP16	Puagsopa (2005)
17	PC1	Suphachai Songsra (2002)
18	PC2	Abert P (2004)
19	PC3	Suphachai Songsra (2002)
20	PC4	Suphachai Songsra (2002)
21	PC5	Suphachai Songsra (2002)
22	PC6	Wongpattananikorn (2005)
23	PC7	K.C.Iyer, K.N.Jha (2003)
24	PC8	Wongpattananikorn (2005)
25	PC9	Intaraphrom (2005)
26	PC10	Abert P (2004)
27	IP1	Suphachai Songsra (2002)
28	IP2	Suphachai Songsra (2002)
29	IP3	Suphachai Songsra (2002)
30	IP4	Suphachai Songsra (2002)
31	IP5	Abert P (2004)
32	IP6	Suphachai Songsra (2002)
33	IP7	Suphachai Songsra (2002)
34	IP8	Suphachai Songsra (2002)
35	IP9	Wongpattananikorn (2005)
36	IP10	Suphachai Songsra (2002)
37	IP11	Suphachai Songsra (2002)
38	IP12	Abert P (2004)
39	IP13	Suphachai Songsra (2002)
40	IP14	Abert P (2004)
41	IP15	D Songer, R Molenaar (1997)
42	IP16	D Songer, R Molenaar (1997)
43	EF1	Suphachai Songsra (2002)
44	EF2	Suphachai Songsra (2002)
45	EF3	Suphachai Songsra (2002)
46	EF4	Suphachai Songsra (2002)
47	EF5	Abert P (2004)
48	EF6	D Songer, R Molenaar (1997)
49	EF7	K.C.Iyer, K.N.Jha (2003)

Step3 Pilot test

The final questionnaire was reviewed by the thesis committee and engineers who have experience in bridge construction.

Step 4 Data collection

Questionnaires are distributed to relevant engineer owners, designers, and contractors across the country by direct summit and by mail. Three aspects, time, cost, and quality are asked the respondents to find out critical success factors affecting bridge construction project in Thailand.

These organizations responding to the questionnaire

1. Department Of Highways
2. Department Of Rural Roads
3. Sengsawang Company
4. Yong Youth Karasin Company
5. Italian-Thai Development public Company Limited
6. CH. Karnchang Public Company Limited
7. Kungton Engirneering company Limited
8. Vichitbhan Construction Company Limited

Step 5 Results

The level of importance, which factor contributes to affect bridge project success was assigned by the respondents, and the statistics mean was computed for each factor. The factors were finally ranked in level of importance

The level of importance:

Mean of 4.51- 5.00	Highest level of importance
Mean of 3.51- 4.50	High level of importance
Mean of 2.51- 3.50	Moderate level of importance
Mean of 1.51- 2.50	Low level of importance
Mean of 1- 1.50	Lowest level of importance

$$M = \frac{\sum f.x}{N}$$

When M = *Mean value*

F =*Frequency*

X = *Weight of scale*

N= *Number of despondences*

On other hand, each factor data can compare the variation of respondents' scores, the standard deviation was applied.

$$S = \frac{\sum (x - \bar{x})^2}{N - 1}$$

When S= *Standard deviation*

X= *Weight of scale*

$\bar{x}$ = *Mean value*

N= *Number of despondences*

Step 6 Conclusion and recommendation

This section concludes and discusses the significant finding and advantage suggestions from this study.

RESULTS AND DISCUSSION

This section discusses significant findings from the study of critical factors affecting bridge project success. Forty nine factors are investigated from the engineers' opinions who work for owners, designers, and contractors in the projects. The first part of questionnaire is general information and the second part is factors affecting project success. The two parts are discussed separately.

The ratios of distributed and responded questionnaires are presented in Table 2. The percentages of total responses are 70% of all distributed, whereas the highest percentage of 74% is contractor party and the lowest percentage 60% is designer party.

Table 2 Percentage of distributed and responded questionnaires

Parties	Distributed forms	Responded forms	Responded percentages
Owner	30	21	70.00%
Designer	15	9	60.00%
Contractor	35	26	74.29%
Total	80	56	70.00%

1. General information

The first part of the questionnaire is to gather general information, including respondents' personal information, function in the projects, parties, and working experience.

The survey invited public sector owners and private sector contractors to investigate factors affecting the success of bridge construction. The 56 respondents including owners, designers, and contractors are presented in Table 3. The percentages of respondents from contractors, designer, and owner parties are 46.43%, 16.07% and 37.50%, respectively.

Table 3 Percentage of responded parties

Parties	Number of Respondents	Percentage (%)
Owner	21	37.50%
Designer	9	16.07%
Contractor	26	46.43%
Total	56	100%

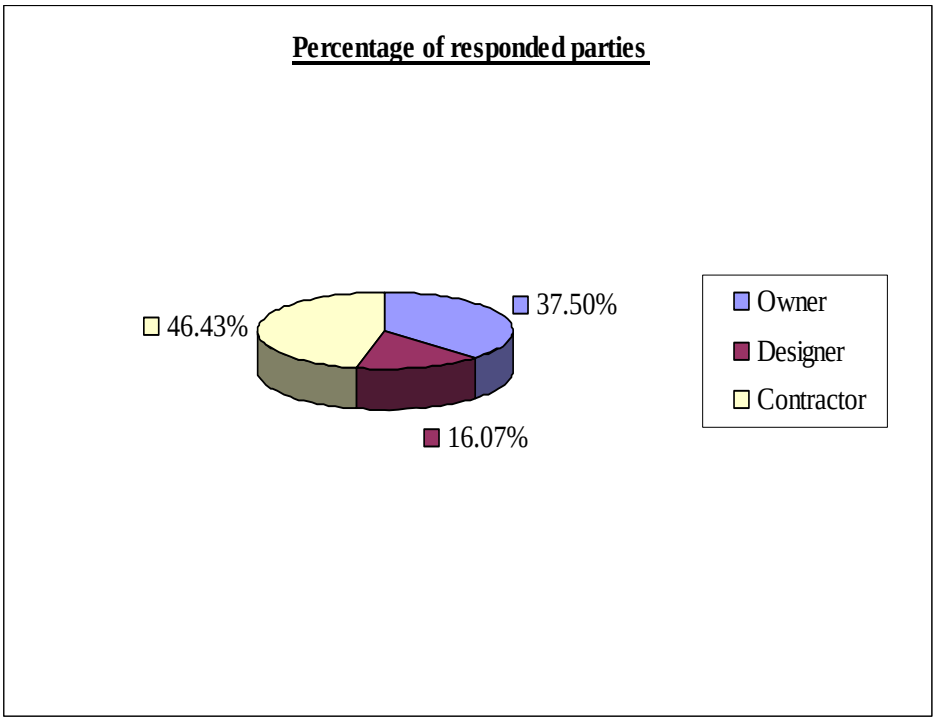

Figure 8 Percentage of responded parties

Table 4 shows the distribution of working experience. It can be seen that most of the respondents (55.36%) have working experience between 11-20 years, 30.36% have working experience between 5-10 years. But only 14.29% of all respondents have working experience between 21-30 years, and none of them has working experience over 30 years.

Table 4 Working experience of all respondents

Years of working experience	Number of Respondents	Percentage
5-10 years	17	30.36%
11-20 years	31	55.36%
21-30 years	8	14.29%
31years and Over	0	0.00%
Total	56	100%

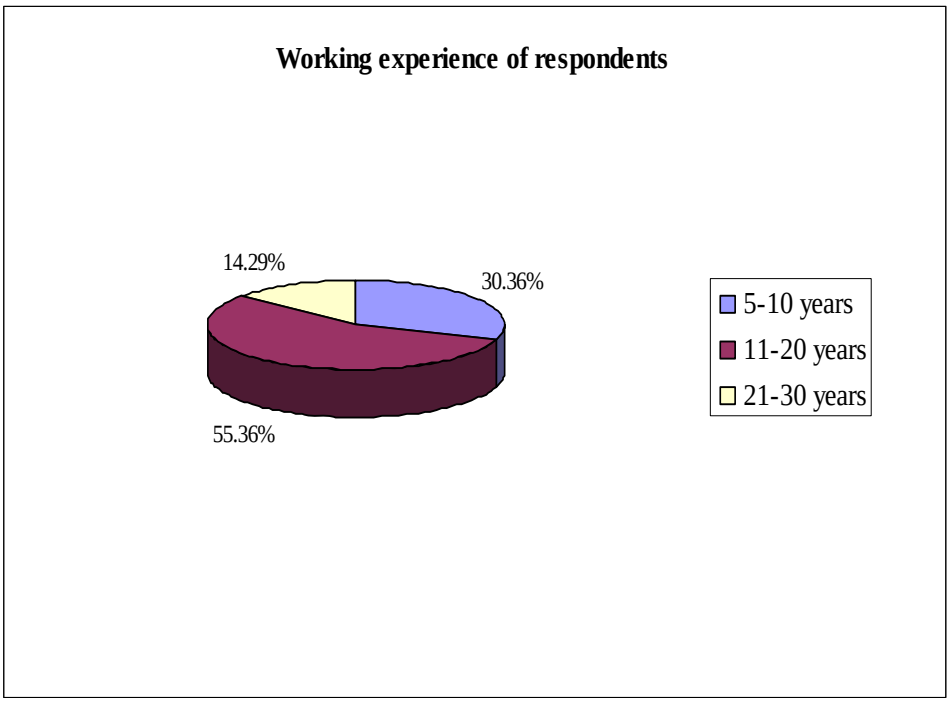

Figure 9 Working experience of respondents

The project roles of the respondents are shown in Table 5. The highest number of the respondent is site engineers at 46.43%, and the others are consultant (23.21%), designer (16.07%), and project manager (14.29%).

Table 5 Respondent's project roles.

Respondent's project roles	Number of Respondents	Percentage
Consultant	13	23.21%
Project manager	8	14.29%
Designer	9	16.07%
Site engineer	26	46.43%
Total	56	100%

2. Factors affecting the success of bridge construction in Thailand

Based on the 56 respondent's analysis, forty nine factors affecting bridge construction in Thailand were found as the project important factors. In order to fully understanding the studying result, these factors are identified in to four categories as project participant, project characteristic, interactive process, and external factors. The results of each factor analysis are separately discussed.

2.1. Project participant factors affecting project success

The project participant factors are determined for their significance based on the 56 respondents of the owners, designers, and contractors. The sixteen project participant factors are (1) knowledge and experience of owner ,(2) skill and experience of designer, (3) constructability of drawing, (4) responsibility of designer on dealing project construction phase, (5) managerial skills of project manager, (6) experience in managing of similar projects, (7) leadership of project manager, (8) cash flow of contractors, (9) experience of contractor in bridge construction projects, (10) workable machines and instruments at site of contractor, (11) number of jobs in hand of contractor company, (12) the coordination between contractor and sub-contractors, (13) safety performance and safety policy of contractors, (14) relationship between the contractors and suppliers, (15) experience in bridge construction of sub-contractors, (16) and sufficiency of skilled labor and machine of sub-contractors.

2.1.1 Project participant factors affecting project duration

Table 6 shows 16 project participant factors and the data of 56 respondents. The significance of each factor affecting project duration was examined through average and standard deviation.

The overall averages score 3.79 of project participant factor is shown at the end of table. That is the project participant factors were determined as high important level.

Table 6 Project participant factors affecting project duration

ID	Factors/Respondents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
PP1	Knowledge and experience of owner	4	3	2	4	3	2	5	4	3	4	3	4	4	4	4	4	3	5	5	4	4	4	4	5	4	4	4	4	4	3	5
PP2	Skills and experience of designer	4	4	3	4	2	3	5	4	4	5	3	4	4	4	4	4	3	4	4	5	5	4	3	5	4	4	3	3	3	3	4
PP3	Constructability of drawing	3	3	3	4	4	3	5	4	4	5	4	4	2	4	4	4	4	4	4	4	4	5	3	5	3	5	4	4	3	3	4
PP4	Responsibility of designer on dealing construction phase	3	3	3	4	2	3	4	3	4	5	3	4	2	3	4	3	3	4	4	5	4	4	3	4	3	4	3	4	5	5	3
PP5	Managing skills of project manager	3	4	4	4	4	4	5	4	4	5	4	5	3	4	5	4	4	5	5	4	5	4	4	4	3	4	4	4	4	4	4
PP6	Experience in managing of similar projects	3	4	4	4	3	5	5	4	4	5	3	5	3	4	5	4	4	5	5	4	4	4	4	4	3	3	4	4	3	3	4
PP7	Leadership quality of project manager	4	4	3	4	4	3	4	4	4	5	4	5	3	4	5	5	4	5	5	4		4	4	3	3	4	4	4	5	4	2
PP8	Cash flow of contractors	5	5	4	4	4	5	5	5	4	5	4	5	2	3	5	4	4	5	5	4	5	5	3	3	3	5	4	5	3	2	5
PP9	Experience of contractor in bridge construction projects	5	3	4	4	4	4	5	4	4	5	4	4	2	4	5	4	4	5	5	4	5	4	3	3	3	4	3	4	4	4	5
PP10	Workable machines and instruments at site of contractor	5	5	4	4	4	4	5	4	4	5	4	4	3	3	4	4	4	5	5	4	4	4	2	4	3	5	4	5	4	4	4
PP11	Number of jobs in hand	4	3	3	4	4	3	5	3	3	4	4	4	2	3	4	4	4	5	4	4	4	4	2	3	3	3	4	4	3	3	3
PP12	The coordination between contractors and sub-contractors	4	4	3	4	3	3	5	4	4	4	3	3	2	3	5	4	4	5	5	4	4	5	2	4	3	4	4	4	3	3	4
PP13	Safety performance and safety policies of contractors	2		3	4	2	4	3	4	4	5	3	4	3	3	3	4	2	5	5	4	3	2	2	4	3	4	3	3	3	3	3
PP14	Relationship of the contractors and the suppliers	2	4	3	4	3	4	4	4	4	4		4	2	4	5	4	3	5	5	4	4	4	3	3	3	4	4	4	2	2	2
PP15	Experience in bridge construction of sub-contractors	4	4	4	4	4	4	5	3	4	5	3	4	3	3	4	4	4	5	5	4	4	4	2	4	2	4	4	4	4	3	3
PP16	Sufficiency of skilled labor and machines of sub-	3	5	4	4	4	4	5	3	4	5	3	4	2	2	4	4	4	5	5	4	4	5	1	4	3	4	4	4	4	4	4

Table 6 Project participant factors affecting project duration (contd.)

ID	Factor/Respondents	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average $\bar{X}=\frac{\sum x}{N}$	Standar $S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
PP1	Knowledge and experience of owner	4	4	4	3	4	3	3	4	4	4	3	4	4	4	4	3	3	3	4	4	4	3	4	3	4	56	3.75	0.68
PP2	Skills and experience of designer	4	4	4	3	4	4	3	3	3	4	3	3	3	3	4	4	4	3	4	3	3	4	4	4	4	56	3.70	0.67
PP3	Constructability of drawing	5	4	4	4	4	2	2	4	2	3	2	2	4	3	4	2	4	3	5	4	4	3	3	3	4	56	3.63	0.87
PP4	Responsibility of designer on dealing construction phase	5	5	4	2	5	2	2	5	2	3	3	2	4	3	4	3	3	3	4	3	3	4	4	3	4	56	3.50	0.9
PP5	Managing skills of project manager	5	4	4	3	4	5	5	4	4	4	5	5	4	5	3	5	5	3	4	4	4	3	3	3	4	56	4.11	0.65
PP6	Experience in managing of similar projects	5	4	4	3	4	4	4	3	4	4	4	5	4	4	3	4	5	4	3	3	3	4	4	3	3	56	3.89	0.68
PP7	Leadership quality of project manager	5	4	4	4	4	4	3	4	4	3	4	4	3	4	3	3	5	4	4	3	4	3	3	2	3	55	3.84	0.76
PP8	Cash flow of contractors	5	5	5	4	5	4	5	2	4	4	4	5	4	5	3	5	4	3	4	4	3	3	4	3	4	56	4.13	0.9
PP9	Experience of contractor in bridge construction projects	5	5	5	3	5	4	5	3	4	4	4	5	4	5	4	5	5	3	4	4	4	4	3	2	4	56	4.07	0.78
PP10	Workable machines and instruments at site of contractor	5	5	5	4	5	4	4	4	4	4	4	5	4	4	4	4	5	3	5	4	3	3	3	3	4	56	4.09	0.7
PP11	Number of jobs in hand	5	4	5	3		4	4	4	4	3	4	4	4	4	4	4	3	3	5	4	4	3	3	2	4	55	3.65	0.73
PP12	The coordination between contractors and sub-contractors	5	3	4	3	4	4	5	3	4	3	3	5	4	3	4	4	3	4	5	4	3	3	4	3	3	56	3.73	0.78
PP13	Safety performance and safety policies of contractors	4	3	4	2	3	4	3	3	3	3	3	3	4	3	4	3	3	4	4	3	4	3	4	2	3	55	3.31	0.79
PP14	Relationship of the contractors and the suppliers	4	4	4	2	4	5	3	3	3	3	3	4	3	4	3	3	3	3	4	4	3	4	4	3	3	55	3.51	0.8
PP15	Experience in bridge construction of sub-contractors	5	5	4	3	4	5	5	4	4	3	4	5	4	5	3	5	4	3	4	3	4	3	4	2	4	56	3.88	0.79
PP16	Sufficiency of skilled labor and machines of sub-contractors	5	5	4	3	4	3	4	5	4	4	4	4	4	4	4	5	4	5	4	4	4	4	4	3	4	56	3.95	0.8
		Total average																										3.79	0.77

According to Table 6, Table 7 presents average scores as well as ranking of the sixteen project participant factors. These factors were ranked from the highest to the lowest. It illustrates that Cash flow of contractor (PP8) has the highest average score of 4.13, which was determined as high important level. While the safety performance and safety policy of contractor (PP13) has the lowest average score of 3.31, and it was determined as moderate level.

Table 7 Average level of importance and ranks of 16 project participant factors affecting project duration

Rank	ID	Project participant factors	Average
1	PP8	Cash flow of contractors	4.13
2	PP5	Managerial skills of project manager	4.11
3	PP10	Workable machines and instruments at site of contractor	4.09
4	PP9	Experience of contractor in bridge construction projects	4.07
5	PP16	Sufficient skilled labors and machine of sub-contractors	3.95
6	PP6	Experience in managing of similar projects	3.89
7	PP15	Experience in bridge construction of sub-contractors	3.88
8	PP7	Leadership of project manager	3.84
9	PP1	Knowledge and experience of owner	3.75
10	PP12	The coordination between contractor and sub-contractors	3.73
11	PP2	Skill and experience of designer	3.70
12	PP11	Number of jobs on hand of contractor company	3.65
13	PP3	Constructability of drawing	3.63
14	PP14	Relationship between contractors and suppliers	3.51
15	PP4	Responsibilities of designer on dealing with construction phase	3.50
16	PP13	Safety performance and safety policy of contractors	3.31

2.1.2 Project participant factors affecting project cost

Table 4.7 shows 16 project participant factors and the data of 56 respondents. The significance of each factor affecting project cost was examined through average and standard deviation.

The overall averages score 3.67 of project participant factor is shown at the end of table. In conclusion, the project participant factors were determined as high important level.

Table 8 Project participant factors affecting project cost

ID	Factors/Respondents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
PP1	Knowledge and experience of owner	4	2	3	4	3	2	4	2	3	5	3	4	3	4	4	4	4	4	4	4	4	2	3	5	5	3	4	4	3	2	5
PP2	Skills and experience of designer	4	4	3	4	4	4	5	2	4	5	3	5	3	4	5	4	4	5	5	4	5	4	3	5	5	3	4	3	2	2	4
PP3	Constructability of drawing	3	3	3	4	4	3	5	4	4	4	4	5	3	3	5	4	4	5	5	4	3	5	3	5	3	5	4	4		4	4
PP4	Responsibility of designer on dealing construction phase	3	3	2	4	3	3	4	3	4	4	3	4	4	3	4	3	3	5	4	4	4	3	3	4	2	4	3	3	4	3	2
PP5	Managing skills of project manager	3	4	4	4	4	2	4	3	4	5		4	3	4	4	4	4	3	3	4	2	3	4	4	4	4	4	4	3	3	4
PP6	Experience in managing of similar projects	3	4	4	4	3	4	3	4	3	5		4	4	4	4	4	4	3	3	4	2	3	4	4	3	3	4	4	4	3	4
PP7	Leadership quality of project manager	4	4	3	4	3	3	3	3	4	5		4	4	4	4	4	4	3	3	4		3	4	3	3	3	4	4	3	3	2
PP8	Cash flow of contractors	4	5	3	4	4	3	5	4	4	5	3	4	4	4	5	4	4	3	3	4	3	4	3	3	3	4	4	4	3	3	3
PP9	Experience of contractor in bridge construction projects	5	3	3	4	4	4	4	4	4	5	3	4	4	3	5	4	4	3	3	4	3	4	4	3	3	5	4	3	4	4	4
PP10	Workable machines and instruments at site of contractor	5	5	4	4	4	4	3	4	4	5		4	3	3	5	4	4	5	5	4	4	4	3	4	3	4	4	4	4	4	4
PP11	Number of jobs in hand	4	3	2	4	2	3	3	3	3	4	3	4	3	3	4	4	4	4	3	3	3	2	3	3	3	3	3	4	3	3	2
PP12	The coordination between contractors and sub-contractors	4	4	3	4	3	3	3	3	4	4	2	4	4	4	5	3	3	4	4	4	2	4	3	4	3	4	3	4	4	4	3
PP13	Safety performance and safety policies of contractors	2		3	4		4	3	3	4	5	2	4	4	3	4	4	3	5	5	4	3	5	3	4	3	4	3	3	2	3	2
PP14	Relationship of the contractors and the suppliers	3	3	2	4	2	3	3	3	3	4		4	4	3	5	4	3	4	4	4	3	3	3	3	3	4	3	4	2	2	3
PP15	Experience in bridge construction of sub-contractors	4	3	3	4	3	3	3	3	4	5	3	4	4	3	4	4	4	5	5	4	2	3	2	4	3	4	4	4	3	3	3
PP16	Sufficiency of skilled labor and machines of sub-contractors	3	5	3	4	2	2	3	3	4	5	2	4	2	3	4	4	4	4	4	4	1	3	2	4	3	3	4	3	4	3	3

Table 8 Project participant factors affecting project cost (contd.)

ID	Factors/Respondents	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average $\overline{X} = \frac{\sum x}{N}$	Standar $S = \sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$ d
PP1	Knowledge and experience of owner	4	3	4	3	3	3	3	3	3	3	3	3	4	3	4	4	2	3	5	4	3	3	4	4	4	56	3.48	0.81
PP2	Skills and experience of designer	5	3	4	4	4	4	3	3	3	3	3	4	5	4	4	3	3	3	4	4	3	4	4	3	4	56	3.79	0.83
PP3	Constructability of drawing	5	4	4	4	4	3	3	5	3	3	3	4	4	4	3	3	4	4	4	5	4	4	4	3	4	55	3.89	0.71
PP4	Responsibility of designer on dealing construction phase	5	3	4	4	4	2	2	3	2	3	3	2	4	2	3	2	3	4	4	4	5	3	4	3	4	56	3.34	0.82
PP5	Managing skills of project manager	4	3	4	4	4	4	4	3	3	4	3	4	4	4	3	5	5	5	4	4	4	3	4	4	4	55	3.75	0.65
PP6	Experience in managing of similar projects	4	3	4	4	4	4	5	3	4	4	4	4	4	5	3	5	5	5	5	4	5	3	4	3	4	55	3.84	0.69
PP7	Leadership quality of project manager	4	3	4	3	4	4	3	4	4	4	4	3	4	3	3	4	5	4	5	4	4	3	4	3	4	54	3.63	0.63
PP8	Cash flow of contractors	5	4	5	3	5	3	3	3	3	4		5	3	4	3	4	4	4	5	4	4	4	4	3	3	55	3.78	0.71
PP9	Experience of contractor in bridge construction projects	5	4	5	3	5	3	5	4	4	4	5	5	3	4	4	5	5	5	4	4	3	3	4	3	3	56	3.93	0.74
PP10	Workable machines and instruments at site of contractor	5	4	5	4	4	3	4	4	4	3	5	4	3	4	4	5	5	4	4	4	4	3	4	3	4	55	4.02	0.62
PP11	Number of jobs in hand	5	3	5	3		4	3	3	3	4	4	4	3	4	4	4	3	5	5	5	5	3	4	3	4	55	3.47	0.8
PP12	The coordination between contractors and sub-contractors	5	3	4	3	4	4	5	3	3	4	4	5	3	5	4	4	3	4	4	4	3	4	4	3	4	56	3.68	0.7
PP13	Safety performance and safety policies of contractors	4	3	4	3	3	3	4	3	3	4	4	3	3	3	3	4	3	5	5	5	4	4	4	4	3	54	3.56	0.82
PP14	Relationship of the contractors and the suppliers	5	4	4	2	3	4	4	2	3	3	4	3	4	3	4	3	3	4	4	4	5	4	3	4	4	55	3.42	0.9
PP15	Experience in bridge construction of sub-contractors	5	4	4	2	3	4	5	2	4	4	4	4	4	4	4	3	3	5	4	5	3	4	3	3	3	56	3.63	0.8
PP16	Sufficiency of skilled labor and machines of sub-contractors	5	4	4	3	4	4	4	3	4	3	4	5	3	4	4	5	4	5	4	4	4	4	4	4	4	56	3.61	0.87
		Total average																										3.67	0.76

According to Table 8, Table 9 shows average scores as well as ranking of the sixteen project participant factors. These factors were ranked from the highest to the lowest. It illustrates that workable machines and instruments at site of contractor (PP8) has the highest average score of 4.02, which was determined as high important level. While the responsibility of designer on dealing construction phase (PP4) has the lowest average score of 3.34, and it was determined as moderate level.

Table 9 Average level of importance and ranks of 16 project participant factors affecting project cost

Rank	ID	Project participant factors	Average
1	PP10	Workable machines and instruments at site of contractor	4.02
2	PP9	Experience of contractor in bridge construction projects	3.93
3	PP3	Constructability of drawing	3.89
4	PP6	Experience in managing of similar projects	3.84
5	PP2	Skill and experience of designer	3.79
6	PP8	Cash flow of contractors	3.78
7	PP5	Managerial skills of project manager	3.75
8	PP12	The coordination between contractors and sub-contractors	3.68
9	PP15	Experience in bridge construction of sub-contractors	3.63
10	PP7	Leadership of project manager	3.63
11	PP16	Sufficient skilled labor and machine of sub-contractors	3.61
12	PP13	Safety performance and safety policy of contractors	3.56
13	PP1	Knowledge and experience of the owner	3.48
14	PP11	Number of jobs on hand of contractor company	3.47
15	PP14	Relationship between contractors and suppliers	3.42
16	PP4	Responsibilities of designers on dealing construction phase	3.34

2.1.3 Project participant factors affecting project quality

Table 10 shows 16 project participant factors and the data of 56 respondents. The significance of each factor affecting project quality was examined through average and standard deviation.

The overall averages score 3.75 of project participant factor is shown at the end of table. That is the project participant factors were determined as high important level influencing project quality.

Table 10 Project participant factors affecting project quality

ID	Factors/Respondents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
PP1	Knowledge and experience of owner	4	3	3		4	2	5	4	3	5	3	4	4	4	5	4	4	5	5	4	4	4	3	4	4	4	4	4	3	3	4
PP2	Skills and experience of designer	3	4	4	4	4	3	4	3	4	5	3	4	4	3	5	4	3	4	4	4	4	4	3	5	4	4	4	3	2	2	4
PP3	Constructability of drawing	3	4	3	4	4	3	5	3	4	5	3		3	4	5	4	3	4	4	4	4	5	3	5	2	5	3	4	3	3	3
PP4	Responsibility of designer on dealing construction phase	3	3	4	4	3	3	5	3	4	5	2		4	3	5	4	2	5	5	4	4	2	3	4	2	4	3	3		4	2
PP5	Managing skills of project manager	3	3	4	4	5	5	5	4	4	5			4	4	4	4	4	5	5	4	4	2	4	4	4	4	4	4	2	3	4
PP6	Experience in managing of similar projects	3	3	3	4	3	3	4	4	3	5			4	4	5	4	4	5	5	4	4	3	4	4	3	3	4	4	5	2	4
PP7	Leadership quality of project manager	4	3	2	4	2	2	5	4	4	5			4	4	5	4	4	5	5	4		2	4	3	3	3	4	4	4	3	2
PP8	Cash flow of contractors	4	5	4	4	2	3	5	3	4	5	3	4	3	3	5	4	4	5	5	4	5	4	3	3	4	4	4	4	4	3	3
PP9	Experience of contractor in bridge construction projects	5	3	4	4	4	3	5	4	4	5	2	4	3	3	5	4	4	5	5	4	5	5	4	3	4	4	4	4	4	4	4
PP10	Workable machines and instruments at site of contractor	5	5	4	4	4	3	5	4	4	5	3	4	4	4	5	4	4	5	5	4	4	5	3	4	4	5	4	4	5	3	4
PP11	Number of jobs in hand	4	3	2	4	2	2	5	3	3	5	2	3	3	4	4	4	4	4	3	3	5	4	3	3	4	4	3	4	3	3	2
PP12	The coordination between contractors and sub-contractors	4	4	3	4	2	2	5	3	4	5	3	4	3	3	5	4	4	5	5	4	4	4	3	4	4	4	3	4	4	2	3
PP13	Safety performance and safety policies of contractors	2		3	4	1	3	3	3	4	5	3	4	4	3	3	4	3	4	4	4	4	3	2	4	4	4	3	3	3	3	2
PP14	Relationship of the contractors and the suppliers	3	2	3	4	1	2	4	4	3	5		4	4	3	5	4	3	4	3	3	4	3	3	3	4	4	3	4	1	4	2
PP15	Experience in bridge construction of sub-contractors	4	5	4	4	1	3	5	3	4	5	3	5	4	3	5	4	4	5	5	4	4	4	2	4	4	4	4	4	3	4	4
PP16	Sufficiency of skilled labor and machines of sub-contractors	3	5	4	4	4	3	5	3	4	5	2	4	2	3	5	4	4	4	4	5	4	5	2	4	3	4	3	4	3	4	4

Table 10 Project participant factors affecting project quality (contd.)

ID	Factor/Respondents	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average $\bar{X}=\frac{\sum X}{N}$	Standar $S=\sqrt{\frac{\sum(X-\bar{X})^2}{N-1}}$
PP1	Knowledge and experience of owner	4	4	4	3	5	5	5	3	4	2		5	4	4	4	4	1	3	5	4	3	4	4	4	3	54	3.83	0.84
PP2	Skills and experience of designer	5	4	4	4	4	5	4	2	4	3	4	5	4	4	4	3	5	4	4	5	4	4	3	4	3	56	3.82	0.75
PP3	Constructability of drawing	5	3	4	4	4	5	5	3	5	3	5	5	4	5	4	5	5	3	4	4	4	4	4	4	3	55	3.93	0.82
PP4	Responsibility of designer on dealing construction phase	5	3	4	4	2	2	2	4	2	4	2	4	3	2	3	3	3	4	3	5	4	3	3	4	4	54	3.41	0.98
PP5	Managing skills of project manager	5	3	4	4	4	5	5	3	4	4	4	4	3	4	3	5	5	3	3	5	4	3	3	3	4	54	3.93	0.77
PP6	Experience in managing of similar projects	5	3	4	3	4	5	5	2	4	4	4	4	3	4	3	5	5	3	3	4	3	3	3	3	5	54	3.78	0.82
PP7	Leadership quality of project manager	5	3	4	4	4	4	3	3	3	4	4	3	3	3	4	4	5		3	4	3	4	3	4	4	52	3.65	0.84
PP8	Cash flow of contractors	5	3	5	4	5	4	4	3	3	4	5	4	3	4	3	5	1	3	4	4	3	4	3	3	4	56	3.8	0.86
PP9	Experience of contractor in bridge construction projects	5	4	5	3	5	5	5	3	3	4	5	4	3	4	4	4	3	4	4	5	3	3	3	3	5	56	4	0.79
PP10	Workable machines and instruments at site of contractor	5	5	5	4	5	4	4	4	3	4	5	4	3	4	4	3	4	4	4	4	3	3	3	3	5	56	4.09	0.7
PP11	Number of jobs in hand	5	4	5	3		4	3	3	3	4	4	3	4	4	4	4	3		4	4	3	3	3	4	4	54	3.52	0.8
PP12	The coordination between contractors and sub-contractors	5	3	4	4	4	5	5	2	4	4	4	3	3	4	4	3	3		4	5	4	3	4	4	4	55	3.76	0.82
PP13	Safety performance and safety policies of contractors	3	3	4	3	3	4	3	2	3	3	4	3	3	3	4	3	2		4	4	4	3	4	4	4	54	3.31	0.76
PP14	Relationship of the contractors and the suppliers	5	3	4	2	4	4	3	2	3	4	3	4	4	3	4	3	3		4	5	4	3	4	3	4	54	3.41	0.91
PP15	Experience in bridge construction of sub-contractors	5	4	4	3	4	4	5	3	5	3	4	4	3	3	3	4	5	4	4	5	3	3	3	3	3	56	3.84	0.85
PP16	Sufficiency of skilled labor and machines of sub-contractors	5	3	4	4	4	5	5	4	5	4	5	5	3	5	3	5	4	4	4	4	4	4	4	4	4	56	3.96	0.81
		Total average																										3.75	0.82

According to Table 10, Table 4.11 presents average scores as well as ranking of the sixteen project participant factors. These factors were ranked from the highest to the lowest. It illustrates that workable machines and instruments at site of contractor (PP10) has the highest average score of 4.09, which was determined as high important level. While the safety performance and safety policy of contractor (PP13) has the lowest average score of 3.31, and it was determined as moderate level.

Table 11 Average level of importance and ranks of 16 project participant factors affecting project quality

Rank	ID	Project participant factors	Average
1	PP10	Workable machines and instruments at site of contractor	4.09
2	PP9	Experience of contractor in bridge construction projects	4
3	PP16	Sufficient skilled labor and machine of sub-contractors	3.96
4	PP3	Constructability of drawing	3.93
5	PP5	Managerial skills of project manager	3.93
6	PP15	Experience in bridge construction of sub-contractors	3.84
7	PP1	Knowledge and experience of the owner	3.83
8	PP2	Skill and experience of designer	3.82
9	PP8	Cash flow of contractors	3.8
10	PP6	Experience in managing of similar projects	3.78
11	PP12	The coordination between contractors and sub-contractors	3.76
12	PP7	Leadership of project manager	3.65
13	PP11	Number of jobs on hand of contractor company	3.52
14	PP14	Relationship between contractors and suppliers	3.41
15	PP4	Responsibilities of designers on dealing with construction phase	3.41
16	PP13	Safety performance and safety policy of contractors	3.31

2.2. Project characteristic factors affecting project success

Factors in this group, those relating to project characteristics including the factors of (1) using appropriate contract type, (2) well defined scope of works in the contract, (3) clarity of contract documents, (4) clarity of conflict resolution specified in contract documents, (5) clarity of term of payment in contract documents, (6) density of traffic that interrupts construction activities, (7) the limitation of project site, (8) the advantage utility supplies, (9) size and cost of project , (10) uniqueness of project requiring advanced technical know-how .This study is based on 56 participants of three parties. The three aspects of project duration, project cost, and project quality are separately considered.

2.2.1. Project characteristic factors affecting project duration.

Table 12 shows 10 project characteristic factors and the data of 56 respondents. The significance of each factor affecting project duration was examined through average and standard deviation.

The overall averages score 3.74 of project characteristic factor is shown at the end of table. That is the project characteristic factors were determined as high important level influencing project duration.

Table 12 Project characteristic factors affecting project duration

ID	Factors/Respondents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
PC1	Using appropriate contract type	4	4	3	4	2	5	5	2	4	5	2	5	3	3	5	5	4	5	5	3	4	2		4	2	3	4	4	3	4	3
PC2	Well defined scope of works in the contract	4	4	3	4	3	3	4	3	4	5	3	4	3	4	4	4	4	5	5	4	4	3		5	4	4	4	3	2	3	4
PC3	Clarity of contract documents	5	4	2	4	3	3	4	3	4	5	4	4	3	3	3	4	4	5	5	4	3	2		5	4	4	4	3	2	2	4
PC4	Clarity of conflict resolution specified in contract document	4	4	2	4	2	5	3	3	4	4	3	4	3	3	4	4	4	5	5	3	3	3		2		4	4	3	3	3	4
PC5	Clarity of terms of payment in contract documents	4	4		4	3	3	4	4	4	4	4	3	3	4	2	4	4	3	2	3	3	2		2	4	4	4	2	4	4	3
PC6	Density of traffic that interrupts construction activities	4	5	3	4	4	5	5	5	4	4	4	5	4	5	5	4	4	5	4	4	4	4	4	2	5	5	4	4	4	4	4
PC7	The limitation of project site access	4	3	3	4	4	4	5	4	4	4	3	4	4	4	4	4	4	5	5	4	4	4	3	3	4	5	4	3	3	2	4
PC8	Availability of utilities	4	2	3	4	5	3	5	4	4	4	4	4	4	3	5	4	3	5	5	4	5	4	2	2	4	5	3	4	2	3	3
PC9	Size and cost of project	5		4	4	2	4	4	3	4	3	3	4	3	3	5	4	4	5	5	4	4	4	4	4	3	4	4	3	2	3	5
PC10	Uniqueness of project which requiring advanced technical know-how	4	5	3	4	3	5	5	3	4	4	4	4	3	3	5	4	4	5	5	4	5	5	3	5	4	4	4	3	3	4	4

ID	Factors/Respondents	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average $\overline{X}=\frac{\sum X}{N}$	Standard $S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
PC1	Using appropriate contract type	4	5	5	3	4	3	2	5	3	3	3	3	4	2	4	2	3	3	4	5	4	3	3	3	4	55	3.60	1.01
PC2	Well defined scope of works in the contract	4	4	5	4	3	3	2	4	3	4	3	2	4	2	4	3	4	4	3	5	4	4	4	4	4	55	3.69	0.77
PC3	Clarity of contract documents	4	4	5	4	3	3	3	3	3	3	3	3	3	2	4	3	3	5	3	4	4	4	4	3	3	55	3.54	0.84
PC4	Clarity of conflict resolution specified in contract document	3	3	5	3		4	4	3	5	3	4	4	3	4	3	4	3	3	4	4	5	4	4	4	4	53	3.62	0.77
PC5	Clarity of terms of payment in contract documents	5	3	5	4	4	4	4	4	5	4	4	3	3	4	3	4	3	3	4	3	4	3	3	3	3	54	3.52	0.75
PC6	Density of traffic that interrupts construction activities	5	4	5	4	5	5	5	4	5	4	4	5	3	5	4	5	4	4	3	3	3	3	3	3	4	56	4.16	0.73
PC7	The limitation of project site access	5	4	5	4	4	5	5	4	5	2	4	5	4	5	4	5	5	3	4	4	3	3	3	4	4	56	3.96	0.76
PC8	Availability of utilities	5	4	5	3	4	4	4	2	4	3	4	5	4	5	4	4	3	3	4	4	3	3	3	3	4	56	3.75	0.88
PC9	Size and cost of project	4	3	5	3	4	3	3	4	4	3	3	3	4	4	4	3	5	3	4	4	4	3	3	4	4	55	3.71	0.73
PC10	Uniqueness of project which requiring advanced technical know-how	5	3	4	2	5	3	4	3	4	3	3	3	4	4	4	3	4	4	3	3	4	4	4	3	4	56	3.84	0.76
		Total average																										3.74	0.8

According to Table 12, Table 13 presents average scores as well as ranking of the ten project characteristic factors. These factors were ranked from the highest to the lowest. It illustrates that the density of the traffic that interrupts construction activities (PC6) has the highest average score of 4.16, which was determined as high important level. While the clarity of term of payment in contract documents (PC5) has the lowest average score of 3.52, and it was determined as high important level.

Table 13 Average level of importance and ranks of 10 project characteristic factors affecting project duration

Rank	ID	Project characteristic factors	Average
1	PC6	Density of traffic that interrupts construction activities	4.16
2	PC7	The limitation of project site	3.96
3	PC10	Uniqueness of project requires advance technical know-how	3.84
4	PC8	The advantage utility supplies	3.75
5	PC9	Size and cost of project	3.71
6	PC2	Well defined scope of works in the contract	3.69
7	PC4	Clarity of conflict resolution specified in contract documents	3.62
8	PC1	Using appropriate contract type	3.60
9	PC3	Clarity of contract documents	3.54
10	PC5	Clarity of terms of payment in contract documents	3.52

2.2.2 Project characteristic factors affecting project cost.

Table 14 shows 10 project characteristic factors and the data of 56 respondents. The significance of each factor affecting project cost was examined through average and standard deviation.

The overall averages score 3.62 of project characteristic factor is shown at the end of table. That is the project characteristic factors were determined as high important level influencing project cost.

Table 14 Project characteristic factors affecting project cost

ID	Factors/Respondents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
PC1	Using appropriate contract type	4	4	3	4	2	4	4	4	4	4	3	4	3	3	4	4	4	1	1	4	4	2	2	4	2	3	4	4	2	4	4
PC2	Well defined scope of works in the contract	4	5	3	4	3	5	3	4	4	4	2	4	3	3	4	4	4	5	5	4	4	3		5	4	4	4	3	1	3	4
PC3	Clarity of contract documents	5	5	2	4	2	3	4	5	4	4	3	3	3	3	3	4	4	5	5	4	3	2		5	4	4	4	3	2	3	3
PC4	Clarity of conflict resolution specified in contract document	4	3	2	4	2	3	4	2	4	4	3	3	3	3	2	4	4	3	3	3	3	2		2		3	4	3	3	3	2
PC5	Clarity of terms of payment in contract documents	4	4		4	3	3	5	4	4	4	2	3	4	4	2	3	4	3	3	3	3	2		2	4	4	4	2	2	3	2
PC6	Density of traffic that interrupts construction activities	4	4	3	4	4	4	4	4	4	4		4	4	4	4	4	4	5	5	3	4	3	4	3	5	4	4	3	3	3	4
PC7	The limitation of project site access	4	4	3	4	4	4	4	3	4	4		4	3	4	4	4	4	5	5	4	4	3	3	3	4	5	4	3	2	1	4
PC8	Availability of utilities	4	4	3	4	5	4	4	3	4	4		5	3	4	5	4	3	5	5	3	4	4	3	2	4	5	4	4	3	2	2
PC9	Size and cost of project	5			4	2	5	4	3	4	3	4	5	4	4	5	4	4	5	5	4	4	5	4	4	3	4	3	3	4	3	5
PC10	Uniqueness of project which requiring advanced technical know-how	4	5	4	4	3	4	5	3	4	4	2	5	4	3	5	4	4	5	5	4	5	5	3	5	4	3	4	3	2	4	4

ID	Factors/Respondents	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average $\overline{X}=\frac{\sum X}{N}$	Standard $S=\sqrt{\frac{\sum(X-\overline{X})^2}{N-1}}$
PC1	Using appropriate contract type	4	5	5	3	4	3	3	4	3	4	3	3	3	3	4	3	3	3	4	3	3	4	4	4	3	56	3.41	0.86
PC2	Well defined scope of works in the contract	5	4	5	4	4	4	3	3	3	4	4	4	3	3	4	3	4	4	4	4	4	3	4	3	4	55	3.75	0.78
PC3	Clarity of contract documents	3	4	5	4	4	4	3	3	3	3	4	4	4	4	4	3	3	3	4	4	3	4	3	4	4	55	3.62	0.81
PC4	Clarity of conflict resolution specified in contract document	3	3	5	3		3	3	3	3	3	3	3	4	3	4	3	3	4	4	4	4	4	4	4	4	53	3.25	0.72
PC5	Clarity of terms of payment in contract documents	5	3	5	3	4	4	4	3	4	3	4	4	4	3	4	4	3	3	3	3	4	3	4	4	4	54	3.44	0.8
PC6	Density of traffic that interrupts construction activities	5	3	5	4	4	4	4	3	4	3	4	4	3	4	4	4	3	4	3	3	4	3	4	3	4	55	3.8	0.59
PC7	The limitation of project site access	5	3	5	4	4	4	3	4	3	3	4	4	3	4	4	3	4	3	3	3	3	4	4	3	3	55	3.65	0.75
PC8	Availability of utilities	5	3	5	3	3	4	3	3	3	4	4	3	4	3	4	3	2	3	3	3	3	4	4	3	4	55	3.62	0.83
PC9	Size and cost of project	5	4	5	3	4	3	2	3	2	4	3	2	5	3	3	3	5	3	4	4	3	4	4	3	5	54	3.8	0.9
PC10	Uniqueness of project which requiring advanced technical know-how	5	4	4	4	4	3	4	3	4	4	4	5	4	4	3	4	3	4	4	4	3	3	3	4	4	56	3.89	0.76
		Total average																										3.62	0.78

According to Table 14, Table 15 presents average scores as well as ranking of the ten project characteristic factors. These factors were ranked from the highest to the lowest. It illustrates that the uniqueness of project requiring advanced technical know-how (PC10) has the highest average score of 3.89, which was determined as high important level. While the clarity of conflict resolution specified in contract documents (PC4) has the lowest average score of 3.25, and it was determined as moderate level.

Table 15 Average level of importance and ranks of 10 project characteristic factors affecting project cost

Rank	ID	Project characteristic factors	Average
1	PC10	Uniqueness of project requiring advanced technical know-how	3.89
2	PC6	Density of traffic that interrupts construction activities	3.8
3	PC9	Size and cost of project	3.8
4	PC2	Well defined scope of works in the contract	3.75
5	PC7	The limitation of project site	3.65
6	PC3	Clarity of contract documents	3.62
7	PC8	The advantage utility supplies	3.62
8	PC5	Clarity of terms of payment in contract documents	3.44
9	PC1	Using an appropriate contract type	3.41
10	PC4	Clarity of conflict resolution specified in contract documents	3.25

2.2.3 Project characteristic factors affecting project quality

Table 16 shows 10 project characteristic factors and the data of 56 respondents. The significance of each factor affecting project quality was examined through average and standard deviation.

The overall averages score 3.31 of project characteristic factor is shown at the end of table. That is the project characteristic factors were determined as moderate level influencing project quality.

Table 16 Project characteristic factors affecting project quality

ID	Factors/Respondents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
PC1	Using appropriate contract type	4	3	3	4	2	2	3	2	4	4	2	4	4	3	4	4	4	4	4	4	4	3		4		3	4	4	2	3	2
PC2	Well defined scope of works in the contract	4	3	3	4	2	2	3	4	4	4	4	3	3	4	3	4	4	1	1	3	4	2		5	4	4	4	3	2	2	3
PC3	Clarity of contract documents	4	3	2	4	3	5	4	5	4	4	3	2	3	3	2	4	4	1	1	4	3	2		5	4	4	4	3	1	2	4
PC4	Clarity of conflict resolution specified in contract document	2	3	1	4	2	2	3	2	3	4	4	2	3	4	2	2	4	2	2	2	3	2		2		4	3	3	3	3	2
PC5	Clarity of terms of payment in contract documents	3	3		4	3	2	3	3	3	4	3	3	3	3	2	2	4	2	2	3	3	2		2	2	4	3	3	2	2	2
PC6	Density of traffic that interrupts construction activities	2	3	3	4	4	2	4	3	4	5		4	4	4	4	4	3	5	5	3	4	2	2	2	2	4	4	4	4	3	3
PC7	The limitation of project site access	2	3	3	4	4	2	4	3	4	5		4	4	4	4	4	3	5	5	3	4	2	2	2	4	5	3	3	3	2	3
PC8	Availability of utilities	3	3	2	4	5	3	5	3	3	5		4	4	4	4	4	3	5	5	3	4	3	2	2	1	5	4	3	2	3	2
PC9	Size and cost of project	3			4	2	2	4	3	3	5	4	4	3	4	4	4	4	5	5	4	4	2	4	4	3	4	3	3	3		3
PC10	Uniqueness of project which requiring advanced technical know-how	3	3	3	4	3	3	5	3	3	5	3	4	3	3	5	4	4	5	5	4	5	4	3	5	4	4	4	3	4		4

ID	Factors/Respondents	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average $\overline{X}=\frac{\sum x}{N}$	Standard $S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
PC1	Using appropriate contract type	3	3	5	3	4	4	4	4	3	3	5	4	3	4	4	4	3	4	3	2	3	3	3	3	3	54	3.41	0.77
PC2	Well defined scope of works in the contract	4	3	5	4	4	4	3	3	4	4	4	3	4	3	4	3	4	4	3	2	4	4	3	4	4	55	3.4	0.88
PC3	Clarity of contract documents	4	3	5	4	4	3	3	2	3	3	3	3	4	2	4	4	3	3	3	3	3	4	4	3	4	55	3.29	0.98
PC4	Clarity of conflict resolution specified in contract document	3	3	5	3		1	1	3	1	3	1	1	3	1	4	1	2	4	4	4	3	4	4	3	3	53	2.7	1.07
PC5	Clarity of terms of payment in contract documents	5	3	5	3	4	1	2	2	2	2	1	2	4	2	4	2	2		3	5	4	4	4	3	4	53	2.89	0.99
PC6	Density of traffic that interrupts construction activities	5	3	4	3	3	1	2	3	2	3	2	2	4	2	4	2	4	4	4	4	4	4	3	3	5	55	3.35	0.99
PC7	The limitation of project site access	5	3	5	3	2	2	3	2	3	2	2	3	4	2	4	3	4	3	4	5	4	3	4	4	4	55	3.38	0.98
PC8	Availability of utilities	4	3	5	3	2	2	3	3	3	2	2	3	4	4	3	3	3	3	4	4	3	3	4	3	4	55	3.33	0.97
PC9	Size and cost of project	4	4	5	3	4	2	3		4	3	3	3	4	3	4	3	4	3	4	5	4	3	4	3	4	52	3.58	0.78
PC10	Uniqueness of project which requiring advanced technical know-how	5	4	5	2	4	3	4		4	2	4	4	3	3	4	4	3	3	5	5	3	3	4	3	4	54	3.76	0.82
		Total average																										3.31	0.92

According to Table 16, Table 17 presents average scores as well as ranking of the ten project characteristic factors. These factors were ranked from the highest to the lowest. It illustrates that the uniqueness of project requiring advanced technical know-how (PC10) has the highest average score of 3.76 which was determined as high important level. While the clarity of conflict resolution specified in contract documents (PC4) has the lowest average score of 2.7, and it was determined as moderate level.

Table 17 Average level of importance and ranks of 10 project characteristic factor affecting project quality

Rank	ID	Project characteristic factors	Average
1	PC10	Uniqueness of project requiring advanced technical know-how	3.76
2	PC9	Size and cost of project	3.58
3	PC1	Using an appropriate contract type	3.41
4	PC2	Well defined scope of works in the contract	3.4
5	PC7	The limitation of project site	3.38
6	PC6	Density of traffic that interrupts construction activities	3.35
7	PC8	The advantage utility supplies	3.33
8	PC3	Clarity of contract documents	3.29
9	PC5	Clarity of terms of payment in contract documents	2.89
10	PC4	Clarity of conflict resolution specified in contract documents	2.7

2.3. Interactive process factors affecting project success

In this group, sixteen factors are considered under interactive process factors affecting project success including (1) appropriate and reasonable planning, (2) using the appropriate construction technique, (3) on site planning is integrated to other plan, (4) reasonable project duration, (5) availability of resource throughout project period, (6) effective organization chart, (7) good document system, (8) using efficient construction management techniques, (9) usage of update computer and soft ware in managing, (10) effective conflict solving method, (11) effective monitoring and feedback systems, (12) regular updating plan, (13) good quality control system, (14) use of informal communication among project team, (15) usage formal communication, (16) safety system and safety training program to project members. Based on 56 respondents, three aspects of project duration, project cost, and project quality are discussed below:

2.3.1 Interactive process factors affecting project duration

Table 18 shows 16 interactive process factors and the data of 56 respondents. The significance of each factor affecting project duration was examined through average and standard deviation.

The overall averages score 3.69 of project characteristic factor is shown at the end of table. That is the interactive process factors were determined as moderate level influencing project cost.

Table 18 Interactive process factors affecting project duration

ID	Factors/Respondents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
IP1	Appropriate and reasonable plan	4	5	4	4	4	5	5	5	4	4	5	5	3	3	5	4	4	3	3	4	4	4	4	3	3	4	4	4	4	4	4
IP2	Usage of appropriate construction technique in the project	4	5	4	4		4	5	5	4	4	4	5	4	3	5	4	4	4	4	5	4	4	4	4	3	5	4	4	4	4	4
IP3	On site planning is integrated to other plan	4	5	3	4	4	3	5	4	4	4	4	5	3	3	5	4	4	3	3		4	4	4	3	3	4	4	4	4	4	4
IP4	Reasonable project duration	5	4	4	4	4		5	4	3	4	3	5	3	4	5	4	4	5	5	4	5	3	4	5	3	5	4	4	3	4	4
IP5	Availability of resources throughout the project period		4	3	4	3	4	5	4	4	4	3	4	3	3	3	3	3	4	4	4		4	4	4	3	4	4	3	3	4	4
IP6	Effective organization chart	3	5	3	4	4	3	5	3	4	5	2	4	4	3	4	4	3	4	4	4	4	3	4	3	2	4	4	3	5	4	4
IP7	Good document system	3	4	2	4		3	3	3	4	5	2	4	4	3	4		3	4	4	4	4	3	4	3	3	4	3	4	2	3	3
IP8	Using efficient construction management techniques	3	5	4	4	3	5	5	3	4	5	5	4	4	4	4	3	4	5	5	4	5	4	3	3	3	4	4	3	3	3	4
IP9	Usage effective software in project managing	3	4	3	4	3	3	5	2	4	5	4	4	4	3	4	3	4	4	4	4	4	4	4	3	4	4	4	4	3	3	4
IP10	Effective of conflict resolving method	4	4	3	4	4	5	5	3	4	5	3	5	3	4	5	4	3	5	5	4	4	4	4	5		4	4	4	3	2	5
IP11	Effectiveness of monitoring and feedback systems	4	5	3	4	3	3	5	4	4	4	3	5	3	3	5	4	3	4	4	4	5	3	4	3	3	3	4	4	4	3	4
IP12	Regular updating plan	4	5	4	4		4	5	3	4	4	3	5	3	4	4	4	4	5	5		4	2	3	2	3		3	3	4	4	4
IP13	Good quality control system	4	5	2	4	4	3	5	4	4	4	3	5	3	4	4	4	3	5	5	4	5	2	3	3	3	4	3	4	3	3	4
IP14	Use of informal communication among project teams	3	4	3	4	4	3	5	3	4	5	3	5	2	3	4	2	3	5	5	3	4	3	3	3	4	3	4	4	2	3	3
IP15	Usage formal communication among project teams	4	4	3	4	3	4	5	3	4	5	4	4	2	4	5	4	4	5	5	4	4	4	3	4	3	4	4	3	4	3	4
IP16	Usage system and safety training program to project members	3	3	2	4	3	3	4	2	4	5	4	4	2	4	3	4	3	5	5	4	4	2	3	4		4	4	4	3	3	2

Table 18 Interactive process factors affecting project duration (contd.)

ID	Factors/Respondents	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average $\overline{X}=\frac{\sum X}{N}$	Standard $S=\sqrt{\frac{\sum(x-\overline{x})^2}{N-1}}$
IP1	Appropriate and reasonable plan	5	3	4	4	4	3	3	4	3	3	3	3	4	4	3	4	4	3	3	3	3	4	4	4	3	56	3.80	0.67
IP2	Usage of appropriate construction technique in the project	5	4	4	4	4	3	2	4	3	3	3	3	3	4	3	3	3	4	4	4	4	4	4	4	3	55	3.89	0.66
IP3	On site planning is integrated to other plan	5	3	4	4	4	3	3	5	3	3	3	3	3	3	3	4	2	3	4	4	4	3	4	4	4	55	3.71	0.69
IP4	Reasonable project duration	3	3	4	4	5	3	3	4	3	3	4	3	3	3	4	4	5	4	3	4	3	3	3	3	4	55	3.84	0.74
IP5	Availability of resources throughout the project period	4	3	4	4	4	3	3	4	3	3	4	3	3	3	4	4	2	2	2	3	3	4	3	4	3	54	3.48	0.64
IP6	Effective organization chart	5	3	4	3	4	4	4	4	4	4	4	4	3	5	3	3	3	3	2	4	4	3	4	4	3	56	3.68	0.75
IP7	Good document system	5	3	4	3	4	4	5	4	5	4	4	4	3	5	4	4	3	3	3	4	3	3	4	3	4	54	3.59	0.89
IP8	Using efficient construction management techniques	5	3	4	4	5	4	4	4	4	4	4	4	4	3	4	4	5	4	3	3	4	4	3	3	4	56	3.91	0.71
IP9	Usage effective software in project managing	4	3	4	3	5	4	3	4	3	4	4	3	4	4	3	4	5	4	3	4	3	4	3	4	3	56	3.70	0.64
IP10	Effective of conflict resolving method	5	4	5	4	5	3	3	2	3	1	3	3	4	3	3	4	3	4	3	4	4	5	3	3	3	55	3.78	0.92
IP11	Effectiveness of monitoring and feedback systems	5	4	4	4	4	3	3	4	3	2	3	3	4	3	3	3	3	4	2	3	4	5	4	3	3	56	3.63	0.76
IP12	Regular updating plan	4	3	4	3	5	4	3	4	3	3	3	3	4	3	4	3	2	2		4	4	5	4	4	3	52	3.65	0.82
IP13	Good quality control system	3	5	4	3	5	4	4	4	4	3	4	4	3	4	3	3	3	1	4	4	4	4	4	4	3	56	3.70	0.84
IP14	Use of informal communication among project teams	3	4	4	3	3	4	3	2	3	3	4	3	4	4	4	4	3	2	3	3	3	5	3	3	3	56	3.43	0.83
IP15	Usage formal communication among project teams	4	4	4	2	4	4	3	3	3	4	4	3	3	3	3	3		3	3	4	3	4	4	4	2	55	3.65	0.73
IP16	Usage system and safety training program to project members	3	3	4	3	3	5	5	3	5	4	5	5	3	5	4	4	4	3	2	3	4	3	3	4	3	55	3.58	0.9
		Total average																										3.69	0.76

According to Table 18, Table 19 presents average scores as well as ranking of the sixteen interactive process factors. These factors were ranked from the highest to the lowest. It illustrates that the using efficient construction management techniques (IP8) has the highest average score of 3.91, which was determined as high important level. While the usage friendly and informal communication among project teams (IP14) has the lowest average score of 3.43, and it was determined as Moderate important level.

Table 19 Average level of importance and ranks of 16 interactive process factors affecting project duration

Rank	ID	Interactive process factors	Average
1	IP8	Using efficient construction management techniques	3.91
2	IP2	Usage of appropriate construction technique	3.89
3	IP4	Reasonable project duration	3.84
4	IP1	Appropriate and reasonable planning	3.80
5	IP10	Effective conflict resolving	3.78
6	IP3	On site planning is integrated to other plan	3.71
7	IP9	Usage of update computer and soft ware in managing	3.70
8	IP13	Good quality control systems	3.70
9	IP6	Effective organization chart	3.68
10	IP15	Usage formal communication such as: daily and weekly meeting	3.65
11	IP12	Regular updating plan	3.65
12	IP11	Effective monitoring and feedback systems	3.63
13	IP7	Good document system	3.59
14	IP16	Safety system and safety training program to project members.	3.58
15	IP5	Availability of resources throughout project period	3.48
16	IP14	Use of informal communication among project teams	3.43

2.3.2 Interactive process factors affecting project cost

Table 20 shows 16 interactive process factors and the data of 56 respondents. The significance of each factor affecting project was examined through average and standard deviation.

The overall averages score 3.45 of project characteristic factor is shown at the end of table. That is the interactive process factors were determined as moderate level influencing project cost.

Table 20 Interactive process factors affecting project cost.

ID	Factors/Respondents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
IP1	Appropriate and reasonable plan	4	5	4	4	4	4	3	3	4	4	2	4	2	4	4	4	4	4	4	4	4	2	4	3	3	4	3	4	4	3	4
IP2	Usage of appropriate construction technique in the project	4	5	4	4		4	4	3	4	4	3	5	2	4	5	4	3	4	3	5	4	4	4	4	3	5	3	4	3	3	4
IP3	On site planning is integrated to other plan	4	5	3	4	4	3	4	3	4	4	2	5	2	3	5	4	4	3	3		4	3	4	4	3	3	4	4	4	2	3
IP4	Reasonable project duration	5	4	4	4	4		3	3	3	4	2	4	3	3	5	4	4	5	5	4	4	3	4	4	3	5	4	4	5	3	3
IP5	Availability of resources throughout the project period		4	2	4	3	3	3	3	4	4	3	4	3	3	4	3	3	3	3	4	3	2	4	4	3	4	4	3	2	3	3
IP6	Effective organization chart	3	5	2	4	4	3	3	3	4	5	3	3	2	3	3	4	3	4	4	4	2	2	4	3	4	5	4	3	4	3	3
IP7	Good document system	3	4	2	4		3	3	3	4	5	2	3	2	3	3		3	3	3	3	3	2	4	3	4	3	4	4	3	4	2
IP8	Using efficient construction management techniques	3	5	4	4	2	4	3	3	3	5	3	3	3	3	3	4	4	3	2	4	4	4	4	3	3	4	4	3	3	4	4
IP9	Usage of effective software in project managing	3	4	3	4	2	3	3	3	4	5	4	3	3	3	3	4	3	4	4	4	4	3	4	3	4	4	4	4	4	3	4
IP10	Effective conflict resolving method	4	4	3	4	4	4	3	3	3	5	2	4	3	3	4	4	3	5	5	4	3	2	4	5		4	4	4	4	3	4
IP11	Effectiveness of monitoring and feedback systems	4	5	3	4	4	3	3	4	4	4	3	4	4	4	5	4	3	5	4	4	4	2	4	4	3	4	3	4	3	4	3
IP12	Regular updating plan	4	5	3	4		3	3	4	4	4	3	4	3	2	3	4	3	4	5		3	2	3	2	3		3	3	4	3	2
IP13	Good quality control system	4	5	3	4	4	3	4	4	3	4	3	4	3	4	5	4	3	5	5	4	4	2	3	4	3	4	4	4	3	4	4
IP14	Use of informal communication among project teams	3	4	2	4	3	3	3	3	4	4	2	4	3	3	3	2	3	5	4	3	2	2	3	3	4	3	4	4	4	4	2
IP15	Usage formal communication among project teams	3	4	2	4	3	3	3	3	4	4	2	4	3	4	3	4	3	5	5	4	2	2	3	2	2	4	4	3	3	4	3
IP16	Usage system and safety training program to project members	3	3	2	4	3	3	4	2	4	5	3	4	4	3	3	4	3	5	5	4	2	3	3	4	3	4	4	4	4	3	3

Table 20 (Continued)

ID	Factors/Respondents	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average $\overline{X}=\frac{\sum x}{N}$	Standard $S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
IP1	Appropriate and reasonable plan	5	4	4	3	4	4	3	3	3	3	4	3	3	3	3	3	3	3	4	3	3	4	3	4	3	56	3.54	0.67
IP2	Usage of appropriate construction technique in the project	5	4	4	4	4	2	2	3	2	3	3	3	3	3	3	3	2	4	3	3	3	4	3	4	3	55	3.55	0.82
IP3	On site planning is integrated to other plan	5	4	4	4	4	2	2	4	2	3	3	3	3	3	4	3	3	3	3	3	3	3	3	4	3	55	3.42	0.79
IP4	Reasonable project duration	3	3	4	4	3	2	2	3	2	3	3	4	3	2	4	3	4	4	3	3	3	3	3	4	3	55	3.51	0.82
IP5	Availability of resources throughout the project period	4	3	4	3	4	3	2	3	2	3	3	3	4	2	3	3	1	2	3	3	3	3	3	4	3	55	3.13	0.7
IP6	Effective organization chart	3	3	4	3	3	3	3	3	2	4	4	4	3	3	4	4	3	3	4	4	3	3	3	3	3	56	3.36	0.73
IP7	Good document system	4	3	4	3	3	3	4	4	2	4	4	5	3	4	3	4	3	3	4	4	3	4	4	4	4	54	3.37	0.87
IP8	Using efficient construction management techniques	5	3	4	3	4	3	3	3	2	4	3	4	4	3	4	3	3	4	4	4	4	4	4	3	4	56	3.52	0.69
IP9	Usage of effective software in project managing	4	3	4	3	4	4	3	3	3	3	3	3	3	3	3	3	3	4	4	4	3	4	3	3	4	56	3.46	0.58
IP10	Effective conflict resolving method	5	4	4	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	4	5	5	4	4	3	55	3.65	0.76
IP11	Effectiveness of monitoring and feedback systems	5	4	4	3	4	4	3	4	3	3	3	3	4	3	3	3	3	3	4	4	4	4	3	3	4	56	3.64	0.65
IP12	Regular updating plan	4	3	4	3	4	4	2	3	2	3	2	2	4	3	3	2	2	1	3	4	4	4	4	3	3	53	3.19	0.86
IP13	Good quality control system	4	3	4	3	4	4	4	4	4	3	3	4	4	3	3	4	1	2	4	3	4	4	3	3	3	56	3.61	0.76
IP14	Use of informal communication among project teams	3	4	4	2	2	4	3	4	4	2	3	3	3	4	4	3	1	3	3	3	4	3	4	3	3	56	3.2	0.81
IP15	Usage formal communication among project teams	3	3	4	2	4	4	3	4	4	3	3	3	4	3	3	3		2	3	3	4	4	3	4	4	55	3.31	0.77
IP16	Usage system and safety training program to project members	3	3	4	3	3	5	5	3	5	4	5	5	4	5	3	5	4	4	3	4	3	4	4	4	3	56	3.68	0.84
		Total average																										3.45	0.76

According to Table 20, Table 21 presents average scores as well as ranking of the sixteen interactive process factors. These factors were ranked from the highest to the lowest. It illustrates that the safety system and safety training program to project members (IP16) has the highest average score of 3.68, which was determined as high important level. While the availability of resource throughout project period (IP5) has the lowest average score of 3.13, and it was determined as moderate level.

Table 21 Average level of importance and ranks of 16 interactive process factors affecting project cost

Rank	ID	Interactive process factors	Average
1	IP16	Safety system and safety training program to project members.	3.68
2	IP10	Effective conflict resolving	3.65
3	IP11	Effective monitoring and feedback systems	3.64
4	IP13	Good quality control systems	3.61
5	IP2	Usage of appropriate construction technique	3.55
6	IP1	Appropriate and reasonable planning	3.54
7	IP8	Using efficient construction management techniques	3.52
8	IP4	Reasonable project duration	3.51
9	IP9	Using of update computer and soft ware in managing	3.46
10	IP3	On site planning is integrated to other plan	3.42
11	IP7	Good document system	3.37
12	IP6	Effective organization chart	3.36
13	IP15	Using formal communication such as: daily and weekly meeting	3.31
14	IP14	Use of informal communication among project teams	3.2
15	IP12	Regular plan updating	3.19
16	IP5	Availability of resources throughout project period	3.13

2.3.2 Interactive process factors affecting project quality

Table 4.21 shows 16 interactive process factors and the data of 56 respondents. The significance of each factor affecting project was examined through average and standard deviation.

The overall averages score 3.64 of project characteristic factor is shown at the end of table. That is the interactive process factors were determined as moderate level influencing project quality.

Table 22 Interactive process factors affecting project quality.

ID	Factors/Respondents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
IP1	Appropriate and reasonable plan	3	5	3	4	3	2	5	4	4	4	2	4	3	4	4	4	4	3	3	4	4	3	4	3	3	4	4	4	3	3	3
IP2	Usage of appropriate construction technique in the project	3	5	4	4		4	5	3	4	4		5	3	3	5	4	4	3	3	4	4	4	4	4	3	4	4	4	3	4	3
IP3	On site planning is integrated to other plan	4	5	3	4	4	2	4	4	4	4	3	5	4	4	5	4	4	4	4		4	2	4	2	3	4	4	4	4	3	2
IP4	Reasonable project duration	3	4	4	4	4		3	3	3	4	2	5	3	3	5	4	4	5	5	4	4	4	4	3	3	5	4	4	3	4	2
IP5	Availability of resources throughout the project period		5	3	4	3	3	4	3	4	4	2	3	4	3	3	2	3	4	4	4	3	4	4	2	3	4	4	3	2	5	3
IP6	Effective organization chart	3	5	3	4	4	4	3	3	4	5	3	4	3	4	4		3	4	4	4	4	3	4	3	2	4	4	3	4	3	3
IP7	Good document system	3	4	2	4		2	3	4	4	5	2	3	4	3	3		3	4	3	3	4	2	4	3	2	4	4	4	3	3	2
IP8	Using efficient construction management techniques	3	5	3	4	3	2	3	2	4	5	2	3	3	3	4	4	3	3	2	4	4	3	4	3	3	4	4	3	2	3	3
IP9	Usage of effective software in project managing	3	3	3	4	3	3	5	2	4	5	2	4	4	3	3	4	3	4	4	4	4	3	4	3	4	4	4	4	2	4	2
IP10	Effective conflict resolving method	3	5	2	4	3	2	4	3	4	5	1	5	3	3	4	4	3	5	5	3	4	4	4	4		4	4	4	2	4	2
IP11	Effectiveness of monitoring and feedback systems	4	5	4	4	4	5	5	3	4	5	4	5	3	4	5	4	3	4	4	4	5	4	4	2	4	4	3	4	4	4	4
IP12	Regular updating plan	3	5	3	4		2	5	4	4	5	3	4	4	3	4	4	3	4	4		4	4	3	2	3		3	3	5	3	2
IP13	Good quality control system	5	5	4	4	4	5	5	4	4	5	4	4	3	4	5	4	4	5	5	4	5	4	3	5	4	4	4	4	3	4	4
IP14	Use of informal communication among project teams	3	4	2	4	4	3	5	3	4	5	2	4	4	3	4	2	3	5	5	3	3	3	3	3	2	4	4	4	5	4	4
IP15	Usage formal communication among project teams	3	4	3	4	3	3	4	3	4	5	2	4	4	3	4	4	4	5	5	4	4	4	3	3	2	3	4	3	5	3	4
IP16	Usage system and safety training program to project members	3	3	3	4	3	3	4	2	4	5	2	3	4	3	3	4	3	5	5	4	4	3	3	4	3	4	4	4	4	4	3

Table 22 (Continued)

ID	Factors/Respondents	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average $\bar{X}=\frac{\sum X}{N}$	Standard $S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
IP1	Appropriate and reasonable plan	4	4	4	3	4	3	3	4	4	4	3	4	3	3	3	4	3	3	4	4	3	4	3	3	4	56	3.54	0.64
IP2	Usage of appropriate construction technique in the project	5	4	4	4	4	3	2	3	4	4	3	3	3	2	4	3	4	2	4	5	3	4	3	3	4	54	3.67	0.76
IP3	On site planning is integrated to other plan	3	3	4	4	4	3	3	4	4	4	3	3	4	2	4	4	4	3	5	4	4	4	3	3	4	55	3.65	0.75
IP4	Reasonable project duration	4	3	4	4	5	3	3	5	4	3	3	3	3	2	3	4	3	3	4	4	3	4	3	4	3	55	3.62	0.78
IP5	Availability of resources throughout the project period	5	3	4	3	4	3	3	4	3	3	3	4	4	3	3	4	2	1	4	4	4	4	3	3	3	55	3.38	0.83
IP6	Effective organization chart	4	3	4	3	4	1	2	4	5	3	3	3	4	2	3	2	5	3	4	4	4	3	4	4	3	55	3.49	0.94
IP7	Good document system	3	3	4	3	4	4	5	4	5	3	5	4	4	5	4	4	3	3	4	4	4	4	4	4	3	54	3.54	0.95
IP8	Using efficient construction management techniques	5	3	4	3	4	4	5	4	4	3	5	4	4	5	3	5	4	2	4	4	3	4	4	4	3	56	3.54	0.86
IP9	Usage of effective software in project managing	4	3	4	3	4	3	3	4	5	4	4	4	4	4	4	4	3	2	4	4	4	3	4	4	3	56	3.57	0.74
IP10	Effective conflict resolving method	5	4	4	3	4	3	3	4	3	4		3	4	3	4	4	2	3	3	4	4	2	4	4	4	54	3.56	0.91
IP11	Effectiveness of monitoring and feedback systems	5	4	4	4	4	5	5	4	5	4	3	5	3	4	3	5	5	4	3	4	3	3	4	4	3	56	4.02	0.74
IP12	Regular updating plan	3	3	4	3	4	5	5	3	5	4	5	5	3	4	4	4	3	3	4	3	3	4	4	3	3	53	3.66	0.84
IP13	Good quality control system	5	3	4	3	4	5	5	4	5	3	5	5	3	5	4	4	5	5	4	3	3	4	4	3	3	56	4.14	0.72
IP14	Use of informal communication among project teams	4	4	4	3	4	4	3	4	4	4	4	4	3	3	4	3	2	3	3	3	3	4	4	3	3	56	3.54	0.82
IP15	Usage formal communication among project teams	4	4	4	3	4	4	3	3	4	4	4	3	4	4	3	3		3	4	3	4	4	4	4	3	55	3.64	0.68
IP16	Usage system and safety training program to project members	4	3	4	3	3	4	5	4	5	4	5	5	3	5	3	5	5	5	4	4	3	4	3	4	3	56	3.75	0.82
		Total average																										3.64	0.72

According to Table 22, Table 23 presents average scores as well as ranking of the sixteen interactive process factors. These factors were ranked from the highest to the lowest. It illustrates that the good quality control systems (IP13) has the highest average score of 4.14, which was determined as high important level. While the availability of resource throughout project period (IP5) has the lowest average score of 3.38, and it was determined as moderate level.

Table 23 Average level of importance and ranks of interactive process factors affecting project cost

Rank	ID	Interactive process factors	Average
1	IP13	Good quality control systems	4.14
2	IP11	Effective monitoring and feedback systems	4.02
3	IP16	Safety system and safety training program to project members.	3.75
4	IP2	Usage of appropriate construction technique	3.67
5	IP12	Regular plan updating	3.66
6	IP3	On site planning is integrated to other plan	3.65
7	IP15	Using formal communication such as: daily and weekly meeting	3.64
8	IP4	Reasonable project duration	3.62
9	IP9	Using of update computer and soft ware in managing	3.57
10	IP10	Effective conflict resolving	3.56
11	IP1	Appropriate and reasonable planning	3.54
12	IP7	Good document system	3.54
13	IP14	Using informal communication among project teams	3.54
14	IP8	Using efficient construction management techniques	3.54
15	IP6	Effective organization chart	3.49
16	IP5	Availability of resources throughout project period	3.38

2.4. External factors affecting project success

External factors affecting project success or failure contain (1) conflict cause by people nearby project, (2) Project affected byinflation and exchange rate, (3) trend of economics, (4) fluctuation of material, machine and labor costs, (5) the positive government policies affect construction industries, (6) risk from natural disasters, and (7) geological condition of project site. Based on 56 respondents the discussion of these factors affecting project duration, project cost, and project quality are presented below:

2.4.1 External factors affecting project duration

Table 24 shows 7 external factors and the data of 56 respondents. The significance of each factor affecting project duration was examined through average and standard deviation.

The overall averages score 3.59 of project characteristic factor is shown at the end of table. That is the external factors were determined as moderate level influencing project duration.

Table 24 External factors affecting project duration.

ID	Factors/Respondents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
EF1	Conflict caused by people nearby project	4	4	2	3	4	4	5	3	4	3	4	4	3	3	4	4	4	5	4	4	4	4		4	4	3	3	2	3	4	4
EF2	Effected by inflation and exchange rates	5	4	2	3	2	3	4	3	3	3	3	4	4		4	2	3	5	5	4	3	3		2	3	4	3	2	3	3	2
EF3	Economic tendency	5	4	2	4	4	2	3	4	3	3	1	3	5	4	3	3	3	5	5	3		3	3	2	3	3	3	3	5	4	2
EF4	Fluctuation of material, machine, and labor costs	5	4	2	4	4	4	4	4	3	4	4	4	4	4	4	4	4	5	5	4	3	3	3	2	2	4	4	3	4	3	3
EF5	Government policies which can affect construction industries	4	2	2	4	4	4	3	3	3	4	2	5	4	3	5	4	4	4	4	3	4	3		2	2	4	4	3	4		3
EF6	Risk from natural disasters such as heavy rain, flooding , and storm	2	5	3	3	4	5	5	4	3	3	4	5	3	2	5	4	2	1	1	3	5	4	4	4	2	3	3	3	4	3	3
EF7	Geological condition of project site	2	3	2	4	2	3	4	4	3	4	2	4	3	4	4	4	3	4	4	3	4	3	1	4		4	4	3	2	3	4

ID	Factors/Respondents	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average $\bar{X}=\frac{\sum x}{N}$	Standar $S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
EF1	Conflict caused by people nearby project	5	5	2	3	3	4	4	4	5	3	4	4	4	5	4	4	3	4	4	4	4	4	4	4	4	55	3.78	0.71
EF2	Effected by inflation and exchange rates	3	4	3	3		5	5	3	5	4	5	5	4	5	4	5	4	3	4	5	4	4	3	4	4	53	3.62	0.97
EF3	Economic tendency	3	4	3	2		4	4	4	5	4	4	4	3	4	4	4	5	3	4	5	4	4	3	3	3	54	3.52	0.93
EF4	Fluctuation of material, machine, and labor costs	4	4	4	4		4	3	3	3	4	4	3	4	4	4	3	4	4	3	5	5	4	3	3	3	55	3.69	0.87
EF5	Government policies which can affect construction industries	5	3	3	4		4	3	3	3	4	4	3	4	4	3	3	4	4	3	4	5	3	3	3	3	53	3.49	0.78
EF6	Risk from natural disasters such as heavy rain, flooding , and storm	5	5	3	4	4	4	4	3	3	3	4	4	4	4	4	4	5	2	4	5	4	3	4	4	4	56	3.61	1.02
EF7	Geological condition of project site	4	3	3	3	4	4	3	4	3	3	3	4	3	4	3	3	4	3	4	4	4	4	4	4	4	55	3.40	0.74
		Total Average																										3.59	0.86

According to Table 24, Table 25 presents average scores as well as ranking of the seven external factors. These factors were ranked from the highest to the lowest. It illustrates that the conflicts caused by people who live nearby project (EF1) has the highest average score of 3.78, which was determined as high important level. While the geological condition of project site (EF7) has the lowest average score of 3.40, and it was determined as moderate level.

Table 25 Average level of importance and ranks of external factors affecting project duration

Rank	ID	Project participant factors	Average
1	EF1	Conflict caused by people nearby project	3.78
2	EF4	Fluctuation of material, machine and labor costs	3.69
3	EF2	Project affected by inflation and exchange rate	3.62
4	EF6	Risk from natural disasters	3.61
5	EF3	Trend of economics	3.52
6	EF5	The positive government policies affecting construction industries	3.49
7	EF7	Geological condition of project site	3.40

2.4.2 External factors affecting project cost

Table 26 shows 7 external factors and the data of 56 respondents. The significance of each factor affecting project cost was examined through average and standard deviation.

The overall averages score 3.74 of project characteristic factor is shown at the end of table. That is the external factors were determined as moderate level influencing project cost.

Table 26 External factors affecting project cost

ID	Factors/Respondents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
EF1	Conflict caused by people nearby project	2	4		4	3	3	4	3	4	4	3	4	3	3	5	4	2	4	4	4	3	4		4	4	2	4	3	3	3	3
EF2	Effected by inflation and exchange rates	5	5	3	4	3	4	5	4	3	4	4	5	4	4	5	2	4	5	5	4		4		3	3	4	3	3	4	3	3
EF3	Economic tendency	5	5	3	4	4		5	4	4	4	3	3	5	4	3	3	4	5	5	3		4	2	2	3	3	4	3	3	4	4
EF4	Fluctuation of material, machine, and labor costs	5	5	3	4	4	5	5	4	4	4	5	5	3	3	5	4	4	5	5	4	5	4	4	4	4	5	4		4	4	4
EF5	Government policies which can affect construction industries	4	3	2	4	4		4	3	3	4	2	5	3	3	5	4	4	4	4	3	4	3		2	2	4	4	2	5		3
EF6	Risk from natural disasters such as heavy rain, flooding , and storm	2	5	3	4	5	3	4	4	3	4	3	4	3	2	4	4	4	1	1	3	3	3	4	3	2	2	4	3	4	4	2
EF7	Geological condition of project site	2	5	3	4	2	4	5	5	3	4	3	4	3	4	4	3	4	4	4	4	4	4	2	2		4	3	3	3	3	4

ID	Factors/Respondents	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average $\bar{X}=\frac{\sum x}{N}$	Standar $S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
EF1	Conflict caused by people nearby project	4	3	2	3	4	4	4	3	4	3	4	4	3	5	4	4	3	3	4	5	4	4	4	4	4	54	3.57	0.75
EF2	Effected by inflation and exchange rates	3	4	3	4		4	4	4	4	3	4	4	4	5	4	4	5	4	4	4	4	4	3	3	3	53	3.85	0.76
EF3	Economic tendency	3	4	3	3		4	4	4	4	3	4	4	4	4	4	4	5	3	4	4	4	3	4	3	4	53	3.74	0.75
EF4	Fluctuation of material, machine, and labor costs	5	5	5	4		4	5	4	4	4	4	5	4	4	4	4	5	4	5	4	4	3	4	3	4	54	4.24	0.61
EF5	Government policies which can affect construction industries	5	3	3	3		4	4	4	4	3	4	4	4	4	4	4	3	4	4	5	3	3	3	4	3	52	3.58	0.81
EF6	Risk from natural disasters such as heavy rain, flooding , and storm	5	2	4	2	4	4	4	4	4	4	3	4	3	5	4	3	5	4	5	4	4	4	4	4	4	56	3.52	0.98
EF7	Geological condition of project site	4	4	5	4	4	4	3	3	4	4	3	4	3	4	4	3	4	3	5	4	4	4	4	4	3	55	3.65	0.76
		Total Average																										3.74	0.77

According to Table 26, Table 27 presents average scores as well as ranking of the seven external factors. These factors were ranked from the highest to the lowest. It illustrates that the fluctuation of material, machine and labor costs (EF4) has the highest average score of 4.24, which was determined as high important level. While the risk from natural disasters (EF7) has the lowest average score of 3.52, and it was determined as moderate level.

Table 27 Average level of importance and ranks of external factors affecting project cost

Rank	ID	External factors	Average
1	EF4	Fluctuation of material, machine and labor costs	4.24
2	EF2	Project affected by inflation and exchange rate	3.85
3	EF3	Trend of economics	3.74
4	EF7	Geological condition of project site	3.65
5	EF5	The positive government policies affecting construction industries	3.58
6	EF1	Conflict caused by people nearby project	3.57
7	EF6	Risk from natural disasters	3.52

2.4.3 External factors affecting project quality

Table 28 shows 7 external factors and the data of 56 respondents. The significance of each factor affecting project quality was examined through average and standard deviation.

The overall averages score 3.13 of project characteristic factor is shown at the end of table. That is the external factors were determined as moderate level influencing project cost.

Table 28 External factors affecting project quality

Factors/Respondents	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Conflict caused by people nearby project	3	4		4	1	2	3	3	2	5	2	3	3	4	3	2	4	4	4	4	3	2		4	1	2	4	1	3	4	2
Effected by inflation and exchange rates	4	3	2	4	2	2	3	3	3	4	2	3	3	3	3	2	3	4	3	4		2		2	3	3	3	3	4	3	2
Economic tendency	4	3	2	4	3	2	3	3	3	4	1	2	3	3	2	2	3	4	3	3		3	2	2	3	3	3	3	3	3	2
Fluctuation of material, machine, and labor costs	4	3	2	4	2	2	5	4	3	4	3	5	5	3	5	3	4	5	5	4	3	4	2	2	4	4	4		5	3	3
Government policies which can affect construction industries	4	2	2	4	4	2	3	3	3	4	2	4	3	3	4	2	4	4	4	3	4	3		2	2	4	3	2	4		2
Risk from natural disasters such as heavy rain, flooding , and storm	2	4	3	4	5	2	5	2	3	4	2	3	3	2	4	3	4		2	3	4	2	2	4	1	3	3	3	4	4	3
Geological condition of project site	2	4	2	4	4	3	4	3	3	4	1	4	3	4	4	3	4		4	3	4	2	2	4		4	3	3	3	3	3

ID	Factors/Respondents	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average $\overline{X}=\frac{\sum x}{N}$	Standar $S=\sqrt{\frac{\sum(x-\overline{x})}{N-1}}$
EF1	Conflict caused by people nearby project	3	2	1	4	1	2	2	4	2	4	2	2	3	2	3	2	3	3	4	4	4	3	4	3	4	54	2.91	1.05
EF2	Effected by inflation and exchange rates	3	3	3	2		2	2	4	2	4	2	2	3	2	3	3	3	4	3	4	5	4	3	3	3	53	2.96	0.87
EF3	Economic tendency	3	3	3	3		2	2	3	2	4	2	2	3	2	2	3	3	4	3	4	4	4	3	3	4	54	2.87	0.74
EF4	Fluctuation of material, machine, and labor costs	4	3	3	4		2	3	3	2	3	2	3	4	2	3	4	3	4	3	3	4	4	3	3	4	54	3.43	0.93
EF5	Government policies which can affect construction industries	5	3	3	3		2	3	3	2	3	3	3	4	4	4	4	2	3	3	3	4	4	3	3	3	53	3.15	0.82
EF6	Risk from natural disasters such as heavy rain, flooding , and storm	4	2	4	3	4	3	3	5	3	4	3	3	4	3	4	3	4	3	2	3	4	4	3	4	4	55	3.25	0.89
EF7	Geological condition of project site	4	3	5	4	4	4	3	4	3	3	3	3	3	3	5	3	3	4	2	3	4	3	3	3	4	54	3.33	0.78
		Total Average																										3.13	0.87

According to Table 28, Table 29 presents average scores as well as ranking of the seven external factors. These factors were ranked from the highest to the lowest. It illustrates that the fluctuation of material, machine and labor costs (EF4) has the highest average score of 3.43, which was determined as moderate level. While the economic tendency(EF3) has the lowest average score of 2.87, and it was determined as moderate level.

Table 29 Average level of importance and ranks of external factors affecting project quality

Rank	ID	External factors	Average
1	EF4	Fluctuation of material, machine and labor costs	3.43
2	EF7	Geological condition of project site	3.33
3	EF6	Risk from natural disasters	3.25
4	EF5	The positive government policies affecting construction industries	3.15
5	EF2	Project affected by inflation and exchange rate	2.96
6	EF1	Conflict caused by people nearby project	2.91
7	EF3	Trend of economics	2.87

3. Summarized factors affecting project success

This section summarizes and discusses the result based on the previous data analysis.

With respect to project duration, most important factor is the project participant with total average score of 3.79. 93.75% of factors in this group have average level of importance over 3.5. The external factor is least important factors with the total average score of 3.59. 71.43% of factors have average level of important over 3.5.

With respect to project cost, the external factor is the most important factor with the total average score of 3.74. Most factors in this group have average level of

importance over 3.5. The interactive process factor is the least important factor with the total average score of 3.45. 50% of factors in this group have average level of importance over 3.5.

With respect to project quality, the most important factor is the project participant factor with total average score of 3.75. 81.25% of factors in this group have average level of importance over 3.5. The external factor is the least important factor with the total average score of 3.13. None of the factors in this group have average level of importance over 3.5.

Table 30 Summarized factors affecting three aspects of project success

Groups	Factors	Project duration		Project cost		Project quality	
		Total Average	%of factors with the average over 3.5	Total Average	%of factors with the average over 3.5	Total Average	%of factors with the average over 3.5
1	Project participant	3.79	93.75%	3.67	75.00%	3.75	81.25%
2	Project characteristic	3.74	100.00%	3.62	70.00%	3.31	20.00%
3	Interactive process	3.69	87.50%	3.45	50.00%	3.64	87.50%
4	Eternal factor	3.59	71.43%	3.74	100.00%	3.13	0.00%

The rankings of 49 factors in three aspects are shown in Table 31. Based on 56 respondents, the top three most important factors are in each aspect explained as follows:

The first rank factor affecting project duration is the density of traffic that interrupts construction activities factor, the second rank is the cash flow of contractor factor, and last one is skills and capabilities in managing of manager factor.

The fluctuation of material, machine and labor cost, the workable machine and instrument at site of contractor, and the experience of contractor in bridge construction project factors are determined as the first, second, and the third ranks respectively affecting project cost.

The first rank factor affecting project quality is the good quality control, the second rank is workable machines and instruments at site of contractor factor, and the last one is effective monitoring and feedback systems factor.

Table 31 Ranking of 49 critical factors affecting all three aspects of project success

ID	Factors	Rank		
		Project duration	Project cost	Project quality
PP1	Knowledge and experience of owner	16	31	9
PP2	Skills and experience of designer	23	6	10
PP3	Constructability of drawing	30	5	6
PP4	Responsibility of designer on dealing construction phase	36	41	34
PP5	Managing skills of project manager	3	13	7
PP6	Experience in managing of similar projects	9	7	12
PP7	Leadership quality of project manager	15	29	19
PP8	Cash flow of contractors	2	9	11
PP9	Experience of contractor in bridge construction projects	5	3	4
PP10	Workable machines and instruments at site of contractor	4	2	2
PP11	Number of jobs in hand	33	37	29
PP12	The coordination between contractors and sub-contractors	18	12	13
PP13	Safety performance and safety policies of contractors	49	35	41
PP14	Relationship of the contractors and the suppliers	39	40	33
PP15	Experience in bridge construction of sub-contractors	10	17	8
PP16	Sufficiency of skilled labor and machines of sub-contractors	7	19	5
PC1	Using appropriate contract type	34	41	32
PC2	Well defined scope of works in the contract	27	10	35
PC3	Clarity of contract documents	37	23	42
PC4	Clarity of conflict resolution specified in contract document	42	48	49
PC5	Clarity of terms of payment in contract documents	45	12	47
PC6	Density of traffic that interrupts construction activities	1	8	38
PC7	The limitation of project site access	6	22	37
PC8	Availability of utilities	17	24	40
PC9	Size and cost of project	26	15	22
PC10	Uniqueness of project which requires advanced technical know-how	11	4	14
IP1	Appropriate and reasonable plan	15	31	25
IP2	Usage of appropriate construction technique in the project	10	30	16
IP3	On site planning is integrated to other plan	21	46	18
IP4	Reasonable project duration	13	34	21
IP5	Availability of resources throughout the project period	46	49	36
IP6	Effective organization chart	28	43	30
IP7	Good document system	38	42	28
IP8	Using efficient construction management techniques	8	32	27
IP9	Usage of effective software in project managing	24	37	23
IP10	Effective conflict resolving method	16	39	24
IP11	Effectiveness of monitoring and feedback systems	32	20	3
IP12	Regular updating plan	31	48	17
IP13	Good quality control system	23	25	1
IP14	Use of informal communication among project teams	47	47	26
IP15	Usage formal communication among project teams	29	45	20
IP16	Usage system and safety training program to project members	39	16	15
EF1	Conflict caused by people nearby project	20	34	46
EF2	Effected by inflation and exchange rates	41	14	45
EF3	Economic tendency	44	26	48
EF4	Fluctuation of material, machine, and labor costs	29	1	31
EF5	Government policies which can affect construction industries	48	42	44
EF6	Risk from natural disasters such as heavy rain, flooding , and storm	31	27	43
EF7	Geological condition of project site	47	20	39

4 Critical success factors in different views of project participants: owner' view, designer' view, and contractor' view.

Previously we have discussed the result of all 49 success factors in the overall views of project participants. Here we discussed these critical factors in different views: owner' view, designers' view, and contractor' view. Top ten factors were listed based on average from all respondent, their respective ranking according to different parties were tabulated below in Table 32, 33, and 34.

4.1 Critical success factors in different views of project participants affecting project duration

Table 32 shows the top ten most critical factors affecting project duration based on 56 respondents' view, owners' view, designers' view, and contractors' view.

With respect to owners' point of view, the factors of PC6, PP8, PP5, PP10, PP9, and IP2 are the most critical success factors affecting project duration.

With respect to designers' point of view, the factors of PC6, PP8, PP5, PP10, PP9, IP8, and IP2 are the most critical success factors affecting project duration.

Whereas respect to contractors' point of view, the factors of PC6, PP8, PP5, PP10, PP9, PC7, and PP16 are the most critical success factors affecting project duration.

Table 32 Top ten factors affecting project duration from different views of project participants, owners, designers, and contractors

ID	Factors	All respondents		Owner		Designer		Contractor	
		Average	Rank	Average	Rank	Average	Rank	Average	Rank
PC6	Density of traffic that interrupts construction activities	4.16	1	4.33	1	4.22	3	4.00	4
PP8	Cash flow of contractors	4.13	2	4.29	2	4.11	6	4.00	5
PP5	Skills and capabilities in managing of manager	4.11	3	4.19	5	4.11	7	4.04	2
PP10	Experience of Contractor Company	4.09	4	4.14	7	4.11	4	4.04	3
PP9	Workable machines and instruments at site of contractor	4.07	5	4.19	4	4.11	5	3.96	8
PC7	The limitation of project site	3.96	6	4.10	10	3.67	24	3.96	7
PP16	Adequate skilled labors and machine of sub-contractors	3.95	7	3.90	19	3.89	10	4.00	6
IP8	Using efficient construction management techniques	3.91	8	3.95	14	4.00	8	3.85	11
PP6	Manager's experience in managing the similar projects	3.89	9	4.05	11	3.89	11	3.77	13
IP2	Skill and experience of designer	3.89	10	4.10	8	4.25	2	3.62	29

4.2 Critical success factors in different views of project participants affecting project cost

Table 33 shows the top ten most critical factors affecting project cost based on 56 respondents' view, owners' view, designers' view, and contractors' view.

With respect to owners' point of view, the factors of EF4, PP10, PP9, PC10, PP3, PC6, PC9, and PP2 are the most critical success factors affecting project cost.

With respect to designers' point of view, the factors of EF4, PP9, PC10, PP3, and EF2 are the most critical success factors affecting to project cost.

Whereas respect to contractors' point of view, the factors of EF4, PP9, PC10, EF2, and PP6 are the most critical success factors affecting project cost.

Table 33 Top ten factors affecting project cost from different views of project participants, owners, designers, and contractors.

ID	Factors	All respondents		Owner		Designer		Contractor	
		Average	Rank	Average	Rank	Average	Rank	Average	Rank
EF4	Fluctuation of material, machine and labor costs	4.24	1	4.30	1	4.22	1	4.20	1
PP10	Workable machines and instruments at site of contractor	4.02	2	4.10	3	3.44	17	4.00	4
PP9	Experience of contractor in bridge construction projects	3.93	3	3.95	8	3.78	3	3.96	5
PC10	Project size: the value in US dollar of project price in	3.89	4	4.00	6	3.67	6	3.88	8
PP3	Constructability of drawing	3.89	5	4.05	4	3.89	2	3.77	14
EF2	Project affected by inflation and exchange rate	3.85	6	3.74	22	3.67	6	4.00	3
PP6	Manager's experience in managing the similar projects	3.84	7	3.67	25	3.11	39	4.08	2
PC6	Density of traffic that interrupts construction activities	3.80	8	4.00	7	3.33	23	3.65	22
PC9	Size and cost of project	3.80	9	4.14	2	3.22	32	3.56	27
PP2	Skill and experience of designer	3.79	10	4.00	5	3.44	18	3.73	19

4.3 Critical success factor affecting project quality from different views of project participants, owners, designers, and contractors

Table 34 shows the top ten most critical factors affecting project quality based on 56 respondents' view, owners' view, designers' view, and contractors' view.

With respect to owners' point of view, the factors of IP14, PP10, PP11, PP9, PP15, and PP1 are the most critical success factors affecting project quality.

With respect to designers' point of view, the factors of IP13, PP10, IP11, PP9, PP16, PP5 and PP3are the most critical success factors affecting to project quality.

Whereas respect to contractors' point of view, the factors of IP13, PP10, IP11, PP9, PP16, PP3, and PP2 are the most critical success factors affecting project quality.

Table 34 Top ten factors affecting project quality from different views of project participants, owners, designers, and contractors.

ID	Factors	All respondents		Owner		Designer		Contractor	
		Average	Rank	Average	Rank	Average	Rank	Average	Rank
IP13	Safety performance and safety policy of contractors	4.14	1	4.10	4	4.22	2	4.15	3
PP10	Workable machines and instruments at site of contractor	4.09	2	4.43	1	3.78	5	3.92	6
IP11	Effective monitoring and feedback systems	4.02	3	4.05	8	4.11	3	3.96	4
PP9	Experience of contractor in bridge construction projects	4.00	4	4.29	2	3.78	6	3.85	8
PP16	Adequate skilled labor and machine of sub-contractors	3.96	5	3.81	17	3.67	7	4.19	1
PP3	Constructability of drawing	3.93	6	3.81	19	3.56	9	4.16	2
PP5	Skills and capabilities in managing of manager	3.93	7	3.95	11	3.50	11	3.80	13
PP15	Experience in bridge construction of sub-contractors	3.84	8	4.05	9	3.44	17	3.81	11
PP1	Knowledge and experience of owner	3.83	9	4.10	8	3.38	21	3.76	15
PP2	Skill and experience of designer	3.82	10	3.86	15	3.44	19	3.92	5

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

It is evident that bridge construction project is one of the most important works in Thailand. Many factors, such as geographical and climatic environments, construction methods and technologies, project participants, and the characteristic of bridges greatly influence the success of the project. Therefore, the studies of critical success factors affecting bridge construction projects are of greater use in planning and performing the project construction. Based on the opinion of 56 participants who work for bridge construction projects with the minimum of 5years experience, critical success factors affecting bridge construction project are as follows:

1. It was found that project duration highly depends on project participant factors which have 93.75% of factors in this group with average score over 3.50. Project cost is greatly affected by external factors. All factors in this group have average score over 3.50. And project quality also depends on project participant factors which have 81.25% of factors in this group have average score over 3.50.

2. The empirical study found the top three ranks of factors affecting project success as follows:

(A) The project duration was essentially affected by the density of traffic that interrupted construction activities (PC6), the level of qualification of project manager (PP8), and the management skills of manager (PP5)

(B) The project cost was significantly influenced by the fluctuation of material, machine and labor costs (EF4), the experience of contractor’s company (PP10), and the cash flow management of contractors (PP9).

(C) The project quality was greatly affected by the quality control system (IP13), the experience of contractor company (PP10), and the effectiveness of monitoring and feedback systems (IP11)

3. Furthermore, the survey result was further investigated for critical factor in different views of project participants as follows.

(A) The critical factors affecting project duration: In the owners' view, the density of traffic that interrupted construction activities (PC6), and the cash flow of contractor (PP8) were the main factors. In the designers' view, the Skills and experience of designer (IP2) and the density of traffic that interrupted construction activity (PC6) were the most important. In the contractors' view, the skills and capabilities in managing of manager (PP5) and the experience of contractor company (PP10) have the most important.

(B) Critical factor affecting project cost: In the owners' view, the fluctuation of material, machine and labor costs (EF4), the size and cost of project (PC9), and workable machine and instruments at site of contractor (PC10) have significantly impacted. In the designers' view, the fluctuation of material, machine and labor costs (EF4), uniqueness of project activities requiring high technical know-how (PP3) and the workable machines and instrument at site of contractor (PP10) have the greatest impacts. In the contractors' view, the factor of fluctuation of material, machine and labor costs (EF4), the manager's experience in managing to similar project (PP6), and the project affecting from inflation and exchange rate (EF2) were the main factors.

(C) The critical factor affecting project quality: In the owners' view, the workable machine and instrument on site of contractor (PP10) and the experience of contractor in bridge construction projects (PP9) have most influence. In the designers' view, the safety performance and safety policy of contractor (IP13) and the effective monitoring and feedback systems (IP11) have the greatest impact. The contractors' view, the adequate skill labors and machine of sub-contractors (PP16), the adequate skilled labors and machine of sub-contractor (PP3), skills and capability in managing of manager (PP5) and safety performance and safety policy of contractor (IP13) have significantly impact.

Recommendation

According to the study result, project duration and quality depend greatly on project participant factors, therefore the project manager should pay much attention in

selecting the qualified designers, contractors, and sub-contractors to perform the bridge project. The external factors directly influence project cost, indeed the fluctuation of material, machine and labor cost factor could be carefully concentrated.

In this paper, we emphasized the factors affecting project success of bridge construction in Thailand. The major findings need to be reviewed if the bridge project is performed in other countries.

LITERATURE CITED

Abert, P. 2004. Factors Affecting the Success of a Construction Project. **Journal of Construction Engineering and Management**. ASCE/January/February.

Chovichien. 2001. Factors Affecting the Construction Operations of Mass Transit Electrical Train Project in Bangkok Metropolis. The seventh national civil work meeting.

Chan, S.cott, and W.M.Lam. 2002. Frame work of Success criteria for Design/ Build Project. **Journal of Management in Engineering**.

Songer, D. and R. Molenaar. 1997. Project Characteristics for Successful Public-Sector Design-Build. **Journal of Construction Engineering and Management/March**

Intaraphrom. 2005. **Factors affecting the quality of building projects in construction phase**. M.S. thesis, Thammasart University.

Kunraya. 2000. **Spss for window in Data Analysis**. Chulalongkorn University.

Iyer, K.C. and K.N.Jha. 2003. Factors affecting cost performance: evidence from Indian construction project. **International Journal Project Management** 23.

Odeh, M. and T. Battaineh. 2002. Causes of Construction delay: Traditional Contracts. **International Journal of Project Management** 20.

Puagsopa. 2005. **Causes of contractor's delays in large building construction projects**. M.S. thesis, North Prachomkao Pranakon Institute of Technoloy.

Suphachai, S. 2002. **The Evaluation of Factors Affecting Quality of Building Construction Process**. M.S. thesis, Kasetsart University.

Wongpattananikorn .2005. **Cause of Construction Delay: A Mega Infrastructure Project case study in Thailand**. Master of Science Independent Study, Kasetsart University.

APPENDIX

Appendix A

FACTORS AFFECTING BRIDGE PROJECT DURATION

DATA OF ALL RESPONDENTS STUDY ON PROJECT DURATION

Owner opinion on factors affecting project duration

ID	Case	10	13	14	15	16	17	18	19	20	21	22	23	25	26	27	28	29	31	32	33	34	N	Average $\bar{X}=\frac{\sum X}{N}$	Standard $S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
EF1		3	3	3	4	4	4	5	4	4	4	4		4	3	3	2	3	4	5	5	2	20	3.65	0.88
EF2		3	4		4	2	3	5	5	4	3	3		3	4	3	2	3	2	3	4	3	19	3.32	0.89
EF3		3	5	4	3	3	3	5	5	3		3	3	3	3	3	3	5	2	3	4	3	20	3.45	0.89
EF4		4	4	4	4	4	4	5	5	4	3	3	3	2	4	4	3	4	3	4	4	4	21	3.76	0.70
EF5		4	4	3	5	4	4	4	4	3	4	3		2	4	4	3	4	3	5	3	3	20	3.65	0.75
EF6		3	3	2	5	4	2	1	1	3	5	4	4	2	3	3	3	4	3	5	5	3	21	3.24	1.22
EF7		4	3	4	4	4	3	4	4	3	4	3	1		4	4	3	2	4	4	3	3	20	3.40	0.82
PC1		5	3	3	5	5	4	5	5	3	4	2		2	3	4	4	3	3	4	5	5	20	3.85	1.30
PC2		5	3	4	4	4	4	5	5	4	4	3		4	4	4	3	2	4	4	4	5	20	3.95	0.76
PC3		5	3	3	3	4	4	5	5	4	3	2		4	4	4	3	2	4	4	4	5	20	3.75	0.91
PC4		4	3	3	4	4	4	5	5	3	3	3			4	4	3	3	4	3	3	5	19	3.68	0.75
PC5		4	3	4	2	4	4	3	2	3	3	2		4	4	4	2	4	3	5	3	5	20	3.40	0.94
PC6		4	4	5	5	4	4	5	4	4	4	4	4	5	5	4	4	4	4	5	4	5	21	4.33	0.48
PC7		4	4	4	4	4	4	5	5	4	4	4	3	4	5	4	3	3	4	5	4	5	21	4.10	0.62
PC8		4	4	3	5	4	3	5	5	4	5	4	2	4	5	3	4	2	3	5	4	5	21	3.95	0.97
PC9		3	3	3	5	4	4	5	5	4	4	4	4	3	4	4	3	2	5	4	3	5	21	3.86	0.85
PC10		4	3	3	5	4	4	5	5	4	5	5	3	4	4	4	3	3	4	5	3	4	21	4.00	0.77
PP1		4	4	4	4	4	3	5	5	4	4	4	4	4	4	4	4	4	5	4	4	4	21	4.10	0.44
PP2		5	4	4	4	4	3	4	4	5	5	4	3	4	4	3	3	3	4	4	4	4	21	3.90	0.62
PP3		5	2	4	4	4	4	4	4	4	4	5	3	3	5	4	4	3	4	5	4	4	21	3.95	0.74
PP4		5	2	3	4	3	3	4	4	5	4	4	3	3	4	3	4	5	3	5	5	4	21	3.81	0.87
PP5		5	3	4	5	4	4	5	5	4	5	4	4	3	4	4	4	4	4	5	4	4	21	4.19	0.60
PP6		5	3	4	5	4	4	5	5	4	4	4	4	3	3	4	4	3	4	5	4	4	21	4.05	0.67
PP7		5	3	4	5	5	4	5	5	4		4	4	3	4	4	4	5	2	5	4	4	20	4.15	0.81
PP8		5	2	3	5	4	4	5	5	4	5	5	3	3	5	4	5	3	5	5	5	5	21	4.29	0.96
PP9		5	2	4	5	4	4	5	5	4	5	4	3	3	4	3	4	4	5	5	5	5	21	4.19	0.87
PP10		5	3	3	4	4	4	5	5	4	4	4	2	3	5	4	5	4	4	5	5	5	21	4.14	0.85
PP11		4	2	3	4	4	4	5	4	4	4	4	2	3	3	4	4	3	3	5	4	5	21	3.71	0.85
PP12		4	2	3	5	4	4	5	5	4	4	5	2	3	4	4	4	3	4	5	3	4	21	3.86	0.91
PP13		5	3	3	3	4	2	5	5	4	3	2	2	3	4	3	3	3	3	4	3	4	21	3.38	0.92
PP14		4	2	4	5	4	3	5	5	4	4	4	3	3	4	4	4	2	2	4	4	4	21	3.71	0.90
PP15		5	3	3	4	4	4	5	5	4	4	4	2	2	4	4	4	4	3	5	5	4	21	3.90	0.89
PP16		5	2	2	4	4	4	5	5	4	4	5	1	3	4	4	4	4	4	5	5	4	21	3.90	1.09
IP1		4	3	3	5	4	4	3	3	4	4	4	4	3	4	4	4	4	4	5	3	4	21	3.81	0.60
IP2		4	4	3	5	4	4	4	4	5	4	4	4	3	5	4	4	4	4	5	4	4	21	4.10	0.54
IP3		4	3	3	5	4	4	3	3		4	4	4	3	4	4	4	4	4	5	3	4	20	3.80	0.62
IP4		4	3	4	5	4	4	5	5	4	5	3	4	3	5	4	4	3	4	3	3	4	21	3.95	0.74
IP5		4	3	3	3	3	3	4	4	4		4	4	3	4	4	3	3	4	4	3	4	20	3.55	0.51
IP6		5	4	3	4	4	3	4	4	4	4	3	4	2	4	4	3	5	4	5	3	4	21	3.81	0.75
IP7		5	4	3	4		3	4	4	4	4	3	4	3	4	3	4	2	3	5	3	4	20	3.65	0.75
IP8		5	4	4	4	3	4	5	5	4	5	4	3	3	4	4	3	3	4	5	3	4	21	3.95	0.74
IP9		5	4	3	4	3	4	4	4	4	4	4	4	4	4	4	4	3	4	4	3	4	21	3.86	0.48
IP10		5	3	4	5	4	3	5	5	4	4	4	4		4	4	4	3	5	5	4	5	20	4.20	0.70
IP11		4	3	3	5	4	3	4	4	4	5	3	4	3	3	4	4	4	4	5	4	4	21	3.86	0.65
IP12		4	3	4	4	4	4	5	5		4	2	3	3		3	3	4	4	4	3	4	19	3.68	0.75
IP13		4	3	4	4	4	3	5	5	4	5	2	3	3	4	3	4	3	4	3	5	4	21	3.76	0.83
IP14		5	2	3	4	2	3	5	5	3	4	3	3	4	3	4	4	2	3	3	4	4	21	3.48	0.93
IP15		5	2	4	5	4	4	5	5	4	4	4	3	3	4	4	3	4	4	4	4	4	21	3.95	0.74
IP16		5	2	4	3	4	3	5	5	4	4	2	3		4	4	4	3	2	3	3	4	20	3.55	0.94
Parties	owner	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21		
	Designer																						0		
	Contractor																						0		

Designer opinion on factors affecting project duration

ID	Case	3	4	5	6	7	8	9	11	30	N	Average	Standard
												$\bar{X}=\frac{\sum x}{N}$	$S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
EF1		2	3	4	4	5	3	4	4	4	9	3.67	0.87
EF2		2	3	2	3	4	3	3	3	3	9	2.89	0.60
EF3		2	4	4	2	3	4	3	1	4	9	3.00	1.12
EF4		2	4	4	4	4	4	3	4	3	9	3.56	0.73
EF5		2	4	4	4	3	3	3	2	0	8	3.13	0.83
EF6		3	3	4	5	5	4	3	4	3	9	3.78	0.83
EF7		2	4	2	3	4	4	3	2	3	9	3.00	0.87
PC1		3	4	2	5	5	2	4	2	4	9	3.44	1.24
PC2		3	4	3	3	4	3	4	3	3	9	3.33	0.50
PC3		2	4	3	3	4	3	4	4	2	9	3.22	0.83
PC4		2	4	2	5	3	3	4	3	3	9	3.22	0.97
PC5		0	4	3	3	4	4	4	4	4	8	3.75	0.46
PC6		3	4	4	5	5	5	4	4	4	9	4.22	0.67
PC7		3	4	4	4	5	4	4	3	2	9	3.67	0.87
PC8		3	4	5	3	5	4	4	4	3	9	3.89	0.78
PC9		4	4	2	4	4	3	4	3	3	9	3.44	0.73
PC10		3	4	3	5	5	3	4	4	4	9	3.89	0.78
PP1		2	4	3	2	5	4	3	3	3	9	3.22	0.97
PP2		3	4	2	3	5	4	4	3	3	9	3.44	0.88
PP3		3	4	4	3	5	4	4	4	3	9	3.78	0.67
PP4		3	4	2	3	4	3	4	3	5	9	3.44	0.88
PP5		4	4	4	4	5	4	4	4	4	9	4.11	0.33
PP6		4	4	3	5	5	4	4	3	3	9	3.89	0.78
PP7		3	4	4	3	4	4	4	4	4	9	3.78	0.44
PP8		4	4	4	5	5	5	4	4	2	9	4.11	0.93
PP9		4	4	4	4	5	4	4	4	4	9	4.11	0.33
PP10		4	4	4	4	5	4	4	4	4	9	4.11	0.33
PP11		3	4	4	3	5	3	3	4	3	9	3.56	0.73
PP12		3	4	3	3	5	4	4	3	3	9	3.56	0.73
PP13		3	4	2	4	3	4	4	3	3	9	3.33	0.71
PP14		3	4	3	4	4	4	4	0	2	8	3.50	0.76
PP15		4	4	4	4	5	3	4	3	3	9	3.78	0.67
PP16		4	4	4	4	5	3	4	3	4	9	3.89	0.60
IP1		4	4	4	5	5	5	4	5	4	9	4.44	0.53
IP2		4	4	0	4	5	5	4	4	4	8	4.25	0.46
IP3		3	4	4	3	5	4	4	4	4	9	3.89	0.60
IP4		4	4	4	0	5	4	3	3	4	8	3.88	0.64
IP5		3	4	3	4	5	4	4	3	4	9	3.78	0.67
IP6		3	4	4	3	5	3	4	2	4	9	3.56	0.88
IP7		2	4	0	3	3	3	4	2	3	8	3.00	0.76
IP8		4	4	3	5	5	3	4	5	3	9	4.00	0.87
IP9		3	4	3	3	5	2	4	4	3	9	3.44	0.88
IP10		3	4	4	5	5	3	4	3	2	9	3.67	1.00
IP11		3	4	3	3	5	4	4	3	3	9	3.56	0.73
IP12		4	4	0	4	5	3	4	3	4	8	3.88	0.64
IP13		2	4	4	3	5	4	4	3	3	9	3.56	0.88
IP14		3	4	4	3	5	3	4	3	3	9	3.56	0.73
IP15		3	4	3	4	5	3	4	4	3	9	3.67	0.71
IP16		2	4	3	3	4	2	4	4	3	9	3.22	0.83
Parties	owner										0		
	Designer	1	1	1	1	1	1	1	1	1	9		
	Contractor										0		

Contractor opinion on factors affecting project duration

ID	Case	1	2	12	24	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average	Standard
																													$\bar{X}=\frac{\sum X}{N}$	$S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
EF1		4	4	4	4	3	3	4	4	4	5	3	4	4	4	5	4	4	3	4	4	4	4	4	4	4	4	26	3.92	0.48
EF2		5	4	4	2	3	0	5	5	3	5	4	5	5	4	5	4	5	4	3	4	5	4	4	3	4	4	25	4.12	0.83
EF3		5	4	3	2	2	0	4	4	4	5	4	4	4	3	4	4	4	5	3	4	5	4	4	3	3	3	25	3.76	0.83
EF4		5	4	4	2	4	0	4	3	3	3	4	4	3	4	4	4	3	4	4	3	5	5	4	3	3	3	25	3.68	0.75
EF5		4	2	5	2	4	0	4	3	3	3	4	4	3	4	4	3	3	4	4	3	4	5	3	3	3	3	25	3.48	0.77
EF6		2	5	5	4	4	4	4	4	3	3	3	4	4	4	4	4	4	5	2	4	5	4	3	4	4	4	26	3.85	0.78
EF7		2	3	4	4	3	4	4	3	4	3	3	3	4	3	4	3	3	4	3	4	4	4	4	4	4	4	26	3.54	0.58
PC1		4	4	5	4	3	4	3	2	5	3	3	3	3	4	2	4	2	3	3	4	5	4	3	3	3	4	26	3.46	0.86
PC2		4	4	4	5	4	3	3	2	4	3	4	3	2	4	2	4	3	4	4	3	5	4	4	4	4	4	26	3.62	0.80
PC3		5	4	4	5	4	3	3	3	3	3	3	3	3	3	2	4	3	3	5	3	4	4	4	4	3	3	26	3.50	0.76
PC4		4	4	4	2	3	0	4	4	3	5	3	4	4	3	4	3	4	3	3	4	4	5	4	4	4	4	25	3.72	0.68
PC5		4	4	3	2	4	4	4	4	4	5	4	4	3	3	4	3	4	3	3	4	3	4	3	3	3	3	26	3.54	0.65
PC6		4	5	5	2	4	5	5	5	4	5	4	4	5	3	5	4	5	4	4	3	3	3	3	3	3	4	26	4.00	0.89
PC7		4	3	4	3	4	4	5	5	4	5	2	4	5	4	5	4	5	5	3	4	4	3	3	3	4	4	26	3.96	0.82
PC8		4	2	4	2	3	4	4	4	2	4	3	4	5	4	5	4	4	3	3	4	4	3	3	3	3	4	26	3.54	0.81
PC9		5	0	4	4	3	4	3	3	4	4	3	3	3	4	4	4	3	5	3	4	4	4	3	3	4	4	25	3.68	0.63
PC10		4	5	4	5	2	5	3	4	3	4	3	3	3	4	4	4	3	4	4	3	3	4	4	4	3	4	26	3.69	0.74
PP1		4	3	4	5	3	4	3	3	4	4	4	3	4	4	4	4	3	3	3	4	4	4	3	4	3	4	26	3.65	0.56
PP2		4	4	4	5	3	4	4	3	3	3	4	3	3	3	3	4	4	4	3	4	3	3	4	4	4	4	26	3.62	0.57
PP3		3	3	4	5	4	4	2	2	4	2	3	2	2	4	3	4	2	4	3	5	4	4	3	3	3	4	26	3.31	0.93
PP4		3	3	4	4	2	5	2	2	5	2	3	3	2	4	3	4	3	3	3	4	3	3	4	4	3	4	26	3.27	0.87
PP5		3	4	5	4	3	4	5	5	4	4	4	5	5	4	5	3	5	5	3	4	4	4	3	3	3	4	26	4.04	0.77
PP6		3	4	5	4	3	4	4	4	3	4	4	4	5	4	4	3	4	5	4	3	3	3	4	4	3	3	26	3.77	0.65
PP7		4	4	5	3	4	4	4	3	4	4	3	4	4	3	4	3	3	5	4	4	3	4	3	3	2	3	26	3.62	0.70
PP8		5	5	5	3	4	5	4	5	2	4	4	4	5	4	5	3	5	4	3	4	4	3	3	4	3	4	26	4.00	0.85
PP9		5	3	4	3	3	5	4	5	3	4	4	4	5	4	5	4	5	5	3	4	4	4	4	3	2	4	26	3.96	0.82
PP10		5	5	4	4	4	5	4	4	4	4	4	4	5	4	4	4	4	5	3	5	4	3	3	3	3	4	26	4.04	0.66
PP11		4	3	4	3	3	0	4	4	4	4	3	4	4	4	4	4	4	3	3	5	4	4	3	3	2	4	25	3.64	0.64
PP12		4	4	3	4	3	4	4	5	3	4	3	3	5	4	3	4	4	3	4	5	4	3	3	4	3	3	26	3.69	0.68
PP13		2	0	4	4	2	3	4	3	3	3	3	3	3	4	3	4	3	3	4	4	3	4	3	4	2	3	25	3.24	0.66
PP14		2	4	4	3	2	4	5	3	3	3	3	3	4	3	4	3	3	3	3	4	4	3	4	4	3	3	26	3.35	0.69
PP15		4	4	4	4	3	4	5	5	4	4	3	4	5	4	5	3	5	4	3	4	3	4	3	4	2	4	26	3.88	0.77
PP16		3	5	4	4	3	4	3	4	5	4	4	4	4	4	4	4	5	4	5	4	4	4	4	4	3	4	26	4.00	0.57
IP1		4	5	5	3	4	4	3	3	4	3	3	3	3	4	4	3	4	4	3	3	3	3	4	4	4	3	26	3.58	0.64
IP2		4	5	5	4	4	4	3	2	4	3	3	3	3	3	4	3	3	3	4	4	4	4	4	4	4	3	26	3.62	0.70
IP3		4	5	5	3	4	4	3	3	5	3	3	3	3	3	3	3	4	2	3	4	4	4	3	4	4	4	26	3.58	0.76
IP4		5	4	5	5	4	5	3	3	4	3	3	4	3	3	3	4	4	5	4	3	4	3	3	3	3	4	26	3.73	0.78
IP5		0	4	4	4	4	4	3	3	4	3	3	4	3	3	3	4	4	2	2	2	3	3	4	3	4	3	25	3.32	0.69
IP6		3	5	4	3	3	4	4	4	4	4	4	4	4	3	5	3	3	3	3	2	4	4	3	4	4	3	26	3.62	0.70
IP7		3	4	4	3	3	4	4	5	4	5	4	4	4	3	5	4	4	3	3	3	4	3	3	4	3	4	26	3.73	0.67
IP8		3	5	4	3	4	5	4	4	4	4	4	4	4	4	3	4	4	5	4	3	3	4	4	3	3	4	26	3.85	0.61
IP9		3	4	4	3	3	5	4	3	4	3	4	4	3	4	4	3	4	5	4	3	4	3	4	3	4	3	26	3.65	0.63
IP10		4	4	5	5	4	5	3	3	2	3	1	3	3	4	3	3	4	3	4	3	4	4	5	3	3	3	26	3.50	0.95
IP11		4	5	5	3	4	4	3	3	4	3	2	3	3	4	3	3	3	3	4	2	3	4	5	4	3	3	26	3.46	0.81
IP12		4	5	5	2	3	5	4	3	4	3	3	3	3	4	3	4	3	2	2	0	4	4	5	4	4	3	25	3.56	0.92
IP13		4	5	5	3	3	5	4	4	4	4	3	4	4	3	4	3	3	3	1	4	4	4	4	4	4	3	26	3.69	0.84
IP14		3	4	5	3	3	3	4	3	2	3	3	4	3	4	4	4	4	3	2	3	3	3	5	3	3	3	26	3.35	0.75
IP15		4	4	4	4	2	4	4	3	3	3	4	4	3	3	3	3	3	0	3	3	4	3	4	4	4	2	25	3.40	0.65
IP16		3	3	4	4	3	3	5	5	3	5	4	5	5	3	5	4	4	4	3	2	3	4	3	3	4	3	26	3.73	0.87
Parties	owner 1																											0		
	Designer 2																											0		
	Contractor 4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	26		

Ranks of important factors affecting project duration from three parties

Rank	Owners			Designers			Contractors		
	Factors	Average	Standard d	Factors	Average	Standard d	Factors	Mean	Average
1	PC6	4.33	0.48	IP1	4.44	0.53	EF2	4.12	0.83
2	PP8	4.29	0.96	IP2	4.25	0.46	PP5	4.04	0.77
3	IP10	4.20	0.70	PC6	4.22	0.67	PP10	4.04	0.66
4	PP9	4.19	0.87	PP10	4.11	0.33	PC6	4.00	0.89
5	PP5	4.19	0.60	PP9	4.11	0.33	PP8	4.00	0.85
6	PP7	4.15	0.81	PP8	4.11	0.93	PP16	4.00	0.57
7	PP10	4.14	0.85	PP5	4.11	0.33	PC7	3.96	0.82
8	IP2	4.10	0.54	IP8	4.00	0.87	PP9	3.96	0.82
9	PP1	4.10	0.44	IP3	3.89	0.60	EF1	3.92	0.48
10	PC7	4.10	0.62	PP16	3.89	0.60	PP15	3.88	0.77
11	PP6	4.05	0.67	PP6	3.89	0.78	IP8	3.85	0.61
12	PC10	4.00	0.77	PC10	3.89	0.78	EF6	3.85	0.78
13	IP15	3.95	0.74	PC8	3.89	0.78	PP6	3.77	0.65
14	IP8	3.95	0.74	IP12	3.88	0.64	EF3	3.76	0.83
15	IP4	3.95	0.74	IP4	3.88	0.64	IP4	3.73	0.78
16	PP3	3.95	0.74	EF6	3.78	0.83	IP7	3.73	0.67
17	PC8	3.95	0.97	IP5	3.78	0.67	IP16	3.73	0.87
18	PC2	3.95	0.76	PP15	3.78	0.67	PC4	3.72	0.68
19	PP16	3.90	1.09	PP7	3.78	0.44	PC10	3.69	0.74
20	PP15	3.90	0.89	PP3	3.78	0.67	PP12	3.69	0.68
21	PP2	3.90	0.62	PC5	3.75	0.46	IP13	3.69	0.84
22	IP11	3.86	0.65	IP15	3.67	0.71	PC9	3.68	0.63
23	IP9	3.86	0.48	IP10	3.67	1.00	EF4	3.68	0.75
24	PP12	3.86	0.91	PC7	3.67	0.87	PP1	3.65	0.56
25	PC9	3.86	0.85	EF1	3.67	0.87	IP9	3.65	0.63
26	PC1	3.85	1.30	IP14	3.56	0.73	PP11	3.64	0.64
27	IP6	3.81	0.75	IP13	3.56	0.88	PP2	3.62	0.57
28	IP1	3.81	0.60	IP11	3.56	0.73	PP7	3.62	0.70
29	PP4	3.81	0.87	EF4	3.56	0.73	IP2	3.62	0.70
30	IP3	3.80	0.62	IP6	3.56	0.88	IP6	3.62	0.70
31	IP13	3.76	0.83	PP12	3.56	0.73	PC2	3.62	0.80
32	EF4	3.76	0.70	PP11	3.56	0.73	IP1	3.58	0.64
33	PC3	3.75	0.91	PP14	3.50	0.76	IP3	3.58	0.76
34	PP14	3.71	0.90	PC1	3.44	1.24	IP12	3.56	0.92
35	PP11	3.71	0.85	IP9	3.44	0.88	PC5	3.54	0.65
36	IP12	3.68	0.75	PP4	3.44	0.88	PC8	3.54	0.81
37	PC4	3.68	0.75	PP2	3.44	0.88	EF7	3.54	0.58
38	EF5	3.65	0.75	PC9	3.44	0.73	PC3	3.50	0.76
39	IP7	3.65	0.75	PC2	3.33	0.50	IP10	3.50	0.95
40	EF1	3.65	0.88	PP13	3.33	0.71	EF5	3.48	0.77
41	IP16	3.55	0.94	IP16	3.22	0.83	IP11	3.46	0.81
42	IP5	3.55	0.51	PC3	3.22	0.83	PC1	3.46	0.86
43	IP14	3.48	0.93	PP1	3.22	0.97	IP15	3.40	0.65
44	EF3	3.45	0.89	PC4	3.22	0.97	PP14	3.35	0.69
45	EF7	3.40	0.82	EF5	3.13	0.83	IP14	3.35	0.75
46	PC5	3.40	0.94	EF7	3.00	0.87	IP5	3.32	0.69
47	PP13	3.38	0.92	IP7	3.00	0.76	PP3	3.31	0.93
48	EF2	3.32	0.89	EF3	3.00	1.12	PP4	3.27	0.87
49	EF6	3.24	1.22	EF2	2.89	0.60	PP13	3.24	0.66

Appendix B

FACTORS AFFECTING BRIDGE PROJECT COST

DATA OF ALL RESPONDENTS STUDY ON PROJECT COST

Owner opinion on factors affecting project cost

ID	Case	10	13	14	15	16	17	18	19	20	21	22	23	25	26	27	28	29	31	32	33	34	N	Average	Standard
																								$\bar{X}=\frac{\sum X}{N}$	$S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
EF1		4	3	3	5	4	2	4	4	4	3	4	0	4	2	4	3	3	3	4	3	2	20	3.40	0.82
EF2		4	4	4	5	2	4	5	5	4	0	4	0	3	4	3	3	4	3	3	4	3	19	3.74	0.81
EF3		4	5	4	3	3	4	5	5	3	0	4	2	3	3	4	3	3	4	3	4	3	20	3.60	0.82
EF4		4	3	3	5	4	4	5	5	4	5	4	4	4	5	4	0	4	4	5	5	5	20	4.30	0.66
EF5		4	3	3	5	4	4	4	4	3	4	3	0	2	4	4	2	5	3	5	3	3	20	3.60	0.88
EF6		4	3	2	4	4	4	1	1	3	3	3	4	2	2	4	3	4	2	5	2	4	21	3.05	1.12
EF7		4	3	4	4	3	4	4	4	4	4	4	2	0	4	3	3	3	4	4	4	5	20	3.70	0.66
PC1		4	3	3	4	4	4	1	1	4	4	2	2	2	3	4	4	2	4	4	5	5	21	3.29	1.19
PC2		4	3	3	4	4	4	5	5	4	4	3	0	4	4	4	3	1	4	5	4	5	20	3.85	0.93
PC3		4	3	3	3	4	4	5	5	4	3	2	0	4	4	4	3	2	3	3	4	5	20	3.60	0.88
PC4		4	3	3	2	4	4	3	3	3	3	2	0	0	3	4	3	3	2	3	3	5	19	3.16	0.76
PC5		4	4	4	2	3	4	3	3	3	3	2	0	4	4	4	2	2	2	5	3	5	20	3.30	0.98
PC6		4	4	4	4	4	4	5	5	3	4	3	4	5	4	4	3	3	4	5	3	5	21	4.00	0.71
PC7		4	3	4	4	4	4	5	5	4	4	3	3	4	5	4	3	2	4	5	3	5	21	3.90	0.83
PC8		4	3	4	5	4	3	5	5	3	4	4	3	4	5	4	4	3	2	5	3	5	21	3.90	0.89
PC9		3	4	4	5	4	4	5	5	4	4	5	4	3	4	3	3	4	5	5	4	5	21	4.14	0.73
PC10		4	4	3	5	4	4	5	5	4	5	5	3	4	3	4	3	2	4	5	4	4	21	4.00	0.84
PP1		5	3	4	4	4	4	4	4	4	4	2	3	5	3	4	4	3	5	4	3	4	21	3.81	0.75
PP2		5	3	4	5	4	4	5	5	4	5	4	3	5	3	4	3	2	4	5	3	4	21	4.00	0.89
PP3		4	3	3	5	4	4	5	5	4	3	5	3	3	5	4	4	0	4	5	4	4	20	4.05	0.76
PP4		4	4	3	4	3	3	5	4	4	4	3	3	2	4	3	3	4	2	5	3	4	21	3.52	0.81
PP5		5	3	4	4	4	4	3	3	4	2	3	4	4	4	4	4	3	4	4	3	4	21	3.67	0.54
PP6		5	4	4	4	4	4	3	3	4	2	3	4	3	3	4	4	4	4	4	3	4	21	3.67	0.66
PP7		5	4	4	4	4	4	3	3	4	0	3	4	3	3	4	4	3	2	4	3	4	20	3.60	0.68
PP8		5	4	4	5	4	4	3	3	4	3	4	3	3	4	4	4	3	3	5	4	5	21	3.86	0.73
PP9		5	4	3	5	4	4	3	3	4	3	4	4	3	5	4	3	4	4	5	4	5	21	3.95	0.74
PP10		5	3	3	5	4	4	5	5	4	4	4	3	3	4	4	4	4	4	5	4	5	21	4.10	0.70
PP11		4	3	3	4	4	4	4	3	3	3	2	3	3	3	3	4	3	2	5	3	5	21	3.38	0.80
PP12		4	4	4	5	3	3	4	4	4	2	4	3	3	4	3	4	4	3	5	3	4	21	3.67	0.73
PP13		5	4	3	4	4	3	5	5	4	3	5	3	3	4	3	3	2	2	4	3	4	21	3.62	0.92
PP14		4	4	3	5	4	3	4	4	4	3	3	3	3	4	3	4	2	3	5	4	4	21	3.62	0.74
PP15		5	4	3	4	4	4	5	5	4	2	3	2	3	4	4	4	3	3	5	4	4	21	3.76	0.89
PP16		5	2	3	4	4	4	4	4	4	1	3	2	3	3	4	3	4	3	5	4	4	21	3.48	0.98
IP1		4	2	4	4	4	4	4	4	4	4	2	4	3	4	3	4	4	4	5	4	4	21	3.76	0.70
IP2		4	2	4	5	4	3	4	3	5	4	4	4	3	5	3	4	3	4	5	4	4	21	3.86	0.79
IP3		4	2	3	5	4	4	3	3	0	4	3	4	3	3	4	4	4	3	5	4	4	20	3.65	0.75
IP4		4	3	3	5	4	4	5	5	4	4	3	4	3	5	4	4	5	3	3	3	4	21	3.90	0.77
IP5		4	3	3	4	3	3	3	3	4	3	2	4	3	4	4	3	2	3	4	3	4	21	3.29	0.64
IP6		5	2	3	3	4	3	4	4	4	2	2	4	4	5	4	3	4	3	3	3	4	21	3.48	0.87
IP7		5	2	3	3	0	3	3	3	3	3	2	4	4	3	4	4	3	2	4	3	4	20	3.25	0.79
IP8		5	3	3	3	4	4	3	2	4	4	4	4	3	4	4	3	3	4	5	3	4	21	3.62	0.74
IP9		5	3	3	3	4	3	4	4	4	4	3	4	4	4	4	4	4	4	4	3	4	21	3.76	0.54
IP10		5	3	3	4	4	3	5	5	4	3	2	4	0	4	4	4	4	4	5	4	4	20	3.90	0.79
IP11		4	4	4	5	4	3	5	4	4	4	2	4	3	4	3	4	3	3	5	4	4	21	3.81	0.75
IP12		4	3	2	3	4	3	4	5	0	3	2	3	3	0	3	3	4	2	4	3	4	19	3.26	0.81
IP13		4	3	4	5	4	3	5	5	4	4	2	3	3	4	4	4	3	4	4	3	4	21	3.76	0.77
IP14		4	3	3	3	2	3	5	4	3	2	2	3	4	3	4	4	4	2	3	4	4	21	3.29	0.85
IP15		4	3	4	3	4	3	5	5	4	2	2	3	2	4	4	3	3	3	3	3	4	21	3.38	0.86
IP16		5	4	3	3	4	3	5	5	4	2	3	3	3	4	4	4	4	3	3	3	4	21	3.62	0.80
Parties	Owner	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21		
	Designer																						0		
	Contractor																						0		

Designer opinion on factors affecting project cost

ID	Case	3	4	5	6	7	8	9	11	30	N	Average	Standard
												$\overline{X}=\frac{\sum x}{N}$	$S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
EF1		0	4	3	3	4	3	4	3	3	8	3.38	0.52
EF2		3	4	3	4	5	4	3	4	3	9	3.67	0.71
EF3		3	4	4	0	5	4	4	3	4	9	3.44	0.74
EF4		3	4	4	5	5	4	4	5	4	9	4.22	0.67
EF5		2	4	4	0	4	3	3	2	0	8	2.75	0.92
EF6		3	4	5	3	4	4	3	3	4	9	3.67	0.71
EF7		3	4	2	4	5	5	3	3	3	9	3.56	1.01
PC1		3	4	2	4	4	4	4	3	4	9	3.56	0.73
PC2		3	4	3	5	3	4	4	2	3	9	3.44	0.88
PC3		2	4	2	3	4	5	4	3	3	9	3.33	1.00
PC4		2	4	2	3	4	2	4	3	3	9	3.00	0.87
PC5		0	4	3	3	5	4	4	2	3	8	3.50	0.93
PC6		3	4	4	4	4	4	4	0	3	9	3.33	0.60
PC7		3	4	4	4	4	3	4	0	1	9	3.00	1.06
PC8		3	4	5	4	4	3	4	0	2	9	3.22	0.95
PC9		0	4	2	5	4	3	4	4	3	9	3.22	1.48
PC10		4	4	3	4	5	3	4	2	4	9	3.67	0.87
PP1		3	4	3	2	4	2	3	3	2	9	2.89	0.78
PP2		3	4	4	4	5	2	4	3	2	9	3.44	1.01
PP3		3	4	4	3	5	4	4	4	4	9	3.89	0.60
PP4		2	4	3	3	4	3	4	3	3	9	3.22	0.67
PP5		4	4	4	2	4	3	4	0	3	9	3.11	1.36
PP6		4	4	3	4	3	4	3	0	3	9	3.11	1.27
PP7		3	4	3	3	3	3	4	0	3	9	2.89	1.17
PP8		3	4	4	3	5	4	4	3	3	9	3.67	0.71
PP9		3	4	4	4	4	4	4	3	4	9	3.78	0.44
PP10		4	4	4	4	3	4	4	0	4	9	3.44	0.54
PP11		2	4	2	3	3	3	3	3	3	9	2.89	0.60
PP12		3	4	3	3	3	3	4	2	4	9	3.22	0.67
PP13		3	4	0	4	3	3	4	2	3	9	2.89	0.75
PP14		2	4	2	3	3	3	3	0	2	8	2.75	0.71
PP15		3	4	3	3	3	3	4	3	3	9	3.22	0.44
PP16		3	4	2	2	3	3	4	2	3	9	2.89	0.78
IP1		4	4	4	4	3	3	4	2	3	9	3.44	0.73
IP2		4	4	0	4	4	3	4	3	3	8	3.63	0.52
IP3		3	4	4	3	4	3	4	2	2	9	3.22	0.83
IP4		4	4	4	0	3	3	3	2	3	8	3.25	0.71
IP5		2	4	3	3	3	3	4	3	3	9	3.11	0.60
IP6		2	4	4	3	3	3	4	3	3	9	3.22	0.67
IP7		2	4	0	3	3	3	4	2	4	8	3.13	0.83
IP8		4	4	2	4	3	3	3	3	4	9	3.33	0.71
IP9		3	4	2	3	3	3	4	4	3	9	3.22	0.67
IP10		3	4	4	4	3	3	3	2	3	9	3.22	0.67
IP11		3	4	4	3	3	4	4	3	4	9	3.56	0.53
IP12		3	4	0	3	3	4	4	3	3	8	3.38	0.52
IP13		3	4	4	3	4	4	3	3	4	9	3.56	0.53
IP14		2	4	3	3	3	3	4	2	4	9	3.11	0.78
IP15		2	4	3	3	3	3	4	2	4	9	3.11	0.78
IP16		2	4	3	3	4	2	4	3	3	9	3.11	0.78
Parties	owner										0		
	Designer	1	1	1	1	1	1	1	1	1	9		
	Contractor										0		

Contractors' opinion on factors affecting project cost

ID	Case	1	2	12	24	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average	Standard
																													$\bar{X}=\frac{\sum X}{N}$	$S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
EF1		2	4	4	4	3	4	4	4	3	4	3	4	4	3	5	4	4	3	3	4	5	4	4	4	4	4	26	3.77	0.65
EF2		5	5	5	3	4	0	4	4	4	4	3	4	4	4	5	4	4	5	4	4	4	4	4	3	3	3	25	4.00	0.65
EF3		5	5	3	2	3	0	4	4	4	4	3	4	4	4	4	4	4	5	3	4	4	4	3	4	3	4	25	3.80	0.71
EF4		5	5	5	4	4	0	4	5	4	4	4	4	5	4	4	4	4	5	4	5	4	4	3	4	3	4	25	4.20	0.58
EF5		4	3	5	2	3	0	4	4	4	4	3	4	4	4	4	4	4	3	4	4	5	3	3	3	4	3	25	3.68	0.69
EF6		2	5	4	3	2	4	4	4	4	4	4	3	4	3	5	4	3	5	4	5	4	4	4	4	4	4	26	3.85	0.78
EF7		2	5	4	2	4	4	4	3	3	4	4	3	4	3	4	4	3	4	3	5	4	4	4	4	4	3	26	3.65	0.75
PC1		4	4	4	4	3	4	3	3	4	3	4	3	3	3	3	4	3	3	3	4	3	3	4	4	4	3	26	3.46	0.51
PC2		4	5	4	5	4	4	4	3	3	3	4	4	4	3	3	4	3	4	4	4	4	4	3	4	3	4	26	3.77	0.59
PC3		5	5	3	5	4	4	4	3	3	3	3	4	4	4	4	4	3	3	3	4	4	3	4	3	4	4	26	3.73	0.67
PC4		4	3	3	2	3	0	3	3	3	3	3	3	3	4	3	4	3	3	4	4	4	4	4	4	4	4	25	3.40	0.58
PC5		4	4	3	2	3	4	4	4	3	4	3	4	4	4	3	4	4	3	3	3	3	4	3	4	4	4	26	3.54	0.58
PC6		4	4	4	3	4	4	4	4	3	4	3	4	4	3	4	4	4	3	4	3	3	4	3	4	3	4	26	3.65	0.49
PC7		4	4	4	3	4	4	4	3	4	3	3	4	4	3	4	4	3	4	3	3	3	3	4	4	3	3	26	3.54	0.51
PC8		4	4	5	2	3	3	4	3	3	3	4	4	3	4	3	4	3	2	3	3	3	3	4	4	3	4	26	3.38	0.70
PC9		5	0	5	4	3	4	3	2	3	2	4	3	2	5	3	3	3	5	3	4	4	3	4	4	3	5	25	3.56	0.96
PC10		4	5	5	5	4	4	3	4	3	4	4	4	5	4	4	3	4	3	4	4	4	3	3	3	4	4	26	3.88	0.65
PP1		4	2	4	5	3	3	3	3	3	3	3	3	3	4	3	4	4	2	3	5	4	3	3	4	4	4	26	3.42	0.76
PP2		4	4	5	5	4	4	4	3	3	3	3	4	5	4	4	3	3	3	4	4	3	4	4	3	4	4	26	3.73	0.67
PP3		3	3	5	5	4	4	3	3	5	3	3	3	4	4	4	3	3	4	4	4	5	4	4	4	3	4	26	3.77	0.71
PP4		3	3	4	4	4	4	2	2	3	2	3	3	2	4	2	3	2	3	4	4	4	5	3	4	3	4	26	3.23	0.86
PP5		3	4	4	4	4	4	4	4	3	3	4	3	4	4	4	3	5	5	5	4	4	4	3	4	4	4	26	3.88	0.59
PP6		3	4	4	4	4	4	4	5	3	4	4	4	4	4	5	3	5	5	5	5	4	5	3	4	3	4	26	4.08	0.69
PP7		4	4	4	3	3	4	4	3	4	4	4	4	3	4	3	3	4	5	4	5	4	4	3	4	3	4	26	3.77	0.59
PP8		4	5	4	3	3	5	3	3	3	3	4	0	5	3	4	3	4	4	4	5	4	4	4	4	3	3	25	3.76	0.72
PP9		5	3	4	3	3	5	3	5	4	4	4	5	5	3	4	4	5	5	5	4	4	3	3	4	3	3	26	3.96	0.82
PP10		5	5	4	4	4	4	3	4	4	4	3	5	4	3	4	4	5	5	4	4	4	4	3	4	3	4	26	4.00	0.63
PP11		4	3	4	3	3	0	4	3	3	3	4	4	4	3	4	4	4	3	5	5	5	5	3	4	3	4	25	3.76	0.72
PP12		4	4	4	4	3	4	4	5	3	3	4	4	5	3	5	4	4	3	4	4	4	3	4	4	3	4	26	3.85	0.61
PP13		2	0	4	4	3	3	3	4	3	3	4	4	3	3	3	3	4	3	5	5	5	5	4	4	4	3	25	3.60	0.76
PP14		3	3	4	3	2	3	4	4	2	3	3	4	3	4	3	4	3	3	4	4	4	5	4	3	4	4	26	3.46	0.71
PP15		4	3	4	4	2	3	4	5	2	4	4	4	4	4	4	4	3	3	5	4	5	3	4	3	3	3	26	3.65	0.80
PP16		3	5	4	4	3	4	4	4	3	4	3	4	5	3	4	4	5	4	5	4	4	4	4	4	4	4	26	3.96	0.60
IP1		4	5	4	3	3	4	4	3	3	3	3	4	3	3	3	3	3	3	3	4	3	3	4	3	4	3	26	3.38	0.57
IP2		4	5	5	4	4	4	2	2	3	2	3	3	3	3	3	3	3	2	4	3	3	3	4	3	4	3	26	3.27	0.83
IP3		4	5	5	4	4	4	2	2	4	2	3	3	3	3	3	4	3	3	3	3	3	3	3	3	4	3	26	3.31	0.79
IP4		5	4	4	4	4	3	2	2	3	2	3	3	4	3	2	4	3	4	4	3	3	3	3	3	4	3	26	3.27	0.78
IP5		0	4	4	4	3	4	3	2	3	2	3	3	3	4	2	3	3	1	2	3	3	3	3	3	4	3	25	3.00	0.76
IP6		3	5	3	3	3	3	3	3	3	2	4	4	4	3	3	4	4	3	3	4	4	3	3	3	3	3	26	3.31	0.62
IP7		3	4	3	3	3	3	3	4	4	2	4	4	5	3	4	3	4	3	3	4	4	3	4	4	4	4	26	3.54	0.65
IP8		3	5	3	3	3	4	3	3	3	2	4	3	4	4	3	4	3	3	4	4	4	4	4	4	3	4	26	3.50	0.65
IP9		3	4	3	3	3	4	4	3	3	3	3	3	3	3	3	3	3	3	4	4	4	3	4	3	3	4	26	3.31	0.47
IP10		4	4	4	5	3	4	4	3	3	3	3	3	3	4	3	4	3	3	3	3	4	5	5	4	4	3	26	3.62	0.70
IP11		4	5	4	4	3	4	4	3	4	3	3	3	3	4	3	3	3	3	3	4	4	4	4	3	3	4	26	3.54	0.58
IP12		4	5	4	2	3	4	4	2	3	2	3	2	2	4	3	3	2	2	1	3	4	4	4	4	3	3	26	3.08	0.98
IP13		4	5	4	4	3	4	4	4	4	4	3	3	4	4	3	3	4	1	2	4	3	4	4	3	3	3	26	3.50	0.81
IP14		3	4	4	3	2	2	4	3	4	4	2	3	3	3	4	4	3	1	3	3	3	4	3	4	3	3	26	3.15	0.78
IP15		3	4	4	2	2	4	4	3	4	4	3	3	3	4	3	3	3	0	2	3	3	4	4	3	4	4	25	3.32	0.69
IP16		3	3	4	4	3	3	5	5	3	5	4	5	5	4	5	3	5	4	4	3	4	3	4	4	4	3	26	3.92	0.80
Parties	owner																											0		
	Designer																											0		
	Contractor	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	26		

Ranks of important factors affecting project cost

Repondent	Owners			Designers			Contractors		
Rank	Factors	Average	Standard	Factors	Average	Standard	Factors	Average	Standard
1	EF4	4.30	0.66	EF4	4.22	0.67	EF4	4.20	0.58
2	PC9	4.14	0.73	PP3	3.89	0.60	PP6	4.08	0.69
3	PP10	4.10	0.70	PP9	3.78	0.44	EF2	4.00	0.65
4	PP3	4.05	0.76	EF6	3.67	0.71	PP10	4.00	0.63
5	PP2	4.00	0.89	PP8	3.67	0.71	PP9	3.96	0.82
6	PC10	4.00	0.84	EF2	3.67	0.71	PP16	3.96	0.60
7	PC6	4.00	0.71	PC10	3.67	0.87	IP16	3.92	0.80
8	PP9	3.95	0.74	IP2	3.63	0.52	PC10	3.88	0.65
9	IP4	3.90	0.77	PC1	3.56	0.73	PP5	3.88	0.59
10	PC8	3.90	0.89	EF7	3.56	1.01	PP12	3.85	0.61
11	PC7	3.90	0.83	IP13	3.56	0.53	EF6	3.85	0.78
12	IP10	3.90	0.79	IP11	3.56	0.53	EF3	3.80	0.71
13	IP2	3.86	0.79	PC5	3.50	0.93	EF1	3.77	0.65
14	PP8	3.86	0.73	PC2	3.44	0.88	PP3	3.77	0.71
15	PC2	3.85	0.93	IP1	3.44	0.73	PP7	3.77	0.59
16	IP11	3.81	0.75	EF3	3.44	0.74	PC2	3.77	0.59
17	PP1	3.81	0.75	PP10	3.44	0.54	PP8	3.76	0.72
18	IP13	3.76	0.77	PP2	3.44	1.01	PP11	3.76	0.72
19	IP9	3.76	0.54	IP12	3.38	0.52	PP2	3.73	0.67
20	IP1	3.76	0.70	EF1	3.38	0.52	PC3	3.73	0.67
21	PP15	3.76	0.89	IP8	3.33	0.71	EF5	3.68	0.69
22	EF2	3.74	0.81	PC3	3.33	1.00	PC6	3.65	0.49
23	EF7	3.70	0.66	PC6	3.33	0.60	PP15	3.65	0.80
24	PP12	3.67	0.73	IP4	3.25	0.71	EF7	3.65	0.75
25	PP6	3.67	0.66	IP10	3.22	0.67	IP10	3.62	0.70
26	PP5	3.67	0.54	IP9	3.22	0.67	PP13	3.60	0.76
27	IP3	3.65	0.75	IP6	3.22	0.67	PC9	3.56	0.96
28	IP16	3.62	0.80	IP3	3.22	0.83	PC5	3.54	0.58
29	IP8	3.62	0.74	PP15	3.22	0.44	PC7	3.54	0.51
30	PP14	3.62	0.74	PP12	3.22	0.67	IP7	3.54	0.65
31	PP13	3.62	0.92	PP4	3.22	0.67	IP11	3.54	0.58
32	EF5	3.60	0.88	PC9	3.22	1.48	IP8	3.50	0.65
33	EF3	3.60	0.82	PC8	3.22	0.95	IP13	3.50	0.81
34	PP7	3.60	0.68	IP7	3.13	0.83	PP14	3.46	0.71
35	PC3	3.60	0.88	IP16	3.11	0.78	PC1	3.46	0.51
36	PP4	3.52	0.81	IP15	3.11	0.78	PP1	3.42	0.76
37	IP6	3.48	0.87	IP14	3.11	0.78	PC4	3.40	0.58
38	PP16	3.48	0.98	IP5	3.11	0.60	PC8	3.38	0.70
39	EF1	3.40	0.82	PP6	3.11	1.27	IP1	3.38	0.57
40	IP15	3.38	0.86	PP5	3.11	1.36	IP15	3.32	0.69
41	PP11	3.38	0.80	PC7	3.00	1.06	IP3	3.31	0.79
42	PC5	3.30	0.98	PC4	3.00	0.87	IP6	3.31	0.62
43	PC1	3.29	1.19	PP16	2.89	0.78	IP9	3.31	0.47
44	IP14	3.29	0.85	PP13	2.89	0.75	IP2	3.27	0.83
45	IP5	3.29	0.64	PP11	2.89	0.60	IP4	3.27	0.78
46	IP12	3.26	0.81	PP7	2.89	1.17	PP4	3.23	0.86
47	IP7	3.25	0.79	PP1	2.89	0.78	IP14	3.15	0.78
48	PC4	3.16	0.76	EF5	2.75	0.92	IP12	3.08	0.98
49	EF6	3.05	1.12	PP14	2.75	0.71	IP5	3.00	0.76

Appendix C

FACTORS AFFECTING BRIDGE PROJECT QUALITY

DATA OF ALL RESPONDENTS STUDY ON BRIDGE PROJECT QUALITY

Owners' opinion on factors affecting project quality

ID	Case	10	13	14	15	16	17	18	19	20	21	22	23	25	26	27	28	29	31	32	33	34	N	Average	Standard
																								$\bar{X}=\frac{\sum x}{N}$	$S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
EF1		5	3	4	3	2	4	4	4	4	3	2	0	1	2	4	1	3	2	3	2	1	20	2.85	1.18
EF2		4	3	3	3	2	3	4	3	4	0	2	0	3	3	3	3	4	2	3	3	3	19	3.05	0.62
EF3		4	3	3	2	2	3	4	3	3	0	3	2	3	3	3	3	3	2	3	3	3	20	2.90	0.55
EF4		4	5	3	5	3	4	5	5	4	3	4	2	4	4	4	0	5	3	4	3	3	20	3.85	0.88
EF5		4	3	3	4	2	4	4	4	3	4	3	0	2	4	3	2	4	2	5	3	3	20	3.30	0.86
EF6		4	3	2	4	3	4	0	2	3	4	2	2	1	3	3	3	4	3	4	2	4	20	3.00	0.92
EF7		4	3	4	4	3	4	0	4	3	4	2	2	0	4	3	3	3	3	4	3	5	19	3.42	0.77
PC1		4	4	3	4	4	4	4	4	4	4	3	0	0	3	4	4	2	2	3	3	5	19	3.58	0.77
PC2		4	3	4	3	4	4	1	1	3	4	2	0	4	4	4	3	2	3	4	3	5	20	3.25	1.07
PC3		4	3	3	2	4	4	1	1	4	3	2	0	4	4	4	3	1	4	4	3	5	20	3.15	1.18
PC4		4	3	4	2	2	4	2	2	2	3	2	0	0	4	3	3	3	2	3	3	5	19	2.95	0.91
PC5		4	3	3	2	2	4	2	2	3	3	2	0	2	4	3	3	2	2	5	3	5	20	2.95	1.00
PC6		5	4	4	4	4	3	5	5	3	4	2	2	2	4	4	4	4	3	5	3	4	21	3.71	0.96
PC7		5	4	4	4	4	3	5	5	3	4	2	2	4	5	3	3	3	3	5	3	5	21	3.76	1.00
PC8		5	4	4	4	4	3	5	5	3	4	3	2	1	5	4	3	2	2	4	3	5	21	3.57	1.16
PC9		5	3	4	4	4	4	5	5	4	4	2	4	3	4	3	3	3	3	4	4	5	21	3.81	0.81
PC10		5	3	3	5	4	4	5	5	4	5	4	3	4	4	4	3	4	4	5	4	5	21	4.14	0.73
PP1		5	4	4	5	4	4	5	5	4	4	4	3	4	4	4	4	3	4	4	4	4	21	4.10	0.54
PP2		5	4	3	5	4	3	4	4	4	4	4	3	4	4	4	3	2	4	5	4	4	21	3.86	0.73
PP3		5	3	4	5	4	3	4	4	4	4	5	3	2	5	3	4	3	3	5	3	4	21	3.81	0.87
PP4		5	4	3	5	4	2	5	5	4	4	2	3	2	4	3	3	0	2	5	3	4	21	3.43	1.08
PP5		5	4	4	4	4	4	5	5	4	4	2	4	4	4	4	4	2	4	5	3	4	21	3.95	0.80
PP6		5	4	4	5	4	4	5	5	4	4	3	4	3	3	4	4	5	4	5	3	4	21	4.10	0.70
PP7		5	4	4	5	4	4	5	5	4	0	2	4	3	3	4	4	4	2	5	3	4	20	3.90	0.91
PP8		5	3	3	5	4	4	5	5	4	5	4	3	4	4	4	4	4	3	5	3	5	21	4.10	0.77
PP9		5	3	3	5	4	4	5	5	4	5	5	4	4	4	4	4	4	4	5	4	5	21	4.29	0.64
PP10		5	4	4	5	4	4	5	5	4	4	5	3	4	5	4	4	5	4	5	5	5	21	4.43	0.60
PP11		5	3	4	4	4	4	4	3	3	5	4	3	4	4	3	4	3	2	5	4	5	21	3.81	0.81
PP12		5	3	3	5	4	4	5	5	4	4	4	3	4	4	3	4	4	3	5	3	4	21	3.95	0.74
PP13		5	4	3	3	4	3	4	4	4	4	3	2	4	4	3	3	3	2	3	3	4	21	3.43	0.75
PP14		5	4	3	5	4	3	4	3	3	4	3	3	4	4	3	4	1	2	5	3	4	21	3.52	0.98
PP15		5	4	3	5	4	4	5	5	4	4	4	2	4	4	4	4	3	4	5	4	4	21	4.05	0.74
PP16		5	2	3	5	4	4	4	4	5	4	5	2	3	4	3	4	3	4	5	3	4	21	3.81	0.93
IP1		4	3	4	4	4	4	3	3	4	4	3	4	3	4	4	4	3	3	4	4	4	21	3.67	0.48
IP2		4	3	3	5	4	4	3	3	4	4	4	4	3	4	4	4	3	3	5	4	4	21	3.76	0.62
IP3		4	4	4	5	4	4	4	4	0	4	2	4	3	4	4	4	4	2	3	3	4	20	3.70	0.73
IP4		4	3	3	5	4	4	5	5	4	4	4	4	3	5	4	4	3	2	4	3	4	21	3.86	0.79
IP5		4	4	3	3	2	3	4	4	4	3	4	4	3	4	4	3	2	3	5	3	4	21	3.48	0.75
IP6		5	3	4	4	0	3	4	4	4	4	3	4	2	4	4	3	4	3	4	3	4	20	3.65	0.67
IP7		5	4	3	3	0	3	4	3	3	4	2	4	2	4	4	4	3	2	3	3	4	20	3.35	0.81
IP8		5	3	3	4	4	3	3	2	4	4	3	4	3	4	4	3	2	3	5	3	4	21	3.48	0.81
IP9		5	4	3	3	4	3	4	4	4	4	3	4	4	4	4	4	2	2	4	3	4	21	3.62	0.74
IP10		5	3	3	4	4	3	5	5	3	4	4	4	0	4	4	4	2	2	5	4	4	20	3.80	0.89
IP11		5	3	4	5	4	3	4	4	4	5	4	4	4	4	3	4	4	4	5	4	4	21	4.05	0.59
IP12		5	4	3	4	4	3	4	4	0	4	4	3	3	0	3	3	5	2	3	3	4	19	3.58	0.77
IP13		5	3	4	5	4	4	5	5	4	5	4	3	4	4	4	4	3	4	5	3	4	21	4.10	0.70
IP14		5	4	3	4	2	3	5	5	3	3	3	3	2	4	4	4	5	4	4	4	4	21	3.71	0.90
IP15		5	4	3	4	4	4	5	5	4	4	4	3	2	3	4	3	5	4	4	4	4	21	3.90	0.77
IP16		5	4	3	3	4	3	5	5	4	4	3	3	3	4	4	4	4	3	4	3	4	21	3.76	0.70
Parties	owner	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	21		
Designer																							0		
Contractor																							0		

Designers' opinion on factors affecting project quality

ID	Case	3	4	5	6	7	8	9	11	30	N	Average	Standard
												$\bar{X}=\frac{\sum X}{N}$	$S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
EF1		0	4	1	2	3	3	2	2	4	8	2.63	1.06
EF2		2	4	2	2	3	3	3	2	3	9	2.67	0.71
EF3		2	4	3	2	3	3	3	1	3	9	2.67	0.87
EF4		2	4	2	2	5	4	3	3	3	9	3.11	1.05
EF5		2	4	4	2	3	3	3	2	0	8	2.88	0.83
EF6		3	4	5	2	5	2	3	2	4	9	3.33	1.22
EF7		2	4	4	3	4	3	3	1	3	9	3.00	1.00
PC1		3	4	2	2	3	2	4	2	3	9	2.78	0.83
PC2		3	4	2	2	3	4	4	4	2	9	3.11	0.93
PC3		2	4	3	5	4	5	4	3	2	9	3.56	1.13
PC4		1	4	2	2	3	2	3	4	3	9	2.67	1.00
PC5		0	4	3	2	3	3	3	3	2	8	2.88	0.64
PC6		3	4	4	2	4	3	4	0	3	8	3.38	0.74
PC7		3	4	4	2	4	3	4	0	2	8	3.25	0.89
PC8		2	4	5	3	5	3	3	0	3	8	3.50	1.07
PC9		0	4	2	2	4	3	3	4	0	7	3.14	0.90
PC10		3	4	3	3	5	3	3	3	0	8	3.38	0.74
PP1		3	0	4	2	5	4	3	3	3	8	3.38	0.92
PP2		4	4	4	3	4	3	4	3	2	9	3.44	0.73
PP3		3	4	4	3	5	3	4	3	3	9	3.56	0.73
PP4		4	4	3	3	5	3	4	2	4	9	3.56	0.88
PP5		4	4	5	5	5	4	4	0	3	8	4.25	0.71
PP6		3	4	3	3	4	4	3	0	2	8	3.25	0.71
PP7		2	4	2	2	5	4	4	0	3	8	3.25	1.16
PP8		4	4	2	3	5	3	4	3	3	9	3.44	0.88
PP9		4	4	4	3	5	4	4	2	4	9	3.78	0.83
PP10		4	4	4	3	5	4	4	3	3	9	3.78	0.67
PP11		2	4	2	2	5	3	3	2	3	9	2.89	1.05
PP12		3	4	2	2	5	3	4	3	2	9	3.11	1.05
PP13		3	4	1	3	3	3	4	3	3	9	3.00	0.87
PP14		3	4	1	2	4	4	3	0	4	8	3.13	1.13
PP15		4	4	1	3	5	3	4	3	4	9	3.44	1.13
PP16		4	4	4	3	5	3	4	2	4	9	3.67	0.87
IP1		3	4	3	2	5	4	4	2	3	9	3.33	1.00
IP2		4	4	0	4	5	3	4	0	4	7	4.00	0.58
IP3		3	4	4	2	4	4	4	3	3	9	3.44	0.73
IP4		4	4	4	0	3	3	3	2	4	8	3.38	0.74
IP5		3	4	3	3	4	3	4	2	5	9	3.44	0.88
IP6		3	4	4	4	3	3	4	3	3	9	3.44	0.53
IP7		2	4	0	2	3	4	4	2	3	8	3.00	0.93
IP8		3	4	3	2	3	2	4	2	3	9	2.89	0.78
IP9		3	4	3	3	5	2	4	2	4	9	3.33	1.00
IP10		2	4	3	2	4	3	4	1	4	9	3.00	1.12
IP11		4	4	4	5	5	3	4	4	4	9	4.11	0.60
IP12		3	4	0	2	5	4	4	3	3	8	3.50	0.93
IP13		4	4	4	5	5	4	4	4	4	9	4.22	0.44
IP14		2	4	4	3	5	3	4	2	4	9	3.44	1.01
IP15		3	4	3	3	4	3	4	2	3	9	3.22	0.67
IP16		3	4	3	3	4	2	4	2	4	9	3.22	0.83
Parties	owner										0		
	Designer	1	1	1	1	1	1	1	1	1	9		
	Contractor										0		

Contractors' opinion on factors affecting project quality

ID	Case	1	2	12	24	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	N	Average	Standard
																													$\bar{X}=\frac{\sum x}{N}$	$S=\sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$
EF1		3	4	3	4	4	1	2	2	4	2	4	2	2	3	2	3	2	3	3	4	4	4	3	4	3	4	26	3.04	0.92
EF2		4	3	3	2	2	0	2	2	4	2	4	2	2	3	2	3	3	3	4	3	4	5	4	3	3	3	25	3.00	0.87
EF3		4	3	2	2	3	0	2	2	3	2	4	2	2	3	2	2	3	3	4	3	4	4	4	3	3	4	25	2.92	0.81
EF4		4	3	5	2	4	0	2	3	3	2	3	2	3	4	2	3	4	3	4	3	3	4	4	3	3	4	25	3.20	0.82
EF5		4	2	4	2	3	0	2	3	3	2	3	3	3	4	4	4	4	2	3	3	3	4	4	3	3	3	25	3.12	0.73
EF6		2	4	3	4	3	4	3	3	5	3	4	3	3	4	3	4	3	4	3	2	3	4	4	3	4	4	26	3.42	0.70
EF7		2	4	4	4	4	4	4	3	4	3	3	3	3	3	3	5	3	3	4	2	3	4	3	3	3	4	26	3.38	0.70
PC1		4	3	4	4	3	4	4	4	4	3	3	5	4	3	4	4	4	3	4	3	2	3	3	3	3	3	26	3.50	0.65
PC2		4	3	3	5	4	4	4	3	3	4	4	4	3	4	3	4	3	4	4	3	2	4	4	3	4	4	26	3.62	0.64
PC3		4	3	2	5	4	4	3	3	2	3	3	3	3	4	2	4	4	3	3	3	3	3	4	4	3	4	26	3.31	0.74
PC4		2	3	2	2	3	0	1	1	3	1	3	1	1	3	1	4	1	2	4	4	4	3	4	4	3	3	25	2.52	1.16
PC5		3	3	3	2	3	4	1	2	2	2	2	1	2	4	2	4	2	2	0	3	5	4	4	4	3	4	25	2.84	1.07
PC6		2	3	4	2	3	3	1	2	3	2	3	2	2	4	2	4	2	4	4	4	4	4	4	3	3	5	26	3.04	1.00
PC7		2	3	4	2	3	2	2	3	2	3	2	2	3	4	2	4	3	4	3	4	5	4	3	4	4	4	26	3.12	0.91
PC8		3	3	4	2	3	2	2	3	3	3	2	2	3	4	4	3	3	3	3	4	4	3	3	4	3	4	26	3.08	0.69
PC9		3	0	4	4	3	4	2	3	0	4	3	3	3	4	3	4	3	4	3	4	5	4	3	4	3	4	24	3.50	0.66
PC10		3	3	4	5	2	4	3	4	0	4	2	4	4	3	3	4	4	3	3	5	5	3	3	4	3	4	25	3.56	0.82
PP1		4	3	4	4	3	5	5	5	3	4	2	0	5	4	4	4	4	1	3	5	4	3	4	4	4	3	25	3.76	0.97
PP2		3	4	4	5	4	4	5	4	2	4	3	4	5	4	4	4	3	5	4	4	5	4	4	3	4	3	26	3.92	0.74
PP3		3	4	0	5	4	4	5	5	3	5	3	5	5	4	5	4	5	5	3	4	4	4	4	4	4	3	25	4.16	0.75
PP4		3	3	0	4	4	2	2	2	4	2	4	2	4	3	2	3	3	3	4	3	5	4	3	3	4	4	25	3.20	0.87
PP5		3	3	0	4	4	4	5	5	3	4	4	4	4	3	4	3	5	5	3	3	5	4	3	3	3	4	25	3.80	0.76
PP6		3	3	0	4	3	4	5	5	2	4	4	4	4	3	4	3	5	5	3	3	4	3	3	3	3	5	25	3.68	0.85
PP7		4	3	0	3	4	4	4	3	3	3	4	4	3	3	3	4	4	5	0	3	4	3	4	3	4	4	25	3.44	0.59
PP8		4	5	4	3	4	5	4	4	3	3	4	5	4	3	4	3	5	1	3	4	4	3	4	3	3	4	26	3.69	0.88
PP9		5	3	4	3	3	5	5	5	3	3	4	5	4	3	4	4	4	3	4	4	5	3	3	3	3	5	26	3.85	0.83
PP10		5	5	4	4	4	5	4	4	4	3	4	5	4	3	4	4	3	4	4	4	4	3	3	3	3	5	26	3.92	0.69
PP11		4	3	3	3	3	0	4	3	3	3	4	4	3	4	4	4	4	3	0	4	4	3	3	3	4	4	24	3.50	0.51
PP12		4	4	4	4	4	4	5	5	2	4	4	4	3	3	4	4	3	3	0	4	5	4	3	4	4	4	25	3.84	0.69
PP13		2	0	4	4	3	3	4	3	2	3	3	4	3	3	3	4	3	2	0	4	4	4	3	4	4	4	24	3.33	0.70
PP14		3	2	4	3	2	4	4	3	2	3	4	3	4	4	3	4	3	3	0	4	5	4	3	4	3	4	25	3.40	0.76
PP15		4	5	5	4	3	4	4	5	3	5	3	4	4	3	3	3	4	5	4	4	5	3	3	3	3	3	26	3.81	0.80
PP16		3	5	4	4	4	4	5	5	4	5	4	5	5	3	5	3	5	4	4	4	4	4	4	4	4	4	26	4.19	0.63
IP1		3	5	4	3	3	4	3	3	4	4	4	3	4	3	3	3	4	3	3	4	4	3	4	3	3	4	26	3.50	0.58
IP2		3	5	5	4	4	4	3	2	3	4	4	3	3	3	2	4	3	4	2	4	5	3	4	3	3	4	26	3.50	0.86
IP3		4	5	5	2	4	4	3	3	4	4	4	3	3	4	2	4	4	4	3	5	4	4	4	3	3	4	26	3.69	0.79
IP4		3	4	5	3	4	5	3	3	5	4	3	3	3	3	2	3	4	3	3	4	4	3	4	3	4	3	26	3.50	0.76
IP5		0	5	3	2	3	4	3	3	4	3	3	3	4	4	3	3	4	2	1	4	4	4	4	3	3	3	25	3.28	0.84
IP6		3	5	4	3	3	4	1	2	4	5	3	3	3	4	2	3	2	5	3	4	4	4	3	4	4	3	26	3.38	0.98
IP7		3	4	3	3	3	4	4	5	4	5	3	5	4	4	5	4	4	3	3	4	4	4	4	4	4	3	26	3.85	0.67
IP8		3	5	3	3	3	4	4	5	4	4	3	5	4	4	5	3	5	4	2	4	4	3	4	4	4	3	26	3.81	0.80
IP9		3	3	4	3	3	4	3	3	4	5	4	4	4	4	4	4	4	3	2	4	4	4	3	4	4	3	26	3.62	0.64
IP10		3	5	5	4	3	4	3	3	4	3	4	0	3	4	3	4	4	2	3	3	4	4	2	4	4	4	25	3.56	0.77
IP11		4	5	5	2	4	4	5	5	4	5	4	3	5	3	4	3	5	5	4	3	4	3	3	4	4	3	26	3.96	0.87
IP12		3	5	4	2	3	4	5	5	3	5	4	5	5	3	4	4	4	3	3	4	3	3	4	4	3	3	26	3.77	0.86
IP13		5	5	4	5	3	4	5	5	4	5	3	5	5	3	5	4	4	5	5	4	3	3	4	4	3	3	26	4.15	0.83
IP14		3	4	4	3	3	4	4	3	4	4	4	4	4	3	3	4	3	2	3	3	3	3	4	4	3	3	26	3.42	0.58
IP15		3	4	4	3	3	4	4	3	3	4	4	4	3	4	4	3	3	0	3	4	3	4	4	4	4	3	25	3.56	0.51
IP16		3	3	3	4	3	3	4	5	4	5	4	5	5	3	5	3	5	5	5	4	4	3	4	3	4	3	26	3.92	0.84
Parties	owner																											0		
	Designer																											0		
	Contractor	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	26		

Ranks of important factors affecting bridge project quality

Rank	Owners			Designers			Contractors		
	Factors	Average	Standard	Factors	Average	Standard	Factors	Average	Standard
1	PP10	4.43	0.60	PP5	4.25	0.71	PP16	4.19	0.63
2	PP9	4.29	0.64	IP13	4.22	0.44	PP3	4.16	0.75
3	PC10	4.14	0.73	IP11	4.11	0.60	IP13	4.15	0.83
4	IP13	4.10	0.70	IP2	4.00	0.58	IP11	3.96	0.87
5	PP8	4.10	0.77	PP10	3.78	0.67	PP2	3.92	0.74
6	PP6	4.10	0.70	PP9	3.78	0.83	PP10	3.92	0.69
7	PP1	4.10	0.54	PP16	3.67	0.87	IP16	3.92	0.84
8	IP11	4.05	0.59	PP4	3.56	0.88	PP9	3.85	0.83
9	PP15	4.05	0.74	PP3	3.56	0.73	IP7	3.85	0.67
10	PP12	3.95	0.74	PC3	3.56	1.13	PP12	3.84	0.69
11	PP5	3.95	0.80	IP12	3.50	0.93	PP15	3.81	0.80
12	IP15	3.90	0.77	PC8	3.50	1.07	IP8	3.81	0.80
13	PP7	3.90	0.91	IP14	3.44	1.01	PP5	3.80	0.76
14	IP4	3.86	0.79	IP6	3.44	0.53	IP12	3.77	0.86
15	PP2	3.86	0.73	IP5	3.44	0.88	PP1	3.76	0.97
16	EF4	3.85	0.88	IP3	3.44	0.73	PP8	3.69	0.88
17	PP16	3.81	0.93	PP15	3.44	1.13	IP3	3.69	0.79
18	PP11	3.81	0.81	PP8	3.44	0.88	PP6	3.68	0.85
19	PP3	3.81	0.87	PP2	3.44	0.73	IP9	3.62	0.64
20	PC9	3.81	0.81	IP4	3.38	0.74	PC2	3.62	0.64
21	IP10	3.80	0.89	PP1	3.38	0.92	PC10	3.56	0.82
22	IP16	3.76	0.70	PC10	3.38	0.74	IP10	3.56	0.77
23	IP2	3.76	0.62	PC6	3.38	0.74	IP15	3.56	0.51
24	PC7	3.76	1.00	EF6	3.33	1.22	PC9	3.50	0.66
25	IP14	3.71	0.90	IP9	3.33	1.00	PP11	3.50	0.51
26	PC6	3.71	0.96	IP1	3.33	1.00	IP1	3.50	0.58
27	IP3	3.70	0.73	PP7	3.25	1.16	IP2	3.50	0.86
28	IP1	3.67	0.48	PP6	3.25	0.71	IP4	3.50	0.76
29	IP6	3.65	0.67	PC7	3.25	0.89	PC1	3.50	0.65
30	IP9	3.62	0.74	IP16	3.22	0.83	PP7	3.44	0.59
31	PC1	3.58	0.77	IP15	3.22	0.67	IP14	3.42	0.58
32	IP12	3.58	0.77	PC9	3.14	0.90	EF6	3.42	0.70
33	PC8	3.57	1.16	PP14	3.13	1.13	PP14	3.40	0.76
34	PP14	3.52	0.98	PC2	3.11	0.93	IP6	3.38	0.98
35	IP8	3.48	0.81	EF4	3.11	1.05	EF7	3.38	0.70
36	IP5	3.48	0.75	PP12	3.11	1.05	PP13	3.33	0.70
37	PP13	3.43	0.75	EF7	3.00	1.00	PC3	3.31	0.74
38	PP4	3.43	1.08	IP10	3.00	1.12	IP5	3.28	0.84
39	EF7	3.42	0.77	IP7	3.00	0.93	PP4	3.20	0.87
40	IP7	3.35	0.81	PP13	3.00	0.87	EF4	3.20	0.82
41	EF5	3.30	0.86	IP8	2.89	0.78	EF5	3.12	0.73
42	PC2	3.25	1.07	PP11	2.89	1.05	PC7	3.12	0.91
43	PC3	3.15	1.18	EF5	2.88	0.83	PC8	3.08	0.69
44	EF2	3.05	0.62	PC5	2.88	0.64	EF1	3.04	0.92
45	EF6	3.00	0.92	PC1	2.78	0.83	PC6	3.04	1.00
46	PC5	2.95	1.00	EF3	2.67	0.87	EF2	3.00	0.87
47	PC4	2.95	0.91	EF2	2.67	0.71	EF3	2.92	0.81
48	EF3	2.90	0.55	PC4	2.67	1.00	PC5	2.84	1.07
49	EF1	2.85	1.18	EF1	2.63	1.06	PC4	2.52	1.16

Appendix D

QUESTIONNAIRE

<u>แบบสอบถามเรื่อง ปัจจัยความสำเร็จในการก่อสร้างสะพาน</u>

แบบสอบถามนี้ใช้ รวบรวมข้อมูลจากผู้บริหารโครงการหรือวิศวกรด้านสะพานที่มีประสบการณ์อย่างน้อย 5 ปี ขึ้นไปซึ่งเกี่ยวข้องกับงานก่อสร้างสะพานในประเทศไทยเพื่อหาปัจจัยความสำเร็จในการก่อสร้างสะพาน

Part I: ข้อมูลทั่วไป

1. ชื่อ-สกุล:_____
2. ชื่อ-ที่อยู่หน่วยงาน:_____
3. ระยะเวลาที่ทำงานในวงการก่อสร้าง: _____ ปี
4. ระยะเวลาที่ทำงานในหน่วยงาน: _____ ปี
5. ประสบการณ์ในงานก่อสร้างสะพาน: _____ ปี, จำนวน _____ โครงการ
6. ตำแหน่งปัจจุบัน _____
7. บทบาทในโครงการก่อสร้าง
   - ❒ เจ้าของงาน ❒ ผู้รับเหมา
   - ❒ ผู้ออกแบบ ❒ ผู้ควบคุมงาน
   - ❒ ที่ปรึกษา ❒ อื่น ๆ _____

Part II: โปรดทำเครื่องหมาย **(X)** ในช่องว่างของแบบสอบถาม โดยประเมินค่าน้ำหนัก **“ปัจจัยความสำเร็จในการสร้างสะพานในประเทศไทย”** ซึ่งเรียงลำดับจาก **1** ถึง **5**

ลำดับ	ปัจจัย	ระดับความสำคัญ ต่อเวลา						ระดับความสำคัญ ต่อค่าก่อสร้าง						ระดับความสำคัญ ต่อคุณภาพงาน					
		มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น	มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น	มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น
		5	4	3	2	1	#	5	4	3	2	1	#	5	4	3	2	1	#
	ปัจจัยภายนอก																		
	ปัจจัยสังคม																		
1	ความขัดแย้งกับประชาชนที่อาศัยรอบโครงการ																		
	ปัจจัยทางเศรษฐกิจ																		
2	ผลกระทบจากภาวะเงินเฟ้อ และอัตราแลกเปลี่ยน																		
3	แนวโน้มของเศรษฐกิจ																		
4	ความเปลี่ยนแปลงราคาของ วัสดุ เครื่องจักรกล และแรงงาน																		
5	นโยบายเชิงบวกของรัฐบาลที่มีผลดีต่ออุตสาหกรรมก่อสร้าง																		
	ปัจจัยเกี่ยวข้องธรรมชาติ																		
6	ความเสี่ยงภัยธรรมชาติ เช่น: น้ำท่วม พายุ																		
7	สภาพของชั้นดินในบริเวณโครงการ																		
	ปัจจัยที่เกี่ยวข้องกับตัวโครงการ																		
	ปัจจัยเกี่ยวข้องเอกสารสัญญา																		
8	การเลือกใช้รูปแบบและประเภทของสัญญาที่เหมาะสม																		
9	ความชัดเจนของขอบเขตงานในเอกสารประมูล																		
10	ความละเอียดของเอกสารสัญญา																		

ลำดับ	ปัจจัย	ระดับความสำคัญ ต่อเวลา						ระดับความสำคัญ ต่อค่าก่อสร้าง						ระดับความสำคัญ ต่อคุณภาพงาน					
		มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น	มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น	มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น
		5	4	3	2	1	#	5	4	3	2	1	#	5	4	3	2	1	#
11	การระบุวิธี/ ขั้นตอนการการแก้ไขข้อพิพาท โดยคณะอนุญาโตตุลาการในสัญญาที่ชัดเจน																		
12	การระบุเงื่อนไขการชำระเงินในสัญญาที่ชัดเจน																		
	ปัจจัยด้านสถานที่โครงการ																		
13	ความแออัดของการจราจร ที่มีผลกระทบต่อ การเคลื่อนย้าย เครื่องจักร และวัสดุ																		
14	ข้อจำกัดของพื้นที่โครงการ																		
15	ความสะดวกของสาธารณูปโภค																		
	ลักษณะเฉพาะของโครงการ																		
16	ขนาดและมูลค่าของโครงการ																		
17	การใช้เทคโนโลยีขั้นสูง/ ความซับซ้อนของงานก่อสร้าง																		
	ปัจจัยของฝ่ายต่างๆที่เกี่ยวข้องกับโครงการ																		
	ปัจจัยเกี่ยวข้องเจ้าของโครงการ																		
18	ความรู้ และประสบการณ์ของเจ้าของงาน																		
	ปัจจัยเกี่ยวข้องผู้ออกแบบ																		
19	ทักษะและ ประสบการณ์ของผู้ออกแบบ																		

ลำดับ	ปัจจัย	ระดับความสำคัญ ต่อเวลา						ระดับความสำคัญ ต่อค่าก่อสร้าง						ระดับความสำคัญ ต่อคุณภาพงาน					
		มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น	มากที่สุด	มาก	ปานกลาง		น้อย	น้อยที่สุด	มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น
		5	4	3	2	1	#	5	4	3		2	1	5	4	3	2	1	#
20	ความสามารถในการก่อสร้างจริงของแบบก่อสร้าง																		
21	ความรับผิดชอบในระหว่างดำเนินการก่อสร้างของผู้ออกแบบ																		
	ปัจจัยเกี่ยวข้องผู้บริหารโครงการ																		
22	ทักษะและความสามารถในการบริหารงาน																		
23	ประสบการณ์ด้านบริหารงาน ในโครงการที่คล้ายกัน																		
24	ลักษณะ ความเป็นผู้นำของผู้บริหารโครงการ																		
	ปัจจัยเกี่ยวข้องผู้รับเหมา																		
25	ความพร้อมด้านการเงินของผู้รับเหมา																		
26	ประสบการณ์งานก่อสร้างสะพานของผู้รับเหมาหลัก																		
27	ความพร้อมของเครื่องจักร และ วัสดุอุปกรณ์																		
28	จำนวนโครงการอื่นที่อยู่ระหว่างการดำเนินงาน																		
29	การประสานงานของของผู้รับเหมาหลักกับผู้รับเหมาย่อย																		
30	การปฏิบัติความปลอดภัยและนโยบายความปลอดภัยของผู้รับเหมา																		
31	ความสัมพันธ์ของผู้รับเหมาหลักกับผู้ผลิต (supplier)																		
	ปัจจัยเกี่ยวข้องผู้รับเหมาย่อย																		
32	ประสบการณ์ในงานก่อสร้างสะพานของผู้รับเหมาย่อย																		

ลำดับ	ปัจจัย	ระดับความสำคัญ ต่อเวลา						ระดับความสำคัญ ต่อค่าก่อสร้าง						ระดับความสำคัญ ต่อคุณภาพงาน					
		มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น	มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น	มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น
		5	4	3	2	1	#	5	4	3	2	1	#	5	4	3	2	1	#
33	ความสามารถและความพร้อมของแรงงานฝีมือ และเครื่องจักรของผู้รับเหมาย่อย																		
	ปัจจัยเกี่ยวข้องกับการดำเนินการและการบริหารโครงการ																		
	ปัจจัยด้านการวางแผน																		
34	ความเหมาะสมของแผนงาน																		
35	การใช้เทคนิคก่อสร้างที่เหมาะสมกับโครงการ																		
36	การวางแผนหน้างานที่สอดคล้องกับแผนอื่นเช่น: แผนการเงินและวัสดุ																		
37	ความเหมาะสมของระยะเวลาโครงการในสัญญา																		
38	ความสามารถที่จะตอบสนองความต้องการด้านแรงงาน																		
	ปัจจัยเกี่ยวข้องระบบองค์กร																		
39	ผังองค์กรที่มีประสิทธิภาพ																		
40	ระบบงานเอกสารที่ดี																		
	ปัจจัยด้านการจัดการ																		
41	นำใช้เทคนิคในการบริหารงาน ที่มีประสิทธิภาพ เช่น: CPM, Time cost trade off, Resource allocation																		
42	นำใช้เครื่องมือ และsoftware ที่ทันสมัยในการทำงาน																		

ลำดับ	ปัจจัย	ระดับความสำคัญ ต่อเวลา						ระดับความสำคัญ ต่อค่าก่อสร้าง						ระดับความสำคัญ ต่อคุณภาพงาน					
		มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น	มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น	มากที่สุด	มาก	ปานกลาง	น้อย	น้อยที่สุด	ไม่ออกความเห็น
		5	4	3	2	1	#	5	4	3	2	1	#	5	4	3	2	1	#
43	การแก้ไขปัญหาขัดแย้งอย่างมีประสิทธิภาพ																		
	ปัจจัยด้านควบคุมและตรวจสอบ																		
44	การใช้ระบบการควบคุมและตรวจสอบอย่างมีประสิทธิภาพ																		
45	การปรับแผนงานเป็นประจำ																		
46	การใช้ระบบควบคุมคุณภาพที่ดี (quality control)																		
	ปัจจัยด้านการสื่อสาร																		
47	การใช้วิธีการสื่อสารที่ไม่เป็นทางการระหว่างทีมงานในโครงการ																		
48	การติดต่อสื่อสารที่เป็นทางการ เช่น การจัดประชุมประจำสัปดาห์																		
	ปัจจัยด้านความปลอดภัย																		
49	ระบบการดูแลความปลอดภัยและการจัดฝึกอบรมความปลอดภัยแก่บุคลากรในโครงการ																		