Delay Factors and Time-Cost Performance of Construction Projects in Gaborone City Council, Botswana

Aderemi Y. Adeyemi (PhD)
University of Botswana
Gaborone, Botswana

Keabetswe Masalila (BSc)
China Jiangsu International
Palapye, Botswana

The problem of delays in the construction industry is a global phenomenon and the construction industry in Botswana is not an exception. The objectives of this study were to confirm the presence of significant delay in GCC projects; to identify and rank the perceived delay causes; and construct a Bromilow-type time-cost model for the council's projects. The study made use of archival data and questionnaire survey soliciting the perceived causes and effects of delay from the clients, consultants, and contractors that are associated with GCC projects. Chi-square statistical method was employed to prove the presence of statistically significant delay in the council's project. About 150 respondents drawn from three client organizations, five consulting firms and 23 construction contracting companies participated in the survey to rank the perceived causes of delay. The study identified 10 most important causes of delay from a list of twenty eight different causes and six different effects of delay. The ten most important causes are: contractor's improper planning, contractor's poor site management, inadequate contractor experience, inadequate client's finance and payments for completed work, problems with subcontractors, shortage in material, labor supply, equipment availability and failure, lack of communication between parties, and mistakes during the construction stage. The six main effects of delay were: time overrun cost overrun, disputes, arbitration, litigation and total abandonment. In addition, archival data were used to establish the time-cost relationship of the council's projects using Bromilow's model. The derived relationship was given by Time = 1.18Cost0.361861. The adjusted R2 of the model was 0.817812 showing that the model had high predictability. It was concluded that the results of this study can be of immense assistance to the stakeholders of GCC projects in terms of planning future projects and better understanding of the dynamics of project management as lessons for reducing the incidences of project delay and high cost.

Keywords: Delay, time-cost construction projects, Gaborone City Council, Botswana.

Introduction

All over the world the delivery of basic services is invested on the ministry of local government for implementation through its arms. In Botswana therefore, the Ministry of Local Government (MLG) and local authorities under it are responsible for delivering essential services to the populace. Botswana is a landlocked country and is made up of nine districts (provinces) comprising a total of 28 local authorities of which Gaborone City Council (GCC) is one (figure 1). The city council is mandated with the provision, operation and maintenance of all basic services and infrastructure. Hence the council's mandate straddles mainly development projects such as: parks, public toilets, construction of boundary walls, construction of schools and teachers quarters, and sport facilities at community centers and maintenance projects.

Figure 1: Map of Botswana Showing International Boundaries and the Nine Districts (Mapsworld, 2015).

The Construction industry in Botswana is considered to be one of the most significant industries in terms of its contribution to the gross domestic product (GDP) which is currently estimated at 5.3%, gross capital formation, and employment and also in terms of its impact on health and safety of the populace. Like many other developing countries, the main procurement strategy is the traditional procurement system or design-bid-build system at various tiers of government. The contractors and consultants have varying experiences, capabilities and management skills, all of which have major impact on the completion times of construction projects. The growth in the number of these players in the industry over the years has not seen a corresponding

improvement in the timely delivery of projects, although with more contractors and consultants, there has been considerable increase in competition for construction jobs and the clients thus have greater varieties of service providers from which to select. The construction sector in Gaborone is now at a stage where most contractors, both emerging as well as the established, can hardly deliver their projects on schedule, not to mention failing to perform all together. This failure to deliver projects on time and on budget is mind boggling to both public clients and the end users who are expected to benefit from the completed project. This state of affairs becomes more undesirable to the contractors and clients as it is costly and has the potential to trigger disputes whose resolution is usually time-consuming and expensive.

Project success can be defined as meeting the goal and objectives set out during the initiation stage of the project. The main objective of construction project is to complete the construction on time and within budget without sacrificing quality. This cardinal objective is compromised when delays occur and according to Sweis et al. (2008), construction delays are often responsible for turning profitable projects into loss-making ventures. Persistent and painstaking probes are therefore required in all spheres of construction around the world why delays are endemic in the construction industry when it needs not be so. The consequences of these delays, which often manifest as cost overruns, loss of profit, increased overheads, stress, acrimony among stakeholders, project abandonment, corporate contractor failure, litigation, loss of job opportunities and resources tied up in delayed projects, warrant in-depth study. The first step in correcting this anomaly is to identify the root causes of delays so that corrective measures can be taken.

The maintenance and infrastructure development projects of Gaborone City Council are considered as key indicators of its development and economic growth. Many infrastructure and maintenance projects in Gaborone and environ have been facing serious problems of delay for multifarious reasons. Moreover, delivery of projects becomes more complex due to the entrance of new firms, tools, equipment, technology and innovation. When a project exceeds its stipulated time there are always some financial implications that are incurred by both the contractors and clients. A delayed project implies that the contractor is going to be on site longer than planned and hence incur additional overheads while missing out on other contract opportunities as the resources are tied up on the delayed project.

A study was therefore conducted to identify and prioritize the causes and effects of delay in completing construction projects within Gaborone municipality, and to establish the relationship between time and cost of the council's project. The belief here is that when the severity of each factor of delay on project delivery is known, the project stakeholders will be able to prioritize and hedge against them in rank order and hence make the time-cost model more reliable.

Literature Review

Delay could be defined as an act or event that extends beyond the required time to perform the task under a contract. It usually shows up as additional days of work or as a delayed start of an activity (Sweis et al. 2008). According to Assaf et al. (2006) in construction, delay could be defined as the time overrun either beyond completion date specified in a contract, or beyond the

date that the parties agreed upon for delivery of a project. It is a project slipping over its planned schedule and is considered as common problem in construction projects. In some cases, to the contractor, delay means higher overhead costs because of longer work period, high material costs through inflation, and due to labor cost increases. Aibinu et al. (2002), described delay as a situation where the contractor and the project owner jointly or severally contribute to the non-completion of the project within the agreed contract period. Delays in construction projects are frequently expensive, since there is usually a construction loan involved which charges interest, management staff dedicated to the project whose costs are time dependent, and ongoing inflation in wage and material prices.

As indicated by Frimpong and Oluwoye (2003), construction industry all over the world is facing delays in completion of their projects due to different reasons. Various factors are found to be causing delay in completion of construction project. Ahmed et al., (2010), classified into two categories such as internal causes (client, contractor and consultant) and external causes which are beyond the control of the organization. Various scholars stressed the significance of proactive measures to identify the delays in construction projects and came up with key remedies to overcome the delays. Sweis et al. (2008), are of the view that delays occur in all types of construction projects whether small or large, simple and complex and reported that it is very difficult to analyze and classify the delays because there is a large number of activities involved in any construction project. In general many researchers have conducted their studies and identified a large number of causes which are involved in the construction project. Such causes include extreme weather, scarcity of resources, financial problems faced by public organizations and contractors, poor contract management, shortages of materials, and inadequate resources. The issue had also been found as of equal importance in Arab countries. Assaf et al. (2006), conducted a study in construction industry of Saudi Arabia and reported critical causes of delay related to contractor, constructor and client in large building projects. They further classified the causes into nine divergent clusters like financing, materials, contract relationships, government relations, manpower, scheduling and control, equipment, and environment. Later on, El-Razek et al. (2008), used these causes and revised the lists of delay causes with respect to the Egyptian construction industry. They further emphasized the important role of consultants and payment by owner in reducing the delays in large construction projects.

In the Pakistan construction industry, Shaikh et al. (2010), introduced a theoretical framework by analyzing the previous studies highlighting the client, contractor, general and resource related problems are key factors causing delay in construction industry. In the same vein, Haseeb et al., (2011), concluded in their study that the most important and highly ranked causes are related to financial matters causing delays in Pakistan construction industry. They further elaborated and identified the delays like delay in payment to supplier, inadequate fund allocation, inflation and monthly payment problems. However, there is need to identify the client, contractor, consultant, material, equipment, labor related and general factors causing delay in project execution.

Researchers have identified causes of delay on construction projects and classified their sources as being related to the client, consultant, materials supply, availability of equipment and labor supply. Assaf et al. (2006) identified 56 main causes of delay in Saudi large building construction projects and their relative importance. Based on the contractors surveyed the most important delay factors were: preparation and approval of shop drawings, delays in contractor's

progress, payment by owners and design changes. From the view of the architects and engineers the cash problems during construction, the relationship between subcontractors and the slow decision making process of the owner were the main causes of delay. However, the owners agreed that the design errors, labor shortages and inadequate labor skills were important delay factors.

Chan and Kumaraswamy (1997) conducted a survey to determine and evaluate the relative importance of the significant factors causing delays in Hong Kong construction projects. They analyzed and ranked main reasons for delays and classified them into two groups the role of the parties in the local construction industry (clients, consultants or contractors) and the type of projects. Frimpong and Oluwoye (2003), conducted a survey to identify and evaluate the relative importance of significant factors contributing to delay and cost overruns in Ghana groundwater construction projects. The result of the study revealed that the main causes of delay and cost overruns in construction of groundwater projects are monthly payment difficulties from agencies; poor contractor management, material procurement, poor technical performance, and material price escalation.

A number of studies by researchers have identified the contractor related delaying factors. According to Sambasivan and Soon (2007) improper planning by contractor, inefficient site management and inadequate experience of the contractor are the major causes of delay. Financial problems of contractors, sub-contractor issues quality of contractor's work are the main causes of delay, Zaneldin (2006). Similarly, Frimpong and Oluwoye (2003) also proved that contractor related factors play an important role in delaying any construction project. While writing about contractor related delaying factors. Odeh and Battaineh (2002) identified that the major issues related to contractors are the poor site management. Sub-contractors, inadequate planning approaches used for construction and insufficient experience of contractors. In the same vein, Wei (2010) reported that the difficulties in financing, clashes in sub-contractors schedule during the execution of project, rework due to errors, deprived communication and organization, unsuccessful planning and scheduling of project, improper implementation of construction methods, insufficient contractor's work, inadequate sub-contractors work, frequent change of sub-contractors, poor qualification of technical staff and site deployment are the important factors related to contractor.

There are many researchers who identified the client related delay factors. For clients, construction delays are the loss of revenue, lacking in productivity, dependency on existing resources and the lack of rentable resources. Abdul-Rahman et al. (2006) carried out a study in Malaysian construction projects. They extended the concept given by Mezher (1998) and proved through survey that financial problems are the main cause of delay in construction projects. A number of studies conducted in Saudi Arabia found the delay in payments or nonpayment to contractors by clients is the major cause of delay in construction projects of Saudi Arabia. Change orders by clients also play an important role in delaying any construction project. AlKhalil and Al-Gliafly (1999) found that decision making by client is the major problem of delay in construction industry. The reason for slow decision making is low level of technical expertise of the client.

Assaf and Al-Hejji (2006) reported that the main causes of delay from the consultant's point of view are inadequate planning of contractors, contractor's poor site management, payment of completed work and less availability of equipment and materials. According to Haseeb et al. (2011) the drawing changes inefficiency of consultants, preparation and approval of drawings, wrong site investigation, contract management and slow response and inspection are the major problems arose by the consultants in the construction industry of Pakistan.

Material is also a critical factor in the construction industry. There are many researches which have been done to identify the material related delaying factors in the construction industry. According to Sainbasivan and Soon (2007) quality of material and scarcity in material during the execution of projects are the main material related factors which are responsible for delaying a project. Koushki and Kartam (2005), concluded that selection of material is the main contributor of delay in construction industry. According to Sweis et al. (2007) the main causes for delay are the shortage of materials and late delivery of material. Aibinu and Jagboro (2002) identified that the management problems in managing materials are the main contributor of the project delay. Equipment related factors are one of the many delaying factors that cause suspension of construction project**.** Assaf et al. (1995) conducted a study in respect of Saudi construction industry and concluded that equipment failures, scarcity of equipment, unskilled equipment operators, little output and efficiency of equipment and absence of high-technology mechanical equipment. Shree (2007) implied that increase in the cost of renting construction equipment play a substantial role in delaying any construction project. Also it was inferred that short supply of construction equipment can result in serious constraint for successfully completing a project on time. The major factors relate to equipment which may result in schedule delay of any project are the equipment failures, scarcity of material, low skill levels of equipment operators, low productivity and efficiency of equipment and lack of high technology mechanical equipment are material related factors which are responsible for delay in construction projects (Wei, 2010).

A number of studies identified the factors of labor related delays. Frimpong and Oluwoye (2003), identify the labor shortages that contribute to causes of delays. Assaf et al. (2006) identify the shortage of laborers and low productivity level of laborers that contribute to project delays. Sweis *et al* (2007), Sambasivan and Soon (2007), Odeh and Battaineh (2002), Assaf and Hejji (2006) attributed shortage of manpower (skilled, semi-skilled, unskilled labor) and presence of unskilled labor to project delays.

Time and cost are of major concern in construction projects delay studies. In the construction industry, it is customary for contractors to use previous experiences on a project to estimate the new project duration and cost. Bromilow (1969) pioneered the empirical study of the relationship between project time and cost. His model predicts that there is exponential function relating the duration of a project (time) to the cost of the project. The function is given by:

$T=K*C^B$ …….. (1)

Where:

T = construction duration from project start date to handover.

C = project final cost in million dollars.

K = a constant that describes the level of time performance for a one million dollar project.

B = a constant that describes the sensitivity of the time performance affected by project cost.

The model was later updated in a study of time-cost data for a total of 419 building projects in Australia (Bromilow et al., (1980) giving the time cost relationship on these projects as:

$T=3l3\ C^{0.3}$ …….. (2)

Many researchers around the world have since taken a cue from this study. For example, Ireland (1986) replicated the study to predict construction time for high-rise buildings in Australia; Kaka & Price (1991) conducted a similar survey both for buildings and road works in the United Kingdom; Kumaraswamy & Chan (1995) investigated the effect of construction cost on time with particular reference to Hong Kong: Chan (2001) did a similar research for Malaysian construction industry: and Choudhury, Khan, & Martin (2002) conducted a study on health sector construction projects in Bangladesh. All these studies found that the mathematical model presented by Bromilow et al. holds good for prediction of construction time if the cost of construction is known.

Literature does not exist on delay factors and time cost performance GCC projects. Therefore, the existing tools of delay analysis were applied to projects executed by the council with the objective of (i) ranking the delay factors and (ii) determining the empirical relationship between project time and cost.

Research Methods

The subjects of this investigation were projects carried out by the Gaborone City Council from the year 2009 to 2014 and the construction stakeholders related to the council projects. The projects were of development and maintenance types. Archival data were used to collect data on project title, initial contract duration, project start date, expected completion date, actual completion date, initial tender price, and revised price for final account. Delay factors were sought in a preliminary study from the three groups of stakeholders (client, consultant and contractor) in addition to those identified in the literature (Masalila and Adeyemi, 2015).

Questionnaires were then distributed to the stakeholders to rate on a five-point Likert-type scale of 1 to 5 the established factors causing delays on Gaborone City Council projects. Before distributing the questionnaire a pilot study was conducted using GCC (client) professional staff. The basic purpose of the pilot study was to verify the completeness of the questionnaire in capturing the factors relevant to the council projects. The Likert-type scale is often used to measure respondents' attitudes by asking the extent to which they agree or disagree with a particular question or statement. The responses were coded as: strongly disagree = 1, disagree = 2, neutral = 3, agree = 4, strongly agree = 5. The sampling method used in this study is convenience/snowball sampling. The relative importance index (RII) for each factor of delay is given by:

$$\mathrm{RII} = \frac{\sum W}{A * N} \qquad \text{…… (3)}$$

Where *W* is the weighting given to each factor by the respondents (ranging from 1 to *5), A* is the highest weight (i.e. *5* in this case), and *N* is the total number of respondents. The higher the value of RII, the more severe the cause or effect of the delay factor.

Archival data relating to project time and cost were obtained for 26 major projects executed by the council between 2009 and 2014. These were subjected to statistical modeling to (i) determine if the difference between the expected project duration (E) and the observed actual project duration (O) is significant using chi square test, and (ii) to arrive at a Bromilow type model for the council.

Results and Discussion

Table 1 shows the comparative expected project duration as contained in the contract documents versus the observed actual project duration for each of the projects with the associated chi square calculations. Chi square was employed to test if there is significant difference between the two categories of project duration.

Null Hypothesis: There is no significant difference between the observed actual project duration (O) and the expected project duration (E).

The critical value when DF is 25 (n-1) for 95% confidence of accepting or rejecting the null hypothesis is 37.652

Decision Criteria:

- If the calculated chi square value is greater than 37.652 reject the null hypothesis.
- If the calculated chi square value is less than 37.652 accept our null hypothesis.

Chi square is given by:

$$\chi_c^2 = \sum \frac{(O_i - E_i)^2}{E_i} \qquad \text{..... (4)}$$

Table 1

Comparative expected and actual project duration with chi square calculation

S/No.	Project Description	Expected Project Duration (E) (Weeks)	Observed Actual Project Duration (O) (Weeks)	$(O-E)^2/E$
1	Construction of public toilet	16	30	12.25
2	Refurbishment and Maintenance of a clinic	25	39	7.84
3	Erection of a pharmacy block	20	31	6.05
4	Primary school boundary wall	22	29	2.23
5	Primary school boundary wall	36	32	0.44
6	Primary school boundary wall	24	23	0.04
7	Primary school boundary wall	14	17	0.64
8	Community sports facility	14	19	1.79
9	Water reticulation of teachers' quarters	12	17	2.08
10	Nurses houses	20	60	80.00
11	Construction of special education classrooms	36	54	9.00
12	Teachers quarters	34	107	156.74
13	Teachers quarters	40	60	10.00
14	Maintenance work	8	13	3.13
15	Maintenance work	10	11	0.10
16	Maintenance work	8	13	3.13
17	Maintenance work	11	69	305.82
18	Maintenance work	16	16	0.00
19	Maintenance work	14	29	16.07
20	Maintenance work	13	14	0.08
21	Roofing	16	16	0.00
22	Maintenance work	15	22	3.27
23	Maintenance work	16	48	64.00
24	Maintenance work	7	11	2.29
25	Maintenance work	4	4	0.00
26	Supply and Installation of abattoir equipment	12	20	5.33
			Chi-square value (x_c^2)	**692.30**

Since our Chi-square value (i.e. 692.30) is greater than the critical value at 95% confidence level (i.e. 37.652), the null hypothesis is rejected. This means that there is a significant difference between the expected project duration and the actual project duration. It is therefore inferred that the time overrun incurred in the councils' projects are statistically significant.

The primary data collected from the questionnaire was analyzed from the perspective of clients, consultants and contractors. The relative importance index, RII, was computed for each cause to identify the most significant causes. The causes were ranked based on RII values. From the ranking assigned to each cause of delays, it was possible to identify the most important factors or causes of delays for Gaborone City Council projects. Based on the ranking, the five most important causes of construction delays as perceived by clients were: (1) Contractor's improper planning (RII = 0.811); (2) contractor's site management (RII = 0.789): (3) inadequate contractor experience (RII = 0.778): (4) labor supply problems (RII = 0.778) and (5) subcontractor problems (RII = 0.756). The five most important causes of construction delays as perceived by consultants were: (1) contractor's improper planning (RII = 0.842): (2) contractor's site management (RII = 0.821); (3) shortage in material (RII= 0.804): (4) inadequate contractor

experience (RII = 0.770), and (5) inadequate client's finance and payments of completed work (RII = 0.792). The five most important causes of construction delays as perceived by contractor were: (1) contractor's poor site management (RII = 0.869): (2) inadequate client's finance and payments of completed work **(**RII = 0.823): (3) subcontractors (RII = 0.789); (4) inadequate contractor experience (RII = 0.783), and (5) equipment availability and failures (RII = 0.777). From the above list, it is interesting to compare the causes as perceived by clients and contractors. Most of the disputes that arise in the construction industry in Gaborone, Botswana are between clients and contractors, most often one party blaming the other. Three of the factors perceived common between clients and contractors are: contractor's site management, inadequate contractor experience, and subcontractors. The clients blame contractor's improper planning and labor supply as other important causes of delay. The contractor’s inability to plan can be attributed to contractor's inexperience. A significant portion of the labor force in the construction industry is from neighboring countries like Zimbabwe. It is quite difficult to prevent the movement of these laborers from one construction company to another, causing disruption of work. The contractors blame client's inability to pay for the completed work and equipment availability and failures as other important causes of delay. These causes can be attributed to the client’s financial position and contractor's improper planning. In government related projects, payments to the contractors take relatively longer time. It is the responsibility of the contractors to factor in this time during the planning process. Table 2 gives the ranking of the delay factors based on the response of all respondents (clients, contractors and consultants). It can be drawn from the table above that the ten most important causes of delay on GCC projects in ranked order are: contractor's improper planning, contractor's poor site management, inadequate contractor experience, inadequate client's finance and payments for completed work, problems with subcontractors, shortage in material, labor supply, equipment availability and failure, lack of communication between parties, and mistakes during the construction stage.

Table 2

Overall Ranking of the Causes of Delay

Causes of Delays	RII	Rank
Client related		
Finance of and payments for completed work	0.820	4
Owner Interference	0.360	20
Slow decision making	0.520	13
Unrealistic contract duration and requirements imposed	0.300	24
Contractor related		
Subcontractors	0.760	5
Site management	0.860	2
Construction methods	0.460	15
Improper planning	0.880	1
Mistakes during construction stage	0.600	10
Inadequate contractor experience	0.840	3
Consultant related		
Contract management	0.378	19
Preparation and approval of drawings	0.440	16
Quality assurance/control	0.333	22
waiting time for approval of tests and inspection	0.320	23

Material related	RII	Rank
Quality of material	0.560	12
Shortage in material	0.750	6
Labor and equipment category		
Labor supply	0.740	7
Labor productivity	0.580	11
Equipment availability and failure	0.680	8
Contract related		
Change orders	0.350	21
Mistakes and discrepancies in contract document	0.420	17
Contractor relationships related		
Major disputes and negotiations	0.500	14
Inappropriate overall organizational structure linking to the project	0.267	25
Lack of communication between the parties	0.660	9
External		
Weather condition	0.200	26
Regulatory changes	0.200	26
Problem with neighbors	0.200	26
Unforeseen site condition	0.380	18

The main effects of delay were identified as: time overrun, cost overrun, disputes, arbitration, litigation and total abandonment. Their rankings are as produced in Table 3.

Table 3

Rank order of the effects of delay on Gaborone City Council projects

Effects of delays	RII	Rank
Time overrun	0.855	1
Cost overrun	0.825	2
Dispute	0.650	3
Arbitration	0.600	4
Litigation	0.580	5
Total abandonment	0.450	6

Time-Cost Performance

Data related to the construction time and cost were collected for 26 major construction projects completed by the council between 2009 and 2014. SPSS statistical program was used for the analysis of the data. A scatter plot of the data was prepared preparatory to analysis to preview the pattern of the relationship between the actual construction time and total project cost (Figure 2). The plot exhibited positive curvilinear relationship between the two variables as first predicted by Bromilow (1969). The data collected for the study was then used to validate the time-cost relationship model in accordance with Bromilow et al. (1980) procedures using the following equation:

$Time = K*Cost^{B}$ …… (5)
Where:
Time = duration of construction time in days.
Cost = completed cost of the project in thousand BWP or project value (in national currency).
K = a constant indicating the general level of time performance for a project worth one thousand BWP.
B = a constant indicating how the time performance is affected by the size of the construction project measured by its cost.

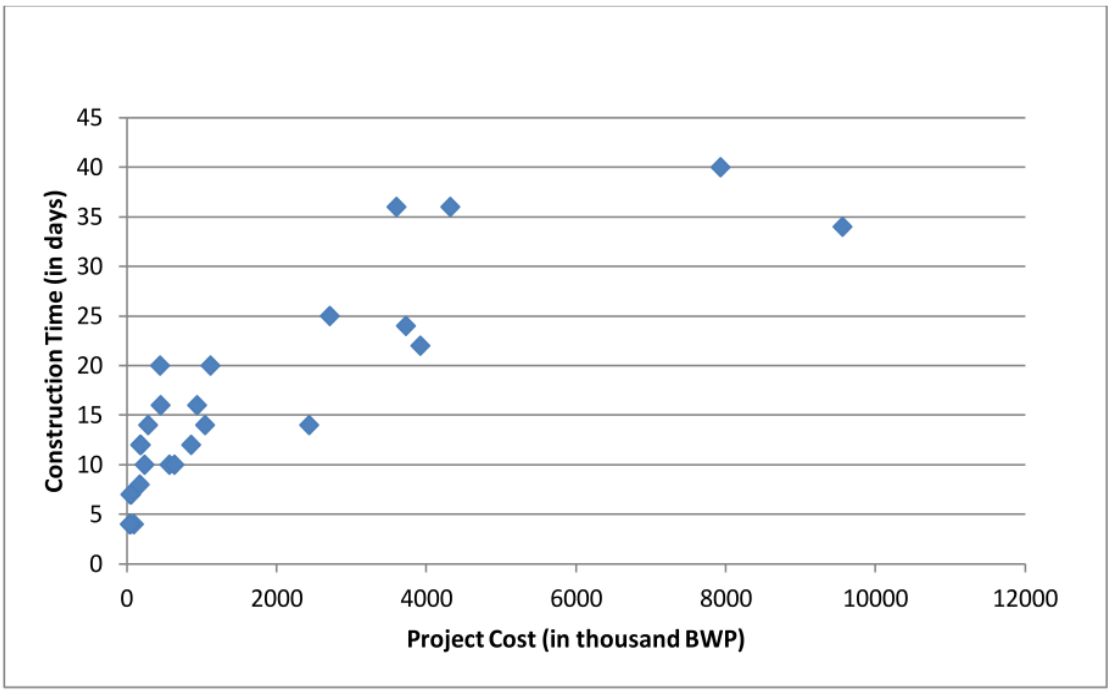

Figure 2: Scattered diagram of the relationship between construction time and project cost.

For statistical analysis, Equation (5) was rewritten in the natural logarithmic form as follows:

LnTime = Log K + BLnCost …….(6)
Where:
LnTime = Natural logarithm of time.
Log K = Natural logarithm of K.
B = coefficient of LnCost.
LnCost = natural logarithm of cost.

The computer output for the input time and cost data collected and based on Equation 6 is shown in Table 6. The results of the analysis indicated a positive relationship between construction time and project cost for GCC construction works. The value of LnK is required to be transformed to K, using an exponential function (exp (LnK), for expressing the model in its original form (Equation 1). Hence, Exp (LnK) = Exp (0.110998) = 1.18.

An important aspect of a statistical procedure that derives a model from empirical data is how well the model predicts the results. A widely used measure of the predictive efficacy of a model

is its coefficient of determination, or R-Squared value. If there is a perfect relationship between the dependent and independent variables, R-Squared is 1. In case of no relationship between the dependent and independent variables, R^2 is 0. Predictive efficacy of this particular model was found to be quite high with an R^2 of 0.825099, and an adjusted R^2 of 0.817812. It can therefore be concluded that the time-cost relationship for the GCC construction project can be expressed using the model developed by Bromilow et al. (1980). This can be expressed as:

$$\text{Time} = 1.18\text{Cost}^{0.361861} \quad \ldots\ldots\ldots\ldots (7)$$

Table 4

Computer Output for Time-Cost Relationship

```
Dependent Variable: LNTIME
Method: Least Squares
Date: 03/13/15   Time: 14:26
Sample: 1 26
Included observations: 26
Convergence achieved after 3 iterations
LNTIME=LOG(C(1))+C(2)*LNCOST

                         Coefficient    Std. Error    t-Statistic    Prob.

          C(1)            0.110998      0.050523      2.196976      0.0379
          C(2)            0.361861      0.034008      10.64052      0.0000

R-squared                 0.825099    Mean dependent var          2.608334
Adjusted R-squared        0.817812    S.D. dependent var          0.668229
S.E. of regression        0.285224    Akaike info criterion       0.402717
Sum squared resid         1.952460    Schwarz criterion           0.499493
Log likelihood           -3.235317    Hannan-Quinn criter.        0.430585
Durbin-Watson stat        1.822223
```

Conclusions

The objectives of this study were to confirm the presence of significant delay in GCC projects; to identify and rank the perceived delay causes, and construct a Bromilow-type time-cost model for the council's projects. The study used both archival materials and questionnaires distributed to the three major groups of stakeholders (clients, consultants and contractors). Chi-square statistical method was employed to prove the presence of statistically significant delay in the council's project. Relative importance index was used to rank the perceived causes of delay and the ten most important causes in ranked order were: contractor's improper planning, contractor's poor site management, inadequate contractor experience, inadequate client's finance and payments for completed work, problems with subcontractors, shortage of material, labor supply, equipment availability and failure, lack of communication between parties, and mistakes during the construction stage. The main effects of delay in ranked order were identified as: time overrun, cost overrun, disputes, arbitration, litigation and total abandonment. The derived GCC project time-cost model (Eq. 7) hah adjusted R^2 of 0.818 and could be used reliably to predict the project time if the cost is known.

It is believed that the results of this study can be of immense assistance to the council's project stakeholders in planning future projects and better understanding of the dynamics of project management as lessons for reducing the incidences of delay.

Recommendation

The overwhelming adoption of traditional procurement system (TPS) in the country as a whole and at GCC in particular has the tendency to negatively affect project outcomes. TPS has been widely criticized in literature as lacking in vision and value and as a major source of corruption in public project delivery (Kong & Gray, 2006; Davis et al. 2008; Chan and Kumaraswamy, 1997; Love et al., 1998; Kashiwagi and Byfield, 2002**;** Adeyemi and Kashiwagi, 2014; Adeyemi et al. 2014; Adeyemi et al. 2015).

There has been a decline in the popularity and use of traditional procurement system (Mo and Ng,1997; Rwelamila and Myer, 1999;Kashiwagi & Savicky, 2002; Kashiwagi et al. 2004; Love et al. 2008; Tan, 2011). Adeyemi et al. (2011) have recommended adoption of performance-based model, the Performance Information Procurement System (PIPS) for implementation in the Botswana built environment due to its demonstrable efficacy in delivering projects at 98% on time, budget and quality as experienced in the USA and the Netherlands where it found wider applicability. Experiment with two projects in Botswana even confirms these feet. The superior strength of PIPS to any other procurement system lies in the contractor sieving stages during bid adjudication to arrive at one contractor that can best identify and manage the risks (all possible delay factors) associated with the project. All the ten most critical factors of delay identified in this research are hallmarks of TPS which have no place in best value procurement system.

Acknowledgement

The authors wish to acknowledge Gaborone City Council for the assistance given to us in the course of this research.

References

Adeyemi, A., Mselle, P. Kashiwagi, D. & Kashiwagi, J. (2011). A new approach to the delivery of construction in Botswana. *Journal of Civil Engineering and Architecture*, 5(7), 606-617.

Adeyemi, A. Y. & Kashiwagi, D. T. **(**2014). Non-Sustainability of low-bid infrastructure, procurement system: lessons for developing countries. *International Journal of Engineering and Innovative Technology (IJEIT),* 4 (6), 246-251.

Adeyemi, A. Y. Oladele, A. S. & Kashiwagi, D. T. (2014). Linking PIPS to sustainable consumptions in African transportation sector facilities projects. *International Journal of Transportation Technology Transfer (T^2) in Africa*, 1(2), 11-26.

Adeyemi, A. Y., Samman, J. & Mselle, P. C. (2015). Traditional procurement system as a source of unsustainable development: empirical evidence from public infrastructure projects delivery in Botswana. *Proceedings of the International Conference on Infrastructure Development and Investment Strategies for Africa (DII-2015)*, 16th -18th September, Livingstone, Zambia, 430-437.

Abdul-Rahman, H., Berawi, M., Berawi, A., Mohamed, O., Othman, M., & Yahya, I. (2006). Delay Mitigation in the Malaysian Construction Industry, *Journal of Construction Engineering and Management*, 132(2), 125–133.

Ahmed, S.M., Azhar, S., Kappagntula, P., &Gollapudil, D. (2003). Delays in construction: a brief study of the Florida construction industry, *Proceedings of the 39th Annual ASC Conference*, 10-12th April, Clemson University, Clemson, South Carolina, 257-266.

Aibinu. A. & Jagboro, G. (2002). The effects of construction delays on project delivery in Nigerian construction industry. *International Journal of Project Management*, 20(8), 593-599.

Alaghbari. W., Kadir, M.R.A. & Salim, A. (2007). The significant factors causing delay of building construction projects in Malaysia. *Engineering, Construction and Architectural Management.* 14(2), 192-206.

Al-Khalil M. & Al-Ghafly M. (1999) .Important causes of delay in public utility projects in Saudi Arabia. *Construction Management and Economics*, 17(5), 647–55.

Assaf, S.A., Al-Khalil, M. & A1-Hazmi, M. (1995). Causes of delay in large building construction projects. *Journal of Management in Engineering*. 11(2), 45-50.

Assaf, S.A. & Al-Hejji, S. (2006). Causes of delay in large construction projects. *International Journal of Project Management*, 24(4), 349-357.

Bromilow, F.J, (1969) Contract time performance expectations and the reality. *Building Forum*, 1(3), 70-80.

Bromilow, F. J., Hinds, M. F. & Moody, N. F. (1980). Australian Institute of Quantity Surveyors (AIQS) survey of building contract time performance. *The Building Economist,* 19(2), 79-82.

Chan, D. W. M. & Kumaraswamy, M. M. (1997). A comparative study of causes of time overruns in Hong Kong construction projects, *International Journal of Project Management*, 15(1), 55-63.

Chan, A. P. C. (2001). Time-cost relationship of public sector projects in Malaysia. International Journal of Project Management, 19(4), 223-229.

Choudhury, I., Khan, M. M., & Matin, A. (2002). Relationship between construction time and project cost of health sector construction works in Bangladesh. *Proceedings of the* 38th *Annual Conference of the Associated Schools of Construction.* Roanoke, Virginia.

Davis, P., Love, P. & Baccarini, D. (2008). *Report: Building Procurement Methods.* CRC Construction Innovation (Research Project No.2006-034-C-02). Brisbane, Australia: Cooperative Research Centre for Construction Innovation.

El-Razek, M.E.A., H. Bassioni, & A. Mobarak, (2008). Causes of delay in building construction projects in Egypt. *Journal of Construction Engineering and Management,* 134(11), 831-841.

Frimpong, Y. & Oluwoye, J., (2003). Significant factors causing delay and cost overruns in construction of groundwater projects in Ghana. *Journal of Construction Research*, 4(02), 175-187.

Haseeb, M., A. Bibi, & W. Rabbani, (2011). Problems of Projects and Effects of Delays in the Construction Industry of Pakistan. *Australian Journal of Business and Management Research*1 (5), 4 1-50.

Ireland, V. (1986). A comparison of Australia and US building performance for high-rise buildings. *School of Building Studies,* University of Technology, Sydney, Australia.

Kaka, A. & Price, A. D. F. (1991). Relationship between value and duration of construction projects. *Construction Management and Economics*, 9, 383-400.

Kashiwagi, D. & Byfield, R. E. (2002), Selecting the best contractor to get performance: On time, on budget, meeting quality expectations, *Journal of Facilities Management*, 1(2), 103 – 116.

Kashiwagi, D., Parmar, D. and Savicky, J. (2004) Traditional low-bid procurement system versus performance information procurement system (PIPS) in construction industry. *In:* Khosrowshahi, F. (Ed.), *20th Annual ARCOM Conference*, 1-3 September, Heriot Watt University. Association of Researchers in Construction Management, 703-709.

Kashiwagi, D. & Savicky, J (2002). The Relationship between the Specification, Low-Bid Process and Construction Nonperformance. *First International Conference on Construction in the 21st Century*, Miami, FL, 371-377.

Kong, A. T. & Gray, J. (2006). Problems with Traditional Procurement in the Malaysian Construction Industry - a Survey. In Runeson, Goran and Best, Rick, Eds. *Proceedings Australasian Universities Building Educators Association Annual Conference*, 1-21, University of Technology, Sydney.

Koushki, P. A. Al-Rashid, K. & Kartam N. (2005). Delays and cost increases in construction of private residential projects in Kuwait. *Construction Management and Economics*, 23(3), 285–94.

Kumaraswamy, M. M. & Chan, D. W. M. (1995). Determinants of construction duration. *Construction Management and Economics*, 13, 209-217.

Love, P.E.D., Skitmore, R.M., & Earl, G. (1998). Selecting a suitable procurement method for a building project. *Construction Management and Economics*, 16(2), 221-233.

Love, P.E.D., Davis, P.R., Baccarini, D., Wilson, G. and Lopez, R. (2008), Procurement selection in the public sector: a tale of two states, paper presented at 3rd International Conference of the Cooperative Research Centre for Innovation, Clients Driving Innovation: The Benefits of Innovation, Gold Coast, and 12-14th March. Retrieved from: https://www.researchgate.net/publication/27483717_Procurement_selection_in_the_public_sector_a_tale_of_two_states.

Manavazhia M.R. &Adhikarib, D. K. (2002). Material and equipment procurement delays in highway projects in Nepal. *International Journal of Project Management* 20, 627-32.

Mapsworld Political Map of Botswana. Retrieved from: http://www.mapsofworld.com/zimbabwe/zimbabwe-political-map.html.

Masalila, K. and Adeyemi, A. Y. (2015). Delay Analysis of Gaborone Municipal Council Construction Projects, *Proceedings of the 14th Biennial Conference of the Botswana Institute of Engineers*, Phakalane Gulf Estate, Gaborone, Botswana, 6th – 8th October, 430-437.

Mezher, T. M. & Tawil W. (1998). Causes of delays in the construction industry in Lebanon, *Engineering, Construction and Architectural Management*, 5(3), 252-260.

Odeh, A.M. & Battaineh, H. T. (2002). Causes of construction delay: traditional contracts. *International Journal of Project Management*, 20(1), 67-73.

Sambasivan. M. & Soon, Y. W. **(**2007). Causes and effects of delays in Malawian construction industry. *International Journal of Project Management.* 25(5), 5 17-526.

Shaikh, A.W., Muree, M. R. & Soomro, A. S. (2010). *Identification of Critical Delay Factors in Construction.* Sindh University Resource Journal, 42(2), 11-14.

Shree, S. (2007). Equipment rentals hit construction industry. *Live Mint.* Retrieved from http://www.livemint.com/2007/09/20020703/Equipment-rentals-hit-construc.html.

Sweis, G., Sweis, R., Hammad, A.A., & Shboul, A. (2008). Delays in construction projects: The case of Jordan. *International Journal of Project Management*, 26(6), 665-674.

Wei, K.S., (2010). Causes, Effects and Methods of Minimizing Delays in Construction Projects, *Bachelor Thesis*, University of Technology, Malaysia, Skudai, Malaysia.

Zaneldin, E.K. (2006). Construction claims in United Arab Emirates: Types, causes, and frequency. *International Journal of Project Management*, 24(5), 453-459.

