

Report On

Automation in Tender Evaluation in Construction Industry to
increase Procurement Planning Efficiency, Transparency, Quality
Bidding and focus on Sustainability Factors

By

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An internship report submitted to the Department of Procurement and Supply
Management in partial fulfillment of the requirements for the degree of
Masters in Procurement and Supply Management

Procurement and Supply Management
Brac University
August, 2021

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Declaration

It is hereby declared that

1. The internship report submitted is my/our own original work while completing degree at Brac University.
2. The report does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The report does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I/We have acknowledged all main sources of help.

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Letter of Transmittal

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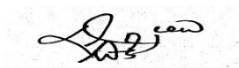
Dear Sir,

This is my pleasure to report you that, I have collected the primary data from essential resources as you suggested and completed the analysis based on the best practices available in the modern research methodology.

I have attempted my best to finish the report with the essential data and recommended proposition in a significant compact and comprehensive manner as possible.

I trust that the report will meet the standard as expected.

Sincerely yours,



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Non-Disclosure Agreement

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Subject: Non-disclosure agreement.

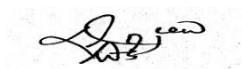
Dear Sir,

This is my pleasure to report you that, I have collected the primary data from essential resources as you suggested and completed the analysis based on the best practices available in the modern research methodology.

I hereby give my sincere words that nor I neither BRAC University will disclose this company information collected for the sake of this research to any other medium or entity. It will be kept safe under the university authority.

I trust that the report will meet the standard as expected.

Sincerely yours,



Qudrati Al Wasiew
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Acknowledgement

I would like to thank the Almighty for everything we are blessed with. Sincere gratitude goes to my report/practicum supervisor for his role. It is a great deal of cooperation that has made it possible to reinforce this report with such strong data analysis. I would also like to thank my workplace supervisor for his great assistance and experienced views. Last but not the least I would like to thank my family who has made it possible for me to come this far and achieve a master's degree which still remains a dream for millions of students all over the globe.

Executive Summary

With the ever-changing tools and machineries in construction industry and revolution in material manufacturing, prediction of market price on construction materials has become a tough nut to crack. At the same time, the increasing standards of living and doing things has also affected the labor costs. So, in case of being a buyer of construction goods, works or services can be a vexatious task. Evaluating the bids for varying types of construction works with multi-layers of specifications can be cumbersome. Though in Bangladesh most of the buyers use the PPR as a standard for procurement and LGED schedule of rates as a standard for market price for goods, works and services; but still the bid evaluation procedure has not changed its pattern with the modern touches of IT.

It can be seen that GoB has produced eGP and several MNCs and INGOs have produced integrated ERP systems like SAP; but they all end up to collecting bids but not evaluating them automatically in the system. In most cases, the bidders end up bidding lower than 10% to 15% of the pre-analyzed market price. According to PPR and GSCM policies of private sector buyer urges for rate analysis from bidders. This also consumes another one to two weeks before the notification of award. But, in reality all the buyers are doing boring repetitive works of rate analysis during this period. The primary aim of this study is to build and show a model that can automatically evaluate the bids compared to pre-fetched market rates. The objective is also to show a process that will be able to predict future market changes and bid changes from continuous flow of data from new tenders and bids.

The collection of data was from the archive of Tongi Urban Program, World Vision Bangladesh but used as crypto for serving the purpose of company policies. The study is focused to ease the hectic work of construction SCM. The primary aim is to increase transparency, quality bids and also provide enough time to evaluate sustainability factors of the bidders by the procurement officers or buyers.

The main idea of increasing transparency is evaluating bids in a medium or system that will be noticeable to both the bidders and the buyers. This method would take training of the bidders and data entry specialists. By involving the bidders into the system, a huge amount of transparency can be achieved. Again, by evaluating bids through automatic system would mean a lot less biasness towards any individual. Again, the system is designed to achieve threshold value that will be continuously closer

to the market rates. This will encourage bidders to quote better rates and coerce them from quoting unrealistic rates in specific items of work to gain work in anyway. It will result in quality bidding as well as quality of work. Also by automated evaluating system, the organization can provide enough time to the experts and procurement officers to evaluate the sustainability factors and required documents submitted by the bidders with more accountability. This will eliminate fake certificates, illegal documents and force bidders towards achieving a total sustainability.

Keywords: Tender Evaluation; Construction; Market Analysis; Automation; Supply Chain Management.

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List of Acronyms

PPR	Public Procurement Rules
GSCM	Global Supply Chain Management
IT	Information Technology
AI	Artificial Intelligence
LGED	Local Government Engineering Department
PWD	Public Works Department
CBA	Comparative Bid Analysis
GoB	Government of Bangladesh
eGP	Electronic Government Procurement
MNC	Multi-National Company
INGO	International Non-Government Organization

Glossary

Tender	A process to select suppliers or contractors for specific goods supply, work or service through some competitive stages of evaluation
Bid	Quotations submitted against item of works by any supplier or bidder
Tender Evaluation	Process to evaluate bids dropped by enlisted (limited tendering) or national and international (open tendering) bidders against a previously published tender package
Comparative Bid Analysis	A process to rank the bidders according to the Public Procurement Rules or Standard rules set by the organization
Construction Management	Arrangement of various units or departments regarding a construction project and managing budget, schedule, risk etc. through efficient use of these segregated sectors

Chapter 1

Introduction

1.1 Background of the study

Construction industry covers a very big part of National and International revenue. The focus in this sector is mainly towards the ease of construction at field level. With the modernization through IT and AI all other fields like technology, electronics, network etc. are trying to automate in their own ways to ease the hectic work pressures of day-to-day life. In case of construction industry, the modern technology has invented multi-layered tools and machineries that facilitate during construction works and ease the procedures and reduce risks in the system. On the other hand, comparatively low focus has been given in planning and procurement phase of a construction. There have been systems in place to produce virtual and cloud-based designs to link up different professionals. On the other hand in case of competitive tendering only system improvement seems to be up to bid collection. There is also low level of interest to train contractors and suppliers in the modern technology to take the best benefits out of these systems. Thus, manual tendering procedures are still seen in a lot of organizations around the globe and Bangladesh. A large amount of manual decisions still being made which proves the lack of transparency and biasness in different sectors. So, the study focuses to propose a system to improve these conditions in case of construction tendering and tender evaluation. The main idea is to create a system to automatically evaluate the bids with reference to the previously trained data sets of market price and also to create an automation system that will feed from continuous bid documents and create threshold values for future sets of market rates.

1.2 Research Objectives

The objectives of this study were-

- To create a system to automatically evaluate bids from bidders up to preferred specification levels to conclude a decision regarding particular project's contractor or supplier selection.
- To create an automation system that will produce threshold values for future market rates from continuous bid data.
- To increase effectiveness of yearly procurement plan and solve budget burning issues.
- To increase scope for transparency, quality bidding and promote sustainability factors.

1.3 Research Outline

Chapter (1) provides an introduction and background study regarding tendering procedure and tender evaluation in construction industry and its merits and demerits.

Chapter (2) represents up to date reviews and literature available regarding construction industry tender evaluation and possible improvements in this sector.

Chapter (3) comprises of the proposed methods and tools to achieve the research objectives up to the desired level of satisfaction.

Chapter (4) represents the results and analysis. The results include the coding, system build up, data analysis, data entry and automation outputs.

Chapter (5) represents the conclusion regarding this study and future possibilities to expand the horizon.

Chapter 2

Literature Review

Tendering would generally refer to invitation to bid. References such as PPR and other international GSCM policies would outline tendering method to be a competitive way to select a supplier or contractor for a particular project or a yearlong contract. Traditional way of receiving bids and awarding contract to the lowest bidder has been a study prospectus for researchers all over the globe (Hatush and Skitmore 1997, Hatush and Skitmore 1997, Hatush and Skitmore 1998, Koushki, Al-Rashid et al. 2005). Several studies also show that, some contractors end up bidding such a low price in desperateness to win the contract that eventually the bid amount becomes grievous for them to even complete the project. Several difficulties such as cost, schedule and quality become cruxes towards achievements of those projects (Abedi, Fathi et al. 2011).

Some conducted studies in UK construction industry proves that the best parameter to select construction contractor is their previous work performance rather than the bid response (Holt, Olomolaiye et al. 1995, Shukery, Amirudin et al. 2016). On the other hand, some studies also show that price evaluation in construction projects belongs under the most valuable aspects for buyer or clients to understand or control the project cost (Zhang, Luo et al. 2015). Generally, the client wants to complete construction projects with maximum economic efficiency whereas the bidder will look for the best profit margin (Brian 2007). Construction projects are mainly evaluated based on economic and technical terms. Evaluating on technical terms could be a success with the right expertise at the right position but evaluating economic bid only based on total quoted price still remains apple of discord among a lot of entities because of the technical dependency of the project cost, market rate inflations and unbalanced quoting (Zhang, Luo et al. 2015). Several studies show that big data technologies through internet, medicine and other products can be a reference for construction cost management. Predictions of google on flu occurrence and Wal Mart could be great examples (Zhang, Du et al. 2014, Shin and Choi 2015). Rarity is seen in those kinds of IT and AI based cost control methods in construction projects mainly in bidding phases and tender evaluation period (Dean and Ghemawat 2008, Shen, Yu et al. 2013, Zhang, Luo et al. 2015).

Chapter 3

Methodology

3.1 Introduction

This chapter describes the successive methods applied to achieve the objectives of this research. The steps taken to organize the documents and also how to utilize this information is the main key rationale in this section.

3.2 Research Matrix or Algorithm

A research matrix or algorithm was prepared to follow throughout the course of action in this research. The main purpose of this research was to propose a model that can ease the process of tender evaluation for construction industry both government and private sectors. By prompting the tender evaluation the focus was to achieve efficient procurement planning. Quality bidding from suppliers and increased transparency can also be achieved. It will also allow procurement officers more time for evaluating sustainability criteria for specific tenders. Below is a framework that will summarize the approach of methods or course of action.

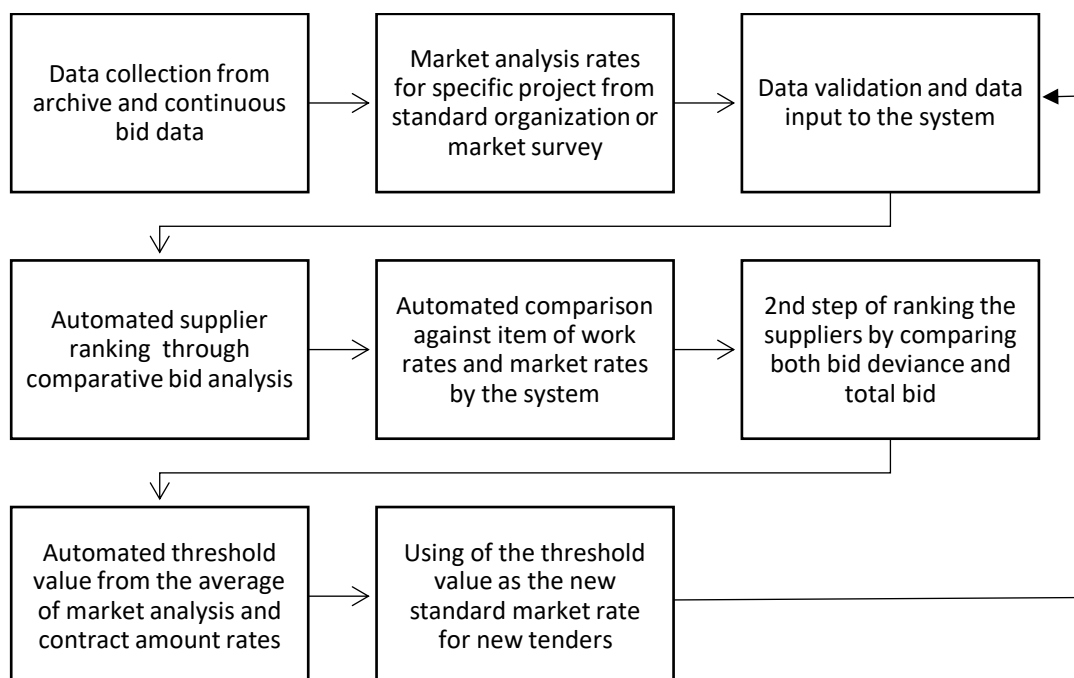


Figure 1: Flowchart/algorithm of Course of work/methodology.

3.2 Data collection from archive and continuous bid data

As the main idea focus on feeding on existing data to forge a new threshold market rate and also to train the system in efficient comparative bid analysis and ranking the system would need a large amount of data of the similar features or items. The best place to fetch these data is the existing organizations archive. An organization following traditional way of procurement would have archived lots of similar bid responses in the earlier years. Thus, the first task would be to collect similar bid responses from the archive and input in the system. Again, the system will also be made technically efficient to feed data from the incoming new bid responses from new tenders.

3.3 Input market rates

Another important work for the data training step is to collect and input the market rates available. Either the market rates could be collected from any standard organization or a market survey could be arranged for specific type of procurement. For example, LGED and PWD arranges these market survey once a two year and publish these rates through books and other means. The target organization may fetch those rates to plot as market rates or organize a pre-planned survey to the market and collect rates that are closely related to the procurement of that specific organization.

3.4 Data validation and data input

Next stage would be the data validation and data input. As there would be a lot of archive data to input from previous bid documents there could be manual errors, eye errors and data entry dissimilarities that will make the input data variable from each other. Again, the collected data need to be set as per item of work in the system. These procedures will be very hectic for the IT department. Thus, continuous data input and data validation needed in this stage of the research.

3.5 Comparative bid analysis and segregation

The idea is much similar to the traditional process of comparative bid analysis but is tiered into several stages. The first step of CBA would be to analyze the total bid amount from the bidders and rank the bidders in an ascending order based on lower bids. This stage looks exactly like the traditional system is. The next tier would be to segregate the 3-5 lowest bidders as proposed or planned in the system based on the organization policy. After system segregates the lowest bidders, it will fetch the rates for every Individual item of work against that specific tender and compare the deviance from the market rate for every individual item of works. This would give us a plenty of deviances to measure. For promptness the system will also calculate the average deviation of contractor's bid against every individual item of work from the plotted market rate. The final stage is to produce another ranking based on this deviance. The lowest the deviance the higher the rank for that contractor or bidder. By producing another rank, the system will plot two significant ranking in front of the buyer or procurement officer to evaluate these bids. From this system the buyer would be able to see who the lowest bidders are and how much quality did they ensure while bidding for an individual item. For, example if contractor A is the 1st ranked as per the lowest total bid but the system says his average bid is 40% deviated from market rates and another Contractor B is the 2nd ranked as per the lowest total bid and also the system says his average bid deviates just by 2.5% from the market rates that proves somewhat that Contractor B has better information about the market and also about the specific items. This could be a great criterion to select Contractor B over Contractor A in this case. This system will also help in decreasing the procurement lead time. In traditional ways, the procurement officer asks for rate analysis from a supplier if the bid is more than 10% below the estimated rate for government sector and also more about 15-20% below the estimated rate for private sectors. This practice increases the lead time for awarding a contract thus increasing the total project period. By practicing what have been proposed in the system

we can already have a rate analysis from the system itself thus eliminating any lag or slack time. This would also be a practice of lean system.

3.6 Automated threshold value for increasing accuracy

The main focus of tendering has been achieving cost effectiveness at the same time maintaining desired quality. So, this can be assumed that the contractors will try to bid a rationale rate at which they could complete the work with quality and also some amount of profit maintaining cost effectiveness. Thus, from this concept the system would be designed to produce a new threshold value every time a new tender is published and bids collected through system. The idea is to produce a threshold value that will be the average of the contract amount and the previously collected market rates. By producing an average threshold value, it will easier for the procurer to predict the upcoming contractor bids and the possible contract amount range. This is bringing less deviation in the tender procedure and better predictability for better results. It will also put a positive effect in yearly procurement planning and depth review for the Central Procurement Committee about what is happening in the market and better control over the market inflation of construction goods and materials.

3.7 Application of threshold value to achieve greater results

The threshold value would be a product of the contractor's or bidder's bids from market analysis and the buyer's market analysis. The common theory would be that the buyer will analyze the market for better understanding and the bidder will also analyze the market for bidding a well competitive amount on which he can work and also gain some profit. So, averaging the contract amount and previous market rates would mean finding out a threshold value which is the average of existing market rates and the lowest possible value the work can be done. Thus, having a huge number of bids to predict the threshold value. By automating the system, it can be easier to predict future market rates for products or services of the same

category. The big deviances in the bid price and standard rate can also be minimized thus accruing greater efficiency over time to time. This will help the procurement team to predict future bids, project value and at the same time help the organization in yearly, quarterly and monthly procurement planning.

Chapter 4

Results and Discussion

4.1 Introduction

This chapter presents the tested outputs and possible outcomes of the proposed study. The hypothesis was tested according to the methodology stated in the previous chapter and the results are shown through graphical and charted representations. The positive effects of this study are the ones that were focused in the beginning of the study and recommendations to do better are also suggested in the next chapter.

4.2 Comparative Bid Analysis against Item of Work Deviations

As stated in the methodologies collected data were tested in the similar procedure to judge the effectiveness of the system. One specific project was selected from the archive of Tongi Urban Program, World Vision Bangladesh. The specific project was related to boring works and installation of submersible pump for creating man made water source. The data collected were synchronized and plotted in the expected procedure. The first step was traditional comparative bid analysis. The second step was ranking the bidders against the deviation made in item of works specific bids from collected market rates. The tested procedural charts are given below.

		51		52
		Rank/Position	Total 1 nos	Total 2 nos
1	Market Rate	0	580103.85	1160207.7
2	Supplier-01	7	521796.55	1043593.1
3	Supplier-02	6	518538.62	1037077.24
4	Supplier-03	1	464617.6	929235.2
5	Supplier-04	4	492789.7	985579.4
6	Supplier-05	5	511284.45	1022568.9
7	Supplier-06	2	470942.51	941885.02
8	Supplier-07	3	473903.04	947806.08

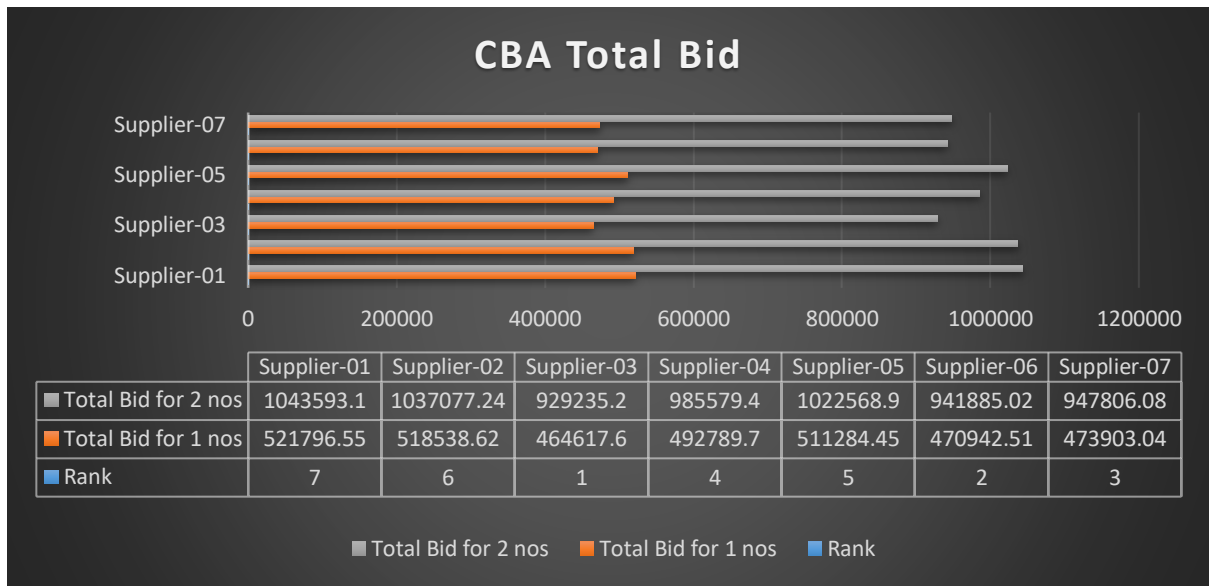


Figure 2: Graphical representation of CBA based on total bid amount.

Average Deviation	Rank Based on Average Deviation	Supplier ID
2.8887876	1	Supplier 03
2.8925029	2	Supplier 06
-25.650676	3	Supplier 07

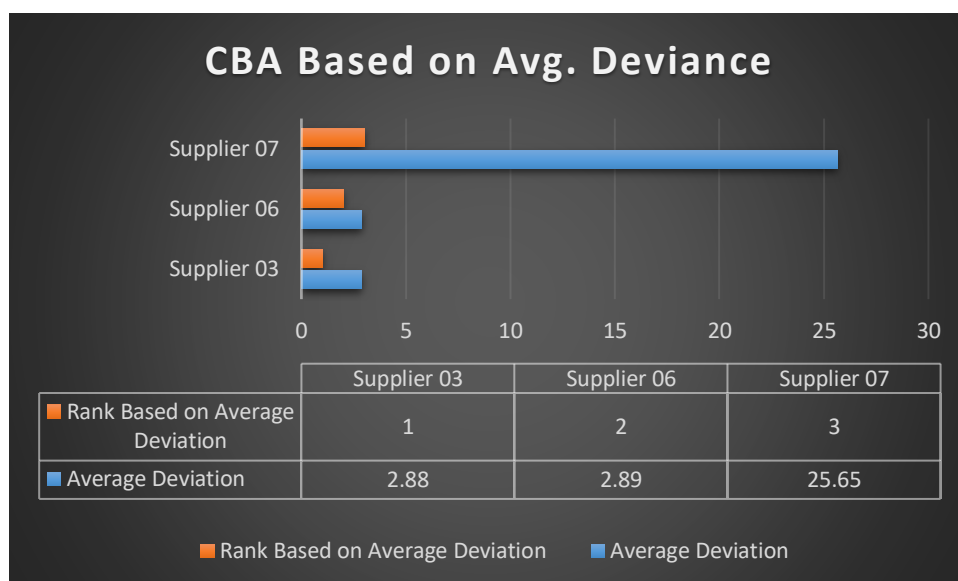


Figure 3: Graphical representation of ranking based on average deviation from market rates.

4.3 Threshold value as new standard rate

The next step of automation is to take values from the existing bid data against item of works and plot and predict the average for each item based on previous market rate and contract value. The plan is to use these average values as threshold values for future purpose of tendering and plotting these as standard rates. The idea was to generate these threshold values and see if the deviation from contract amount decreases and the predicting accuracy increases. By creating the system, it is proved that the threshold value will work as an important element to produce decreasing deviation tender by tender and of course increasing the efficiency of procurement planning. Some graphical representations are given below.

Previous Yearly Procurement Plan Based on Design, BOQ and LGED Rate (Yearly Budget = 5000000 BDT)											
S.N	Name of Construction	Area of Construction	Reference in ERP	Project Code	Technical Program	T code	Achievement Month	PR Value	Contract value	Deviation	
1	Installation of Submersible	Ward- 001	CONS00001		1 WASH	0.0.1.2	March	580103.84	464617.60		0.20
2	Installation of Submersible	Ward- 002	CONS00002		1 WASH	0.0.1.2	April	580103.84	484500.00		0.16
3	Installation of Submersible	Ward- 003	CONS00003		1 WASH	0.0.1.2	May	580103.84	495800.50		0.15
4	Installation of Submersible	Ward- 004	CONS00004		1 WASH	0.0.1.2	June	580103.84	465000.80		0.20
5	Installation of Submersible	Ward- 005	CONS00005		1 WASH	0.0.1.2	April	580103.84	500000.00		0.14
6	Installation of Submersible	Ward- 001	CONS00006		1 WASH	0.0.1.2	May	580103.84	550000.00		0.05
7	Installation of Submersible	Ward- 006	CONS00007		1 WASH	0.0.1.2	June	580103.84	490000.00		0.16
8	Installation of Submersible	Ward- 007	CONS00008		1 WASH	0.0.1.2	July	580103.84	493000.00		0.15
9	Installation of Submersible	Ward- 008	CONS00009		1 WASH	0.0.1.2	July	580103.84	500000.00		0.14
							Total PR Value=	5220934.56	Total Deviation =	1.34	

Figure 4: Deviation without using threshold value.

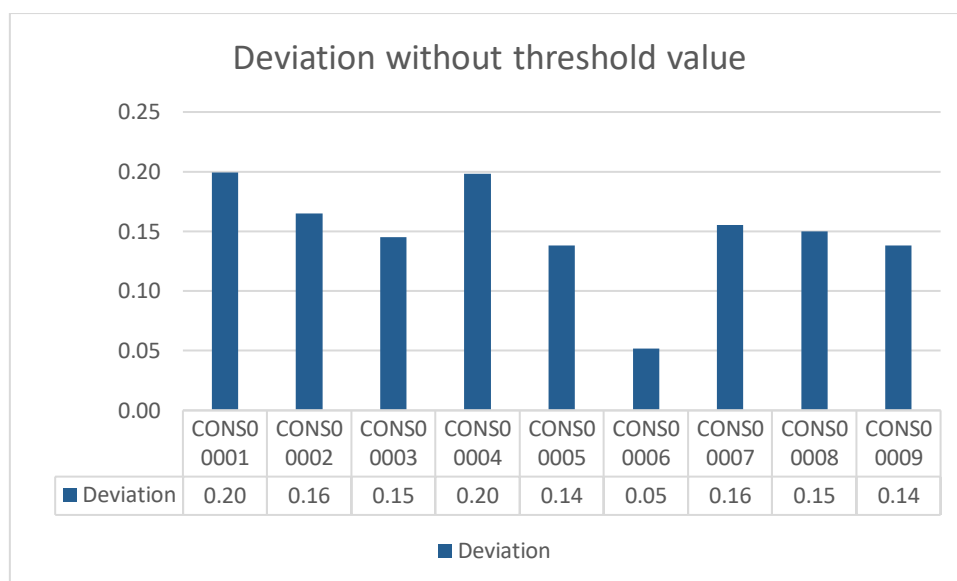


Figure 5: Graphical representation of deviation without threshold value.

Revised Yearly Procurement Plan Based on Design, BOQ and LGED Rate and Continuous Threshold Value from System (Yearly Budget = 5000000 BDT)										
S.N	Name of Construction	Area of Construction	Reference in ERP	Project Code	Technical Program	T code	Achievement Month	PR Value	Contract value	Deviation
1	Installation of Submersible	Ward- 001	CONS00001		1 WASH	0.0.1.2	March	580103.84	464617.60	0.20
2	Installation of Submersible	Ward- 002	CONS00002		1 WASH	0.0.1.2	April	522360.73	484500.00	0.07
3	Installation of Submersible	Ward- 003	CONS00003		1 WASH	0.0.1.2	May	522360.73	495800.50	0.05
4	Installation of Submersible	Ward- 004	CONS00004		1 WASH	0.0.1.2	June	522360.73	465000.80	0.11
5	Installation of Submersible	Ward- 005	CONS00005		1 WASH	0.0.1.2	April	522360.73	500000.00	0.04
6	Installation of Submersible	Ward- 001	CONS00006		1 WASH	0.0.1.2	May	522360.73	550000.00	-0.05
7	Installation of Submersible	Ward- 006	CONS00007		1 WASH	0.0.1.2	June	522360.73	490000.00	0.06
8	Installation of Submersible	Ward- 007	CONS00008		1 WASH	0.0.1.2	July	522360.73	493000.00	0.06
9	Installation of Submersible	Ward- 008	CONS00009		1 WASH	0.0.1.2	July	522360.73	500000.00	0.04
Total PR Value=								4758989.64	Total Deviation =	0.58

Figure 6: Deviation with threshold value.

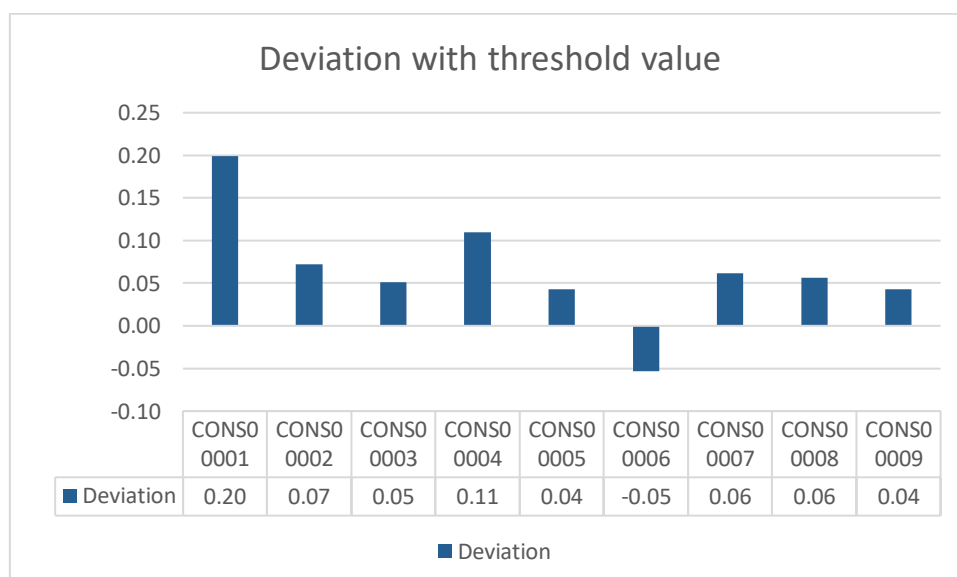


Figure 7: Graphical representation of deviation with threshold value.

Chapter 5

Recommendation

5.1 Recommendation for future researchers

This method of evaluating tender is new and innovative. There are several recommendations for future researchers on this technique. These recommendations will notice on the gaps of the system and focus on how to build the system better. Below are the essential recommendations-

- a) Training of the vendors is highly recommended. Without training the enlisted bidders, achieving this system will be impossible. Several central meetings should be arranged and proper steps should be taken to train the vendors to quote in that system properly.
- b) The model should be tested in a highly competitive sector like Government or International Platforms who are highly capable of training their vendors and raising salaries of their staff.
- c) Training of the data entry specialists is a vital point to get maximum output of this system. Failing to understand the model or failing to input essential data could prove to be a failure of the model. At the same time there is high chance of data manipulation from the data entry personnel and point of data entry. The recommendation would be to raise salaries of these positions to keep them accountable to the position.
- d) There could be another system in place for data safety and data supervision. The idea could be to appoint another team for data safety and add another layer for supervision of these data.

5.2 Pros and Cons of the System

The system can be at maximum efficient when its pros and cons will be visible to the organization. The organization can act accordingly and gain benefit from the system by putting importance in those areas. Below are some of the pros and cons of the proposed system-

Pros:

- a) The proposed system will increase transparency to some extent.
- b) It will increase quality bidding by forcing bidders to adapt the system.
- c) It will enable procurement officers to accurately measure sustainability factors.
- d) It will increase efficiency of bid evaluation through automation.
- e) It will decrease use of resources, time, and biasness.
- f) This system will help to increase efficiency of procurement planning to some extent.

Cons:

- a) Without training of vendors or bidders this system will prove to be a failure.
- b) Failing to appoint trained and honest data entry personnel can result into manipulation of data or wrong entry of data.
- c) There could be a potential danger of data breach, which could lead to loss of reputation for both the buyers and bidders and even could result in lawsuits.
- d) There is also a possibility of data loss due to power failure and lack of backup servers.
To prevent this, organizations need to install backup power source and backup servers.
This will cost organization a great deal.

- e) There is also a cost of licensed software, which could prove to be a hindrance of this model.
- f) Supervision of the system is important. The supervision should include both data safety and supervision team as well as an audit team. This could cost organization.

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