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The Use of 80:20 Pareto Rule: A Guide in Testing Accuracy of Cost Estimating of Residential Buildings in Nigeria

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Abstract-This study focused on testing the compliance of 80:20 Pareto rule on cost estimating accuracy of residential buildings in Nigeria with a view to enhancing estimating process on delivery of residential buildings in Nigeria. The secondary data of 30 bills of quantities of past executed projects in Abuja, Nigeria were selected by purposive sampling while 27 of the bills of quantities were analyzed using Pareto analysis and descriptive statistical tools of percentile and arithmetic mean. The study discovered that the relationship between the cost significant items and the estimated construction cost of residential building of semi – detached two- bedroom bungalow was 80:44 which only confirms 80% compliance and thus implies that 80% of the estimated construction cost of the estimated cost of semi- detached bedroom bungalow is contained in 44% of cost significant items of the bills of quantities. The study thereby recommended that factors such as location and inflation should be put into consideration when developing a cost model using Pareto rule likewise, use of closed prototype designs and past bill of quantities for the analysis will enhance a more accurate result of 80:20 Pareto rule.

Key words: bill of quantity, cost, estimate, pareto rule, residential buildings, significant items.

1.0 Introduction

Preparation of preliminary cost estimates is one of the major functions of quantity surveyors, and preliminary cost estimates is the probable cost or the approximation cost of construction projects which is the product of the cost estimating process. The accuracy of preliminary cost estimates for building projects are extremely important to the developers, owner occupiers, investors, the financiers and much more important in preparation of budgets for public projects and most especially in a depressed economy like that of Nigeria. Even though, the main objective of preparing preliminary estimates is to prepare the mind of the clients of the likely cost or probable cost of a proposed projects before the production of contract documents (Akinsiku, Babatunde and Opawole, 2011). However, an estimate cannot be more accurate as the information and the time available for its preparation (Harris and McCaffer, 2013). Leung, *et al.* (2005) observed that estimators are often faced with the challenge of preparing cost estimates within a difficult and limited time frame. Consequently, this limited time for the preparation of cost estimates had been claimed to be among the major causes of preliminary cost estimate inaccuracies as established by Akintoye and Fitzgerald (1999) and Leung, *et al.* (2005).

In view of foregoing, Kadiri (2015) proposed that there is need for Quantity Surveyors to devise a means to meet the dire need of the construction industry in terms of prompt and accurate cost estimates. Blackman and Chan (2005) proposed that 80/20 principle of Pareto rule can be one of the means of improving the cost estimating accuracy at the preliminary stage of estimating which is one of the major duties of Quantity Surveying profession, hence the need for this study. The main objective of this study is to test the 80/20 Pareto Rule; estimating accuracy residential buildings in Nigeria with a view to improving the delivery of residential buildings in the study area.

2. 0 Theoretical Frame Work (Pareto Rule)

Pareto rule was named after the Italian man, an economist and a professor of political economics called Vilfredo Pareto who lived between 1848 – 1943.The Pareto theory lay emphasis on few significant where he asserted that 80% of the outcome of any project is determined by the 20% of its included in

elements. The rule applies to many aspects of business; the rule can be referred to significant few in relation to insignificant many, it can as well be referred to as 80% of important quality being supplied by 20% the group (Jogg, 1986).

This theory further established that 80% of the works are carried out by 20% of the workers likewise its application can as well be that 80% of the cost of contract is embedded in 20% of the few significant items. The Pareto Principle holds that in most situations roughly 80% of effects come from only 20% of the causes, this can be as well applied in one's daily endeavor i.e. it can be useful to better manage time and focus on the things on ask list that really make a difference in life. This few significant cost items can be referred to as major cost of the element items which need to be identified at the early stage of the contract, monitored and controlled in order to give client value for money (AACE, 2004). Greg MCKeown (2012), likewise submitted that the world is a place where virtually everything is insignificant and just very few are exceptionally valuable.

The principle, also known as the 80/20 rule, is a theory maintaining that 80 percent of the output from a given situation or system is determined by 20 percent of the input. It can also explain in terms of workers employed to carry out a task, the principle holds that only 20% of the workers employed generates 80% of the output (Oikhelome, 2016).

Curran, (1989) studied to link the Pareto's principle with cost estimating accuracy and efficiency where he found out the following;

- Uncertainty is concentrated in a selected number of critical item in project estimate
- Small items are critical while large ones may not be critical
- 20% of items of bill contain 80% value
- Majority of the cost lies in a small number of cost significant items.

Blackman and Chan (2005) established that, the Pareto Principle has been identified as one of the most constructive theories, which could be used to establish cost estimate models, in support of this assertion, Bouabaze and Belachia (2012) developed two cost considerable models for predicting the costs of projects: the cost significance method (80/20 rule) which utilizes valuable historical data to predict the future cost of a project bridge repair and the artificial neutral network which is the aspect of the art that produces near optimal output in terms of accuracy. Alan Chapman (2016) likewise summarized the theory of Pareto Rule as Alan Chapman (2016):

- The 80/20 rule is a theory maintaining that 80 percent of the output from a given situation or system is determined by 20 percent of the input.
- 80 percent of results come from 20 percent of efforts
- 80 percent of activity will require 20 percent of resources
- 80 percent of usage is by 20 percent of users
- 80 percent of the difficulty in achieving something lies in 20 percent of the challenge
- 80 percent of revenue comes from 20 percent of customers
- 80 percent of problems come from 20 percent of causes
- 80 percent of profit comes from 20 percent of the product range
- 80 percent of complaints come from 20 percent of customers
- 80 percent of sales will come from 20 percent of sales people
- 80 percent of corporate pollution comes from 20 percent of corporations
- 80 percent of work absence is due to 20 percent of staff
- 80 percent of road traffic accidents are caused by 20 percent of drivers
- 80 percent of a restaurant's turnover comes from 20 percent of its menu

Pareto rule can also be adopted practically by all professionals in their various professions, such as: Project managers, Planning engineers can employ the rule to know that 80% of delays in a construction project arise from 20% of possible causes of the delays. Marketing managers can also use the rule to evaluate and know the significant staff' effort that will be needed to generate a higher marketing result thereby paying attention to those important staff, (i.e. 20% of his marketing efforts generate 80% of his marketing results).

3.0 Literature Review

From 1980s, the 80/20 Pareto rule was widely used in the construction industry, Ashworth and Skitmore (1982) and by extension Quantity Surveyor (QS) had adopted the 80:20 rule for various Quantity Surveying functions (cost planning, estimating and cost control) from inception to completion and even more after the completion of projects by identifying cost significant items in a Bill of Quantities. Kadiri (2015) attested that Pareto rule is a means of determining a reliable and accurate project cost estimate, Yu, Lai and Lee (2006) likewise affirmed that this rule has been used by many academics, in the early cost estimating stages of projects to improve the cost estimating accuracy and efficiency. Blackman and Chan (2013) likewise asserted that the Pareto principle can be applied to improve the estimation accuracy and efficiency especially in design development stage of projects. Thompson (1981), likewise attested that 20% of the items of a bill contained 80% of the value, in addition to this, Frederick (1986) and Morrison (1984), agreed to that majority of the cost (contract sum) lies in a small number of cost significant items.

On the afore mentioned, this study has faith that the cost to be established will be a estimating model in assisting the quantity surveyor to improve the understanding and skills of conducting the cost estimating in the early budgeting and cost planning stages of projects, such as in the conceptual and sketch design stages. Most importantly, it is also believed that the proposed cost model will enhance the efficiency and accuracy of the cost estimate.

4.0 Research Methodology

This study explored the use of secondary data to extract information from historical bills of quantities of 27 completed 2bedroom semi - detached bungalow which was selected by purposive sampling in the study area. Both the consulting and contracting firms of quantity surveying formed the study population, this population was chosen for ease of accessing the bills of quantities of executed construction projects needed for this study. The major tool that was employed for the analysis of the data extracted from the past bills of quantities was the Pareto analysis while the descriptive statistical tools like percentile and arithmetic mean were used to tabulate, summarize and describe the data.

5.0 Pareto Analysis

Pareto analysis is a statistical tool in decision making used for the purpose of selecting limited number of task that has a higher significant overall effect Akinola (2015). The Pareto Analysis which was used to analyze and obtain significant items of works in the past bill of quantities in which Mohamed and Mouloud (2012) defined "as those items whose value are greater than the mean. For the purpose of this study Pareto analysis was used as one of the techniques for data analysis and this was achieved by analyzing historical bills of quantity of residential buildings in order to identify the significant cost items whose value were greater than the geometrical mean.

Descriptive Tools

Descriptive tools used for realizing the intention of this study were frequencies, percentages and mean through the means of Microsoft excel software.

Frequency

Frequency is described as the rate at which something occurs or is repeated over a particular period or time, it is the level / rate of occurrence of an element of a group in a whole data, frequency is usually indicated by (f).

Percentage

This refers to a number of ratio expressed as a fraction of one hundred (100), it is often denoted using the sign % sometimes denoted "PC", a percentage is a dimensionless number. Assuming an element is represented by X and the total in the group is represented by Y, therefore the percentage of X in the group will be represented as shown below:

Percentage of X in the group = X / Y x 100

Geometrical Mean

Geometrical Mean is also known as the arithmetic mean or average, and is a basic for mathematical function which is used to better understand population. It is derived by adding up all the population or numbers and then dividing by the number of characters in the population as shown below:

$Y = \sum X/N$

Where; Y is the mean value

$\sum X$ is summation of variables (items)

N is the total number of items

6.0 Data Analysis and Discussion of Findings

Table 1.0 Rate of Secondary Data: Historical Bill of Quantities (BOQ)

No of Historical BOQ proposed	No of BOQ collected	Percentage of BOQ used for analysis
30	27	90%

Source: Analysed by the Researcher

Table 2.0 below, showed the Cost Significant Items (CSIs), their values, percentages, ranks and the analysis of estimated cost. The cost significant items are those items analyzed in the appendix "A" whose values are greater than the mean. The percentage of each CSIs is obtained by finding the percentage of each significant item to the total cost. As a result of the analysis, it was discovered that block work in superstructure ranked 1st position with the largest percentage of 10.330%, followed by concrete in substructure with 2nd position (10.323%), wall finishes was 3rd (7.613%), roof covering 4th (7.169), Electrical services 5th (6.068%), ceiling finishes 6th (5.814%), Floor finishes 7th (5.670%), Roof carcass 8th (4.705%), Doors 9th (4.337%) External works 10th (4.336%), Painting & decoration 11th (3.896%), Contingencies12th (3.529%), windows and burglary 13th (3.294%), 225m block in foundation 14th (3.267%), which was totaled to 80.4% in twenty seven (27) number of bills. Therefore, the total number of significant items obtained in analyzing 27 bills of two-bedroom semi-detached bungalow was fourteen (14) out of thirty-two (32) bill items which was half (1/2) of the total bill items as depicted in Table 2.0.

Table 2.0 Cost Significant Item

CSIs	**Value (N)**	**Percentage (%)**	**Rank**
Block walls in Superstructure.	1,196,616.34	10.330	1
Concrete in substructure	1,195,713.68	10.323	2
Wall finishes	881,803.59	7.613	3
Roof covering	830,474.69	7.169	4
Elect. Services	702,925.94	6.068	5
ceiling finishes	673,428.49	5.814	6
Floor finishes	656,779.16	5.670	7
Roof Carcass	544,992.74	4.705	8
Doors	502,350.00	4.337	9
External work	502,298.00	4.336	10
Painting & decoration.	451,346.12	3.896	11
Contingencies	408,821.06	3.529	12

Windows & burglary.	381,616.31	3.594	13
Blockwalls in Substructure.	378,413.76	3.3267	14
Estimated Cost =	**₦11,583,525.63**		

Source: Analyzed by the Researcher

Table 3.0 below, showed the relationship between the percentage of cost-significant items and the percentage of estimated construction cost, where the ratio of relationship between the cost significant items to the estimated construction cost was 43.8 to 80.4 in percentage; this implied that 43.8% of the bill items accounted for 80.4% of the total value of construction cost. This result deviated a bit from Pareto Rule of 80: 20

Table 3 .0: Relationship between CSIs and Construction Cost

	Percentage of total no. of bill items (%)	**Cost significant items (CSIs)**	**Value of CSIs (N)**	**Cumulative Value (N)**	**Cumulative percentage of Construction cost (%)**
1	3.1	Block walls in superstructure.	1,196,616.34	1,196,616.34	10.3
2	6.3	Conc. in sub.	1,195,713.68	2,392,330.02	20.7
3	9.4	Wall finishes	881,803.59	3,274,133.60	28.3
4	12.5	Roof covering	830,474.69	4,104,608.29	35.4
5	15.6	Elect. Services	702,925.94	4,807,534.24	41.5
6	18.8	ceiling finishes	673,428.49	5,480,962.73	47.3
7	21.9	Floor finishes	656,779.16	6,137,741.89	53.0
8	25	Roof Carcass	544,992.74	6,682,734.63	57.7
9	28.1	Doors	502,350.00	7,185,084.63	62.0
10	31.3	External work	502,298.00	7,687,382.63	66.4
11	34.4	Paint & deco.	451,346.12	8,138,728.75	70.3
12	37.5	Contingencies	408,821.06	8,547,549.81	73.8
13	40.6	Windows & burglary	381,616.31	8,929,166.12	77.1
14	43.8	Block walls in superstructure	378,413.76	9,307,579.88	80.4

Source: Analyzed by the Researcher

7.0 Conclusion and Recommendations

The study tested the compliance of 80/20 Pareto rule on selected residential buildings in Nigeria and established that: 14 out of 32 bill items of selected two bedroom semidetached residential bungalow projects in the study area were significant bill items and such items identified as cost significant items were listed in descending order as thus: block work in superstructure, concrete in substructure, wall finishes, roof covering, electrical services, ceiling finishes, floor finishes, roof carcass, doors, external work, painting & decoration, contingencies, windows and burglary and 225m block walls in foundation. Furthermore, the value of each cost significant items were also identified in percentages as thus: block work in superstructure (10.330%), concrete in substructure (10.323%), wall finishes (7.613%), roof covering (7.169), Electrical services (6.068%), ceiling finishes (5.814%); Floor finishes (5.670%), Roof carcass (4.705%), Doors (4.337%) External work (4.336%), Painting & decoration (3.896%), Contingencies (3.529%), windows and burglary (3.294%) and 225m block in foundation (3.267%).

The study concluded that the relationship between the cost significant items and construction cost was ratio 43.8% to 80.4%, thus indicated that 80.4% of the estimated construction cost of two semi-detached bungalows was embedded in 44.8% of the bill items as against the 80/20. Pareto Rule. These findings only showed compliance in 80% rule while it revealed non - compliance with 20% rule, this result was not very far from previous research works carried out in Nigeria but different locations. For instance, kadiri (2015) developed a 72/30 Pareto-based model for highs rise office building projects in Lagos state, while Akinola (2015) developed 78/41 Pareto-based model for hospital buildings in Osun State. From all

the research works cited above, none of the results arrived at an exact value of 80/20 rule; but in this research work 80/44 Pareto-based model for residential building projects was arrived at, which validates only the 80% in the rule.

In line with the conclusion drawn the following recommendations are therefore necessary:

i. S
ince it was established in the study that significant items have the largest contribution to the total construction cost, therefore, cost significant items should at all times be identified in any construction projects as this would assist the Quantity Surveyor in preparing a realistic preliminary estimates and as well saves time.

ii. F
or a more accurate result it is advisable that more prototype bills of executed projects should be used for analysis when developing a model using Pareto, "the closer the design similarity, the closer the result will be to Pareto rule.

iii. L
ocation and inflation factors are highly significant to enhance the accuracy of cost significant items.

There should be another way for calculating the percentage total number of bill items that will give an exact value of 20% i.e. validating the 20 in the rule.

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APPENDIX 1
ANALYSIS OF BILLS OF QUANTITIES

S/N	BILL ITEMS	BILL 1 (2013)	BILL 2 (2013)	BILL 3 (2013)	BILL 4 (2011)	BILL 5 (2013)	BILL 6 (2012)	BILL 7 (2013)	BILL 8 (2013)	BILL 9 (2013)
1	Site *Prep.*	-	22,410.08	25,902.56	24,150.00	-	-	24,214.53	28,014.00	39,465.02
2	Exc. & Ewks.	47,162.50	101,416.41	117,221.57	49,900.00	89,510.40	63,936.00	604,282.41	57,884.00	160,386.32
3	Disposal	21,875.00	25,198.25	29,125.25	33,600.00	61,500.00	85,300.00	27,227.20	39,976.00	126,786.00
4	Surf. Treatmt.	31,762.50	23,386.90	27,031.61	38,250.00	42,900.00	47,900.00	25,269.85	116,058.00	37,950.60
5	Frmwrk in Coln.	40,572.00	12,349.26	14,273.82	-	-	-	13,343.62	-	18,946.71
6	Frmwrk to bed	34,125.00	65,388.40	75,578.80	24,000.00	39,312.00	28,080.00	70,653.44	27,840.00	100,321.40
7	Conc. in Sub.	298,375.00	1,084,823.57	1,342,475.73	806,250.00	1,642,548.00	1,361,820.00	1,033,860.07	935,250.00	1,989,738.37
8	Blk Wrk. In Sub.	630,000.12	270,362.40	312,496.80	362,500.00	711,244.80	508,032.00	292,131.84	420,500.00	396,765.60
9	Reinf. In coln.	12,600.00	86,190.72	99,623.04	-	-	-	93,130.75	-	126,487.68
10	Fabric mesh	81,550.00	73,768.38	98,552.77	-	283,046.40	202,176.00	86,126.23	-	158,871.39
11	DPM	40,775.00	20,073.90	23,202.30	-	-	-	21,690.23	-	29,429.10
12	Filling	238,525.00	205,317.42	294,806.72	256,600.00	422,300.00	398,500.00	251,708.45	297,654.00	415,191.95
13	Rendering in Sub.	-	24,074.82	27,826.74	49,400.00	62,899.20	44,928.00	26,013.31	54,104.00	35,330.00
14	Conc. In frames	44,000.00	287,980.00	332,860.00	-	-	75,600.00	311,168.00	-	422,620.00
15	Frmwrk in frames	74,697.00	336,343.70	388,760.90	-	-	15,840.00	363,425.92	-	493,620.00
16	Reinf. in frames	12,600.00	76,839.84	88,814.88	-	-	59,148.00	83,026.94	-	12,764.96
17	Roof Carcass	476,402.50	319,810.26	3,696,580.82	495,050.00	1,169,289.60	356,850.00	345,561.21	473,198.00	469,331.94
18	Roof covering	741,912.50	74,070.28	825,353.96	961,280.00	1,236,090.24	882,921.60	771,566.85	1,115,084.80	1,047,921.32
19	Lint. in doors & Widows	167,737.50	182,630.14	211,091.98	142,000.00	306,532.80	218,952.00	197,335.42	164,720.00	268,015.66
20	Blk Wrk in Sup Struc.	1,784,212.50	1,025,784.38	1,185,646.88	875,000.00	1,955,016.00	1,396,440.00	1,108,380.00	1,015,000.00	1,505,371.88
21	widows and burglary	331,400.00	450,000.00	450,000.00	350,760.00	524,867.62	374,905.44	449,998.00	406,881.60	450,000.00
22	Doors	324,000.00	399,300.00	399,000.00	258,000.00	663,536.16	476,954.40	399,300.00	434,676.00	399,300.00
23	Floor finishes	947,865.00	713,200.80	824,348.94	579,400.00	428,904.00	306,360.00	825,811.35	672,104.00	1,102,580.32
24	Wall finishes	1,322,803.25	1,012,786.78	1,160,623.68	559,850.00	896,323.00	640,231.00	1,062,151.84	649,426.00	1,430,362.48
25	ceiling finishes	874,125.00	807,915.41	1,000,351.00	362,250.00	579,723.60	523,074.00	907,340.49	420,210.00	1,385,222.35
26	Plumb. & mech. Serv.	196,000.00	406,700.00	406,700.00	333,200.00	254,840.00	474,600.00	406,700.00	349,312.00	406,700.00
27	Electrical services	311,800.00	951,331.00	979,447.00	763,800.00	450,000.00	480,000.00	965,857.60	841,752.00	1,035,679.00

28	Fittings and fixtures	-	-	-	-	-	-	-	-	-
29	Paint. & decoration	-	466,234.23	538,894.11	284,320.00	476,784.00	340,560.00	503,775.17	329,811,20	684,213.87
30	External work	650,000.00	-	-	226,000.00	250,000.00	-	-	661,000.00	-
31	Contigencies	-	-	-	100,000.00	-	-	-	453,911.29	-
32	Preliminaries	450,000.00	-	-	200,000.00	-	-	-	221,420.14	-
33	Total value	10,186,877.37	9,525,687.33	14,976,591.86	8,135,560.00	12,547,167.82	9,363,108.44	11,271,050.72	9,855,975.83	14,749,373.92
34	Total No of Items	27	28	28	24	23	25	28	24	28
35	Mean value	377,291.75	340,203.12	534,878.28	338,981.67	545,529.04	374,524.34	402,537.53	410,665.66	526,763.35
36	No of CSIs'	9	10	9	10	8	11	11	13	8
37	Value of CSIs'	7,877,320.87	7,318,076.17	11,553,722.12	6,116,140.00	8,853,771.40	7,517,478.44	8,639,723.78	8,498,993.69	10,181,089.59
38	% of CSIs'	33.33%	35.71%	32.14%	41.67%	34.78%	44.00%	39.29%	54.17%	28.57 %
39	% value of CSIs'	77.33%	76.82%	77.15%	75.18%	70.56%	80.29%	76.65%	86.23%	69.03 %
40	Relationship	77 : 33	77:36	77:32	75:42	71:35	80:44	77:39	86:54	69:29

APPENDIX 2
ANALYSIS OF BILLS OF QUANTITIES

7	Conc. in Sub.	1,069,750.00	1,048,125.00	1,502,184.00	1,723,167.28	1,007,812.50	1,291,638.00	851,061.96	927,187.50	1,543,801.54
S/N	BILL ITEMS	BILL 10 (2013)	BILL 11 (2013)	BILL 12 (2013)	BILL 13 (2013)	BILL 14 (2013)	BILL 15 (2013)	BILL 16 (2013)	BILL 17 (2013)	BILL 18 (2013)
1	Site Prep.	-	31,395.00	-	30,559.20	30,187.50	-	18,917.60	27,772.50	27,939.84
2	Exc. & Ewks.	40,425.00	64,870.00	76,723.20	138,295.10	62,375.00	57,542.40	85,611.26	57,385.00	126,441.24
3	Disposal	18,750.00	43,680.00	61,500.00	34,361.25	42,000.00	61,500.00	21,271.25	38,640.00	31,416.00
4	Surf. Treatmt.	26,925.00	49,725.00	42,900.00	31,891.23	47,812.50	42,900.00	19,742.19	43,987.50	54,985.54
5	Formwrk in Coln.	34,776.00	-	-	16,839.90	-	-	10,424.70	-	15,396.48
6	Formwrk to bed	29,250.00	31,200.00	33,696.00	89,166.00	30,000.00	25,272.00	55,198.00	27,600.00	81,523.20
8	blk Wrk. In Sub.	540,000.00	471,250.00	609,638.40	368,676.00	453,125.00	457,228.80	228,228.00	416,875.00	337,075.20
9	Reinf. In coln.	12,600.00	-	-	117,532.80	-	-	72,758.40	-	107,458.56
10	Fabric mesh	69,900.00	-	242,611.20	137,172.61	-	181,958.40	52,567.28	-	114,665.10
11	DPM	34,950.00	-	-	27,373.50	-	-	16,945.50	-	25,027.20
12	Filling	204,450.00	333,580.00	422,300.00	362,878.43	320,750.00	422,300.00	83,319.90	285,090.00	290,432.16
13	Rendering in Sub.	-	58,220.00	53,913.60	32,829.30	56,750.00	40,435.20	20,322.90	53,810.00	30,015.36
14	Conc. in frames	44,000.00	-	90,720.00	392,700.00	-	68,040.00	243,100.00	-	359,040.00
15	Formwrk in frames	93,150.00	-	19,008.00	458,650.00	-	14,256.00	283,926.50	-	419,337.67
16	Reinf. in frames	48,300.00	-	70,977.60	104,781.60	-	53,233.20	64,864.80	-	95,800.32
17	Roof Carcass	408,345.00	500,383.33	428,219.20	436,104.90	618,812.50	321,165.00	269,969.70	569,307.50	398,724.48
18	Roof covering	635,925.00	1,249,664.00	1,059,506.72	973,732.20	1,201,600.00	205,370.56	602,786.60	1,105,472.00	890,269.44
19	Lint. in doors & Windows	95,475.00		262,742.40	249,041.10	177,500.00	197,056.80	154,168.30	163,300.00	227,694.72
20	Blk Wrk in Sup Struc.	1,529,325.00	1,137,500.00	1,675,728.00	1,398,796.88	1,093,750.00	1,256,796.00	865,926.88	1,006,250.00	1,278,900.00
21	Windows and burglary	331,400.00	455,988.00	449,886.53	450,000.00	438,450.00	337,414.90	450,000.00	403,374.00	399,300.00
22	Doors	324,000.00	517,061.68	568,745.28	3,899,300.00	359,500.00	426,558.96	399,300.00	330,740.00	399,300.00
23	Floor finishes	923,226.00	753,220.00	367,632.00	1,024,521.54	724,250.00	275,724.00	634,227.62	666,310.00	136,705.41
24	Wall finishes	1,008,945.00	1,061,365.00	768,277.44	1,329,097.88	699,812.50	576,208.08	822,774.88	643,827.50	1,215,175.20
25	Ceiling finishes	749,250.00	470,925.00	551,398.80	1,256,931.92	452,812.50	508,911.60	615,479.76	416,587.50	1,112,605.18
26	Plumb. & mech. Serv.	196,000.00	419,660.00	489,720.00	406,700.00	405,250.00	217,040.00	406,700.00	376,430.00	425,500.00
27	Electrical	311,800.	909,96	450,00	1,016,9	885,60	450,00	923,2	836,8	995,848.0

	services	00	0.00	0.00	35.00	0.00	0.00	15.00	80.00	0
28	Fittings and fixtures	-	-	300,000.00	-	-	300,000.00	-	-	-
29	Paint. & decoration	850,500.00	369,616.00	408,672.00	635,773.95	354,466.50	306,504.00	393,574.88	326,968.00	518,279.04
30	External work	650,000.00	486,000.00	-	-	569,000.00	250,000.00	-	589,000.00	-
31	Contingencies	-	494,614.42	-	-	480,029.74	-	-	451,003.92	-
32	Preliminaries	-	241,275.33	-	-	234,160.85	-	-	220,001.91	-
33	Total value	10,281,417.00	11,199,277.76	11,006,700.37	17,143,809.57	10,745,807.09	8,345,053.90	8,666,383.86	9,983,799.83	11,658,656.88
34	Total No of Items	27	23	25	28	24	26	28	24	28
35	Mean value	380,793.22	486,925.12	440,268.01	612,278.91	447,741.96	320,963.61	309,513.71	415,991.66	416,380.60
36	No of CSIs'	10	9	10	9	11	9	11	11	9
37	Value of CSIs'	8,365,266.00	7,671,893.43	8,125,085.17	13,258,256.65	8,186,604.74	5,710,806.44	6,965,047.58	7,628,700.92	8,399,716.07
38	% of CSIs'	37.04%	39.13%	40.00%	32.14%	45.83%	34.62%	39.29%	45.83%	32.14%
39	% value of CSIs'	81.36%	68.50%	73.82%	77.34%	76.18%	68.43%	80.37%	76.41%	72.05%
40	Relationship	81:37	69:39	74:40	77:32	76:46	68:35	80:39	76:46	72:32

APPENDIX 3
ANALYSIS OF BILLS OF QUANTITIES

S/N	BILL ITEMS	BILL 19 (2013)	BILL 20 (2013)	BILL 21 (2013)	BILL 22 (2010)	BILL 23 (2013)	BILL 24 (2013)	BILL 25 (2013)	BILL 26 (2010)	BILL 27 (2013)
1	Site Prep.	26,565.00	30,453.50	29,104.00		21,245.92	35,400.00	41,290.56	-	25,466.00
2	Exc. & Ewks.	54,890.00	30,453.50	131,709.63	46,033.92	95,748.03	196,600.00	182,448.72	32,340.00	115,245.92
3	Disposal	36,960.00	45,200.00	32,725.00	61,500.00	23,889.25	51,150.00	55,242.00	15,000.00	28,634.38
4	Surf. Treatmt.	42,075.00	20,509.50	30,372.60	42,900.00	22,172.00	60,450.00	65,286.00	21,780.00	26,576.03
5	Frmwrk in Coln.	-	26,197.92	16,038.00	-	11,707.74	-	-	27,820.00	14,033.25
6	Frmwrk to bed	26,400.00	22,035.00	84,920.00	20,217.60	61,991.60	34,650.00	-	23,400.00	74,305.00
7	Conc. in Sub.	886,875.00	879,670.00	1,599,638.50	1,165,310.40	955,748.75	1,666,120.00	1,682,448.00	655,600.00	1,308,961.07
8	Blk Wrk. in Sub.	398,750.00	406,800.00	124,419.00	365,783.04	256,317.60	350,000.00	377,500.00	432,000.00	307,230.00
9	Reinf. in coln.	-	12,600.00	111,936.00	-	81,713.28	248,400.00	-	12,600.00	97,944.00
10	Fabric mesh	-	52,658.00	124,419.60	145,566.72	66,303.20	-	-	55,920.00	95,258.76
11	DPM	-	26,329.00	26,070.00	-	19,031.10	23,000.00	-	27,960.00	22,811.25

12	Filling	282,260.00	196,507.00	331,243.50	422,300.00	194,651.58	465,484	502,722.72	163,560.00	283,557.75
13	Rendering in Sub.	52,340.00	-	31,266.00	32,348.16	22,824.18	-	-	-	27,357.75
14	Conc. In frames	-	44,000.00	374,000.00	54,432.00	277,020.00	-	-	44,000.00	327,250.00
15	Formwrk in frames	-	70,173.00	436,810.00	11,404.80	318,871.30	-	-	74,520.00	382,208.75
16	Reinf. in frames	-	-	99,792.00	42,586.56	72,848.16	-	-	-	87,318.00
17	Roof Carcass	544,555.00	307,619.90	415,338.00	257,022.00	303,196.74	274,665.00	279,770.00	326,676.00	636,579.25
18	Roof covering	1,057,408.00	479,063.50	927,364.00	635,613.55	676,975.72	1,005,480.00	1,075,032.00	508,740.00	811,443.50
19	Lint. in doors & Windows	156,200.00	108,310.50	237,182.00	157,645.44	173,142.56	134,120.00	134,120.00	115,020.00	207,534.25
20	Blk Wrk in Sup Struc.	962,500.00	1,152,091.50	1,332,187.50	1,005,436.80	972,496.88	1,707,500.00	1,436,400.00	1,223,460.00	1,165,664.00
21	Windows and burglary	316,360.00	324,000.00	470,000.00	269,931.92	450,000.30	193,500.00	193,500.00	331,400.00	450,000.00
22	Doors	316,360.00	324,000.00	399.300.00	341,247	399,300.00	320,000.00	320,000.00	324,000.00	399,300.00
23	Floor finishes	637,340.00	716,235.17	975,734.80	20,579.20	712,286.40	1,191,910.00	1,277,226.00	738,580.80	853,767.95
24	Wall finishes	615,835.00	732,104.40	1,265,807.50	460,965.86	924,039.48	1,301,445.00	1,393,029.00	801,216.00	926,631.56
25	Ceiling finishes	398,475.00	564,435.00	1,176,750.00	483,419.28	743,772.19	570,900.00	610,500.00	599,400.00	976,296.60
26	Plumb. & mech. Serv.	362,020.00	196,000.00	406,700.00	453,432.00	406,700.00	267,200.00	267,200.00	196,000.00	406,700.00
27	Electrical services	812,520.00	311,800.00	1,005,220.00	450,000.00	941,959.00	266,755.00	266,755.00	311,800.00	975,932.50
28	Fittings and fixtures	-	-	-	-	-	50,000.00	50,000.00	-	-
29	Paint. & decoration	312,752.00	640,710.00	605,449.00	245,203.80	442,014.27	760,305.00	819,945.00	680,400.00	529,811.63
30	External work	530,000.00	650,000.00	-	-	-	1,295,000.00	945,000.00	-	-
31	Contingencies	438,467.00	-	-	-	-	-	-	-	-
32	Preliminaries	212,910.78	-	-	-	-	-	-	-	-
33	Total value	9,480,817.78	8,369,956.39	12,402,196.63	7,190,880.22	9,647,967.23	12,470,034.00	11,975,415.00	7,743,192.80	11,563,819.15
34	Total No of Items	28	24	26.00	24	28	24	21	25	28
35	Mean value	338,600.64	348,748.18	477,007.56	299,620.01	344,570.26	519,584.75	570,257.86	309,727.71	412,993.54
36	No of CSIs'	12	9	8	9	11	8	8	12	10
37	Value of CSIs'	7,644,745.00	6,221,109.57	8,888,151.30	5,442,260.93	7,625,292.99	9,498,660.00	9,239,580.00	6,933,272.80	8,635,088.06
38	% of CSIs'	42.86%	37.50%	30.77%	37.50%	39.29%	33.33%	38.10%	48.00%	35.71%
39	% value of CSIs'	80.63%	74.33%	71.67%	75.68%	79.04%	76.17%	77.15%	89.54%	74.67%
40	Relationship	81:43	74:38	72:31	76:38	79:39	76:33	77:38	90:48	75:36