COMPARATIVE PERFORMANCE EVALUATION OF THE TRADITIONAL DESIGN-BID-BUILD (DBB) AND DESIGN-BUILD (DB) PROCUREMENT METHODS IN GHANA

By

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A Thesis submitted to the Department of Building Technology, Kwame Nkrumah University of Science and Technology

in partial fulfilment of the requirements for the degree

of

MASTER OF SCIENCE IN CONSTRUCTION MANAGEMENT

Faculty of Architecture and Building Technology,

College of Architecture and Planning

April, 2009

Table 4.1a: Projects Profile

PROJECT TYPE	DESIGN-BID-BUILD (DBB)																									
			CONTRACT SUM (BILLION CEDIS)														GROSS FLOOR AREA (M2)									
	PROJECT		1 - 2.99		3 - 4.99		5 - 9.99		10 - 19.9		20-29.9		30 - 49.9		> 50		0.0-1000		1001-2000		2001-5000		>5000		[illegible]
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
Residential	12	19	10	16	0	0	1	10	1	25	0	0	0	0	0	0	4	6	1	2	2	3	0	0	5
Factory/Industrial Building	4	6	0	0	1	2	2	3	0	0	2	3	0	0	0	0	1	2	0	0	0	0	0	0	4
Office Accommodation	14	23	7	11	1	2	4	6	1	2	0	0	0	0	0	0	4	6	4	6	1	2	0	0	4
Hostel/Dormitories	18	29	6	10	3	5	2	3	2	3	0	0	0	0	1	2	3	5	3	5	4	6	1	2	3
Lecture Theatre/ Classrooms	9	15	9	15	3	5	1	2	0	0	0	0	0	0	0	0	9	15	0	0	0	0	0	0	4
Banking Hall	3	5	1	2	2	3	0	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	1
Health Facility	2	3	1	2	1	2	0	0	0	0	0	0	0	0	0	0	1	2	0	0	0	0	0	0	1
Gymnasium	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	**62**	**100**	**34**	**55**	**11**	**18**	**10**	**16**	**4**	**6**	**2**	**3**	**0**	**0**	**1**	**2**	**24**	**39**	**8**	**13**	**7**	**11**	**1**	**2**	**22**

Unknown
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Table 4.1b: Projects Profile

PROJECT TYPE	PROJECT		DESIGN AND BUILD (DB)																						
			CONTRACT SUM (BILLION CEDIS)														GROSS FLOOR AREA (M2)								
			1 - 2.99		3 - 4.99		5 - 9.99		10 - 19.9		20-29.9		30 - 49.9		> 50		0.0-1000		1001-2000		2001-5000		>5000		Unknown
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.
Residential	5	29	4	24	1	6	0	0	2	12	0	0	0	0	0	0	4	0	1	0	0	0	0	0	2
Factory/Industrial Building	4	24	0	0	1	6	0	0	0	0	2	12	0	0	0	0	0	0	0	0	2	0	0	0	1
Office Accommodation	5	29	0	0	2	12	3	18	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	2
Hostel/Dormitories	2	12	0	0	0	0	1	6	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Lecture Theatre/ Classrooms	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Banking Hall	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Health Facility	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gymnasium	1	6	1	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
TOTAL	**17**	**100**	**5**	**29**	**4**	**24**	**4**	**23.5**	**2**	**12**	**2**	**12**	**0**	**0**	**0**	**0**	**5**	**29.4**	**3**	**18**	**3**	**18**	**0**	**0**	**6**

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APPENDIX II

APPENDIX II: SUMMARY OF PROJECTS DATA AND PROJECTS' COST & TIME PERFORMANCE COMPUTATIONS (DESIGN AND BUILD)

PROJECT NO.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
PROJECT TITLE	Research Center/Offices	Offices/ Shops	Residential/stores	Residential	Canteens	Warehouse	Administration Block	Warehouse
COMMENCEMENT DATE	02/10/2004	02/03/2006	16/5/2000	03/03/2001	06/12/2004	15/1/2004	05/08/2004	29/4/2005
EXTENSION OF TIME	None	1week	None	None	None	None	None	None
SCHEDULED COMPETION DATE	08/10/2004	12/03/2006	16/5/2001	02/03/2002	16/8/2005	15/6/2005	05/08/2005	30/8/2005
ACTUAL COMPLETION DATE	07/03/2004	12/10/2006	16/5/2001	01/08/2002	16/8/2005	04/10/2005	05/08/2005	21/8/2005
OFFICIAL HOLD-UP	None	None	None	None	None	None	None	None
ORIGINAL CONTRACT SUM (O.C.S.)	4,580,400,000	9,081,668,051	1,110,000,000	1,200,000,000	4,881,401,680	25,691,669,714	8,013,266,344	28,379,675,000
FINAL CONTRACT SUM (F.C.S.)	4,580,400,000	9,100,550,000	1,110,000,000	1,250,000,000	4,881,401,680	24,537,881,558	8,013,266,344	28,379,675,000
CONTINGENCY	None	None	None	57,142,857	None	1,153,788,156	None	None
FLUCTUATION (F)	None	None	None	50,000,000	None	None	None	None
NET VARIATION (N.V.)	None	55,701,750	None	None	None	None	None	None
GROSS FLOOR AREA (M^2)	1039.5	3780	1241	196	Unknown	3455	380	4928
NO. OF FLOORS	1	4	3	2	1	1	4	1
AVERAGE FLOOR HEIGHT (M)	3.5	3	3	3	2	9	3	8.2
PRESENT WORTH OF PROJECT COST (FEB., 2007)	6,496,050,249	10,035,243,196	5,040,436,319	3,878,377,470	6,922,939,175	36,436,638,161	11,364,636,456	36,000,752,925
PROJECTS PERFORMANCE	**COST PERFORMANCE**							
CO.DF= (F/F.C.S.)x100%	0.00%	0.00%	0.00%	4.00%	0.00%	0.00%	0.00%	0.00%
CO.DV=(N.V./F.C.S.)x100%	0.00%	0.61%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	0.00%	0.61%	0.00%	4.00%	0.00%	0.00%	0.00%	0.00%
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	**TIME PERFORMANCE**							
	-14.29%	2.00%	0.00%	-0.91%	0.00%	-11.67%	0.00%	-7.50%

Notes:1. If performance value < zero, project was completed below original contract sum; project was completed ahead of schedule
2. If performance value > zero, project was completed above original contract sum; project was completed behind schedule
3. If performance value = zero, project was completed as budgeted; project was completed as schedule

APPENDIX II: SUMMARY OF PROJECTS DATA AND PROJECTS' COST & TIME PERFORMANCE COMPUTATIONS (DESIGN AND BUILD) CONT'D

PROJECT NO.	9	10	11	12	13	14	15	16
PROJECT TITLE	Bungalows	Residential	Offices	Office Block	Residential	Hostel	2no. Bungalows	Gymnasium
COMMENCEMENT DATE	06/06/2004	08/12/2005	01/05/2004	15/3/2005	02/06/2006	05/03/2005	06/06/2004	11/04/2006
EXTENSION OF TIME	None	3week	None	None	None	None	None	None
SCHEDULED COMPETION DATE	04/06/2005	12/12/2005	06/05/2004	15/9/2005	07/06/2005	06/03/2006	12/06/2004	02/03/2007
ACTUAL COMPLETION DATE	13/3/2005	29/12/2005	25/4/2004	15/9/2005	22/6/2005	06/03/2006	11/12/2004	02/03/2007
OFFICIAL HOLD-UP	None	None	None	None	None	None	None	None
ORIGINAL CONTRACT SUM (O.C.S.)	10,790,000,000.00	1,485,455,600	3,838,260,000.00	7,855,690,300	4,156,854,255	6,825,000,000	2,710,014,060	1,061,760,000.00
FINAL CONTRACT SUM (F.C.S.)	10,790,000,000.00	1,438,529,143	3,838,260,000.00	7,855,690,300	4,039,909,441	6,536,045,455	2,710,014,060	1,061,772,000.00
CONTINGENCY	None	46,926,457	None	None	451,869,342	620,454,545	None	None
FLUCTUATION (F)	None	None	None	None	None	126,750,000	None	None
NET VARIATION (N.V.)	None	None	None	None	88,573,929	204,750,000	None	12,000.00
GROSS FLOOR AREA (M^2)	Unknown	275	Unknown	Unknown	356	1800	285	Unknown
NO. OF FLOORS	1	1	2	3	2	2	1	1
AVERAGE FLOOR HEIGHT (M)	3	3	3.5	3.2	3	3	3	3
PRESENT WORTH OF PROJECT COST (FEB., 2007)	15,302,677,099	1,884,359,847	5,443,526,729	9,965,257,373	4,593,323,952	8,657,785,500	3,843,417,061	1,093,612,800
PROJECTS PERFORMANCE	**COST PERFORMANCE**							
CO.DF= (F/F.C.S.)x100%	0.00%	0.00%	0.00%	0.00%	0.00%	1.94%	0.00%	0.00%
CO.DV=(N.V./F.C.S.)x100%	0.00%	0.00%	0.00%	0.00%	2.19%	3.13%	0.00%	0.00%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	0.00%	0.00%	0.00%	0.00%	2.19%	5.07%	0.00%	0.00%
	TIME PERFORMANCE							
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	-6.00%	14.00%	-19.50%	0.00%	-10.00%	0.00%	-16.67%	0.00%

Notes:1. If performance value < zero, project was completed below original contract sum; project was completed ahead of schedule
2. If performance value > zero, project was completed above original contract sum; project was completed behind schedule

3. If performance value = zero, project was completed as budgeted; project was completed as schedule

APPENDIX II: SUMMARY OF PROJECTS DATA AND PROJECTS' COST & TIME PERFORMANCE COMPUTATIONS (TRADITIONAL DBB)

PROJECT NO.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
PROJECT TITLE	Office Block	Office	Residential	Residential	Show Room	Warehouse	Office	Warehouse
COMMENCEMENT DATE	13/3/2005	02/02/2004	02/07/2001	11/06/2000	12/04/2005	03/05/2003	08/05/2004	22/03/2004
EXTENSION OF TIME	1	12	-	8	1week	5		0
SCHEDULED COMPETION DATE	13/9/2005	02/02/2005	18/04/2002	17/7/2001	06/10/2006	03/05/2005	12/10/2005	22/09/2005
ACTUAL COMPLETION DATE	13/9/2005	02/06/2007	03/05/2004	13/3/2002	07/07/2006	18/11/2006	16/09/06	30/11/2006
OFFICIAL HOLD-UP	1month	0	-	-	1week	2months	0	1month
ORIGINAL CONTRACT SUM (O.C.S.)	6,030,000,000.00	8,234,037,340	1,600,000,000	1,100,000,000	5,419,830,613	20,606,496,580	8,838,555,264	25,759,547,466
FINAL CONTRACT SUM (F.C.S.)	6,255,000,000.00	8,351,021,024	1,850,000,000	1,900,000,000	5,379,113,690	22,104,299,083	11,579,772,915	31,143,089,062
CONTINGENCY	None	815,000,000	240,000,000	143,478,261	495,000,000	1,699,155,456	515,200,000	3,464,916,970
FLUCTUATION (F)	None	675,488,059	78,550,000	557,253,961	0	274,550,518,592	730,177,108	2,402,155,336
NET VARIATION (N.V.)	25000	255,495,625	411,450,000	660,603,182.25	454,283,078	977,411,044	5,098,947,087	5,637,695,283
GROSS FLOOR AREA (M^2)	1800	3580	756	1305	659	Unknown	Unknown	Unknown
NO. OF FLOORS	1	5	-	3	1	1	2	1
AVERAGE FLOOR HEIGHT (M)	5	3	3	3.2	7.8	3.2	4	3.2
PRESENT WORTH OF PROJECT COST (FEB., 2007)	6,663,150,000.00	10,445,205,727	5,171,169,960	3,555,179,347	6,875,271,925.42	36,180,184,371	11,212,060,894	36,532,904,271
PROJECTS PERFORMANCE	**COST PERFORMANCE**							
CO.DF= (F/F.C.S.)x100%	0.00%	8.09%	4.25%	25.33%	0.00%	12.61%	6.32%	7.71%
CO.DV=(N.V./F.C.S.)x100%	3.60%	3.06%	22.24%	30.03%	8.45%	4.42%	44.03%	18.10%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	3.60%	11.16%	26.49%	55.36%	8.45%	17.23%	50.35%	25.85%
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	**TIME PERFORMANCE**							
	0.00%	200.00%	174.07%	82.47%	16.67%	89.58%	50.00%	33.33%

Notes:1. If performance value < zero, project was completed below original contract sum; project was completed ahead of schedule
2. If performance value > zero, project was completed above original contract sum; project was completed behind schedule
3. If performance value = zero, project was completed as budgeted; project was completed as schedule

APPENDIX II: SUMMARY OF PROJECTS DATA AND PROJECTS' COST & TIME PERFORMANCE COMPUTATIONS (TRADITIONAL DBB) CONT'D

PROJECT NO.	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
PROJECT TITLE	Residential	Residential	Office	Office	Hostel	Hostel	Residential	Residential
COMMENCEMENT DATE	23/8/2004	30/01/2004	14/05/2004	12/06/2005	02/02/2005	13/06/2005	01/06/2003	30/12/03
EXTENSION OF TIME	2	0	18	1week	10	8	3	20
SCHEDULED COMPETION DATE	23/8/2005	12/12/2005	14/05/2005	30/8/2006	28/12/2005	13/07/2006	31/12/2004	30/04/04
ACTUAL COMPLETION DATE	16/10/2006	13/6/2006	29/11/2006	12/09/2006	20/12/2006	25/08/2006	30/6/2005	20/08/05
OFFICIAL HOLD-UP	1week	0	0	0	15weeks	0	1month	1 Month
ORIGINAL CONTRACT SUM (O.C.S.)	14,400,000,000.00	1,139,194,268	3,871,868,900	8,867,069,920	3,620,872,365	6,000,000,000	2,200,000,000	1,240,000,000
FINAL CONTRACT SUM (F.C.S.)	17,694,000,000.00	1,321,535,878	6,042,978,449	9,211,599,350	4,835,629,000	6,900,000,000	2,900,000,000	1,259,200,000
CONTINGENCY	685,714,285.71	148,590,557	200,000,000	500,000,000	329,170,215	782,608,696	220,000,000	107,826,087
FLUCTUATION (F)	-	135678600	1,015,241,780	1,722,952,833	987,520,400	846,000,000	375,000,000	93,306,720
NET VARIATION (N.V.)	442,190.48	195,253,567	2,593,138,344	761,622,310.70	556,406,450	836,608,696	545,000,000	97,210,240
GROSS FLOOR AREA (M^2)	3132	785	1305	543	1550	2106	2900	Unknown
NO. OF FLOORS	1	1	3	1	5	3	4	1
AVERAGE FLOOR HEIGHT (M)	3	3.2	3	3	2.7	3	3	3
PRESENT WORTH OF PROJECT COST (FEB., 2007)	15,912,000,000.00	1,615,636,889.34	5,491,191,802.19	9,798,112,261.37	4,593,221,429.90	8,509,366,320.00	3,862,685,018	1,758,602,372.80
PROJECTS PERFORMANCE	**COST PERFORMANCE**							
CO.DF= (F/F.C.S.)x100%	0.00%	10.27%	16.80%	18.69%	20.42%	12.26%	12.93%	7.41%
CO.DV=(N.V./F.C.S.)x100%	22.49%	14.77%	42.91%	8.27%	11.51%	12.12%	18.79%	7.72%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	22.49%	25.04%	64.58%	26.96%	31.93%	24.39%	31.72%	15.12%
	TIME PERFORMANCE							
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	116.67%	49.12%	150.00%	33.33%	109.09%	7.67%	50.00%	395.00%

Notes:1. If performance value < zero, project was completed below original contract sum; project was completed ahead of schedule
2. If performance value > zero, project was completed above original contract sum; project was completed behind schedule
3. If performance value = zero, project was completed as budgeted; project was completed as schedule

APPENDIX II: SUMMARY OF PROJECTS DATA AND PROJECTS' COST & TIME PERFORMANCE COMPUTATIONS (TRADITIONAL DBB) CONT'D

PROJECT NO.	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**
PROJECT TITLE	Student's Hostel	Classroom	Bank	Student's Hostel	Residential	Student's Hostel	Dormitory	Residential
COMMENCEMENT DATE	16/01/03	30/03/05	05/04/2004	15/01/04	13/8/04	28/01/2005	12/05/2003	17/01/06
EXTENSION OF TIME	3	2	6	2	1	3	0	0
SCHEDULED COMPETION DATE	16/06/04	14/05/06	12/03/2004	25/10/04	16/04/05	28/07/06	10/05/2004	17/08/06
ACTUAL COMPLETION DATE	25/10/04	19/07/06	12/04/2006	28/5/05	18/05/05	20/10/06	22/10/2005	15/12/06
OFFICIAL HOLD-UP	10	0	0	0	0	0	0	0
ORIGINAL CONTRACT SUM (O.C.S.)	16,100,000,000.00	1,686,159,850.00	3,558,555,264	1,427,983,871	1,510,000,000	4,554,858,928	1,753,534,969	1,315,126,252
FINAL CONTRACT SUM (F.C.S.)	18,600,000,000.00	1,685,333,075.00	6,079,772,918	1,522,232,567	1,436,477,965	5,215,443,288	2,271,245,378	1,314,545,000
CONTINGENCY	2,290,000,000.00	-153,287,259	464,159,382	71,399,194	151,000,000	414,124,448	114,717,241	119,556,932
FLUCTUATION (F)	1,465,100,000.00	-	267,900,000	0	107,161,256	760,301,273	632,427,650	0
NET VARIATION (N.V.)	3,324,900,000.00	47,212,475.80	2,717,477,037	289,224,187.64	241,902,889	314,407,535	0	18,403,630
GROSS FLOOR AREA (M^2)	4025	Unknown	Unknown	Unknown	Unknown	2028	1792	Unknown
NO. OF FLOORS	4	2	2	1	1	3	2	1
AVERAGE FLOOR HEIGHT (M)	3.6	3	5	3	3	3.15	3	3
PRESENT WORTH OF PROJECT COST (FEB., 2007)	28,267,831,269	2,138,961,216.12	5,046,841,717.85	2,025,206,309.57	2,141,523,857.20	5,778,020,744.53	3,078,796,933	1,453,214,508.46
PROJECTS PERFORMANCE	**COST PERFORMANCE**							
CO.DF= (F/F.C.S.)x100%	7.88%	0.00%	4.41%	0.00%	7.46%	14.58%	27.84%	0.00%
CO.DV=(N.V./F.C.S.)x100%	17.88%	2.80%	44.70%	19.00%	16.84%	6.03%	0.00%	1.40%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	25.75%	2.80%	49.10%	19.00%	24.30%	20.61%	27.84%	1.40%
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	**TIME PERFORMANCE**							
	22.22%	29.41%	328.57%	212.87%	20.00%	50.00%	150.00%	100.00%

Notes:1. If performance value < zero, project was completed below original contract sum; project was completed ahead of schedule

2. If performance value > zero, project was completed above original contract sum; project was completed behind schedule

3. If performance value = zero, project was completed as budgeted; project was completed as schedule

APPENDIX II: SUMMARY OF PROJECTS DATA AND PROJECTS' COST & TIME PERFORMANCE COMPUTATIONS (TRADITIONAL DBB) CONT'D

PROJECT NO.	25	26	27	28	29	30	31	32
PROJECT TITLE	Residential	Dormitory	Bungalows	Block of Flats	Office	Classroom	Office Complex	Classroom
COMMENCEMENT DATE	30/3/2005	01/12/2003	03/09/2006	02/02/2005	03/12/2004	17/3/2004	02/12/2004	17/03/2004
EXTENSION OF TIME	5	0	6	0	8	0	18	0
SCHEDULED COMPETION DATE	30/11/2005	12/08/2005	07/09/2006	02/02/2006	30/8/2004	17/3/2004	06/12/2006	17/7/2004
ACTUAL COMPLETION DATE	29/4/2006	15/12/2006	12/05/2006	17/10/06	30/6/2005	30/2/2005	15/1/2007	25/09/2004
OFFICIAL HOLD-UP	0	0	1month	0	0	0	3weeks	0
ORIGINAL CONTRACT SUM (O.C.S.)	1,475,931,596.24	1,727,859,768.00	1,869,719,934	5,665,468,401	11,360,000,000	1,238,129,072	18,430,969,236	1,379,735,312
FINAL CONTRACT SUM (F.C.S.)	1,572,817,702.57	2,178,000,177.60	2,076,728,613	6,045,913,171	12,541,582,700	1,238,129,072	28,349,202,788	1,379,735,312
CONTINGENCY	134,175,599.66	225,373,013.22	160,353,390	738,974,139	1,481,739,130	112,557,188	2,404,039,466	125,430,483
FLUCTUATION (F)	75,809,813.26	345,571,953.60	145,474,987	464,568,409	511,246,000	0	2,960,798,100	0
NET VARIATION (N.V.)	248,505,197.01	329,941,469.22	221,887,080	654,850,500.00	2,152,075,830	29,715,098	9361474918	65,675,401
GROSS FLOOR AREA (M^2)	Unknown	Unknown	543	2101	Unknown	680	Unknown	689
NO. OF FLOORS	2	2	1	4	2	2	5	2
AVERAGE FLOOR HEIGHT (M)	3	3	3.2	3	4	3	3	3.2
PRESENT WORTH OF PROJECT COST (FEB., 2007)	1,872,278,267.09	3,033,717,291	2,066,040,526.77	7,186,873,285.32	16,111,066,899.20	1,755,948,970.85	26,139,311,476.88	1,956,778,865.74
PROJECTS PERFORMANCE	**COST PERFORMANCE**							
CO.DF= (F/F.C.S.)x100%	4.82%	15.87%	7.01%	7.68%	4.08%	0.00%	10.44%	0.00%
CO.DV=(N.V./F.C.S.)x100%	15.80%	15.15%	10.68%	10.83%	17.16%	2.40%	33.02%	4.76%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	20.62%	31.02%	21.49%	18.52%	21.24%	2.40%	43.47%	4.76%
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	**TIME PERFORMANCE**							
	125.00%	104.55%	83.33%	75.00%	181.82%	50.00%	116.67%	50.00%

Notes:1. If performance value < zero, project was completed below original contract sum; project was completed ahead of schedule
2. If performance value > zero, project was completed above original contract sum; project was completed behind schedule

3. If performance value = zero, project was completed as budgeted; project was completed as schedule

APPENDIX II: SUMMARY OF PROJECTS DATA AND PROJECTS' COST & TIME PERFORMANCE COMPUTATIONS (TRADITIONAL DBB) CONT'D

PROJECT NO.	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
PROJECT TITLE	Hostel	Office	Classroom	Classroom	Classroom	Hostel	Office	Residential
COMMENCEMENT DATE	10/10/2002	22/2/2006	12/10/2004	20/5/2002	17/5/2005	15/7/2003	03/06/2006	09/10/2005
EXTENSION OF TIME	0	0	12	0	0	0	0	
SCHEDULED COMPETION DATE	10/10/2004	21/11/2006	12/10/2005	15/2/2003	31/7/2006	15/8/2005	11/06/2006	02/10/2006
ACTUAL COMPLETION DATE	13/11/2006	11/05/2006	20/12/2006	15/2/2003	15/12/2006	03/04/2006	11/06/2006	29/08/2006
OFFICIAL HOLD-UP	0	0	0	0	0	0	0	0
ORIGINAL CONTRACT SUM (O.C.S.)	8,000,000,000.00	1,840,508,662.00	1,201,776,000	1,352,010,600	1,372,000,000	51,000,000,000	1,817,144,256	1,010,236,497
FINAL CONTRACT SUM (F.C.S.)	14,000,000,000.00	1,957,794,515.00	1,317,816,800	1,331,075,000	1,372,000,000	65,800,000,000	1,817,144,256	1,002,651,402
CONTINGENCY	727,272,727.27	244,499,812.50	109,252,364	122,910,055	124,727,273	5,600,000,000	237,018,817	91,839,682
FLUCTUATION (F)	1,578,900,600.00	39,882,353.00	160,378,305	0	0	12,000,000,000	58,437,000	0
NET VARIATION (N.V.)	5,148,372,127.27	321,903,312.50	112,409,773	84,257,047.50	178,908,800	8,400,000,000	178581817	40,707,647
GROSS FLOOR AREA (M^2)	1740	262	865	860	871	15500	262	Unknown
NO. OF FLOORS	5	1	1	1	1	3	1	1
AVERAGE FLOOR HEIGHT (M)	3	3	3.2	3.2	3.2	3	4.2	2.6
PRESENT WORTH OF PROJECT COST (FEB., 2007)	11,345,821,760	2,033,762,071.51	1,704,392,036.43	1,917,458,911	1,740,436,880.00	72,329,613,720	2,007,944,402.88	1,116,311,329.30
PROJECTS PERFORMANCE	**COST PERFORMANCE**							
CO.DF= (F/F.C.S.)x100%	11.28%	2.04%	12.17%	0.00%	0.00%	18.24%	3.22%	0.00%
CO.DV=(N.V./F.C.S.)x100%	36.77%	16.44%	8.53%	6.33%	13.04%	12.77%	9.83%	4.06%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	48.05%	18.48%	20.70%	6.33%	13.04%	31.00%	13.04%	4.06%
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	**TIME PERFORMANCE**							
	104.17%	-5.00%	104.17%	0.00%	64.18%	28.00%	0.00%	120.00%

Notes:1. If performance value < zero, project was completed below original contract sum; project was completed ahead of schedule
2. If performance value > zero, project was completed above original contract sum; project was completed behind schedule

3. If performance value = zero, project was completed as budgeted; project was completed as schedule

APPENDIX II: SUMMARY OF PROJECTS DATA AND PROJECTS' COST & TIME PERFORMANCE COMPUTATIONS (TRADITIONAL DBB) CONT'D

PROJECT NO.	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**
PROJECT TITLE	Office	Office	Office	Lecture Theatre	Commercial building	Warehouse	Auditorium	Health Centre
COMMENCEMENT DATE	01/12/2006	02/08/2006	22/2/2006	18/11/2003	08/06/2005	15/2/2002	11/04/2003	30/6/2003
EXTENSION OF TIME		-		2	12		3	1
SCHEDULED COMPETION DATE	09/10/2006	22/11/2006	21/11/2006	18/9/2005	12/06/2005	15/2/2004	09/03/2004	30/6/2004
ACTUAL COMPLETION DATE	23/1/2007	12/05/2006	12/12/2006	30/11/2005	13/12/2006	18/8/2005	22/7/2006	31/7/2004
OFFICIAL HOLD-UP	0	0	0	0	5months	0	0	4weeks
ORIGINAL CONTRACT SUM (O.C.S.)	1,105,000,000.00	1,950,000,000.00	1,817,144,256	3,373,443,140.00	1,500,000,000	20,693,146,994	3,373,443,140	3,456,860,000
FINAL CONTRACT SUM (F.C.S.)	1,105,000,000.00	1,928,412,672.73	1,899,044,256	4,986,723,120.00	2,800,000,000	22,564,917,833	5,200,218,189	3,956,860,000
CONTINGENCY	100,454,545.45	177,272,727.27	237,018,816	440,014,322.61	195,652,174	2,699,106,130	440,014,323	345,686,000
FLUCTUATION (F)	-	-	106,683,841	302,693,802.61	85,655,616	2,108,465,005	1,215,570,942	250,000,000
NET VARIATION (N.V.)	19,558,500.00	155,685,400.00	162,234,975	1,750,600,500.00	1,409,996,558	2,462,411,964	1051218429	595,686,000
GROSS FLOOR AREA (M^2)	Unknown	1500	262	Unknown	Unknown	Unknown	Unknown	Unknown
NO. OF FLOORS	1	1	1	3	2	1	3	3
AVERAGE FLOOR HEIGHT (M)	3	3	2.6	3.2	3	5.5	4.4	3.2
PRESENT WORTH OF PROJECT COST (FEB., 2007)	1,221,025,000.00	2,154,750,000.00	2,007,944,402.88	4,784,310,573	1,902,810,000.00	29,347,594,681	4,784,310,573	4,902,614,676
PROJECTS PERFORMANCE	**COST PERFORMANCE**							
CO.DF= (F/F.C.S.)x100%	0.00%	0.00%	5.62%	6.07%	3.06%	9.34%	23.38%	6.32%
CO.DV=(N.V./F.C.S.)x100%	1.77%	8.07%	8.54%	35.11%	50.36%	10.91%	20.21%	15.05%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	1.77%	8.07%	14.16%	41.18%	53.42%	20.26%	43.59%	21.37%
	TIME PERFORMANCE							
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	66.67%	5.26%	6.00%	23.00%	300.00%	83.33%	230.00%	8.33%

Notes:1. If performance value < zero, project was completed below original contract sum; project was completed ahead of schedule

2. If performance value > zero, project was completed above original contract sum; project was completed behind schedule

3. If performance value = zero, project was completed as budgeted; project was completed as schedule

APPENDIX II: SUMMARY OF PROJECTS DATA AND PROJECTS' COST & TIME PERFORMANCE COMPUTATIONS (TRADITIONAL DBB) CONT'D

PROJECT NO.	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**
PROJECT TITLE	Office Block	Classroom block	Hostel	Lecture Hostel	Hostel	Banking Hall/Offices	Operation Theatre	Banking Hall
COMMENCEMENT DATE	04/06/2004	02/10/2006	20/1/2001	02/04/2002	28/02/06	28/01/05	16/01/2006	13/4/2006
EXTENSION OF TIME	2weeks	2	-	-	6weeks	-	3	2
SCHEDULED COMPETION DATE	10/06/2004	02/10/2007	07/02/2002	37718	28/7/06	28/9/05	16/04/2006	13/8/2006
ACTUAL COMPLETION DATE	20/10/04	02/10/2007	07/02/2002	08/10/2004	29/09/06	24/03/06	22/08/2006	20/12/2006
OFFICIAL HOLD-UP	-	-	-	2months	-	-	-	3weeks
ORIGINAL CONTRACT SUM (O.C.S.)	1,522,174,390.00	4,852,909,150.00	1,750,000,000	4,397,829,090.00	4,455,368,928	3,995,328,450	1,081,371,200	1,876,450,601
FINAL CONTRACT SUM (F.C.S.)	1,521,728,692.00	6,198,511,772.50	1,675,381,500	5,272,918,587.62	5,144,176,784	6,551,131,024	1,955,800,500	2,322,000,601
CONTINGENCY	138,379,490.00	632,988,150.00	350,000,000	573,629,881.30	405,033,539	150,000,000	98,306,473	0
FLUCTUATION (F)	-	727,936,372.50	200,763,000	869,018,222.00	0	399,532,845	0	0
NET VARIATION (N.V.)	136,955,582.28	1,250,654,400.00	74,618,500	579,701,156.92	1,093,841,395	2,306,269,729	1,384,168,136	445,550,000
GROSS FLOOR AREA (M^2)	421	Unknown	495	Unknown	2004	830	512	223
NO. OF FLOORS	2	4	3	3	3	2	1	1
AVERAGE FLOOR HEIGHT (M)	3.2	3.2	3.2	3.2	3	4	3	3.5
PRESENT WORTH OF PROJECT COST (FEB., 2007)	2,158,789,914.57	5,362,464,610.75	3,067,626,558	6,237,123,123	4,923,182,665.44	5,068,233,951.96	1,194,915,176.00	2,073,477,913.85
PROJECTS PERFORMANCE	**COST PERFORMANCE**							
CO.DF= (F/F.C.S.)x100%	0.00%	11.74%	11.98%	16.48%	0.00%	6.10%	0.00%	0.00%
CO.DV=(N.V./F.C.S.)x100%	9.06%	20.18%	4.45%	10.99%	21.26%	35.20%	70.77%	19.19%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	9.06%	31.92%	16.44%	27.47%	21.26%	41.30%	70.77%	19.19%
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	**TIME PERFORMANCE**							
	10.00%	0.00%	0.00%	20.00%	40.00%	75.00%	80.00%	130.00%

Notes:1. If performance value < zero, project was completed below original contract sum; project was completed ahead of schedule
2. If performance value > zero, project was completed above original contract sum; project was completed behind schedule
3. If performance value = zero, project was completed as budgeted; project was completed as schedule

APPENDIX II: SUMMARY OF PROJECTS DATA AND PROJECTS' COST & TIME PERFORMANCE COMPUTATIONS (TRADITIONAL DBB) CONT'D

PROJECT NO.	**57**	**58**	**59**	**60**	**61**	**62**
PROJECT TITLE	Dormetory	Dormetory	Classroom	Dormitory	Classroom	Dormetory
COMMENCEMENT DATE	30/6/2004	06/04/2002	27/6/2002	24/2/2004	26/8/03	24/8/03
EXTENSION OF TIME	15months	12months	8months	6months	7months	8months
SCHEDULED COMPETION DATE	06/10/2005	02/01/2004	06/01/2004	24/1/2006	26/08/05	24/8/05
ACTUAL COMPLETION DATE	27/12/2006	28/12/2006	24/10/2006	30/1/2007	28/1/2007	18/8/2006
OFFICIAL HOLD-UP	1month	2months	3months	-	-	3months
ORIGINAL CONTRACT SUM (O.C.S.)	2,819,841,798.00	3,265,447,056.00	1,541,262,458	1,896,744,520.00	1,044,391,904	2,330,000,000
FINAL CONTRACT SUM (F.C.S.)	3,200,441,059.40	3,904,938,942.00	1,755,638,054	2,370,930,650.00	1,854,455,000	2,555,000,000
CONTINGENCY	256,349,254.36	296,858,823.27	140,114,768.91	172,431,320.00	94,944,718.57	211,818,181.82
FLUCTUATION (F)	338,381,015.76	489,817,058.40	169,538,870	293,995,400.60	151,436,826	426,390,000
NET VARIATION (N.V.)	298,567,500.00	446,533,650.87	184,951,495	352,622,049.40	753,570,988.22	10,428,181.82
GROSS FLOOR AREA (M^2)	908	900	896	758	745	900
NO. OF FLOORS	2	2	2	2	2	2
AVERAGE FLOOR HEIGHT (M)	3	3	3	3	3	2
PRESENT WORTH OF PROJECT COST (FEB., 2007)	3,999,177,803.94	4,631,147,533	2,185,861,142	2,690,015,656.02	1,481,185,549	3,304,470,588
PROJECTS PERFORMANCE	**COST PERFORMANCE**					
CO.DF= (F/F.C.S.)x100%	10.57%	12.54%	9.66%	12.40%	8.17%	16.69%
CO.DV=(N.V./F.C.S.)x100%	9.33%	11.44%	10.53%	14.87%	40.64%	0.41%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	19.90%	23.98%	20.19%	27.27%	48.80%	17.10%
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	**TIME PERFORMANCE**					
	75.00%	266.67%	116.67%	50.00%	70.83%	50.00%

Notes:1. If performance value < zero, project was completed below original contract sum; project was completed ahead of schedule

2. If performance value > zero, project was completed above original contract sum; project was completed behind schedule
3. If performance value = zero, project was completed as budgeted; project was completed as schedule

APPENDIX III: YEARLY INFLATION FIGURES

YEAR	*2000*	*2001*	*2002*	*2003*	*2004*	*2005*	*2006*	*2007*
Inflation Figures(%)	40.5	21.3	15.2	23.6	11.8	14.8	10.5	12.7

TABLE 4.0: PROJECTS DATA AND COST & TIME PERFORMA

PROJECT NO.	**1**
PROJECT TITLE	Office Block
COMMENCEMENT DATE	13/3/2005
EXTENSION OF TIME	1
SCHEDULED COMPETION DATE	13/9/2005
ACTUAL COMPLETION DATE	13/9/2005
OFFICIAL HOLD-UP	1month
ORIGINAL CONTRACT SUM (O.C.S.)	$670,000.00
FINAL CONTRACT SUM (F.C.S.)	$695,000.00
CONTINGENCY	None
FLUCTUATION (F)	None
NET VARIATION (N.V.)	25000
GROSS FLOOR AREA (M^2)	360
NO. OF FLOORS	1
AVERAGE FLOOR HEIGHT (M)	5
CO.DF= (F/F.C.S.)x100%	0.00%
CO.DV=(N.V./F.C.S.)x100%	3.60%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	3.60%
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	0.00%

Notes: * Negetive Performance means either the proje
Notes: * Negetive Performance means either the proje
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cost/time overrun to that percentage

17	
10no. 2B/R Duplexes	
09/12/2006	
None	
02/03/2007	
02/03/2007	
None	
15,188,937,504.00	
15,408,000,000.00	
None	
None	1.939245999
219,062,496.00	0.031326282
Unknown	
1	2.192473131
3	
15,644,605,629	
0.00%	
1.42%	
1.42%	
0.00%	

TABLE 4.0: PROJECTS DATA AND COST & TIME PERFORMA

PROJECT NO.	9
PROJECT TITLE	Residential
COMMENCEMENT DATE	23/8/2004
EXTENSION OF TIME	2
SCHEDULED COMPETION DATE	23/8/2005
ACTUAL COMPLETION DATE	16/10/2006
OFFICIAL HOLD-UP	1week
ORIGINAL CONTRACT SUM (O.C.S.)	$1,600,000.00
FINAL CONTRACT SUM (F.C.S.)	$1,966,000.00
CONTINGENCY	$76,190.48
FLUCTUATION (F)	-
NET VARIATION (N.V.)	$442,190.48
GROSS FLOOR AREA (M^2)	3132
NO. OF FLOORS	1
AVERAGE FLOOR HEIGHT (M)	3
CO.DF= (F/F.C.S.)x100%	0.00%
CO.DV=(N.V./F.C.S.)x100%	22.49%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	22.49%
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	116.67%

Notes: * Negetive Performance means either the proje
Notes: * Negetive Performance means either the proje

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TABLE 4.0: PROJECTS DATA AND COST & TIME PERFORMA

PROJECT NO.	**17**
PROJECT TITLE	Student's Hostel
COMMENCEMENT DATE	16/01/03
EXTENSION OF TIME	3
SCHEDULED COMPETION DATE	16/06/04
ACTUAL COMPLETION DATE	25/10/04
OFFICIAL HOLD-UP	10
ORIGINAL CONTRACT SUM (O.C.S.)	16,100,000,000.00
FINAL CONTRACT SUM (F.C.S.)	18,600,000,000.00
CONTINGENCY	2,290,000,000.00
FLUCTUATION (F)	1,465,100,000.00
NET VARIATION (N.V.)	3,324,900,000.00
GROSS FLOOR AREA (M^2)	4025
NO. OF FLOORS	4
AVERAGE FLOOR HEIGHT (M)	3.6
CO.DF= (F/F.C.S.)x100%	7.88%
CO.DV=(N.V./F.C.S.)x100%	17.88%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	25.75%
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	22.22%

Notes: * Negetive Performance means either the proje
Notes: * Negetive Performance means either the proje
Notes: * Negetive Performance means either the proje

TABLE 4.0: PROJECTS DATA AND COST & TIME PERFORMA

PROJECT TITLE	Residential
COMMENCEMENT DATE	30/3/2005
EXTENSION OF TIME	5
SCHEDULED COMPETION DATE	30/7/2005
ACTUAL COMPLETION DATE	29/12/2005
OFFICIAL HOLD-UP	0
ORIGINAL CONTRACT SUM (O.C.S.)	475,931,596.24
FINAL CONTRACT SUM (F.C.S.)	572,817,702.57
CONTINGENCY	21,246,966.00
FLUCTUATION (F)	27,606,400.00
NET VARIATION (N.V.)	90,526,672.33
GROSS FLOOR AREA (M^2)	315
NO. OF FLOORS	1
AVERAGE FLOOR HEIGHT (M)	3
CO.DF= (F/F.C.S.)x100%	4.82%
CO.DV=(N.V./F.C.S.)x100%	15.80%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	20.62%
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	125.00%

Notes: * Negetive Performance means either the proje
Notes: * Negetive Performance means either the proje
Notes: * Negetive Performance means either the proje

TABLE 4.0: PROJECTS DATA AND COST & TIME PERFORMAN

PROJECT NO.	33
PROJECT TITLE	Hostel
COMMENCEMENT DATE	10/10/2002
EXTENSION OF TIME	0
SCHEDULED COMPETION DATE	10/10/2004
ACTUAL COMPLETION DATE	13/11/2006
OFFICIAL HOLD-UP	0
ORIGINAL CONTRACT SUM (O.C.S.)	8,000,000,000.00
FINAL CONTRACT SUM (F.C.S.)	14,000,000,000.00
CONTINGENCY	727,272,727.27
FLUCTUATION (F)	1,578,900,600.00
NET VARIATION (N.V.)	5,148,372,127.27
GROSS FLOOR AREA (M^2)	1740

Notes: * Negetive Performance means either the proje

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TABLE 4.0: PROJECTS DATA AND COST & TIME PERFORMA

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TABLE 4.0: PROJECTS DATA AND COST & TIME PERFORMAN

PROJECT NO.	41
PROJECT TITLE	Classroom

Notes: * Negetive Performance means either the proje

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TABLE 4.0: PROJECTS DATA AND COST & TIME PERFORMA

T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	66.67%

Notes: * Negetive Performance means either the proje

Notes: * Negetive Performance means either the proje

Notes: * Negetive Performance means either the proje

TABLE 4.0: PROJECTS DATA AND COST & TIME PERFORMA

GROSS FLOOR AREA (M^2)	421
NO. OF FLOORS	1
AVERAGE FLOOR HEIGHT (M)	3.2
CO.DF= (F/F.C.S.)x100%	0.00%
CO.DV=(N.V./F.C.S.)x100%	9.06%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	9.06%
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	10.00%

Notes: * Negetive Performance means either the proje
Notes: * Negetive Performance means either the proje

Notes: * Negetive Performance means either the proje

TABLE 4.0: PROJECTS DATA AND COST & TIME PERFORMA

983,064,727

1,671,210,036

1,169,847,025

0.7

70.77%

Notes: * Negetive Performance means either the proje
Notes: * Negetive Performance means either the proje
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TABLE 4.0: PROJECTS DATA AND COST & TIME PERFORMA

GROSS FLOOR AREA (M^2)	421
NO. OF FLOORS	1
AVERAGE FLOOR HEIGHT (M)	3.2
CO.DF= (F/F.C.S.)x100%	0.00%
CO.DV=(N.V./F.C.S.)x100%	9.06%
A.C.G.=(F.C.S. - (O.C.S-C))/F.C.S x 100%	9.06%
T.OV. = (A.C.D. - S.C.D.)/A.C.D. x 100%	10.00%

Notes: * Negetive Performance means either the proje

Notes: * Negetive Performance means either the proje
Notes: * Negetive Performance means either the proje

TABLE 4.0: PROJECTS DATA AND COST & TIME PERFORMA

ANCE CALCULATIONS (DESIGN-BID-BUILD)

2	3	4	5	6	7	8
Office	Residential	Residential	Show Room	Warehouse	Office	Warehouse
02/02/2004	36709	11/06/2000	38454	03/05/2003	08/05/2004	22/3/2003
12	-	8	1week	5		0
02/02/2005	18/4/2001	17/7/2001	06/10/2006	03/05/2005	12/10/2005	22/9/2004
02/06/2007	03/05/2003	13/3/2002	07/07/2006	18/11/2006	16/09/06	30/11/2005
0	-	-	1week	2months	0	1month
8,234,037,340	1,600,000,000	800,000,000	1,204,406,803	29,606,496,580	3,338,555,264	31,259,547,466
8,351,021,024	1,850,000,000	1,600,000,000	1,195,358,598	31,104,299,083	6,079,772,915	36,643,089,062
815,000,000	240,000,000	85,714,286	110,000,000	3,861,716,945	320,000,000	4,077,332,278
675,488,059	78,550,000	405,275,608	0	3,922,150,266	384,323,968	2,826,730,214
255,495,625	411,450,000	480,438,678.11	100,951,795	1,437,369,183	2,676,893,683	6,634,143,660
3580	252	435	659	-	0	0
5	-	3	1	5	2	1
3	3	3.2	7.8	3.2	4	3.2
8.09%	4.25%	25.33%	0.00%	12.61%	6.32%	7.71%
3.06%	22.24%	30.03%	8.45%	4.42%	44.03%	18.10%
11.16%	26.49%	55.36%	8.45%	17.23%	50.35%	25.85%
200.00%	174.07%	82.47%	16.67%	89.58%	50.00%	33.33%

ct was completed below the original sum or before the scheduled completion date
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NCE CALCULATIONS (DESIGN-BID-BUILD)

10	11	12	13	14	15	16
Residential	Office	Office	Hostel	Hostel	Residential	Residential
30/01/2004	14/05/2004	12/06/2005	02/02/2005	13/06/2005	01/06/2003	30/12/03
0	18	1week	10	8	3	20
12/12/2005	14/05/2005	30/8/2006	28/12/2005	13/07/2006	31/12/2004	30/04/04
13/6/2006	29/11/2006	12/09/2006	20/12/2006	25/08/2006	30/6/2005	20/08/05
0	0	0	15weeks	0	1month	1 Month
1,139,194,268	3,871,868,900	1,267,069,920	3,620,872,365	6,000,000,000	2,200,000,000	240,000,000
1,321,535,878	6,042,978,449	1,611,599,350	4,835,629,000	6,900,000,000	2,900,000,000	259,200,000
148,590,557	200,000,000	90,000,000	329,170,215	782,608,696	220,000,000	20,000,000
135678600	1,015,241,780	301,215,530	987,520,400	846,000,000	375,000,000	19,200,000
195,253,567	2,593,138,344	133,313,900.00	556,406,450	836,608,696	545000000	20,000,000
785	445	181	310	702	725.4	173
1	3	1	5	3	4	1
3.2	3	3	2.7	3	3	3
10.27%	16.80%	18.69%	20.42%	12.26%	12.93%	7.41%
14.77%	42.91%	8.27%	11.51%	12.12%	18.79%	7.72%
25.04%	64.58%	26.96%	31.93%	24.39%	31.72%	15.12%
49.12%	150.00%	33.33%	109.09%	7.67%	50.00%	395.00%

ct was completed below the original sum or before the scheduled completion date
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ANCE CALCULATIONS (DESIGN-BID-BUILD)

18	19	20	21	22	23	24
Classroom	Bank	Student's Hostel	Residential	Student's Hostel	Dometory	Residential
30/08/05	38082	15/01/04	13/11/04	28/01/2005	12/05/2003	17/04/06
2	6	2	1	3	0	0
14/05/06	12/03/2004	25/04/04	16/04/05	28/07/06	10/05/2004	17/08/06
19/07/06	38819	28/11/04	18/05/05	20/10/06	22/10/2005	15/12/06
0	0	0	0	0	0	0
686,159,850.00	3,558,555,264	427,983,871	510,000,000	4,554,858,928	1,753,534,969	315,126,252
685,333,075.00	6,079,772,918	522,232,567	436,477,965	5,215,443,288	2,271,245,378	314,545,000
20,000,000.00	464,159,382	5,000,000	46,363,636	414,124,448	114,717,241	5,000,000
-	267,900,000	0	32,554,684	760,301,273	632,427,650	0
19,173,225.00	2,717,477,037	99,248,695.50	73,522,035	314,407,535	0	4,418,748
533	0	55	280	2028	896	110
1	2	1	1	3	2	1
3	5	3	3	3.15	3	3
0.00%	4.41%	0.00%	7.46%	14.58%	27.84%	0.00%
2.80%	44.70%	19.00%	16.84%	6.03%	0.00%	1.40%
2.80%	49.10%	19.00%	24.30%	20.61%	27.84%	1.40%
29.41%	328.57%	212.87%	20.00%	50.00%	150.00%	100.00%

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NCE CALCULATIONS (DESIGN-BID-BUILD)

Dormetory	Bungalows	Block of Flats	Office	Classroom	Office Complex	Classroom
01/12/2003	38963	02/02/2005	03/12/2004	17/3/2004	02/12/2004	17/03/2004
0	6	0	8	0	18	0
12/08/2005	07/09/2006	02/02/2006	30/8/2004	17/6/2004	06/12/2006	17/7/2004
15/12/2006	38849	17/10/06	30/6/2005	30/8/2004	15/1/2007	25/09/2004
0	1month	0	0	0	3weeks	0
1,727,859,768.00	1,869,719,934	5,665,468,401	11,360,000,000	238,129,072	18,430,969,236	379,735,312
2,178,000,177.60	2,076,728,613	6,045,913,171	12,541,582,700	238,129,072	28,349,202,788	379,735,312
225,373,013.22	160,353,390	738,974,139	1,481,739,130	5,808,026	2,404,039,466	18,082,634
345,571,953.60	145,474,987	464,568,409	511,246,000	0	2,960,798,100	0
329,941,469.22	221,887,080	654,850,500.00	2,152,075,830	5,808,026	9361474918	18,082,634
-	543	2101	-	276.7	-	317
2	1	4	2	1	5	1
3	3.2	3	4	3	3	3.2
15.87%	7.01%	7.68%	4.08%	0.00%	10.44%	0.00%
15.15%	10.68%	10.83%	17.16%	2.40%	33.02%	4.76%
31.02%	21.49%	18.52%	21.24%	2.40%	43.47%	4.76%
104.55%	83.33%	75.00%	181.82%	50.00%	116.67%	50.00%

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NCE CALCULATIONS (DESIGN-BID-BUILD)

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NCE CALCULATIONS (DESIGN-BID-BUILD)

34	35	36	37	38	39	40
Office	Classroom	Classroom	Classroom	Hostel	Office	Residential
22/2/2006	38272	20/5/2002	17/1/2006	15/7/2003	03/06/2006	09/10/2005
0	12	0	0	0	0	
21/11/2006	12/10/2005	15/2/2003	31/7/2006	15/8/2005	11/06/2006	02/10/2006
38848	20/12/2006	15/2/2003	15/12/2006	03/04/2006	11/06/2006	29/08/2006
0	0	0	0	0	0	0
1,840,508,662.00	600,888,000	352,010,600	686,000,000	51,000,000,000	1,817,144,256	960,236,497
1,957,794,515.00	658,908,400	331,075,000	686,000,000	65,800,000,000	1,817,144,256	952,651,402
244,499,812.50	78,376,696	41,317,000	89,478,261	5,600,000,000	237,018,817	46,269,995
39,882,353.00	80,174,600	0	0	12,000,000,000	58,437,000	0
321,903,312.50	56,222,496	20,955,600.00	89,478,261	8,400,000,000	178581817	38,684,900
262	380	510	187	15500	262	-

ct was completed below the original sum or before the scheduled completion date
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\NCE CALCULATIONS (DESIGN-BID-BUILD)

\NCE CALCULATIONS (DESIGN-BID-BUILD)

42	43	44	45	46	47	48
Office	Office	Lecture Theatre	Commercial building	Warehouse	Auditorium	Health Centre

ct was completed below the original sum or before the scheduled completion date
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ct was completed below the original sum or before the scheduled completion date

NCE CALCULATIONS (DESIGN-BID-BUILD)

5.26%	6.00%	23.00%	300.00%	83.33%	230.00%	8.33%

ct was completed below the original sum or before the scheduled completion date
ct was completed below the original sum or before the scheduled completion date

ct was completed below the original sum or before the scheduled completion date

ANCE CALCULATIONS (DESIGN-BID-BUILD)

-	495	-	2004	415	512	223
4	3	3	3	2	1	1
3.2	3.2	3.2	3	4	3	3.5
11.74%	11.98%	16.48%	0.00%	6.10%	0.00%	0.00%
20.18%	4.45%	10.99%	21.26%	35.20%	70.31%	19.19%
31.92%	16.44%	27.47%	21.26%	41.30%	70.31%	19.19%
0.00%	0.00%	20.00%	40.00%	75.00%	80.00%	130.00%

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ct was completed below the original sum or before the scheduled completion date

ANCE CALCULATIONS (DESIGN-BID-BUILD)

ct was completed below the original sum or before the scheduled completion date
ct was completed below the original sum or before the scheduled completion date
ct was completed below the original sum or before the scheduled completion date

NCE CALCULATIONS (DESIGN-BID-BUILD)

-	495	-	2004	415	512	223
4	3	3	3	2	1	1
3.2	3.2	3.2	3	4	3	3.5
11.74%	11.98%	16.48%	0.00%	6.10%	0.00%	0.00%
20.18%	4.45%	10.99%	21.26%	35.20%	70.31%	19.19%
31.92%	16.44%	27.47%	21.26%	41.30%	70.31%	19.19%
0.00%	0.00%	20.00%	40.00%	75.00%	80.00%	130.00%

ct was completed below the original sum or before the scheduled completion date

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ct was completed below the original sum or before the scheduled completion date

ANCE CALCULATIONS (DESIGN-BID-BUILD)

TABLE 4.41: SIGNIFICANT SUCCESS FACTORS OF DBB PROJECTS IDENTIFIED

Code	Success Factors	CLIENTS		CONTRACTORS		CONSULTANTS		OVERALL	
		RII	RANK	RII	RANK	RII	RANK	RII	RANK
2.8	Awarding bids to the right bidder	1.00000	1	1.00000	1	1.00000	1	1.0000	1
4.7	Availability of resources	0.93333	2	0.97143	2	1.00000	1	0.9683	3
3.2	Client's ability to adequately fund the project	0.93333	2	1.00000	1	1.00000	1	0.9778	2
5.2	Overall managerial actions in planning, organizing, leading and controlling	0.80000	4	0.82857	3	0.92000	3	0.8495	4
3.5	Project team leader's commitment to time, cost and quality	0.86667	3	0.77143	5	0.84000	5	0.8260	6
4.4	Inflation	0.86667	3	0.82857	3	0.96000	2	0.8851	5
4.5	Interest rates	0.80000	4	0.77143	5	0.88000	4	0.8171	7
2.7	Payment procedures	0.66667	6	0.80000	4	0.80000	6	0.7556	8
2.5	Arbitration as a method of conflict resolution	0.73333	5	0.60000	9	0.76000	7	0.6978	10
5.6	Progress meetings	0.73333	5	0.65714	8	0.76000	7	0.7168	9
5.3	Control mechanisms of sub-contractors' works	0.46667	9	0.71429	6	0.44000	13	0.5403	11

TABLE 4.42: OVERALL SIGNIFICANT SUCCESS FACTORS OF DB PROJECTS IDENTIFIED

Code	Success Factors	CLIENTS		CONTRACTORS		CONSULTANTS		OVERALL	
		RII	RANK	RII	RANK	RII	RANK	RII	RANK
2.8	Awarding bids to the right bidder	1.00000	1	1.00000	1	1.00000	1	1.0000	1
4.7	Availability of resources	0.95000	2	0.96667	2	1.00000	1	0.9722	2
3.2	Client's ability to adequately fund the project	0.90000	3	1.00000	1	1.00000	1	0.9667	3
5.2	Overall managerial actions in planning, organizing, leading and controlling	0.85000	4	0.80000	4	0.88000	2	0.8433	4
5.7	Contract documentation	0.85000	4	0.83333	3	0.76000	3	0.8144	5
3.4	Project team leader's knowledge and skills (competence)	0.80000	5	0.73330	6	0.76000	3	0.7644	6

DECLARATION

I hereby declare that this submission is my own work towards the M.Sc. and that, to the best of my knowledge, it contains no material previously published by another person nor material which has been accepted for the award of any other degree of the University, except where due acknowledgement has been made in the text.

……………………………	……………………………	…..……………….
Student Name	Signature	Date

Certified by:

……………………………	……………………………	…..……………….
Supervisor's Name	Signature	Date

……………………………	……………………………	…..……………….
Head of Dept. Name	Signature	Date

ABSTRACT

The Traditional design-bid-build (DBB) and the emerging design-build (DB) are alternative procurement methods currently in use in the Ghanaian construction industry. The client and stakeholders in the construction industry continue to complain about the industry's inability to deliver projects within the scheduled project duration, budgeted project cost and acceptable project quality.

Construction clients in Ghana, like clients in the rest of the world, are looking for the best procurement method that can meet their needs. This desire calls for an assessment and comparison of the performance of the existing procurement methods with regards to its ability to produce within budget, complete within time and also produce a project which can stand the test of time and also satisfy the purpose for which it was implemented. This research therefore evaluated 62 DBB and 17 DB completed projects in the Greater Accra, Ashanti and Brong Ahafo regions of the country. The study further undertook a comparative analysis of 15 similar projects from the total number of projects evaluated to ascertain whether or not there is a significant difference between the performance of the similar DBB and DB projects studied. The study further identified the reasons behind the projects performance disparity between the two methods.

The study gathered historical records of completed DBB and DB projects between 2000 and 2007 and also sought respondents opinion on which of the 35 factors listed was critical to the success of the project on which information was provided.

The data gathered was analysed using analysis of variance with the aid of Statistical Package for Social Sciences (SPSS 13). The success factors were also identified by subjecting each of the factors to significant test at 99% confidence interval.

The study revealed that most DB projects are completed within their respective budgets whilst a greater number of DBB projects incur cost overruns due to variations and price fluctuations. The time performance comparison also placed DB projects better than their DBB counterparts as most of the DB projects were completed within programme.

The study further revealed that, there is no significant difference between the qualities of completed projects executed under the two procurement methods.

Out of 35 factors listed, 11 were identified as significant to the performance of DBB projects which are: awarding bids to the right bidder, availability of resources, clients' ability to adequately fund the project, overall managerial action in planning, organizing, leading and controlling, project team leaders' commitment to time, cost and quality, inflation, interest rates, payment procedures, arbitration as a method of conflict resolution, progress meeting and control mechanism of sub-contractors work.

Six (6) factors were also identified as significantly important to the success of DB projects. These are: awarding bids to the right bidder, availability of resources, clients' ability to adequately fund the project, overall managerial action in planning and organizing, contract documentation and project team leaders' knowledge and skill (competence).

(Keywords: building projects, traditional design-bid-build (DBB), design and build (DB), success factors and project performance)

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DEDICATION

To God, my dear wife, Jane and daughters Akosua Ofosua Ameyaw and Akua Saante Ameyaw

ACKNOWLEDGEMENT

To God be the glory for the great things he has done in my life. I owe God tons of gratitude for his strength, grace and favour upon my life. I am grateful to God for what I am and what I would become.

I also give thanks to Dr. Samuel Oteng Seifah, my project supervisor. He was really a teacher and a father and did show these by readily attending to me anytime I approached him. God richly bless you, Dr. Oteng Seifah.

All examiners in the Department of Building Technology, KNUST, deserve commendation for their critique and direction through this research anytime it was presented at seminar. Many thanks also go to my colleague candidate Mr. Sarfo Mensah and Senior partner Mr. Ernest Osei-Tutu for their support and encouragement.

The acknowledgement would not be complete without the mentioning of my lovely wife Mrs. Janet Adwoa Ofosua Ameyaw for her moral support. Jane, I say God richly bless you.

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

The Construction industry world-wide is undergoing a lot of transformation especially in the area of procurement due to the ever changing customer requirements, desire to reduce cost and production time.

In Ghana, very little can be said about the transformation in the construction procurement landscape as more than 90 percent of construction projects are still procured through the conventional design-bid-build (DBB) procurement method (Obeng-Ayeribi, 2002) to the neglect of other innovative procurement methods like the integrated system (design and build) which is now the leading trend in the construction industry in the world (Akintoye, 1994; Songer and Molenaar, 1997).

This research seeks to evaluate and compare the performance of the traditional design-bid-build (DBB) and the design and build (DB) procurement methods by the use of some performance and success indicators which includes time, cost and quality. This evaluation will provide a stage for a proper comparison of these methods and help determine whether or not there is a significant difference in the performance of the two procurement methods.

The uniqueness of construction products and the uncertainties in the construction process makes construction procurement comparison onerous but not impossible so long as care is exercised when designing such research method. On the contrary, such comparison can provide novel solutions and/or approaches which may lead to performance improvements in the construction procurement cycles and the entire construction industry in the country.

1.2 DEFINITION OF TERMS

The term "***Procurement"*** relates to the strategic organizational management of resources in a logical sequence in order to meet project objectives. It is a system that describes the total process of meeting the client's needs for a project, starting at the point where this need is first expressed and straight through to when it is finally met" (*Keith H., 1993).*

The **"Traditional design-bid-build"** this method of procurement is a segmented, sequential process in which the promoter contracts an architect to prepare detailed, suitable-for-construction drawings and specifications (or sometimes has them prepared by its in-house engineers), then uses the detailed drawings to solicit competitive bids for construction, and finally awards the construction contract to the lowest evaluated responsive bidder (Masterman, 2002).

"Design and Build" refers to a range of alternatives to the traditional project delivery system. Under design and build procurement arrangements, the promoter contracts one entity to design and construct under a single contract. The American Institute of Architects (AIA) defines the term as "a process in which the owner contracts directly with one entity that is to provide both design and construction services" (Masterman, 2002).

"Project Cost": Cost for the purposes of the study is not only confined to the contract sum, but the overall cost that the promoter incurs from inception to completion, (this includes any cost arising from variations and fluctuations) and life cycle cost (Chan & Chan, 2002).

***"Project Time*"**: Project time or duration is the period from the day the project site was handed over to the contractor to the day the completed building was duly handed over to the client (Hatush and Skitmore, 1997).

. ***"Success factors":*** Success factors in the study were defined as matters or events that must go well to ensure a successful project delivery of a construction project. These factors represent matters or events that must be given special and continual attention to bring about high performance in DBB and DB projects delivery (Long et al. 2004).

"Similar Projects": Similar projects in this study means any two projects that serve the same function (e.g. office, hostel, hotel, lecture theatre, hospital building, factory, residential building and classroom), built of the same material (e.g. steel or concrete framed structure, concrete tile or roofing aluminium, porcelain floor and wall finishing) and built within the same time frame.

1.3 PROBLEM STATEMENT

Generally, construction projects in Ghana experience cost overruns, completed far behind schedule and are of low quality. It is not uncommon to read about determination of contractors employment due to non performance and poor quality workmanship.

Clients are incurring cost overruns of between 60 – 180% (exclusive of inflation) and time overruns of 12 – 24 months on construction projects in Ghana today. (Nicco-Annan, 2006).

These findings, therefore, call for an alternative procurement method to address the problems experienced by construction clients in the country as over 90% of construction projects are procured through the conventional design-bid-build procurement method (Obeng-Ayirebi, 2002).

The design and build procurement method has been described in some quarters as a perfect substitute to the traditional design-bid-build.

The major difference between the traditional method and design and build is that, design is separated from construction while with design and build, the design and construction is undertaken by a single organization to ensure speed of construction, buildability and cost reduction (Best & Gerard, 1999).

Bennet et al. (1996) found out that design and build offered better construction speed than the traditional contracting (12 per cent), and 30 per cent better overall speed. In addition to this, it cuts on average, 13 percent off costs in comparison with traditional method.

The objective of this research is to evaluate the performance of projects completed through DBB and DB methods and compare their performance to establish whether or not truly DB could be used as an alternative to the DBB method.

1.4 AIM AND OBJECTIVES

1.4.1 AIM

The primary goal of this research is to investigate the viability of design and build procurement method in the Ghanaian construction industry as an alternative to the traditional design-bid-build method of procurement.

1.4.2 OBJECTIVES

The main objectives of this study were:

- To evaluate and compare the cost, time and quality performance of the traditional design-bid-build and the design and build procurement methods in Ghana;
- To identify possible causes of performance differences;
- To identify the success factors of the traditional design-bid-build and the design and build procurement methods in Ghana.

1.5 RESEARCH HYPOTHESES

It was hypothesized that:

1. There is no difference in the cost overrun due to fluctuation on DBB and DB Projects;
2. There is no difference in the cost overrun due to variation on DBB and DB projects;
3. The overall cost performance (cost overrun) on DBB and DB projects are the same;
4. That DB projects have the same time performance as DBB projects;
5. That Projects executed through DBB are of the same quality as those of DB.

1.6 JUSTIFICATION OF THE RESEARCH

The evaluation of completed projects to ascertain their performance with regards to cost and time overruns and quality provides a true impression of performance of the procurement method and also serve as a benchmark for stakeholders in the Ghanaian construction industry to make an informed decision in the selection of the procurement method.

The identification of the causes of disparity between projects performance gives construction clients the urge to take appropriate steps to provide adequately for the factors that enhance the performance of the projects.

It also helps; construction clients identify the causes of poor project's performance and therefore help to shape the final decision.

Furthermore, the success factors of the design-bid-build and the design and build procurement methods gives clients and other stakeholders in the Ghanaian construction industry the key to plan their construction projects properly to ensure their smooth implementation.

1.7 RESEARCH METHOD

Data was collected through questionnaires administered to key players of the Ghana construction industry (i.e. clients, consultants and contractors) in three regions of Ghana, namely Ashanti, Brong Ahafo and Greater Accra.

A total of 62 DBB and 17 DB projects were collated in the three (3) regions. The regional distribution of projects surveyed is presented in Table 1.1.

A structured questionnaire was used to collate data on the historical records of completed DBB and DB projects. These include, such factors as original contract sum, final contract sum, original contract period, projects commencement date, practical completion date, extension of time granted and official hold-up. The data that was gathered from the questionnaires in connection with quality of project included, stakeholder's satisfaction with regards to quality of materials used, workmanship and functionality of the building fabric. Information on the number of times a contractor was asked to rectify defects during the defects liability period was also obtained.

Specific questions were also asked to help identify the causes of performance differences. Success factors identified from literature and interview were also listed and respondents were asked to rank them on five point Likert scale from “not significant” to “extremely significant”.

The raw data was reduced to percentages and subsequently analysed by the use of analysis of variance with the aid of Statistical Package for Social Science (SPSS 13) to ascertain whether there is a significant differences in the performance of the two procurement methods.

Table 1.1: Regional Distribution of Projects Surveyed

Region/Method	Ashanti Region	Brong Ahafo	Greater Accra	Total
DBB	22	12	28	62
DB	5	3	9	17

The structured part of the questionnaire was analysed by ranking the success factors in terms of degree of significance using Relative Importance Indices (RII). Significant test (at 99% confidence interval) was conducted on each of the factors which aided in identifying the significant success factors. The Spearman’s rank correlation coefficient was used to test the degree of agreement between the rankings of the respondents’ groups.

1.8 SCOPE OF STUDY

The research focused on completed building projects between 1st January, 2000 and 28th February, 2007 with contract sum not below Hundred Thousand Ghana Cedis (Gh ¢100,000.00) in Greater Accra, Ashanti and Brong Ahafo Regions of Ghana.

The study was limited to D1 and K1 contractors selected from the list of Building Contractors by the Contractors’ Association of Ghana. Choice of this class of contractors was made on the basis that they were found to have used DBB and DB procurement methods to execute a project value of Hundred Thousand Ghana Cedis (Gh ¢100,000.00) which was the threshold of projects considered under the study and projects of this magnitude were chosen because of their ability to attract attention from projects stakeholders in the case of failure or delay.

CHAPTER TWO

LITERATURE REVIEW

2.1. Introduction

The research undertaken to date concerning procurement methods in Ghana has focused around the state of the art of the procurement forms practiced in the country (Obeng-Ayirebi, 2002) and development of model in the selection of procurement forms (Osei-Tutu E., 1999). Osei-Tutu E. (1999), attempted to evaluate the performance of various forms of procurement methods in use in the country but these exercises were based on public and experts opinion on the performance of the various procurement methods. This kind of evaluation and ranking of various forms of procurement in terms of performance is contentious because most people are not familiar with the other forms of the procurement methods (Obeng-Ayirebe, 2002).

Chan and Chan (2004) studied the key performance indicators for measuring construction success. They undertook a case study of Design and build (DB) and Traditional design-bid-build (DBB) procurement projects performance by using some established performance indicators like construction time, speed of construction, time variation, unit cost, health and safety, quality, functionality, stakeholder's satisfaction, environmental performance and overall project performance. Only three projects (two of DB and one of DBB) were studied which makes the result of the study not reflective of the true performance of these procurement methods.

This chapter seeks to review and discuss relevant literature that attempts to address the objectives of the study.

2.2 Methods of Procurement

Procurement has become a more central issue in the construction industry for several reasons. Firstly, clients have been demanding 'better value for money' since the early 1970s driven partly by the industry's own poor productivity performance and partly by comparisons with manufacturing productivity growth (Rick Best & Gerard De Valance, 1999). There have been a number of notable reports published in the 1990s that have identified the plight of the construction industry. The Latham (1994) and Egan (1998) Reports from the UK and Australian Construction Industry Action Agenda, Building for Growth (DISR, 1999) addressed problems of inefficiencies of the traditional procurement methods in the construction industry and identified areas where reform was required.

Procurement method means the project management system and contractual arrangements used by the developer to secure the design and construction services required for the execution of the proposed project to the required quality for the required cost and within the required time* (*Keith H., 1993). Rick Best and Gerard De Valence defined Procurement as the process that deals with project definition and delivery and the technical capabilities of the industry

Masterman (2002), classified procurement systems under four broad sections:

1. Separated/traditional/conventional;
2. Management oriented (e.g. Management Contracting, Construction Management)
3. Integrated (e.g. Design and build, Package deal and Turnkey);

4. Discretionary, which includes (Partnering, Alliancing, Joint Venture and New Engineering).

The choice of a procurement method is perhaps the single most important decision the client makes, other than the decision to build.

The shift that has occurred over the recent decades has been away from the conventional methods characterized by separated design and construction processes (1) and toward both integrated and management style structures (2 and 3). This change has been largely client driven as these alternative systems require the contractor to accept a high degree of risk associated with the design development and construction of the project (Royal Institution of Chartered Surveyors (RICS), 2002).

2.3 Factors to Consider in the Selection of Procurement Method

Experienced clients can select a procurement approach that has previously worked well for them, or they deem to be suitable when considering their prioritized objectives and attitude to risk (Mortledge *et al.*, 2006). Inexperienced clients, on the other hand, will need to seek professional advice to assist them through the process (Love *et al.*, 1998). Mortledge *et al.* (2006) stated that the selection of an appropriate procurement strategy has two components:

1. *Analysis*. Assessing and establishing priorities for the project objectives and client attitude to risk.
2. *Choice*. Considering possible options, evaluating them and selecting the most appropriate.

The efficient procurement of a building project through the choice of the most appropriate procurement strategy has long been recognized as a major determinant of project success (Bennett and Grice, 1990). Indeed, a failure to select an appropriate procurement approach is widely cited as being the primary cause of project dissatisfaction (Masterman, 1992). The selection of a procurement method is more than simply establishing a contractual relationship. It involves creating a unique set of social relationships whereby forms of power within a coalition of competing or cooperative interest groups are established (Liu, 1994). Differing goals and objectives and varying degrees of power within a project team are often the underlying conditions for triggering adversarial relations (Love *et al.*, 2004).

2.3.1 Procurement assessment criteria

A ubiquitous issue within the construction industry relates to clients satisfaction and the means by which projects have been procured (Love *et al.*, 1998). Consequently, it is important to evaluate the clients' criteria, their perceived importance and then seek performance to match that criteria identified (RCIS, 2000). Traditionally, most clients have required projects to be completed on time, within budget and to the highest quality albeit in recent years environmental (e.g. carbon footprint) and legislative requirements (e.g. health and safety) have risen to prominence. While the use of such criteria can be used as a guide to assist decision makers with an initial understanding of the basic attributes of a particular procurement system, they should not be used as a basis for selecting the procurement method (Luu *et al.*, 2003a). This is because of the underlying complexity associated with matching client needs and priorities with a particular method (Kumaraswamy and Dissanayaka, 1998). The New South Wales – NSW

Department of Commerce (2006), for example, states that an appropriate procurement method for a project will depend on the characteristics of the project, the factors that impact its delivery and the desired risk allocation and as a result the appropriate selection will provide value for money, manage risk, and meet project objectives.

2.3.2 Determination of selection criteria

The National Economic Development Organisation (NEDO, 1985) identified nine criteria that clients could use to select their priorities for projects. These are:

1. *Time*. Is early completion required?
2. *Certainty of time*. Is project completion of time important?
3. *Certainty of cost*. Is a firm price needed before any commitment to construction given?
4. *Price competition*. Is the selection of the construction team by price competition important?
5. *Flexibility*. Are variations necessary after work has begun on-site?
6. *Complexity*. Does the building need to be highly specialised, technologically advanced or highly serviced?
7. *Quality*. Is high quality of the product, in terms of material and workmanship and design concept important?
8. *Responsibility*. Is single point of responsibility the client's after the briefing stage or is direct responsibility to the client from the designers and cost consultants desired?
9. *Risk*. Is the transfer of the risk of cost and time slippage from the client important?

Several studies, such as those identified in Love *et al.* (1998), have used modified versions of the NEDO criteria in an attempt to develop a procurement selection framework. Luu *et al.* (2003a, b) state that the use of a limited number of factors such as those identified by NEDO (1985) may give rise to the selection of a sub-optimal procurement system. Since the selection of procurement system is influenced by client characteristics (Moshini and Botros, 1990), project characteristics (Ambrose and Tucker, 2000), and the external environment (Alhazmi and McCaffer, 2000), procurement selection criteria representing the constraints imposed on the project should be considered before a decision is made.

Kumaraswamy and Dissanayaka (1998) first identified the following 11 key performance criteria from among 38 initially considered, on the basis of a Hong Kong-based study. These selection criteria includes the following:

1. Lower capital cost;
2. Lower life cycle costs;
3. Cost certainty;
4. Shorter pre-construction duration;
5. Time certainty;
6. Shorter construction duration;
7. Effective and efficient communication;
8. Higher quality;
9. Effective and efficient decision making;
10. Dispute minimization;
11. Overall client satisfaction.

2.3.4 Problems and prospects in selecting procurement systems

Recent industry studies, such as by Latham (1994) and Egan (1998), echo an underlying lament that can be traced back many decades (for example to the Simon Report in 1944, the Emerson Report in 1962, the Banwell Report in 1964 and the Tavistock Report in 1966, in the UK): viz, that many industry problems arise from poorly structured procurement systems. The polarisation of production from design in the construction industry may have arisen from expected efficiencies from specialisation and the perceived need for independent design and oversight. But the resulting fragmentation and adversarial contractual cultures have now been seen by many to be an unfortunate departure from the single point procurement solutions provided by master-builders in previous centuries. The resulting emergence of design construct, project management and build-operate-transfer type procurement has sought to break down the barriers and bridge the gaps – by integrating efforts towards common goals. However, this is taking a longer time than envisaged, given the ingrained attitudes and apprehensions of different groupings within the industry.

Apart from problems with performance levels on specific projects, a series of studies have recently blamed short-sighted procurement strategies for stifling the development of contractors, consultants and the industry itself, as for example cited by Kumaraswamy (1998). Attempts to redress these imbalances and concerns have led to experimentation with a proliferation of procurement options. These include various approaches to the division of a big construction project into work packages; to the allocation of design, construction, supervision and management functions; to the distribution of risks – as reflected in various conditions of contract; to the methods of payment; and to the selection of project teams/sub-teams.

The above proliferation of options may by itself bewilder clients and even (at times) their professional advisers, who also attempt to select an "optimal" procurement system for a given project. There would thus often be an unfortunate tendency to opt for a familiar system. Nevertheless, it has been said (Love and Skitmore, 1996) that one properly chosen (and assembled) delivery system can be deemed to be "better" for a given project but no one delivery system can be held to be better for all projects.

Decision support systems for more proactive construction procurement (that is designed to enhance performance) have been proposed from the early 1980s at least (e.g. by Franks (1984), the UK National Economic Development Office (NEDO, 1985) and Skitmore and Marsden, (1988)). These were mostly based on matrix-type scoring frameworks that incorporated multiple performance criteria. Potential procurement (sub) systems are rated against about five to ten criteria such as speed, price competition level and quality level required. However, such decision aids have neither been widely supported nor practised. Two probable reasons for such lack of support are:

1. A distorted focus on improving one or two procurement sub-systems, while neglecting others; and
2. Lack of attention to non-procurement related project conditions that also affect performance.

2.4 Integrated Procurement System

2.4.1 Design and Build (DB)

Design and build can be considered as a “family of procurement options” characterized by their integrated approach. One organization, the builder, is responsible for the design and construction of the project. The degree of design undertaken by the contractor is relative to the extremity of the design and build variant (Knight and King, 2002). The original DB method of procurement had the client enter in a single contract with one organization that integrated the design and construction process to promote speed, economy of building and non-adversarial relationships (Gregersen, 1998). The DB Company often utilized an “in house” design team or they contracted externally. DB has many variants, for example “pure design and build”, where the contractor undertakes the full design of the building. The other extreme of the continuum, “develop and construct”, involves the client employing an architect to design the building almost fully before he or she employs a contractor to finish the design and construct the building (Knight and King, 2002).

Akintoye (1994), in an extensive study of contractors’ views, categories six type of design and build:

1. *Traditional (or pure) design and build*. The construction contractor is fully responsible for both the design and construction of the project and typically involved from an early stage in the process;

2. *Package deal:* The contractor provides standard buildings or system buildings that are adapted to suit clients’ space and functional requirements.

3. *Design and manage:* The contractor receives a fee for managing all aspects of planning, design and supervising the contractors. The contractor has design responsibility.
4. *Design, manage and construct:* Similar to the above, the difference lies in its inclusion of the actual construction activities.
5. *Novation:* The client employs the services of a design consultant, who is assigned to the contractor on their appointment. This means that the original contract between the consultant and client is replaced by a new one between contractor and design consultant.
6. *Develop and construct:* The client employs a design consultant to a “scheme design” stage. Once appointed, the contractor will complete the detailing and construction of the project.

2.4.2 Design and build - Past and Present

The Emmerson report of 1962 can perhaps be identified as a catalyst for the shift towards integrated procurement routes. It criticized the separation between design and construction, which characterizes traditional contracting. The general inadequacies of communication were made explicit in the report by focusing on the interaction between architects and contractors.

Two years after Emmerson’s seminal report, Banwell fortified his predecessor’s findings (Banwell Report, 1964). Traditional contracting was criticized for its removal of the contractor from the design process.

These reports paved the way for more integrated procurement forms to evolve, where design and construction are allowed to be executed by a single organization.

Design and build expanded in popularity in the late 1970s and early 1980s fuelled by dissatisfaction with the traditional approach and the need for a guaranteed maximum price in times of economic uncertainty. DB's variations have expanded considerably in the last decade. It has increased dramatically in the 1990s going from a 10 percent share during the 1980s up to a 35 percent share of the construction procurement market (Royal Institution of Chartered Surveyors (RICS), 2000).

Parallel movements towards adopting design and build were occurring in the USA and Australia at the same time (Songer and Molenaar, 1996). Alhazmi and McCaffer's (2000) work on system selection models in design and build surveyed Saudi Arabian public clients. One finding of the research illustrated that clients selected design and build as the most appropriate procurement route for their projects.

Masterman (1997) has collated much information from various government reports on the usage of different procurement systems over recent years. He argues that there is a drought of reliable data. However, what can be established is that design and build has gained in popularity owing to the perceived need for a dynamic alternative to the fractured conventional route.

Bennett et al. (1996) found that design and build offered better construction speed than traditional contracting (12 per cent) and 30 per cent better overall project speed. In addition to this, it cut on average, 13 per cent off costs in comparison with traditional contracting. However, the success of integrated procurement solutions, such as design and build, depends on many interrelated factors.

2.4.3 Characteristics of Design and Build (DB)

In pure design and build, the client procuring the building will typically employ an architect, and employer's agents (architect, quantity surveyors and engineers), at a preliminary stage to frame his or her development needs in the "employer's requirements" document (termed request for proposal (RFP)). This document encapsulates the client's priorities, although as previously mentioned, in pure design and build the degree of design development at this stage of the scheme typically is minimal.

The builder's proposals are the response to the employer's requirements. They present the builders interpretation of the client's needs in a completed building.

The complexities of design and build at the pre-contract stage, as compared to traditional contracting, are summarized by Rowlinson (1999):

The organization of a design and build project is more complex than that of the traditional project at the tender stage as the situation will often occur where different priced bids with different design solutions are competing for the same project.

The degree of control administered by the client over the project design is channeled through the employer's requirements. There are two schools of thought over this control issue. One is to keep the development of the employer's requirements to a minimum, thus allowing the builder flexibility in his scheme o design. The other, arguably rooted in cost control, is to exert greater specificity over the design, therefore reducing the amount of input the contractor is allowed. This variance in the development of the employer's requirements is prominent in several key reports. Bennett et al. (1996) directly related keeping the "employer's requirements" minimal to delivering projects on time. Highlighting the centrality of contractor input to project speed, it advises moving toward a purer form of design and build. Additionally, the HM Treasury report (1999) outlines the need for a non-prescriptive approach to employer's requirements and argues for the use of appropriate output specifications.

Although loose employer's requirements are advocated, this should not detract from clarity in the documentation. In their 1999 work on design and build evolution and performance, Molenaar et al. (1999) stated, "Understanding owner's needs is critical to the success of design and build". Although there are many documented advantages for the use of design and build, the process is still susceptible to fragmentation. Akintoye's (1994) study of contractors' views of design and build supports the notion that builders are increasingly using external design firms rather than having their own in-house design team.

2.5 Traditional Design-Bid-Build (DBB) Procurement System

2.5.1 Historical Perspective

The traditional system has evolved over the centuries. The role of the architect was established in more or less its present form by the end of the 18th century by which time the architect was recognized as the independent designer of buildings and manager of the construction process (Frank J., 1991).

Early in the 19th century bill of quantities began to be used as the means of providing a number of different contractors with a common basis for tendering. By the middle of the century, the Quantity Surveyor was established as an expert in building accounts and cost matters.

Because most clients for construction work seek, at first, someone who can express their needs in the form of design, the architect is traditionally, the leader of the construction process (Frank J., 1991).

The traditional design-bid-build system remains the most popular delivery method for construction projects (McCaffer, 2002).

2.5.2 Characteristics of the Traditional DBB Procurement System

The traditional design-bid-build procurement system, which is probably the most common procurement method, is one whose most significant feature is the carrying out of design and construction as two distinct, separately consecutively executed, processes. The two processes are undertaken by separate parties under contract to the developer (Keith H., 1993).

The traditional procurement system is mainly used in the construction industry. The system is a series of end-on activities incorporating the brief, design development, design finalization, production of tender documents including (Bills of Quantities), estimating the tender and finally the actual construction. (Osei-Tutu E, 1999).

The principal designer: an Architect for building works, Engineer for Civil/Structural works, services engineer for mechanical, plumbing and electrical works, develop within time and economic constraints. The output is then passed on to the Quantity Surveyor for preparation of tender documents (Osei-Tutu E, 1999). Once completed, the design package is presented to interested builder, who prepare bids for the work, and execute contracts with sub-contractors to construct various special sections of the work.

In most cases, the builder with the lowest evaluated responsive bid is awarded the contract (Public Procurement ACT, ACT 663, 2003).

The system allows for sub-consultants to design specialist sections of the works, but the principal designer is generally held responsible for the project. Construction by separate builders may start some considerable time after the inception of the project thus leading to long project duration. Other specialist consultants and contractors are incorporated in the works through the process of 'nomination' or 'naming'(Osei-Tutu E, 1999).

Furthermore, the consultants usually led by the Architect, provide all the technical support for the builders to do the actual construction on site at the tender cost either through competitive, negotiated or selective tendering (Osei-Tutu, 1999).

Supervision of the quality of the builder's work is usually undertaken by the designer, the architect. The administration and settlement of the financial terms of the contract between the developer and the builder is carried out by the quantity surveyor (Keith H., 1993).

2.5.3 Types of Traditional Design-Bid-Build Contracts

In a standard arrangement clients or their project adviser (normally an architect or civil engineer) engages designers, consulting engineers and quantity surveyors to prepare schemes, appoint contractors and supervise the work, the latter function usually for an extra fee.

McCaffer (2005) has identified seven (7) types of separated contracts. These are:

Lump sum, Bill of quantities, Schedule of rates, Fixed or percentage fee, Cost reimbursement, Target cost and Direct cost. Kwakye (1997) in his book, "Construction Project Administration Practice", added measurement contract and bill of approximate quantities as types of separated contracts. These are explained further as follows:

a. Measurement Contract

Price for sections of construction work under this contractual arrangement is pre-estimated but the total price cannot be ascertained until the work is measured and valued on completion. The evaluation of the measured construction work is by the application of an agreed unit rate obtained from either bills of quantities or schedule of rates. This contractual arrangement can be procured on an approximate bills of quantities (when clients requirements are not known in advance) or schedule of rates (when client's requirements are insufficient to permit the production of bills of approximate quantities). It may be adopted for projects where prompt commencement on site is required (Kwakye, 1997).

b. Cost reimbursement contracts

Under this contractual arrangement, the client undertakes to pay the contractor the prime cost (i.e. actual cost of labour, plant and materials utilized in the execution of the construction works). In addition to the prime cost, the contractor is paid an agreed sum to cover for profit and establishment charges. These contractual arrangement may be adopted for projects where:

- The client may wish to influence the execution of the works and, hence, assume the entire risk of site operations;
- An early start is required but the extent of the works cannot be accurately predicted;
- A high standard of work is required;

Work is of an emergency, repair and experimental nature (Kwakye, 1997).

c. Lump Sum Contract

Under this contractual arrangement, the contractor consents to execute the entire work described or specified for a stated total sum. The agreed sum is normally based on information derived from drawings, specification, bills of quantities and/or site inspection. To arrive at the pre-estimated price, the contractor takes into account all contractual risks involved, the condition of the construction market and his or her current workload. The pre-estimated price is paid to the contractor regardless of the actual costs incurred in executing the works, providing there are no variations .(Kwakye, 1997)

d. Schedule of Rates Contract

The Schedule can take one of a number of different forms and is best suited for maintenance and repair contracts, where the exact nature and extent of the works may not be known until the work is executed. The contractor is required to insert rates in the schedule for the listed items of work

This form of contractual arrangement is used to address any difficulties in contracts, where the whole or major parts of the work are provisional (e.g. sinking of a bore-hole for water supply, erection of a process plant or maintenance works). It is also adopted in a situation where it is almost impossible to predict realistic and accurate quantities of to be undertaken. The contract price is derived by measuring the works done and pricing them at the tendered rates (Ivor, 1997)

e. Approximate Quantities

While the best procedure for construction contracts is to provide accurate quantities, there are circumstances where approximate quantities are necessary (Ivor, 1997). The following examples will serve to illustrate suitable applications:

a. Where speed is of paramount importance and the general design has been formulated, it may be necessary to select a contractor before production drawings can be completed. In this situation, it is probable that sufficient design information is available to enable approximate quantities to be produced that can form the basis of a contract.

b. With work below ground, the information is likely to be too imprecise for the preparation of accurate quantities. The perimeter of the building can be established, but the depth of foundations and extent of soft areas will be uncertain.

c. Provisional quantities may be included in accurate bills of quantities to cover work that is uncertain in extent and that is subject to re-measurement when the work is carried out. Excavating in rock, the removal of underground obstructions and work on the site of buildings subject to demolition are in this category (Ivor, 1997).

f. Target Cost

To overcome the inherent weaknesses of the ordinary fee contract, clients have tried to encourage contractors to be more cost conscious by relating the fee to an agreed target estimate based on a set of drawings and specification or alternatively a bill of quantities. However, to accommodate progression of a design during the construction phase provision is made for adjusting the target estimate for variations in quantities. The actual fee paid is determined by increasing or decreasing the original fee by an agreed amount or percentage calculated on the savings or excess between the actual cost of the work and the target estimate adjusted for any variations (Harris and McCarffer, 2005).

g. Direct Labour

Some clients have in-house labour, for example government departments, local authorities, nationalized industries, employed to carry out construction work either design internally or by outside consultants. A formal contract therefore does not arise but some competition can be introduced by inviting outside contractors to tender (Harris and McCarffer, 2005).

2.6 Design and Build Verses Traditional Design-Bid-Build Method

2.6.1 Project Cost

Cost is defined as the degree to which the general conditions promote the completion of a project within the estimated budget (Bubashait and Almohawis, 1994). Cost is not only confined to the tender sum, it is the overall cost that a project incurs from inception to completion, which includes any costs that arises from variations and modification during construction period (Chan & Chan, 2002).

Bennett et al (1996) discovered that design and build reduce project cost close to 13 per cent when compared to the traditional method.

Keith (1993) also noted that, using a traditional procurement system, with competitive tenders invited for the construction work, a substantial certainty of construction cost should be obtained at the stage of receipt of tenders, which is usually a relatively early stage in the overall project programme. The contract made on the basis of the tender, if firmed price, represents a substantially certain indication of final construction cost. This is so, provided the design on which the tender is based, is in reality, complete and the builder's tendered price is realistic.

Failure to obtain complete designs and documentations would result in variations to the builder's work and a consequent adjustment to the contract price. This produces a significant uncertainty as to the ultimate actual cost. The application of the traditional procurement system is usually characterized by a far from complete design at tender stage and thus, in practice, the system is usually characterized by the uncertainty caused by the need for variations to the builder's work.

Failure to ensure a contract sum based on a realistic sum can result in either insolvency of the general contractor or slow progress owing to poor cash flow. The delays caused by both of these consequences produce considerable uncertainty of final actual cost.

Using design and build procurement method, construction cost can be obtained at the stage of making the design and build contract, and this stage can be reached relatively earlier than under a traditional method. When design and build contract is made, the uncertainties of variations due to incomplete design, which are a characteristic of traditional procurement, are not the cost responsibility of the developer and thus do not produce uncertainty for the developer's budget. However, variations made by the developer to the original brief on which the design and build contract was made can cause considerable cost increase (Keith, 1993).

2.6.2 Construction Time

Time refers to the duration for completing the project. It is scheduled to enable the building to be used by a date determined by the client's future plans (Hatush and Skitmore, 1997).

Completion of project on time is said to be the hall mark of design and build. Jaggar et al., (2002), found that design and build overcomes the problem of the separation of design and construction, so saving overall time and allowing the design to reflect improved buildability in the construction solution. A survey conducted by Osei-Tutu E, 1999, revealed that, design and build has better project time performance as compared to the traditional system of project delivery.

Best and Gerard, (1999) stated that, due to the fact that the design and construction phases of the traditional design-bid-build project are 'end on', with no parallel working; the overall speed of the system is adversely affected. The additional time required in procuring the works impacts upon the client's finances, holding costs and consultant's fees. Further, during periods of rapid inflation the client's objectives to have the project completed in the shortest possible time frame are unlikely to be achieved. Benett et al. (1996) found that design and build offered better construction speed than the traditional contracting (12 per cent) and 30 per cent better overall project speed.

2.6.3 Quality

Clients' long-term interests lie in the high quality of their projects. The work performed must conform to the specifications established for the project. Low cost and speedy construction should not be achieved at the expense of the quality of the project. In fact, poor quality of performance results in increased rework, which has significant cost and schedule implications (Hong and David, 2002). Quality of construction products as well as the quality of processes that produce the products is crucial to contractors' competitiveness in the market (Harris and McCaffer, 2001).

However, construction quality may sometimes be taken for granted and insufficient attention may be paid to it (Rad and Khosrowshahi, 1998). Rwelamila & Hall, 1995 and Best and Gerard, (1999), both discovered that, the traditional procurement system where competitive bidding emphasizes on construction cost and time, quality is therefore compromised. This finding is not consistent to the findings of Osei-Tutu E, 1999. His survey rated the traditional system better than design and build in terms of quality performance. Gregersen, 1998, contended that, one of the disadvantages of design and build is that budget and schedule often prevail whilst quality suffers. Love et. al., said, a valid view put forward, which undoubtedly design and build suffered from in the 1980s, was that the quality of the final building was often inferior and the role of design was devalued, as the design and build contractors "shaped" the design to suit their particular methods of construction. They added that more recent views from clients indicated that they were satisfied with the quality of their completed design and build projects. A survey conducted by Bengard, 1999, firms the fact that in the opinion of the clients, quality did not suffer. This same study also found that projects using design and build often resulted in better value for money and less contractual disputes

2.7 Definition of Project Success and Success Factors (SFs)

2.7.1 Project Success

The construction industry is dynamic in nature. The concept of project success has remained ambiguously defined and its criteria often change from project to project (Albert & Ada, 2004). Project success is almost the ultimate goal of every project. However it means different things to different people. While some writers consider cost, time and quality as predominant criteria, others suggest that success is something more complex (Albert & Ada, 2004). Long et al., 2004 noted that a construction project is commonly acknowledge as successful when it is completed on time, within budget, and in accordance with specifications and to stakeholders' satisfaction. Takim and Akintoye (2002) saw functionality, profitability to contractors, absence of claims and court proceedings and "fitness of purpose" for occupiers as a measure of project success. Cooke- Davies (2002) clarified that project success is measured against the overall objective. Sanvido et. al. (1992) insisted that success on a project means that certain expectations for a given participant are met, whether owner, planner, engineer, contractor, or operator.

2.7.2 Success Factors (SFs)

The failure and success factors were first introduced by Rubin and Seeling (1967) while the term "success factors" were first used by Rockart (1982) both cited in Long et al. 2004).

Rockart (1979) defined success factors as those few key areas of activity in which favorable results are absolutely necessary for a particular manager to reach his or her goals. Boynton and Zmud (1984) clarified that success factors are those few things that must go well to ensure success for a manager and an organization, and therefore, they represent those managerial or enterprise areas that must be given special and continual attention to bring about high performance.

2.8 Success Factors (SFs) of Construction Project

A review of the relevant literature in the last decade showed that the area of Success Factors (SFs) has been the focus of researchers. Beale and Freeman (1991), developed a project management model of a construction which explained what factors will affect the successful execution of a project.

Other research centred on the development of a framework for measuring success of construction project. Project characteristics in terms of clear goals should be known and understood by the project team to achieve project success (Liu and Walker, 1998). Moreover, adequate guidelines and communication channels through various contractual arrangements are important to control the process so that the project goals of budget, schedule and quality can be achieved (Eldin, 1997; Liu and Walker, 1998). Review of literature shows that most studies discuss the topic of SFs of a construction project in a generic sense. With the insufficiency of a separate procurement system in meeting the demands of building clients, alternative procurement routes, like design and build, are being increasingly adopted. However, the performance of design and build projects sometimes varies and the lack of knowledge in managing design and build, especially in the context of SFs, may inhibit the growth of such an innovative system. Therefore, it is of great value to study SFs of design and build projects without neglecting the DBB so that the chance of project success can be increased (Albert & Ada, 2004).

Long et al., (2004) identified success factors for construction projects in Vietnam as; clear objectives and scope, commitment to project, top management support, effective strategic planning, awarding bids to the right designer/contractor, continuing involvement of stakeholders in the project, frequent progress meeting, adequate funding throughout the project, availability of resources, absence of bureaucracy, community involvement, clear information/communications channels, accurate initial cost estimates systematic control mechanisms, competent project manager, multidisciplinary/competent project team, comprehensive contract documentation, up to date technology utilization, proper emphasis on past experience and timely, valuable information from different parties.

2.9 Factors determining the success of a Design and Build project

Gregersen 1998, defined design and build as a method of procurement which have the client enter in a single contract with one organization that integrates the design and construction process. As design and build projects require a greater level of managerial expertise from the contractor for the integration of design and construction, the selection of contractors and sub-contractors has been considered as one of the most important success factors (Hemlin, 1999; Molenaar *et al.*, 1999). Smith, 1999 and Yates, 1995 also reports that attention should be paid to the selection method which should be comprehensive and visible.

Akintoye, 1994 found out that the definition of the project scope and brief is important to the success of design and build project. The factor of project participants is also suggested by both researchers and practitioners as one of the success factors for design and build projects (Leung, 1999). Rowlinson, 1997 identified relationship among project participants as one of the success factors. The experience, knowledge and confidence of the contractor in design and build knowledge are also highlighted as critical to the success of design and build projects (Songer and Molenaar, 1996). Endusers' input is also considered necessary to enhance the degree of success of design and build projects (Retherford, 1998).

The various success factors identified from both researchers and practitioners in the construction industry can be consolidated into six headings, namely project characteristics, project procedures, project management strategies, project-related participants, project work atmosphere and project environment, which are also essential to deliver construction projects with other procurement methods (Edmond et al., 2004).

Edmond et al., 2004, identified that the success factors of design and build projects are similar to those of a construction project in generic sense.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This chapter discusses the various methods that were employed in finding answers to the research questions. The primary goal of this research was to investigate the viability of design and build procurement method in the Ghanaian construction industry. To achieve this aim, the specific objectives that were addressed in this research were to:

1. evaluate and compare:-

a. cost performance of the traditional design-bid-build (DBB) and the emerging design and build (DB) procurement methods;

b. time performance of the two procurement methods;

c. quality performance of the projects executed through the two procurement methods;

2. Identify causes of the projects performance differences if any;
3. Identify the success factors for the DBB and DB procurement methods in the country.

To enable the researcher identify and collate data on all the completed DBB and DB projects in Ghana, an initial telephone interview was conducted with Project Consultants (Quantity surveying firms), D1 and K1 Contractors and Clients across the country. This initial investigation revealed that 310 and 33 building projects with a contract sum of 1 billion cedis and above were completed within January, 2000 to February 2007 using DBB and DB respectively. The initial survey further revealed that most of the completed DB projects were within Greater Accra, Ashanti and Brong Ahafo regions of Ghana thereby compelling the researcher to limit the scope to same.

Though the researcher set out to use a purely statistical and more rigorous approach to determine the samples sizes, this was not possible due to the paucity of information on DB projects and the general apathy in the construction industry in the country towards research of this kind. Questionnaires were therefore sent to consultants, contractors and clients who were found to have completed projects with DBB and DB within the three regions.

Questionnaires were therefore distributed to clients, contractors and consultants who were identified to have undertaken a project which fell within the parameters covered under this study. A total of 185 and 33 (i.e. whole populations) questionnaires were distributed to DBB and DB projects stakeholders respectively. These were purposively distributed and shown in the table below:

Table 3.1: Questionnaire Distribution

Procurement Method	Projects Stakeholders	No. of Questionnaires Distributed	Total
DBB	Clients	45	185
	Contractors	60	
	Consultants	80	
DB	Clients	9	33
	Contractors	12	
	Consultants	12	

3.2 Research Questions and methods

One major question in the construction industry today is whether or not design and build procurement system is better than the traditional design-bid-build procurement system in terms of achieving the basic projects objectives: I) completing within budget, II) completing within project duration (time) and III) completing the project in accordance with the specified and the implied quality standards defined in the contract.

The main research question that was investigated in the study was whether similar construction projects procured through the DBB and DB significantly differ in terms of satisfying the basic project objectives.

To address the research objectives, the following methods were used:

Objective: I

In addressing objective one of this research, historical records of completed projects that were procured through DBB and/or DB methods in the three regions were gathered from project clients, contractors, consultancy firms using structured questionnaires.

The basic project objectives of completing within project duration, completing within budget and completing within the specified quality standards were used as performance indicators to measure the success levels of each method. The following data were collected on each variable:

i) Cost: historical records on similar completed projects which included; original contract sum, final contract sum, net variations, fluctuations, gross floor area, number of floors, average floor heights and contingency allowance were gathered. Mathematical formulae were used to calculate the cost overruns due to fluctuations and variations and aggregate cost overruns/underruns of each project. The projects were brought to a common time frame using the yearly inflation figures. For the inflation figures refer to appendix III. This enabled the researcher to compare similar projects in terms of projects value.

ii) Time: historical records on project commencement date, expected completion date, actual completion date, official hold-up periods and total extension of time granted were also gathered from respondents. Time overrun of each project was determined using mathematical formulae.

iii) Quality: stakeholders satisfaction with quality of materials, workmanship, functionality of the building and observed defects on the completed projects within the defects liability period were also obtained from respondents.

This was achieved by the use of five-point Likert Scale from “highly unacceptable” (1), “unacceptable quality” (2), “satisfactory quality” (3), “acceptable quality” (4) and “highly acceptable quality” (5).

Analysis of variance was used to analyse the data to ascertain whether there was a significant difference between the performances of the two methods. Analysis of variance is a statistical technique used to test simultaneously whether two or more population means are significantly different and provided a useful technique in comparing the performance of the two procurement methods.

The analysis was conducted using the Statistical Package for Social Science (SPSS 13) software and Microsoft excel.

Objective II

To ascertain the reasons behind performance differences, respondents were asked specific questions relating to the project with regards to cost, time and quality factors which have the tendency to influence project performance. This afforded the researcher deduction of reasons behind the performance difference recorded.

Objective III

To address this objective which sought to identify the success factors of the projects investigated, respondents were asked to rank 35 success factors against the five-point Likert scale, from “not significant” (1), “slightly significant” (2), “significant” (3), “very significant” (4) and “extremely significant” (5). Responses to the questionnaire were then analysed. The analysis included ranking the success factors in terms of degree of significance using Relative Importance Indices (RII). Significant test (at 99% confidence interval) was conducted on each of the factors which aided in identifying the significant success factors. The analysis also examined whether or not perceptions of different respondents groups affected the ranking. The Spearman’s rank correlation coefficient was used to test the degree of agreement between the rankings of the respondents’ groups.

3.3 *Research Design*

Questionnaire was the major research tool used in investigating the research question. Interviews were conducted to help respondents explain the reason behind certain information provided which actually helped the researcher to find answers to the reasons behind performance disparity between the two procurement methods. Basically, data were collected via the following steps: (1) the entire projects population in the three regions was considered; (2) systematic structured questionnaire and interview procedures were used to ask prescribed questions and answers recorded; (3) answers were numerically coded and analyzed.

3.4 *Measures of Performance*

3.4.1 Cost

Cost was measured in terms of percentage of cost overrun on each project. This was done by considering two variables; overruns due to variations and fluctuations.

Percentage net variation over final cost (per cent NETVAR) is the ratio of net variations to final contract sum expressed in percentage term. It gave an indication of cost overrun or underrun due to variations in design and materials. Yeong's (1994) used this approach in measuring cost performance:

$$\text{Per cent NETVAR} = \frac{\text{Net value of variations}}{\text{Final contract sum}} \times 100 \text{ per cent}$$

Where, Net value of variations = Final contract sum – Base

Base = Original contract sum + Final rise and fall – Contingency allowance

$$\text{Per cent NETFLUC} = \frac{\text{Net value of fluctuations}}{\text{Final contract sum}} \times 100 \text{ per cent}$$

Where, Net value of fluctuations = Final contract sum - Base

3.4.2 Time

Time overrun was assessed by the percentage of increase or decrease in the estimated project duration in days/weeks, discounting the effect of extension of time (E.O.T.) granted by the client.

$$\text{Time overrun} = \frac{\text{Revised contract period} - \text{Original Contract Period}}{\text{Revised Contract period}} \times 100\ \%$$

Where, Revised contract period = Original contract period + EOT

3.4.3 Quality

Quality was measured in terms of: i) clients satisfaction with the project in terms of quality of materials used, workmanship and functionality of the facility. Whether or not a contractor was invited to rectify defects on the finished product during the defects liability period was also used to determine whether or not a particular procurement method performed well in terms of quality.

CHAPTER FOUR

ANALYSIS OF DATA AND DISCUSSIONS

4.1 Introduction

This chapter presents and discusses the results obtained and the major findings arising from the analysis.

4.2 Sample Data Characteristics

Data sets of 62 DBB projects were received from 79 respondents. The respondents comprised 22 clients, 22 contractors and 35 consultants. On the other hand, data sets of 17 DB projects were received from 25 respondents. The respondents comprised 4, 12, 9 clients, contractors and consultants respectively. In all performance data on 15 similar projects were drawn from the list of 62 DBB and 17 DB projects received from the respondents. The details of the project are shown in Tables 4.1 (a & b) and the summary of the historical records of the projects are presented in Appendix II.

A total of 62 DBB and 17 DB projects were evaluated in addressing the first part of the objective I which sought to evaluate the cost, time and quality performance of the two procurement methods.

The second part of objective I (compare the cost, time and quality performance of DBB and DB procurement methods) was addressed using the 15 similar projects drawn from the data collated.

The second objective (i.e. identify possible causes of performance differences) was also addressed by using the information provided on the 15 similar projects used to address the second part of objective I. Finally, data obtained from the responses of the similar projects were used to identify the success factors of each procurement method.

4.3 Cost Performance of DBB and DB Procurement Methods

The evaluation of the two procurement systems reveals contrasting performances of projects evaluated under this study. The analysis revealed varying levels of fluctuations, variations, time and quality performance by the two procurement methods and revealed a number of disparities in this regard.

4.3.1 Cost Overruns due to Fluctuations

The performances of projects in relation to fluctuation, 27.4% and 94% of DBB and DB projects respectively attracted fluctuations in the cost of materials, plant and labour charges below 1% indicating that those projects did not virtually record any fluctuation at all. This means that 94% of the DB projects surveyed, performed very well with regards to fluctuation since there was no cost overrun due to fluctuation on such projects. Again, 40.3% and 6% of DBB and DB projects respectively recorded fluctuations within 10%. However, a total of 27.4% of DBB projects attracted fluctuations above 20% (Table 4.2).

The performance of the two procurement methods DBB and DB with regards to fluctuation on 15 similar projects did not differ from the results obtained above. Out of the total 15 DB projects, only one attracted fluctuation that is 4%. Conversely, all the 15 DBB projects attracted fluctuation ranging from 4.25% to 25.33% and therefore performed relatively poor as compared to the DB.

Table 4.2: Summary of Projects Cost Performance

Performance Range	Cost overrun due to fluctuations				Cost overrun/underrun due to Variations				Aggregate cost overrun /underrun on the project			
	DBB		DB		DBB		DB		DBB		DB	
	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)	No.	(%)
< 1%	17	27.4%	16	94%	2	3.2%	15	88%	0	0%	14	82%
1% - 10%	25	40.3%	1	6%	22	35.4%	2	12%	11	17.7%	3	18%
11% - 20%	17	27.4%	0	0%	24	38.7%	0	0%	14	22.5%	0	0%
21% - 30%	3	4.8%	0	0%	4	6.4%	0	0%	20	32.2%	0	0%
31% - 40%	0	0%	0	0%	5	8%	0	0%	5	8%	0	0%
41% - 50%	0	0%	0	0%	4	6.4%	0	0%	7	11.2%	0	0%
> 50%	0	0%	0	0%	1	1.6%	0	0%	5	8%	0	0%
Total	62	100%	17	100%	62	100%	17	100%	62	100%	17	100%

To further establish the significance of this performance disparity, the samples on similar projects represented in Table 4.5 was subjected to analysis of variance. The results of this analysis as shown in Tables 4.3 and 4.4 re-emphasised the fact that there is a significant difference in the fluctuation performance of DBB and DB as it produced a P-value = 0.00027 < 0.01.

Table 4.3: Results of Analysis on Cost Overruns Due to Fluctuations on the Projects

Group Statistics

	Procurement Method	N	Mean	Std. Deviation	Std. Error Mean
Cost Overruns Due to Fluctuations	DBB	15	10.3787	7.74258	1.99913
	DB	15	0.2667	1.03280	0.26667

Table 4.4: Results of Analysis on Cost Overruns Due to Fluctuations on the Projects

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								99% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Cost Overruns Due to Fluctuations	24.557	0.000031	5.014	28	0.00027	10.11200	2.01683	4.53896	15.68504

Table 4.5: The Cost, Time and Quality Performance of 15 set of Similar Projects

Project No.	Cost Overruns due to Fluctuation (%)		Cost Overruns due to Variations (%)		Aggregate Cost Overrun (%)		Total Time Overruns (%)		Defects observed on Projects	
	DBB	DB	DBB	DB	DBB	DB	DBB	DB	DBB	DB
1	0	0	3.6	0	3.6	0	0	-14.29	YES	YES
2	8.09	0	3.06	0.61	11.16	0.61	200	2	YES	NO
3	4.25	0	22.24	0	26.49	0	174.07	0	NO	YES
4	25.33	4	30.03	0	55.36	4	82.47	-9	YES	YES
5	0	0	8.45	0	8.45	0	16.67	0	YES	NO
6	12.61	0	4.62	0	17.23	0	89.58	-11.76	YES	YES
7	6.32	0	44.03	0	50.35	0	50	0	NO	NO
8	7.71	0	18.1	0	25.82	0	33.33	-7.5	NO	YES
9	0	0	22.49	0	22.49	0	116.67	-6	YES	YES
10	10.27	0	14.77	0	25.04	0	49.12	14	YES	YES
11	16.8	0	42.91	0	64.58	0	150	-19.5	YES	YES
12	18.69	0	8.27	0	26.96	0	33.33	0	NO	NO
13	20.42	0	11.51	2.19	31.93	2.19	109.09	-10	NO	YES
14	12.26	0	12.12	1.94	24.39	3.13	7.69	5.07	YES	YES
15	12.93	0	18.79	0	31.72	0	50	-16.67	YES	YES

Note:[1.] For detailed records of each project in this table, refer to Appendix 1

It is clear from the results that, at 1% significant level, DBB and DB projects differ significantly in performance regarding cost overruns due to fluctuations. Though all the projects suffered the same inflation, 80% of DBB projects attracted fluctuation while 20% did not. On the other hand 6.7% of DB projects attracted fluctuation while 93.3% did not (Table 4.6). One major reason obtained from respondents on why their contract sums were not adjusted to compensate for price changes during the course of the projects revealed that, those projects did not allow for price fluctuations/adjustments in their respective contract conditions.

Table 4.6: Results of Factors that Contributed to the Projects Performance Differences

FACTORS/QUESTIONS	**DBB**				**DB**			
	YES	%	NO	%	YES	%	NO	%
Delay in honouring of certificates	10	66.7%	5	33.3%	8	53.3%	7	46.7%
Were designs complete at start of the projects	5	33.3%	10	66.7%	8	53.3%	7	46.7%
Did the incompleteness of designs affect works programme	9	90%	1	10%	0	0.0%	8	100%
Were there changes to materials specifications	12	80.0%	3	20.0%	4	26.7%	11	73.3%
If yes, did it increase project cost?	11	91.7%	1	8.3%	0	0.0%	4	100.0%
Were there changes to design	11	73.3%	4	26.7%	6	40.0%	9	60.0%
If yes, did it increase project cost?	10	90.9%	1	9.1%	3	50.0%	3	50.0%
Official Hold-up	7	46.7%	8	53.3%	1	6.7%	14	93.3%

How long it took for certificates to be honoured	YES	%	YES	%
2 Weeks	4	26.7%	6	40.0%
4 Weeks	3	25.0%	6	40.0%
6 Weeks	2	13.3%	None	None
8 Weeks	2	13.3%	3	20.0%
10 Weeks or more	3	20.0%	None	None
How long it took for valuations to be certified				
1 Week	2	13.3%	3	20.0%
2 Weeks	6	40.0%	8	53.3%
3 Weeks	7	46.7%	4	26.7%

4.3.2 Cost Overruns due to Variations

Using the sample of 62 DBB and 17 DB projects to evaluate project performance, it is shown that, DB projects perform better than DBB in the area of cost overruns due to variations. The results in Table 4.2 shows that, only 3.2% of DBB projects did not experience variations whilst as much as 88% of DB did not encounter variation leading to cost overruns. Furthermore, 35.4% and 38.7% of the DBB projects recorded variations ranging within 10% and 20% respectively.

Statistical test reaffirmed the fact that DB projects performs better than DBB projects in the area of variations leading to cost overruns. The test on 15 similar DBB and DB projects as presented in Table 4.5 gave a P-value = 0.000018<0.01 obtained from the results in Table 4.7 and 4.8.

Table 4.7: Results of Analysis on Cost Overruns Due to Variations on the Projects

Group Statistics

	Procurement Method	N	Mean	Std. Deviation	Std. Error Mean
Projects Cost Overrun Due to Variations	DBB	15	17.6660	12.99032	3.35409
	DB	15	0.3160	0.72870	0.18815

Table 4.8: Results of Analysis on Cost Overruns Due to Variations on the Projects

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								99% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Cost Overruns Due to Variations	21.741	0.00007	5.165	28	0.000018	17.35000	3.35936	8.06721	26.63279

It was established in this study that variations occur in the life of most construction projects irrespective of the method of procurement used. But the variations may attract additional cost depending on the method of procurement used and the conditions of contract adopted for that particular project. This study discovered that the contract conditions play an important factor as to whether a project would attract additional cost due to variations or not. Results in Table 4.6 revealed that 11 out 15 DBB projects reviewed, experienced variations to their original designs, 12 out of 15 also saw changes to material specification and 8 out of 15 started the projects before some aspects of the designs were completed. These factors are cost sensitive and had the potential to push the contract sum of any project up provided there is no contractual clause that bars the contractor from claiming for increased cost resulting from changes in design (i.e. fixed or firm price contract) and materials. Since design and construction are undertaken by two separate organizations in DBB procurement method, the client bears any extra cost arising from changes in designs and materials and therefore explains why most of the DBB projects attracted variations leading to cost overruns.

Designs are undertaken by the contractor in DB procurement system and therefore bears the risk of variations in designs provided such changes do not emanate from the client. The results in Table 4.6 shows DB projects recording 40% of design changes, 26.6% of changes to specification and 53.3% of projects having their designs complete at the start of the projects. These factors have the tendency to affect the cost performance of any project. Variation in contract may either increase the quantity of the works (i.e. additions) or reduce it (i.e. omissions). However, in most instances additions overrides the omissions. The results shows 91.7% of the DBB projects that experienced changes in their designs increasing in cost while 50% DB projects that encountered design changes also swelled up in cost but these cost on most occasions were borne by the contractors.

A total of 73.3% of the DBB projects experienced one or more cheap material replaced with an expensive one which affected cost increase and hence those projects recorded extra cost. On the contrary, only 26.7% of DB projects had some materials changed but this did not culminate in any price change either upward or downwards.

Incomplete designs also impacted negatively on the performance of the DBB project. It was discovered that 66.7% of the DBB projects designs were not complete at the start of those projects (Table 4.6). Incomplete designs suggest that initial estimates were based on approximate quantities which had the tendency to throw the project budget out of gear. In the same vain, only 53.3% of DB projects had their designs complete before the projects started but this did not affect the project cost because contractors under DB contracts were expected to have completed their designs before submitting their bid. Again, most DB projects were prototype designs as a results contractor's were able to price the work with precision.

4.3.3 Aggregate Cost Overruns

The aggregate cost overruns on the projects showed that all the 62 number DBB projects recorded aggregate cost overrun ranging from 1% to 50% whilst 14 DB projects representing 82% out of 17 projects did not record any increase in the original contract sum (Table 4.2). This shows that generally, DB projects performs better than DBB projects in the area of aggregate cost overruns.

The DBB projects showed variability in original cost of the respective projects ranging from 3.6% to 64.58% while DB projects showed a marginal increase ranging from 0.61% to 4% with 73.33% of the DB projects surveyed recording zero cost overruns (Table 4.5). This presupposes that the DB projects performed creditably as compared to the DBB projects in terms of overall cost overruns on the projects surveyed. To ascertain whether the cost overrun performance of the projects differ significantly, the data was further subjected to statistical test. This analysis as presented in Tables 4.9 and 4.10 revealed that the differences are significant since P-value = 0.000001< 0.01 was obtained thereby showing a wide difference.

Table 4.9: Results of Analysis on Aggregate Cost Overrun on the Projects

Group Statistics

	Procurement Method	N	Mean	Std. Deviation	Std. Error Mean
Projects Aggregate Cost Overruns	DBB	15	28.3713	17.01011	4.39199
	DB	15	0.6620	1.31994	0.34081

Table 4.10: Results of Analysis on Aggregate Cost Overrun on the Projects

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								99% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Projects Aggregate Cost Overrun	14.899	0.001	6.290	28	0.000001	27.70933	4.60519	15.53663	39.88204

The combined effect of fluctuation and variations influenced the aggregate cost overrun and for that matter cost performance. It can therefore be argued that, the factors that influenced the fluctuations and variations caused the resulted aggregate cost overrun.

4.4 Time Performance of DBB and DB Procurement Methods

The time performance of the projects appraised showed that most building clients could not use their facilities when they really needed them because of poor time performance of most construction projects in the country as a whole. The summary of the projects time performance in Table 4.11 and Figure 4.1 shows that 88% of the DB projects appraised, completed with scheduled completion duration whilst only 10% of DBB projects finished with their respective time. The DBB projects exceeded their scheduled completion dates ranging from 10% to as high as 400%. The 12% of DB projects that exceeded the programmed completion dates took within 25% extra of their original time to complete.

Table 4.11: Summary of Projects Time Performance

Performance Range (%)	DBB		DB	
	Number	**Percentage**	**Number**	**Percentage**
< 1%	6	10%	15	88%
1% to 10%	5	8%	1	6%
11% to 25%	5	8%	1	6%
26% to 50%	11	18%	-	-
51% to 75%	8	13%	-	-
76% to 100%	6	10%	-	-
101% to 150%	12	19%	-	-
151% to 200%	3	5%	-	-
201% to 300%	4	6%	-	-
301% to 400%	2	3%	-	-
Total	62	100%	17	100%

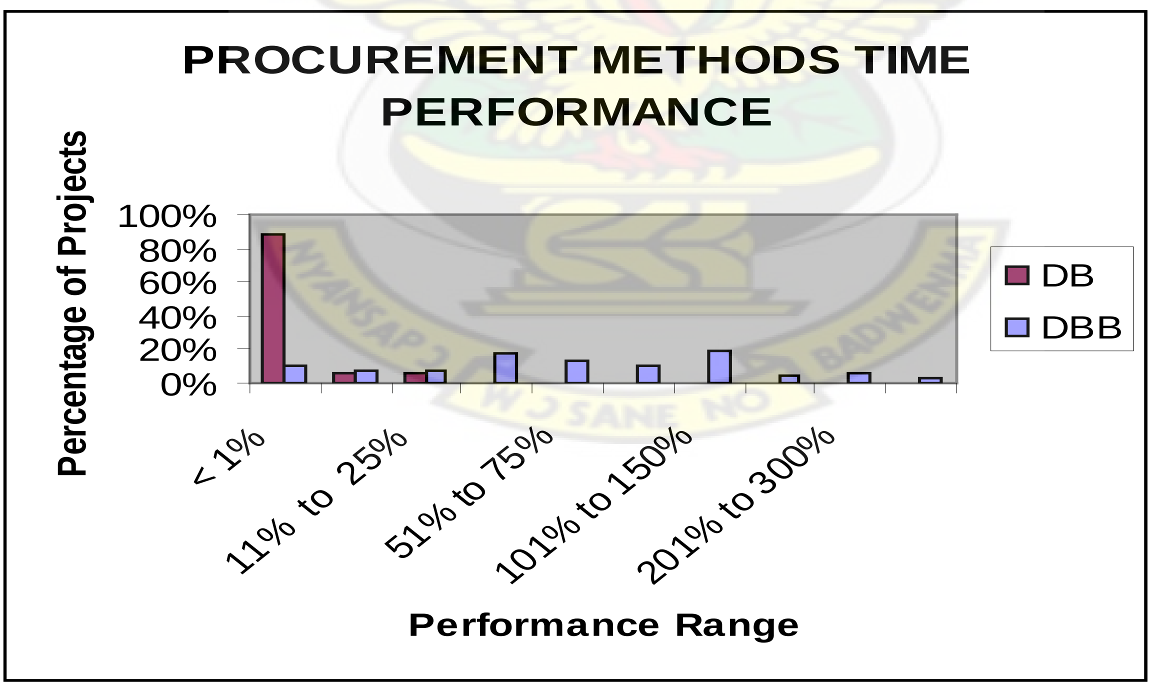

Figure 4.1: Overall Projects Time Performance

Using a sample of 15 similar DBB and DB projects to compare the projects time performance, it is shown that DB projects have very good time performance than their DBB counterparts. The results shown in Table 4.5 indicate an enormous difference between DB and DBB projects time performance. Out of the 15 projects, DB showed 53.33%, 26.67% and 20% completion ahead of scheduled, exactly on schedule and behind schedule respectively. On the other hand, DBB projects showed generally poor time performance. Out of the 15, only 1 representing 6.67 percent completed on scheduled and 14, representing 93.33 percent completed behind scheduled. While 93.33% of the DBB projects experienced time overruns ranging from 7% to 200%, DB projects recorded time overruns ranging from 2% to 14%. Figure 4.2 gives a pictorial representation of the time performance of the similar projects. Further statistical test to ascertain whether there was a significant difference in the time performance of the two methods gave a P-value = 0.000020< 0.01 a very significant difference in the time performance of the two procurement methods (Tables 4.12 and 4.13).

Figure 4.2: Projects Time Performance Comparison

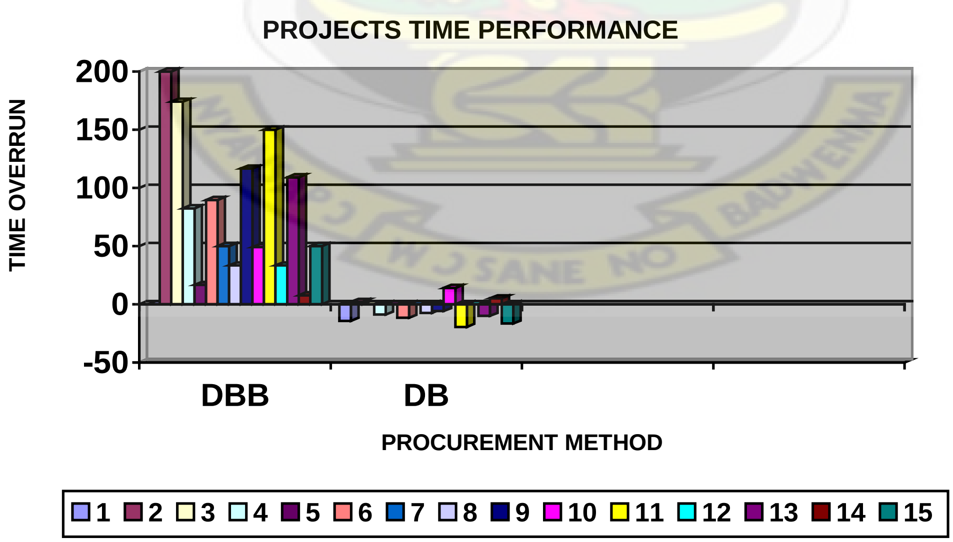

Table 4.12: Results of Analysis on the Time Performance of the Projects

Group Statistics

	Procurement Method	N	Mean	Std. Deviation	Std. Error Mean
Projects Time Performance	DBB	15	77.4680	61.58094	15.90013
	DB	15	-4.9100	9.01576	2.32786

Table 4.13: Results of Analysis on the Time Performance of the Projects

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								99% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Projects Time Performance	26.184	0.00002	5.126	28	0.00002	82.37800	16.06963	37.97339	126.78261

The reasons that could be attributed to the time performance differences between DBB and DB projects are incomplete designs, delay in honouring of certificate, changes to the original designs and official hold-ups. In the case of DBB, 46.7% of the projects encountered official hold-ups ranging from 1week to 3months. On the other hand only 1 project representing 6.67% of DB projects experienced official hold-up of 1 week. The scope of work is directly related to the time it takes to execute such works, and as a result DBB projects experienced a lot of time overruns because most of the projects suffered extension in their scope of works. The results showed that whilst 73.3% of DBB encountered revision of designs only 40% of DB projects suffered same. In addition, whilst 66.7% of DBB projects experienced cost rise as a result of the changes to the designs only 23% of DB project suffered cost increases due to changes to their designs (Table 4.6).

The status of designs at the time of commencement of the projects may have some effect on whether the project can be completed within the scheduled date or not. It is because, contractors would have to wait for designs from the designers before proceeding with the works more so when the procurement method used is DBB where the contractor is not part of the design team to foresee how the design would go. This actually affected the time performance of the DBB projects leading to the generally late completion of the projects. The results showed 46.7% of the DB projects started works before designs were complete whilst as much as 66.7% of DBB projects started before designs were completed (Table 4.6.

Only 13.3% of such respondents in the case of DB projects experienced some sort of delays because of the incomplete designs at the projects commencement date.

The time it took the projects financiers to honour certificates also contributed to the extension of time needed on projects. It is seen from the results that the client of DB projects honour certificates more promptly than their DBB counterparts. Whilst 80% of DB projects received payment within 4weeks, only 46.7% of DBB projects were paid within the same time which definitely had a toll on the progress of the DBB projects

4.5 Quality Performance of DBB and DB Procurement Methods

The quality of the projects which were looked at from the perspective of stakeholders satisfaction with the general quality of works (Table 4.14) and observed defects during the defects liability period (Table 4.15) showed fairly general satisfaction with the quality of both

DBB and DB projects. This finding is not consistent with Gregersen, 1998 discovery that budget and schedule prevail with DB projects whilst quality suffers.

The results further revealed that most contractors in the country as a whole are normally called upon to rectify some defects on the completed projects after the defects liability period irrespective of whether is conventional procurement method (DBB) or the design and build (DB) procurement method.

Table 4.14: Results on Satisfaction with the General Quality of Project

Quality Performance	***Quality Variables***	***Ranking***					***Average***
		1	***2***	***3***	***4***	***5***	
Satisfaction with general quality of project	**DBB PROJECTS – Frequency**						
	Materials Used			7	40	15	4.129
	Workmanship				44	18	4.29
	Functionality				39	23	4.37
	DB PROJECTS						
	Materials Used			2	7	8	4.352
	Workmanship			1	7	9	4.670
	Functionality				9	8	4.670

Table 4.15: Results of Observed Defects on Project

METHOD OF PROCUREMENT	**Defects on Finished Project**		**Without Defects**	
	Frequency	**Percentage**	**Frequency**	**Percentage**
DBB	48	77.4%	14	22.5%
DB	13	76.4%	4	23.6%

The results above show that there is virtually not much to choose between DBB and DB in terms of quality performance.

A glance at Table 4.16 gives a straightforward answer that the disparity in performance of the two methods in terms of quality is very slim. Out of 15 projects, 10 DBB projects making 66.67 percent developed defects of different kinds whilst 11 DB projects making 73.33 percent developed defects. Further statistical test conducted, was to find out whether or not there was much difference between the two methods in terms of the quality of their finished products. The result showed no significant difference in the defects observed on project within the defect liability period and thereby at variance with the findings of Osei-Tutu E., 1999, that the quality of DBB projects are better that that of DB. A P-value of 0.70247 was obtained showing no difference in the quality of the projects in this regard (Tables 4.17 and 4.18).

Table 4.16 : Defects Observed during the Defects Liability Period

PROCUREMENT METHOD	No. of Respondents/ Projects	Defects	Without Defects	Percentage called upon to rectify Defects
DBB	15	10	5	**66.67%**
DB	15	11	4	**73.33%**

Table 4.17: Results of Analysis on the Observed Defects on the Projects

Group Statistics

	Procurement Method	**N**	**Mean**	**Std. Deviation**	**Std. Error Mean**
Observed and Rectified Defects on Projects During Defects Liability Period	DBB	15	0.7333	0.45774	0.11819
	DB	15	0.6667	0.48795	0.12599

Table 4.18: Results of Analysis on the Observed Defects on the Projects

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
								99% Confidence Interval of the Difference	
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Observed and Rectified Defects on Projects DLP	0.592	0.448	0.386	28	0.702	0.06667	0.17275	-0.4106	0.5440 1

The research conducted also sought to discover the level of the quality of materials used for the projects, level of workmanship and functionality of the facilities under study. The result was then analyzed and the necessary comparison carried out to establish whether or not the type of procurement route used had some influence on these aspects of quality on the projects. The result showed that, clearly there is no significant difference in the quality performance of the projects (Tables 4.19, 4.20, 4.21, 4.22, 4.23 and 4.24).

Table 4.19: Results of Analysis on the Quality of Materials used on the Projects
Group Statistics

	Procurement Method	N	Mean	Std. Deviation	Std. Error Mean
Quality of Material Used	DBB	15	4.5333	0.51640	0.13333
	DB	15	4.5333	0.51640	0.13333

Table 4.20: Results of Analysis on the Quality of Materials used on the Projects

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	99% Confidence Interval of the Difference: Lower	Upper
Quality of Material Used	0.000	1.000	0.000	28	1.000	0.00000	0.18856	-.52105	.52105

Table 4.21: Results of Analysis on the Quality of Workmanship on the Projects

Group Statistics

	Procurement Method	N	Mean	Std. Deviation	Std. Error Mean
Quality of Workmanship	DBB	15	4.0667	0.70373	0.18170
	DB	15	4.0667	0.59362	0.15327

Table 4.22: Results of Analysis on the Quality of Workmanship on the Projects

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	99% Confidence Interval of the Difference: Lower	Upper
Quality of Workmanship	0.537	0.470	0.000	28	1.000	0.00000	0.23771	-.65687	.65687

Table 4.23: Results of Analysis on the Functionality of the Projects

Group Statistics

	Procurement Method	N	Mean	Std. Deviation	Std. Error Mean
Functionality of the Project	DBB	15	4.9333	0.25820	0.06667
	DB	15	4.8667	0.35187	0.09085

Table 4.24: Results of Analysis on the Functionality of the Projects

Independent Samples Test

	Levene's Test for Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	99% Confidence Interval of the Difference Lower	Upper
Functionality of the Project	1.463	0.237	0.592	28	0.559	0.06667	0.11269	-0.24472	0.37805

This result is due to the fact that materials like cement are sourced by all contractors from a common supplier and the workforce receives the same training except in house training given by various contractors to their workers.

It can also be attributed to the fact that the workforce of the contractor's were all qualified in their own rights. It also implies that all the contractors used materials of the same quality.

4.6 Determination of Project Success Factors

In the questionnaire, respondents were required to rank in terms of significance 35 DBB and DB success factors drawn from literature and interviews. In addition, respondents were asked to add other success factors that they perceive as being necessary. However, they did not make any significant input. The success factors drawn from the questionnaire were grouped into six (6) categories: project characteristics, project procedures, project related participants, project environment, project management strategies and project work atmosphere. Respondents were required to rank the 35 factors on five-point scale to indicate their importance to respective projects' success/performance. 1 represented not significant, 2 slightly significant, 3 significant, 4 very significant and 5 extremely significant.

4.6.1 Ranking of Success Factors

The rankings made by the respondents using five-point Likert scale were combined and converted into relative importance indices for each factor, by adopting the 'relative importance index' (RII) ranking technique (Equation 4.1)

$$RII = \frac{\sum W}{A \times N} \qquad (0 \leq RII \leq 1) \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (4.1)$$

Where:

$\sum W$ = summation of the weighting given to each success factor

A = highest ranking (5); and

N = total number of respondents for that factor

The relative rankings of the various success factors of DBB and DB, assigned on the basis of the factor RIIs, are presented in Tables 4.25, 4.26, 4.27, 4.28, 4.29 and 4.30.

Results obtained after application of ranking using relative importance indices showed that clients, in the case of DBB, saw the award of bids to the right bidder as the most important factor to the success of projects. This was followed in the order of availability of resources, client's ability to fund the project, inflation and project team leader's commitment to time, cost and quality. The contractor however, ranked the award of bids to the right bidder and clients' ability to fund the projects as having equal importance which were then followed by resources availability, inflation and overall managerial actions in planning, organizing, leading and controlling. The Consultant also ranked the award of bids to the right bidder, clients' ability to fund the project and resources availability first followed by inflation. second and overall managerial actions in planning, organizing, leading and controlling as the most important factor to the success of DBB projects.

The results obtained on the success factors of DB projects did not deviate much from that of the DBB. The Clients saw the award of bids to the right bidder as very critical to the success of DB projects. Resources availability and clients' ability to fund the project were ranked second and third respectively.

From the analysis, contractors also saw the award of bids to the right bidder and clients' ability to fund the project as the first most important, followed by availability of resources and then contract documentation. The consultants also ranked the award of bids to the right bidder, clients' ability to fund the project and availability of resources as the first most important factors. These were followed by overall managerial actions in planning, organizing, leading and controlling, project team leaders' knowledge and skill (competence) and contract documentation.

Generally, the award of bids to the right bidder, clients' ability to adequately fund the project, availability of resources were highly ranked by all respondents and, therefore, took the first three positions in the overall ranking in the two methods. The overall rankings of the success factors in both DBB and DB are shown in Tables 4.31 and 4.32.

4.6.2 Test of Agreement between Respondents on the Success Factors

An agreement analysis (concordance test) was conducted to determine whether the identified success factors vary from respondents (i.e. client, contractors and consultants) on each method. To investigate the agreement of the rank correlation between respondents, a non-parametric statistical method was used (i.e. Spearman's Rank Correlation Coefficient (R); {-1 $\leq$ R $\geq$ +1). An R value approaching -1 or +1 indicates concordance between the sets of respondents within each method whilst an R value approaching 0 indicates non-concordance. R is obtained by means of equation (4.2) (Lucey, 2002; Kendall, 1970).

$$R = 1 - \frac{\left\{ 6\sum_{i=1}^{K} (r_i - r)^2 \right\}}{[n(n^2 - 1)]} \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(4.2)}$$

Where:

k = number of sets of ranking = 5

(ri – r) = the average of the squares of the differences between the rankings assigned to a success factors

n = number of success factors ranked (35)

i = 1, 2 and 3 (1 representing 'Client', 2, 'Contractors' and 3, 'Consultants')

$n(n^2 - 1)$ = the maximum possible squared deviations, i.e. the numerator which will occur if there were perfect agreement among k sets of ranks, and the average ranking were 1,2,3,…n,

R_i = the rank assigned by an individual respondent to one factor.

The null hypothesis tested was that contracting parties vary significantly in their perception of success factors in the construction industry in Ghana. The decision rule was to accept or reject the null hypothesis.

A coefficient of R=1 indicates a perfect agreement and zero indicates no agreement. The value of "R" obtained from calculation are 0.939 and 0.941 for DBB and DB respectively. They express the degree of agreement amongst the three groups (i.e. clients, contractors and consultants) in each case.

The best estimate of the true ranking on 'n' objects is provided where R is significant by the order of the various sum of ranks (Kendal, 1970). Tables 4.33 and 4.34 give results of the responses analyzed by the test for agreement.

4.6.3 Determination of Significant Success Factors

Following determination of the relative importance of the success factors and concordance testing, the next analysis performed was the determination of the significant success factors within each procurement method. For a factor to be considered as significant, the significance test method was conducted. The test involved the formulation of a null and alternative hypothesis, evaluation of the test statistic and determination of the probability (t_α) of observing a value of the test statistics.

The null hypothesis, H_o, is stated as:

"the success factor is NOT significantly important to the success of construction projects within the procurement method"

The alternative Hypothesis H_a is stated as:

"the success factor is significantly important to the success of construction projects within the procurement method"

The t_α was determined through the evaluation of the test statistics at a significance level of 1%. A test statistic less than t_α causes rejection of H_o.

4.6.4 Calculation of the test statistic

The test statistic was obtained by the application of equation 4.3 below.

$$\left(t = \frac{\bar{X} - \mu}{(ó / n^{½})} \right) \text{..................................(4.3)}$$

Where:

$\bar{X}$	= the sample mean
t	= the computed value of the test statistics
μ	= Population mean (mean of means of all the 35 factors)
ó	= standard deviation of the point rankings
n	= number of respondents of each factor

(Devore, 1995)

Tables 4.35 – 4.40 presents the significant testing of all the factors from DBB and DB in terms of respondents groups (i.e. clients, contractors and consultants). The significant factors are highlighted in red. The summary of the significant success factors are also presented in Table 4.41 and 4.42.

4.7 *Discussion of the Identified Significant Success Factors*

4.7.1 Project Procedures

The use of proper procedures in the implementation of every project may increase the chances of its success. The success factors identified under project procedures in both DBB and DB are; awarding bids to the right bidder, payment procedures and arbitration as a means of conflict resolution.

4.7.1.1 Awarding Bids to the Right Bidder

Contractors' or consultants' capacity to undertake the assignment is important to the success of every project irrespective of the method of procurement used. A contractor or consultant who lacks the requisite human and material resources would inevitably delay the completion of the project thereby increasing its overall cost. The award of bids to the right bidder was identified by Long et. al 2004 as being one of the success factors of large construction projects in Vietnam. The selection of contractors/consultant is, therefore, considered a significant factor to achieving project success in both DB and DBB projects in Ghana, and hence, its highest ranking by all respondents in the survey (see Tables 4.41 and 4.42).

4.7.1.2 Arbitration as a means of Conflict resolution

Conflict, they say, is inevitable in every human institution but the most important thing is how these conflicts are resolved. Arbitration as a means of conflict management is seen as a sure way of resolving conflicts which emerges during the execution of construction projects. DBB is believed to be adversarial and would, therefore, need a more friendly means of resolving these disagreements. It is against this background that arbitration as means of conflict management was highly rated as significant to the success of DBB projects (see Table 4.41).

4.7.1.3 Payment Procedures

Payment procedures adopted by clients in releasing funds to the projects executing agencies plays an important role in the success or failure of the construction project. As much as clients' ability to fund the project is crucial, the mode of payment is also very important. This factor was highly ranked by respondents in DBB projects (see Tables 4.41 and 4.42).

4.7.2 Project Related Participants

The construction process demand contribution from several individuals which includes the clients' project team members (architects, quantity surveyors and engineers) and the contractor. The client's ability to fund the project, project team leaders experience, commitment to cost, time and quality were discovered as significant to the success of construction project.

4.7.2.1 Clients' Ability to Fund the Project

Funding is crucial to the success of every construction project. Availability or adequacy of ffunds ensure that construction projects are carried out smoothly and continuously without break irrespective of the procurement method used. Clients' ability to fund the project as a significant success factor to both DBB and DB projects can, therefore, not be overemphasized. This result agrees with the findings of Long et al. 2004, Balassi & Tukel 1996 and White & Fortune, 2002. A look at Tables 4.41 and 4.42 reveals that respondents considered funding as one of the key factors to achieve project success.

4.7.2.2 Project Team Leader

The role of the project team leader is very important to the success of construction projects. The commitment of the entire projects participants in achieving the project success is also very important. The project team leaders experience, knowledge and skills (competence) were identified as significant to the success of DB projects while project team leaders' commitment to cost, time and quality was also identified as significant to the success of DBB projects (see Table 4.41). The respondents to DB projects saw team leaders' knowledge and skill as key to the success of same.

4.7.3 Project Management Strategies

4.7.3.1 Overall Managerial actions in Planning, Organizing and Controlling

To ensure a smooth implementation of a project, the planning, organizing and controlling of all the other aspects of the project including sub-contractors activities is crucial to the success or failure of a project. The result in Tables 4.41 and 4.42 shows the overall management of the project prominently shown as significant to the successful implementation of both DBB and DB projects. The ability of the contractors management to get materials, labour and equipment to site when they are needed through proper allocation of resources, controlling all stakeholders in the job, monitoring progress and implement corrective and preventive measures and proper organization) is key to the success of the project.

4.7.3.2 Contract Documentation

Contract documentation was perceived by respondents as key to the success of DB projects (see Table 4.42). The contract spells out the duties and obligations of all parties to the contract and also outlines the sanctions to defaulters of its terms and conditions such clauses. This confirms Yates, 1995, assertion that the use of proper type of contract may, therefore, increase the chances of project success. Unfortunately, interview with most of the leading design and build contractors in the country revealed that the Government of Ghana do not have any standard conditions of contract for DB projects and, therefore, all DB projects in the country are run on two most popular European conditions of contract (i.e. FIDIC –Conditions of Contract for Design-Build and Turnkey called the Orange book and Conditions of Contract for Plant and Design-Build also called the Yellow Book).

4.7.3.3 Control Mechanism of Sub-Contractors Work

The activities of sub-contractors can badly affect the success of a construction project if not well controlled. The work of the main contractor and the sub-contractor are interdependent and, therefore, need to be coordinated and work together as a team to ensure the success of the project. If the main contractor is competent and the sub-contractors' activities are not controlled and not well coordinated, the project would definitely suffer.

4.7.3.4 Progress Meetings

The analysis identified progress meetings as important to the success of DBB projects. Progress meetings are held during the execution of construction projects meant to share and disseminate information, to assess the progress of work, address pertinent issues militating against the project and updating of stakeholders on the progress of work. The foregoing has the tendency to keep contractors and consultants on their toes to work assiduously to achieve a meaningful progress before the next scheduled meeting and thereby enhancing the success of the project.

4.7.4 Project Environment

4.7.4.1 Resources Availability

Result in Tables 4.41 and 4.42 puts resources availability as one of important success factors of DBB and DB projects studied. Resources in every construction projects include materials, plant, tools and equipment, labour (skilled and unskilled), management and liquid resources in terms of money. It is therefore unthinkable to talk about project success be it DBB or DB without these resources within the project environment. Availability of resources before and during the execution of construction project is important to the success of the project. It therefore confirms Long et. al,'s (2004) statement that, "availability of resources is obvious imperatives to carry out project".

4.7.4.2 Inflation and Interest Rates

Inflation and interest rates were identified as significant success factors of DBB projects. The effect of inflation and interest rates on construction projects cost in third world countries like Ghana is becoming a source of worry to all stakeholders in the construction industry. The results from the evaluation of DBB projects performance with regard to fluctuation shows a very serious trend- almost every constructions project attract very high fluctuations. This trend motivated respondents to rank inflation as key to the success of DBB. Without notwithstanding, DB projects are also influenced by inflation even though the cost may not be transferred to the client depending on the terms of the contract.

4.8 Hypothesis Testing

Hypothesis is some testable belief or opinion, and hypothesis testing alternatively called significant testing is the process by which the belief is tested by statistical means (Lucey, 2002).

The hypotheses put forward under this study were the following significant test:

1. There is no difference in the cost overrun due to fluctuation on DBB and DB Projects;
2. There is no difference in the cost overrun due to variation on DBB and DB projects;
3. The overall cost performance (cost overrun) on DBB and DB projects are the same;
4. Whether DB projects have better time performance than DBB projects;
5. Whether Projects executed through DBB are of higher quality than those of DB.

The above hypothesis tests set from the beginning of the research were statistically tested and rejected or accepted.

4.8.1 Statistical Approach

The study as stated already was based on historical records of similar DBB and DB completed projects in Ghana. The validity of the hypotheses was tested based on the survey results. The hypotheses stated above were formulated as null and alternative hypotheses and denoted by H_o and H_1 respectively. The test of the null hypotheses or significant test is a rule based on the result of a random sample whereby acceptance or rejection of H_o is decided.

4.8.2 Significant Levels

The level of significant is the maximum probability with which one would be willing to risk a Type I error (rejecting H_o when it is true). Thus a 1% level of significant statistically implies that there is 99% confidence that one has made the right decision. It therefore means that there are about one (1) chance in hundred (100) that, one would reject a hypothesis when it should be accepted. A 5% level of significant is normally used for statistical analysis but the researcher decided to be more ambitious thus by using 1%.

4.8.3 Critical Region

The set of values of the test statistic (z) which indicates when to reject H_o is called Critical Region. This also depends on the type and level of test chosen. Critical values are thus the boundaries of the critical region (Lucey, 2002).

The decision rule is that, H_o is rejected when P (the significance level observed) from the analysis is less than 0.01 or 1%.

Test of Hypothesis No. 1

Let the hypothesis:

"There is no difference in the cost overrun due to fluctuation on DBB and DB Projects" be Null Hypothesis and denoted by $H_{o;}$

Let the alternative hypothesis:

"There is a significant difference in the cost overrun due to fluctuation on DBB and DB projects" and be denoted by H_1 at 1% level of significant.

T-test at 99% confidence interval shows significance (P) = 0.00027 (See Table 4.8)

Conclusion:

H_o is rejected since p = 0.00027 < 0.01. It is concluded that there is a significant difference between DBB projects and DB projects with regards to performance in cost overrun due to fluctuations.

Test of Hypothesis No. 2

Let the hypothesis:

"There is no difference in the cost overrun due to variations on DBB and DB Projects" be Null Hypothesis and denoted by $H_{o;}$

Let the alternative hypothesis:

"There is a significant difference in the cost overrun due to variations on DBB and DB projects" and be denoted by H_1 at 1% level of significant.

T-test at 99% confidence interval shows significance (P) = 0.000018 (See Table 4.10)

Conclusion:

H_o is rejected since p = 0.000018 < 0.01. It is concluded that there is a significant difference between DBB projects and DB projects with regards to performance in cost overrun due to variations.

Test of Hypothesis No. 3

Let the hypothesis:

"The overall cost performance (cost overrun) on DBB and DB projects are the same" be Null Hypothesis and denoted by $H_{o;}$

Let the alternative hypothesis:

"There is a significant difference in the overall cost overrun on DBB and DB projects" and be denoted by H_1 at 1% level of significant.

T-test at 99% confidence interval shows significance (P) = 0.000001 (See Table 4.12)

Conclusion:

H_o is rejected since $p = 0.000001 < 0.01$. It is concluded that there is a significant difference between DBB projects and DB projects with regards to aggregate cost overrun on the projects.

Test of Hypothesis No. 4

Let the hypothesis:

"That DB projects have the same time performance as DB projects" be Null Hypothesis and denoted by $H_{o;}$

Let the alternative hypothesis:

"That DB projects do not have the same time performance as DBB projects" and be denoted by H_1at 1% level of significant.

T-test at 99% confidence interval shows significance (P) = 0.00002 < 0.01 (See Table 4.14)

Conclusion:

H_o is rejected since $p = 0.00002 < 0.01$. It is concluded that there is a significant difference in the time performance of DBB and DB. Therefore DB project is likely to be completed far ahead of its DBB counterpart.

Test of Hypothesis No. 5

Let the hypothesis:

"That projects executed through DBB are of the same quality as those of DB" be Null Hypothesis and denoted by $H_{o;}$

Let the alternative hypothesis:

"That projects executed through DBB are not of the same quality as those of DB" and be denoted by H_1at 1% level of significant.

T-test at 99% confidence interval shows significance (P) = 0.702 > 0.01 (table 4.17), P=1.00>0.01 (table 4.19), P=0.470>0.01 (table 4.21), P=0.559>0.01 (4.23)

Conclusion:

H_o is not rejected since all the p-values obtained are greater that 0.01. It is concluded that there is no significant difference in the quality of projects produce via DBB and DB. Therefore DBB projects are of the same quality as that of DB projects.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.0 CONCLUSIONS

5.1 Introduction

Based on the specific objectives and the method of analysis adopted for this study, the following conclusions are drawn:

5.2 Projects Cost Performance

The analysis of variance on the projects performance with regards to fluctuation showed a significant (P) value of 2.7×10^{-4} which implies that there is a significant difference between the performance of DBB and DB projects assessed at 99% confidence interval. DB projects showed very good performance with regards to fluctuation. On the other hand, the performance of the DBB projects studied can be described as very poor due to the high fluctuations recorded by majority of the projects.

The reason behind such wide performance disparity between the DBB and DB projects was attributed to the fact that DB projects take into account any anticipated changes in the prices of materials and labour rates to be used for the projects at the tendering stage and therefore, price for the risk due to fluctuations. Furthermore, most of the DB projects have relatively short duration and would therefore not encounter much change in the prices of building materials.

It was also established from the analysis that DBB and DB projects differ significantly on cost overruns due to variations. A significant (P) value of 1.8×10^{-5} was found when the two methods were subjected to analysis of variance at 99% confidence interval. The DB procurement method had good performance with regards to variations. A good number of the DB projects did not experience variation in cost and those that did were marginal.

It was discovered that, altering of material specification, variations of design and incomplete designs at the start of the projects were found as the main reasons behind the projects performance differences. Clients and consultants in DBB projects were found to be continuously changing the original designs and materials to a higher specification without taking into account the cost of the new materials. On the other hand variations in the material of DB projects were normally substituted with materials of the same price which could equally perform the same function.

It can also be concluded from the analysis that there is a significant difference between the performance of the DBB and DB projects with regard to aggregate cost overrun at 1% level of significant. This is evident in the significant (P) value of 1.0×10^{-6} obtained from the analysis of variance. DB projects recorded better aggregate cost overrun as compared to DBB projects. The reasons attributed to this performance disparity were variations to original designs, variation to materials, incomplete design before the commencement of the projects and price adjustment for fluctuations. These factors really adversely affected the performance of the DBB projects and accounted for the poor performance recorded on aggregate cost overrun.

5.3 Projects Time Performance

The analysis of variance conducted on the time performance of the two methods produced a significant (p) value of 2×10^{-5} at 1% level of significant. This shows that there is a significant difference in the time performance of the two procurement methods. The analysis showed very good time performance of DB projects i.e. 12 out of 15 DB projects completed within their respective contract durations while 14 out of 15 of DBB projects completed after the contract duration. The reasons attributed to the poor time performance of the DBB projects were frequent variations of design and materials, official hold-up and delay in honouring payment certificates. It was also discovered that most DB projects were of repetitive nature and thereby smoothing their learning curve when the same or similar designs are being constructed.

5.4 Quality Performance

This study did not find any significant difference in the quality performance of DBB and DB projects. This means that there are some other factors that influence project quality rather than the procurement method. The implication is that when clients want to obtain high quality projects, they need not waste time debating whether to use DBB or DB. The performance of the two methods was moderately good though majority of the contractors in both cases were called back to site to rectify one defect or two. For DBB projects 10 out of 15 contractors were invited to rectify defects while 11 out of 15 contractors were also invited to rectify defects of various kinds in DB projects. Stakeholders were quite satisfied with the material used, workmanship and functionality of the building fabric by both methods. The reason for this result includes the fact that projects executed by same class of contractors were considered. This class of contractors is more concerned about their reputation and thereby adhering to project specification. They saw management as the most important way to make profit rather than shoddy work which leads to demolishing and rework.

5.5 Success Factors

The third objective of the study which centered on identifying the success factors of DBB and DB was achieved as presented in Tables 4.38. Among the 35 success factors investigated on DBB projects, 11 factors were discovered as significantly important to the success of the traditional procurement method in Ghana. The significant success factor identified under DBB were:

- awarding bids to the right bidder;
- availability of resources;
- clients’ ability to adequately fund the project;
- overall managerial action in planning, organizing, leading and controlling;
- project team leaders’ commitment to time, cost and quality;
- inflation;
- interest rates;
- payment procedures;
- arbitration as a method of conflict resolution;
- progress meeting and
- control mechanism of sub-contractors work.

The study also identified six (6) out of the 35 factors investigated as significantly important to the success of DB projects in the country. These are:

- awarding bids to the right bidder;
- availability of resources;
- clients’ ability to adequately fund the project;
- overall managerial action in planning and organizing;

- contract documentation and
- project team leaders' knowledge and skill (competence).

From the list of factors identified, it could be seen that most of the success factors were human-related since it is human beings who undertake the management of construction projects.

5.6 RECOMMENDATIONS

Based on the findings and the conclusions drawn from the study the following recommendations are made:

5.6.1 Specific Recommendations

1. DB procurement method is a viable method worthy of adoption since projects executed through this method are not likely to exceed their contract sum and are also likely to be completed within the contract duration. The quality performances of projects under this method were also not different from projects implemented through the conventional procurement method (DBB) adopted in the country.

   When time is the most critical aspect of the project, DB is the favourite method recommended by this study since most projects investigated under this method completed within the contract durations.

2. This study has revealed that most clients are unable to adopt this method because of lack of standard tender/contract document for DB method in Ghana. It is therefore recommended that a standard tender/contract document be produced by the Public Procurement Authority to facilitate the use of the method.

3. To improve the performance of the DBB projects, it is recommended that clients should arrange for an adequate funding for the project, reduce to the minimum the variation of design and specifications, and hold consultants liable for inactions that delay in the project delivery and unjustifiable variations.

5.6.2 General Recommendations

1. The researcher again recommends that, the government of Ghana should adopt DB method of procurement for the execution of relatively large government projects to help improve project delivery in the country.

2. It also recommended that the government of Ghana should fund researchers to undertake further study into the reasons behind the low patronage of DB method of procurement.

3. The government of Ghana is also requested to conduct a nationwide seminar on the advantages of DB procurement method to encourage Architects, Engineers, Quantity Surveyors and Contractors to partner and undertake projects via DB method.

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APPENDIX I: QUESTIONNAIRES

QUESTIONNAIRES TO PROJECT CLIENTS

Definition of terms

Design and build (DB): It can be considered as a "family of procurement options" characterized by their integrated approach. One organization, the construction contractor, is responsible for the design and construction of the project. The contractor may use an in-house design team or employ external design team.

Traditional design-bid-build (DBB): this procurement method is one whose most significant feature is the carrying out of design and construction as two distinct, separately, consecutively executed, processes. The two processes are undertaken by separate parties (Consultants and Contractor) under separate contracts to the client.

Cost: Cost for the purposes of the study is not only confined to the contract sum, it is the overall cost that the project incurs from inception to completion, which includes any cost arising from variations and fluctuations

Time: Project duration or time is defined as the period from the day the project site was handed over to the contractor to the day the completed building was duly handed over to the client

Quality: Quality is defined as the level of satisfaction of the projects' stakeholders with quality of materials, workmanship and functionality.

Similar Projects: Two projects are said to be similar in this study when the buildings serve the same purpose (office, hostel, hotel, lecture theatres, hospital buildings etc.) and were built of the same material (concrete framed structure, roofing material, floor and wall finishing etc.)

Success Factors: Success factors are defined as things that must go well to ensure a success of a construction project. They therefore represent factors that must be given special and continual attention to bring about high performance in construction project delivery.

Scheduled Completion Date: This is the programmed date at which the project was supposed to be have been completed and handed over.

SECTION A

Please answer the following question by ticking/filling the spaces provided.

1. Which type of client are you

   (i) Private Client [ ]

   (ii) Corporate Client [ ]

   (iii) Public Client [ ]

   (iv) Others (specify):…………………..

2. How long have you been in the construction industry?

   (i) 0 – 5 years [ ]

   (ii) 6 – 10 years [ ]

   (iii) 11 – 15 years [ ]

   (iv) 16 – 20 years [ ]

   (v) 20 years and above [ ]

3. What is the average number of projects you execute each year?

   [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

SECTION B

Please, if you answer Section B, you may skip Section C and continue from Section D

4. Have you executed project of similar nature by the use of **Design and build (DB)** and **Traditional design-bid-build (DBB)** Procurement methods before?

   Yes [ ] No [ ]

5. If yes to Q.(4), provide information on similar completed projects with contract sum exceeding 1 billion cedis and completed between Jan., 2000 to Feb., 2007 each in the table below and if no to same, continue from Section C:

Procurement Type/ Project Data	**Design-Build Method**	**Traditional design-bid-build (DBB) Method**
Project Title		
Project Commencement Date		
Total Extension of Time granted (Weeks/Months on the project)		
Scheduled Completion Date		
Actual Completion Date		
Official Hold-up period(s) (weeks/months)		
Original Contract Sum		
Final Contract Sum		
Gross Floor Area		
Contingency Allowance		
Total Fluctuation on the project		
Total cost of variations on the project		

6. (i) Did the contractor encountered delay in receiving payment for certificate beyond the specified period in the contract ? **DBB:**Yes [ ] No [ ] **DBB:** Yes [ ] No []

(ii) If yes to Q.6(i), how long?

DBB: [ ] 2Weeks [ ] 4Weeks [ ] 6Weeks [ ] 8Weeks [ ] 10 Weeks or more

DB: [ ] 2Weeks [ ] 4Weeks [ ] 6Weeks [ ] 8Weeks [ ] 10 Weeks or more

7. (i) Was the Contractor invited to rectify defects during/after the defects liability period? **DBB** Yes [ ] No [ ] **DB** Yes [ ] No [ ]

(ii) If yes to Q.7(i), how much was the value of the defects?

DBB……………..………..,… DB…..:………………………

8. Rank the quality of the projects in terms of the variables in the table below:

Quality Variables	DBB					DB				
	Highly Unacceptable	Unacceptable	Satisfactorily	Acceptable	Highly Acceptable	Highly Unacceptable	Unacceptable	Satisfactorily	Acceptable	Highly Acceptable
	1	2	3	4	5	1	2	3	4	5
Materials used for the project										
Workmanship										
Functionality of the project										

9. Were the designs complete at the start of the projects?

DBB Yes [ ] No [ ] **DB** Yes [ ] No [ ]

10. If "**No**" to Q. 9, did it affect the contractors' works programme?

DBB Yes [ ] No [ ] **DB** Yes [ ] No [ ]

11. Was there a change in the materials specification in course of the project?

DBB Yes [ ] No [ ] **DB** Yes [ ] No [ ]

12. If yes to Q. 11, did it increase the project cost?

DBB Yes [ ] No [ ] **DB** Yes [ ] No [ ]

13. If yes to Q. 11, how many materials were changed?

DBB: [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

DB: [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

14. What other factors in your opinion influenced the time performance of the projects?

DBB: 1.……………………………………………………………………………...

2.………………………………………………………………………………

3.………………………………………………………………………………

DB:

1.…………………………………………………………………………

2.…………………………………………………………………………………

3.…………………………………………………………………………………

15. What other factors in your opinion influenced the time performance of the projects?

DBB:

1.…………………………………………………………………………...

2.……………………………………………………………………………

3.……………………………………………………………………………

DB:

1.…………………………………………………………………………

2.………………………………………………………………………………

3.………………………………………………………………………………

SECTION C

This section is only for those who would skip Section B

16. Have you used the **Traditional design-bid-build** Procurement method before?

Yes [ ] No [ ]

17 If yes to Q.16:

(i) How Many projects? [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

(ii)) Provide the following information on one project with contract sum of 1 billion cedis or more and completed between Jan., 2000 to Feb., 2007 in the table below:

Procurement Type/ Project Data	**Project**
Project Title	
Project Commencement Date	
Total Extension of Time granted (Weeks/Months on the project)	
Scheduled Completion Date	
Actual Completion Date	
Official Hold-up period (s) (weeks/months)	
Original Contract Sum	
Final Contract Sum	
Gross Floor Area	
Contingency Allowance	
No. of Floors	
Average floor height	
Total Fluctuation on the project	
Total cost of variations on the project	

18. (i) Did the contractor encountered delay in the specified period in the contract? Yes[] No[]

(ii) If yes to Q.18(i), how long? [] 2Weeks [] 4Weeks [] 6Weeks [] 8Weeks []10Weeks or more

19. Was the Contractor invited to rectify defects during/after the defects liability period?

Yes [ ] No [ ]

20. If yes to Q.19, how much was the value of the defects?...

21. Rank the quality of the project in terms of the variables in the table below:

Quality Variables	Highly Unacceptable	Unacceptable	Satisfactorily	Acceptable	Highly Acceptable
	1	**2**	**3**	**4**	**5**
Materials used for the project					
Workmanship					
Functionality of the project					

22. Were the designs complete at the start of the project? Yes [ ] No [ ]

23. If **"No"** to Q.22, did it affect the contractors' works programme? Yes [ ] No [ ]

24. Was there a change in the material(s) specification in course of the project? Yes [ ] No [ ]

25. If yes to Q. 24, did it increase the project cost? Yes [ ] No [ ]

26. How many materials were changed? [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

27. What other factors in your opinion influenced the time performance of the project?

1. …………………………………………………………………………...
2. ……………………………………………………………………………
3. ……………………………………………………………………………

28. What other factors in your opinion influenced the quality performance of the projects?

1. …………………………………………………………………………...
2. ……………………………………………………………………………
3. ……………………………………………………………………………

<u>DESIGN AND BUILD</u>

29. Have you used **Design and build** Procurement method before?

Yes [ ] No [ ]

30. If yes to Q.29:

(i) How Many projects? [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

(ii) Provide the following information on one project with contract sum of 1 billion cedis or more and completed between Jan., 2000 to Feb., 2007 in the table below:

Procurement Type/ Project Data	**Project**
Project Title	
Project Commencement Date	
Total Extension of Time granted (Weeks/Months on the project)	
Scheduled Completion Date	
Actual Completion Date	
Official Hold-up period (s) (weeks/months)	
Original Contract Sum	
Final Contract Sum	
Gross Floor Area	
Contingency Allowance	
No. of Floors	
Average floor height	
Total Fluctuation on the project	
Total cost of variations on the project	

31. (i) Did the contractor encountered delay in receiving payment for certificate beyond the specified period in the contract ? Yes [ ] No [ ]

(ii) If yes to Q.31(i), how long? [ ] 2 Weeks [ ] 4 Weeks [ ] 6 Weeks [ ] 8 Weeks [ ] 10 Weeks or more

32. Was the Contractor invited to rectify defects during/after the defects liability period?

Yes [ ] No [ ]

33. If yes, to Q.32 how much was the value of the defects?..

34. Rank the quality of the project in terms of the variables in the table below:

Quality Variables	Highly Unacceptable	Unacceptable	Satisfactorily	Acceptable	Highly Acceptable
	1	2	3	4	5
Materials used for the project					
Workmanship					
Functionality of the project					

35. Were the designs complete at the start of the project? Yes [ ] No [ ]

36. If "**No**" to Q.35, did it affect the contractors' works programme? Yes [ ] No [ ]

37. Was there a change in the material(s) specification in course of the project? Yes [ ] No [ ]

38. If yes to Q. 37, did it increase the project cost? Yes [ ] No [ ]

39 How many materials were changed? [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

40. What other factors in your opinion influenced the time performance of the project?

1. …………………………………………………………………………...
2.…………………………………………………………………………
3.…………………………………………………………………………

41. What other factors in your opinion influenced the quality performance of the projects?

1. …………………………………………………………………………...
2.…………………………………………………………………………
3.…………………………………………………………………………

SECTION D

42. The table below contains factors that tend to influence the success of a construction project. **Tick and rank** any of the factors that in your opinion must be given a special attention in other to ensure the success of **Design and Build project and Traditional design-bid-build project**s in Ghana.

ITEM	FACTORS	TRADITIONAL DESIGN-BID-BUILD					DESIGN AND BUILD				
		Not Significant	**Slightly Significant**	**Significant**	**Very Significant**	**Extremely Significant**	**Not Significant**	**Slightly Significant**	**Significant**	**Very Significant**	**Extremely Significant**
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
1.0	**Project Characteristics**										
1.1	Project size (project cost, gross floor area and duration of the project)										
1.2	Project complexity (Physical services, level of technology and uniqueness of project activities)										
1.3	Project objectives (decision to meet a specific cost and duration)										
	Others, specify and Rank										
1.4											
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
1.5											
1.6											
1.7											
2.0	**Project Procedures**										
2.1	Open Competitive Tendering										
2.2	Selective Tendering										
2.3	Negotiated Contract										
2.4	Lump sum contract										
2.5	Arbitration as a method of conflict resolution										
2.6	Litigation as a method of disputes resolution										
2.7	Payment procedures										
2.8	Awarding bids to the right bidder										
	Others specify and Rank										
2.9											
2.10											
2.11											
2.13											
2.14											

3.0	**Project-related participants**										
3.1	Client's experience										
3.2	Client's ability to adequately fund the project throughout its duration										
3.3	Project team leader's experience										
3.4	Project team leader's knowledge and skills (competence)										
3.5	Project team leader's commitment to time, cost and quality										
3.6	Project team leader's effectiveness to coordinate project team members										
	Others specify and Rank										
3.8											
3.9											
3.10											
3.11											
3.12											
4.0	**Project Environment**										
4.1	Weather condition										
4.2	Political environment										
4.3	Influence from government and political leaders										
4.4	Inflation										
4.5	Interest rates										
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
4.6	Bureaucracy										
4.7	Availability of resources										
	Others specify and Rank										
4.8											
4.9											
4.10											
4.11											
4.12											
5.0	**Project Management Strategies**										
5.1	Information and communication channels										
5.2	Overall managerial actions in planning, organizing, leading and controlling										
5.3	Control mechanisms of sub-contractors' works										
5.4	Quality, safety, risk and conflict management systems										

5.5	Organizational structures and culture										
5.6	Progress meetings										
5.7	Contract documentation										
5.8	Transparency in awarding contracts										
	Others specify and Rank										
5.9											
5.10											
5.11											
5.12											
6.0	**Project Work Atmosphere**										
6.1	Project team members' interaction and relationship with each other										
6.2	Project team members' attitude to the work										
6.3	Continuous involvement of stakeholders in the project										
	Others specify and Rank										
6.4											
6.5											
6.6											
6.7											

APPENDIX I: QUESTIONNAIRES CONT'D

QUESTIONNAIRES TO PROJECT CONSTULTANTS

Definition of terms

Design and build (DB): It can be considered as a "family of procurement options" characterized by their integrated approach. One organization, the construction contractor, is responsible for the design and construction of the project. The contractor may use an in-house design team or employ external design team.

Traditional design-bid-build (DBB): this procurement method is one whose most significant feature is the carrying out of design and construction as two distinct, separately, consecutively executed, processes. The two processes are undertaken by separate parties (Consultants and Contractor) under separate contracts to the client.

Cost: Cost for the purposes of the study is not only confined to the contract sum, it is the overall cost that the project incurs from inception to completion, which includes any cost arising from variations and fluctuations

Time: Project duration or time is defined as the period from the day the project site was handed over to the contractor to the day the completed building was duly handed over to the client

Quality: Quality is defined as the level of satisfaction of the projects' stakeholders with quality of materials, workmanship and functionality.

Similar Projects: Two projects are said to be similar in this study when the buildings serve the same purpose (office, hostel, hotel, lecture theatres, hospital buildings etc.) and were built of the same material (concrete framed structure, roofing material, floor and wall finishing etc.)

Success Factors: Success factors are defined as things that must go well to ensure a success of a construction project. They therefore represent factors that must be given special and continual attention to bring about high performance in construction project delivery.

Scheduled Completion Date: This is the programmed date at which the project was supposed to be have been completed and handed over.

SECTION A

Please answer the following question by ticking/filling the spaces provided.

1. Which of the following firms do you work in?
   (i) Architectural Firm [ ]
   (ii) Quantity Surveying Firm [ ]
   (v) Engineering Firm [ ]
   (vi) Others (specify):…………………..

2. Which of the following categories of profession do you belong?
   (ii) Architecture [ ]
   (ii) Quantity Surveying [ ]
   (vi) Civil/Structural Engineering [ ]
   (vii) Others (specify):…………………..

SECTION B

Please, if you answer Section B, you may skip Section C and continue from Section D

3. Have you executed project of similar nature by the use of **Design and build (DB)** and **Traditional design-bid-build (DBB)** Procurement methods before?

   Yes [ ] No [ ]

4. If yes to Q.(3), provide information on similar completed projects with contract sum exceeding 1 billion cedis and completed between Jan., 2000 to Feb., 2007 each in the table below and if no to same, continue from Section C:

Procurement Type/ Project Data	Design and Build Method (DB)	Traditional Design-Bid-Build Method (DBB)
Project Title		
Project Commencement Date		
Total Extension of Time granted (Weeks/Months on the project)		
Scheduled Completion Date		
Actual Completion Date		
Official Hold-up period (s) (weeks/months)		
Original Contract Sum		
Final Contract Sum		
Gross Floor Area		
Contingency Allowance		
No. of Floors		
Average floor height		
Total Fluctuation on the project		
Total net variations on the project		

5. How long did it take for the contractor' certificate to be certified?

DBB: [ ] 1 Week [ ] 2 Weeks [ ] 3 Weeks [ ] 4 Weeks [ ] 5 Weeks or more

DB : [ ] 1 Week [ ] 2 Weeks [ ] 3 Weeks [ ] 4 Weeks [ ] 5 Weeks or more

6. (i) Did the contractor encountered delay in receiving payment for certificate beyond the specified period in the contract ? **DBB:** Yes [ ] No [ ] **DB:** Yes [ ] No [ ]

(iii) If yes to Q.7(i), how long?

DBB: [ ] 2 Week s [ ] 4 Weeks [ ] 6 Weeks [] 8 Weeks [] 10 Weeks or more

DB: [ ] 2 Weeks [ ] 4 Weeks [ ] 6 Weeks [] 8 Weeks [] 10 Weeks or more

7. (i) Was the Contractor invited to rectify defects during/after the defects liability period? **DBB** Yes [ ] No [ ] **DB** Yes [ ] No [ ]

8. Rank the quality of the projects in terms of the variables in the table below:

Quality Variables	DBB					DB				
	Highly Unacceptable	Unacceptable	Satisfactorily	Acceptable	Highly Acceptable	Highly Unacceptable	Unacceptable	Satisfactorily	Acceptable	Highly Acceptable
	1	2	3	4	5					
Materials used for the project										
Workmanship										
Functionality of the project										

9. Were the designs complete at the start of the projects?

DBB: Yes [ ] No [ ] **DB:** Yes [ ] No [ ]

10. If No to Q. 11, did it affect the contractors' works programme?

DBB: Yes [ ] No [ ] **DB:** Yes [ ] No [ ]

11. Was there a change in the material(s) specification in course of the project?

DBB: Yes [ ] No [ ] **DB:** Yes [ ] No [ ]

12. If yes to Q. 11, did it increase the project cost?

DBB: Yes [ ] No [ ] **DB:** Yes [ ] No [ ]

13. If yes to Q. 12, how many materials were changed?

DBB: [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

DB: [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

14. What other factors in your opinion influenced the time performance of the projects?

1. …………………………………………………………………………...
2.……………………………………………………………………………
3.……………………………………………………………………………

15. What other factors in your opinion influenced the quality performance of the projects?

1. …………………………………………………………………………...
2.……………………………………………………………………………
3.……………………………………………………………………………

SECTION C

This section is only for those who would skip Section B

16. Have you used the **Traditional design-bid-build** Procurement method before?

Yes [ ] No [ ]

17. If yes to Q.16:

(i) How Many projects? [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

(ii) Provide the following information on one project with contract sum of 1 billion cedis or more and completed between Jan., 2000 to Feb., 2007 in the table below:

Procurement Type/ Project Data	**Project**
Project Title	
Project Commencement Date	
Total Extension of Time granted (Weeks/Months on the project)	
Scheduled Completion Date	
Actual Completion Date	
Official Hold-up period(s) (weeks/months)	
Original Contract Sum	
Final Contract Sum	
Gross Floor Area	
Contingency Allowance	
No. of Floors	
Average floor height	
Total Fluctuation on the project	
Total cost of variations on the project	

18. How long did you take to certify contractors certificates?

[ ] 1 Week [ ] 2 Weeks [ ] 3 Weeks [ ] 4 Weeks [ ] 5 Weeks or more

19. (i) Did the contractor encountered delay in receiving payment for certificates beyond the specified period in the contract? Yes [ ] No [ ]

(ii) If yes to Q.19(i), how long? [ ] 2 Weeks [ ] 4 Weeks [ ] 6 Weeks [ ] 8 Weeks [ ] 10 Weeks or more

20. Was the Contractor invited to rectify defects during/after the defects liability period? Yes [ ] No [ ]

21. If yes, to Q.20, how much was the value of the defects?..

22. Rank the quality of the project in terms of the variables in the table below:

Quality Variables	**Highly Unacceptable**	**Unacceptable**	**Satisfactorily**	**Acceptable**	**Highly Acceptable**
	1	**2**	**3**	**4**	**5**
Materials used for the project					
Workmanship					
Functionality of the project					

23. Were the designs complete at the start of the projects? Yes [ ] No [ ]

24. If **NO** to Q.23, did it affect the contractors' works programme? Yes [ ] No [ ]

25. Was there a change in the material(s) specification in course of the project? Yes [ ] No [ ]

26. If yes to Q. 25, did it increase the project cost? Yes [ ] No [ ]

27. How many materials were changed? [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

28. What other factors in your opinion influenced the time performance of the projects?

1. …………………………………………………………………………...

2.………………………………………………………………………………

3.………………………………………………………………………………

29. Which of the following factors in your opinion influenced the quality performance of the projects?

1. …………………………………………………………………………...

2.………………………………………………………………………………

3.………………………………………………………………………………

DESIGN AND BUILD

30. Have you used **Design and build** Procurement method before?

Yes [ ] No [ ]

31. If yes to Q.30:

(i) How Many projects? [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

(ii)) Provide the following information on one project with contract sum of 1 billion cedis or more and completed between Jan., 2000 to Feb., 2007 in the table below:

Procurement Type/ Project Data	**Project**
Project Title	
Project Commencement Date	
Total Extension of Time granted (Weeks/Months on the project)	
Scheduled Completion Date	
Actual Completion Date	
Official Hold-up period(s) (weeks/months)	
Original Contract Sum	
Final Contract Sum	
Gross Floor Area	
Contingency Allowance	
No. of Floors	
Average floor height	
Total Fluctuation on the project	
Total cost of variations on the project	

32. (i) How long did you take to certify contractors certificates?

[ ] 1 Week [ ] 2 Weeks [ ] 3 Weeks [ ] 4 Weeks [ ] 5 Weeks or more

33. (i) Did the contractor encountered delay in receiving payment for certificates beyond the specified period in the contract ? Yes [ ] No [ ]

(ii) If yes to Q.33(i), how long? [ ] 2 Weeks [ ] 4 Weeks [ ] 6 Weeks [ ] 8 Weeks [ ] 10 Weeks or more

34. Was the Contractor invited to rectify defects during/after the defects liability period? Yes [ ] No [ ]

35. If yes to Q.34, how much was the value of the defects?..

36. Rank the quality of the project in terms of the variables in the table below:

Quality Variables	**Highly Unacceptable**	**Unacceptable**	**Satisfactorily**	**Acceptable**	**Highly Acceptable**
	1	**2**	**3**	**4**	**5**
Materials used for the project					
Workmanship					
Functionality of the project					

37. Were the designs complete at the start of the projects? Yes [ ] No [ ]

38. If No to Q.46, did it affect the contractors' works programme? Yes [ ] No [ ]

39. Was there a change in the material(s) specification in course of the project? Yes [ ] No [ ]

40. If yes to Q. 39, did it increase the project cost? Yes [ ] No [ ]

41. How many materials were changed? [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

42. What other factors in your opinion influenced the time performance of the projects?

1. …………………………………………………………………………...
2.…………………………………………………………………………
3.…………………………………………………………………………

43. What other factors in your opinion influenced the quality performance of the projects?

1. …………………………………………………………………………...
2.…………………………………………………………………………
3.…………………………………………………………………………

SECTION D

44. The table below contains factors that tend to influence the success of a construction project. **Tick and rank** any of the factors that in your opinion must be given a special attention in other to ensure the success of **Design and Build project and Traditional design-bid-build project**s in Ghana.

ITEM	FACTORS	TRADITIONAL DESIGN-BID-BUILD					DESIGN AND BUILD				
		Not Significant	Slightly Significant	Significant	Very Significant	Extremely Significant	Not Significant	Slightly Significant	Significant	Very Significant	Extremely Significant
		1	2	3	4	5	1	2	3	4	5
1.0	**Project Characteristics**										
1.1	Project size (project cost, gross floor area and duration of the project)										
1.2	Project complexity (Physical services, level of technology and uniqueness of project activities)										
1.3	Project objectives (decision to meet a specific cost and duration)										
	Others, specify and Rank										
1.4											
1.5											
1.6											
1.7											
2.0	**Project Procedures**										
2.1	Open Competitive Tendering										
2.2	Selective Tendering										
2.3	Negotiated Contract										
2.4	Lump sum contract										
2.5	Arbitration as a method of conflict resolution										
2.6	Litigation as a method of disputes resolution										
2.7	Payment procedures										
2.8	Awarding bids to the right designer/contractor										

	Others specify and Rank										
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
2.9											
2.10											
2.11											
2.13											
2.14											
3.0	**Project-related participants**										
3.1	Client's experience										
3.2	Client's ability to adequately fund the project throughout its duration										
3.3	Project team leader's experience										
3.4	Project team leader's knowledge and skills (competence)										
3.5	Project team leader's commitment to time, cost and quality										
3.6	Project team leader's effectiveness to coordinate project team members										
	Others specify and Rank										
3.8											
3.9											
3.10											
3.11											
3.12											
4.0	**Project Environment**										
4.1	Weather condition										
4.2	Political environment										
4.3	Influence from government and political leaders										
4.4	Inflation										
4.5	Interest rates										
4.6	Bureaucracy										
4.7	Availability of resources										
	Others specify and Rank										
4.8											
4.9											
4.10											
4.11											
5.0	**Project Management Strategies**										
5.1	Information and communication channels										

5.2	Overall managerial actions in planning, organizing, leading and controlling										
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
5.3	Control mechanisms of sub-contractors' works										
5.4	Quality, safety, risk and conflict management systems										
5.5	Organizational structures and culture										
5.6	Progress meetings										
5.7	Contract documentation										
5.8	Transparency in awarding contracts										
	Others specify and Rank										
5.9											
5.10											
5.11											
5.12											
6.0	**Project Work Atmosphere**										
6.1	Project team members' interaction and relationship with each other										
6.2	Project team members' attitude to the work										
6.3	Continuous involvement of stakeholders in the project										
	Others specify and Rank										
6.4											
6.5											
6.6											
6.7											

APPENDIX I: QUESTIONNAIRES CONT'D

QUESTIONNAIRES TO PROJECT CONTRACTORS

Definition of terms

Design and build (DB): It can be considered as a "family of procurement options" characterized by their integrated approach. One organization, the construction contractor, is responsible for the design and construction of the project. The contractor may use an in-house design team or employ external design team.

Traditional design-bid-build (DBB): this procurement method is one whose most significant feature is the carrying out of design and construction as two distinct, separately, consecutively executed, processes. The two processes are undertaken by separate parties (Consultants and Contractor) under separate contracts to the client.

Cost: Cost for the purposes of the study is not only confined to the contract sum, it is the overall cost that the project incurs from inception to completion, which includes any cost arising from variations and fluctuations

Time: Project duration or time is defined as the period from the day the project site was handed over to the contractor to the day the completed building was duly handed over to the client

Quality: Quality is defined as the level of satisfaction of the projects' stakeholders with quality of materials, workmanship and functionality.

Similar Projects: Two projects are said to be similar in this study when the buildings serve the same purpose (office, hostel, hotel, lecture theatres, hospital buildings etc.) and were built of the same material (concrete framed structure, roofing material, floor and wall finishing etc.)

Success Factors: Success factors are defined as things that must go well to ensure a success of a construction project. They therefore represent factors that must be given special and continual attention to bring about high performance in construction project delivery.

Scheduled Completion Date: This is the programmed date at which the project was supposed to be have been completed and handed over.

SECTION A

Please answer the following question by ticking/filling the spaces provided.

1. Which type of construction works are you into?
   (i) Building Works [ ]
   (ii) Civil Works [ ]
   (vii) Both Building and Civil Works [ ]
   (viii) Others (specify):…………………………………..

2. How long have you been in the construction industry?
   (iii) 0 – 5 years [ ]
   (ii) 6 – 10 years [ ]
   (viii) 11 – 15 years [ ]
   (ix) 16 – 20 years [ ]
   (x) 20 years and above [ ]

3. What is the average number of projects you execute in a year?
   [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

SECTION B

Please, if you answer Section B, you may skip Section C and continue from Section D

4. Have you executed project of similar nature by the use of **Design and build (DB)** and **Traditional design-bid-build (DBB)** Procurement methods before?
   Yes [ ] No [ ]

4. If yes to Q.(4), provide information on similar completed projects with contract sum exceeding 1 billion cedis and completed between Jan., 2000 to Feb., 2007 each in the table below and if no to same, continue from Section C:

Procurement Type/ Project Data	Design-Build Method	Traditional design-bid-build Method
Project Title		
Project Commencement Date		
Total Extension of Time granted (Weeks/Months on the project)		
Scheduled Completion Date		
Actual Completion Date		
Official Hold-up period(s) (weeks/months)		
Original Contract Sum		
Final Contract Sum		
Gross Floor Area		
Contingency Allowance		
No. of Floors		
Average floor height		
Total Fluctuation on the project		
Total cost of variations on the project		

6. (i) Did your outfit encountered delay in receiving payment for certificates beyond the specified period in the contract ? **DBB:** Yes [ ] No [ ] **DB:** Yes [ ] No [ ]

   (iv) If yes to Q.6(i), how long?

   DBB: [ ] 2 Weeks [ ] 4 Weeks [ ] 6 Weeks [ ] 8 Weeks [ ] 10 Weeks or more

   DB: [ ] 2 Weeks [ ] 4 Weeks [ ] 6 Weeks [ ] 8 Weeks [ ] 10 Weeks or more

7. (i) Were you invited to rectify defects during/after the defects liability period?

   DBB Yes [ ] No [ ] **DB** Yes [ ] No [ ]

   (iii) If yes to Q.7(i), how much was the value of the defects?

   DBB……………..………..… **DB**…..………………………

8. Rank the quality of the projects in terms of the variables in the table below:

Quality Variables	DBB					DB				
	Highly Unacceptable	Unacceptable	Satisfactorily	Acceptable	Highly Acceptable	Highly Unacceptable	Unacceptable	Satisfactorily	Acceptable	Highly Acceptable
	1	2	3	4	5	1	2	3	4	5
Materials used for the project										
Workmanship										
Functionality of the project										

9. Were the designs complete at the start of the projects?

   DBB Yes [ ] No [ ] **DB** Yes [ ] No [ ]

10. If yes to Q. 9, did it affect your works programme?

DBB Yes [ ] No [ ] **DB** Yes [ ] No [ ]

11. Was there a change in the material(s) specification in course of the project?

DBB Yes [ ] No [ ] **DB** Yes [ ] No [ ]

13. If yes to Q. 11, did it increase the project cost?

DBB Yes [ ] No [ ] **DB** Yes [ ] No [ ]

14. If yes to Q. 13, how many materials were changed?

DBB: [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

DB: [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

15. Which other factors in your opinion influenced the time performance of the projects?

DBB:

1.…………………………………………………………………………...
2.………………………………………………………………………………
3.………………………………………………………………………………

DB:
1.…………………………………………………………………………
2.…………………………………………………………………………………
3.…………………………………………………………………………………

16. Which other factors in your opinion influenced the time performance of the projects?
DBB:
1.…………………………………………………………………………...
2.………………………………………………………………………………
3.………………………………………………………………………………
DB:
1.…………………………………………………………………………
2.…………………………………………………………………………………
3.…………………………………………………………………………………

<u>SECTION C</u>

<u>This section is only for those who would skip Section B</u>

17. Have you used the **Traditional design-bid-build** Procurement method before?

Yes [ ] No [ ]

18. If yes to Q.17:

(i) How Many projects? [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

(ii) Provide the following information on one project with contract sum of 1 billion cedis or more and completed between Jan., 2000 to Feb., 2007 in the table below:

Procurement Type/ Project Data	**Project**
Project Title	
Project Commencement Date	
Total Extension of Time granted (Weeks/Months on the project)	
Scheduled Completion Date	
Actual Completion Date	
Official Hold-up period(s) (weeks/months)	
Original Contract Sum	
Final Contract Sum	
Gross Floor Area	
Contingency Allowance	
No. of Floors	
Average floor height	
Total Fluctuation on the project	
Total cost of variations on the project	

19. (i) Did you encounter delay in receiving payment for claims beyond the specified period in the contract? Yes [ ] No [ ]

(ii) If yes to Q.19(i), how long? [ ] 2 Weeks [ ] 4 Weeks [ ] 6 Weeks [ ] 8 Weeks [ ] 10 Weeks or more

20. Were you invited to rectify defects during/after the defects liability period? Yes [ ] No [ ]

21. If yes to Q.20, how much was the value of the defects?...

22. Rank the quality of the project in terms of the variables in the table below:

Quality Variables	**Highly Unacceptable**	**Unacceptable**	**Satisfactorily**	**Acceptable**	**Highly Acceptable**
	1	**2**	**3**	**4**	**5**
Materials used for the project					
Workmanship					
Functionality of the project					

23. Were the designs complete at the start of the project? Yes [ ] No [ ]

24. If "**NO"** to Q.23, did it affect the your works programme? Yes [ ] No [ ]

25. Was there a change in the material(s) specification in course of the project? Yes [ ] No [ ]

26. If yes to Q. 25, did it increase the project cost? Yes [ ] No [ ]

27. How many materials were changed? [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

28. What other factors in your opinion influenced the time performance of the project?
1.…………………………………………………………………………...
2.……………………………………………………………………………
3.……………………………………………………………………………

29. What other factors in your opinion influenced the quality performance of the project?
1.…………………………………………………………………………...
2.……………………………………………………………………………
3.……………………………………………………………………………

DESIGN AND BUILD

30. Have you used **Design and build** Procurement method before?
Yes [ ] No [ ]

31. If yes to Q.30:
(i) How Many projects? [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more
(ii) Provide the following information on one project with contract sum of 1 billion cedis or more and completed between Jan., 2000 to Feb., 2007 in the table below:

Procurement Type/ Project Data	**Project**
Project Title	
Project Commencement Date	
Total Extension of Time granted (Weeks/Months on the project)	
Scheduled Completion Date	
Actual Completion Date	
Official Hold-up period(s) (weeks/months)	
Original Contract Sum	
Final Contract Sum	
Gross Floor Area	
Contingency Allowance	
No. of Floors	
Average floor height	
Total Fluctuation on the project	
Total cost of variations on the project	

32. (i) How long did it take for your certificates to be certified?
[ ] 1 Week [ ] 2 Weeks [ ] 3 Weeks [ ] 4 Weeks [ ] 5 Weeks or more

33. (i) Did you encounter delay in receiving payment for certificate beyond the specified period in the contract ? Yes [ ] No [ ]
(ii) If yes to Q.34(i), how long? [ ] 2 Weeks [ ] 4 Weeks [ ] 6 Weeks [ ] 8 Weeks [ ] 10 Weeks or more

34. Were you invited to rectify defects during/after the defects liability period? Yes [ ] No [ ]

35. If yes, to Q.34, how much was the value of the defects?..

36. Rank the quality of the project in terms of the variables in the table below:

Quality Variables	Highly Unacceptable	Unacceptable	Satisfactorily	Acceptable	Highly Acceptable
	1	**2**	**3**	**4**	**5**
Materials used for the project					
Workmanship					
Functionality of the project					

37. Were the designs complete at the start of the project? Yes [ ] No [ ]

38. If **"NO"** to Q.37, did it affect the your works programme? Yes [ ] No [ ]

39. Was there a change in the material(s) specification in course of the project? Yes [ ] No [ ]

40. If yes to Q. 40, did it increase the project cost? Yes [ ] No [ ]

41. How many materials were changed? [ ] 1 [ ] 2 [ ] 3 [ ] 4 [ ] 5 or more

42. What other factors in your opinion influenced the time performance of the project?

1.…………………………………………………………………………...

2.……………………………………………………………………………

3.……………………………………………………………………………

43. What other factors in your opinion influenced the quality performance of the projects?

1.…………………………………………………………………………...

2.……………………………………………………………………………

3.……………………………………………………………………………

SECTION D

44. The table below contains factors that tend to influence the success of a construction project. **Tick and rank** any of the factors that in your opinion must be given a special attention in other

to ensure the success of **Design and Build project and Traditional design-bid-build project**s in Ghana.

ITEM	FACTORS	TRADITIONAL DESIGN-BID-BUILD					DESIGN AND BUILD				
		Not Significant	Slightly Significant	Significant	Very Significant	Extremely Significant	Not Significant	Slightly Significant	Significant	Very Significant	Extremely Significant
		1	2	3	4	5	1	2	3	4	5
1.0	**Project Characteristics**										
1.1	Project size (project cost, gross floor area and duration of the project)										
1.2	Project complexity (Physical services, level of technology and uniqueness of project activities)										
1.3	Project objectives (decision to meet a specific cost and duration)										
	Others, specify and Rank										
1.4											
1.5											
1.6											
1.7											
2.0	**Project Procedures**										
2.1	Open Competitive Tendering										
2.2	Selective Tendering										
2.3	Negotiated Contract										
2.4	Lump sum contract										
2.5	Arbitration as a method of conflict resolution										
2.6	Litigation as a method of disputes resolution										
2.7	Payment procedures										
2.8	Awarding bids to the right designer/contractor										
		1	2	3	4	5	1	2	3	4	5
	Others specify and Rank										
2.9											
2.10											
2.11											

2.13											
2.14											
3.0	**Project-related participants**										
3.1	Client's experience										
3.2	Client's ability to adequately fund the project throughout its duration										
3.3	Project team leader's experience										
3.4	Project team leader's knowledge and skills (competence)										
3.5	Project team leader's commitment to time, cost and quality										
3.6	Project team leader's effectiveness to coordinate project team members										
	Others specify and Rank										
3.8											
3.9											
3.10											
3.11											
3.12											
4.0	**Project Environment**										
4.1	Weather condition										
4.2	Political environment										
4.3	Influence from government and political leaders										
4.4	Inflation										
4.5	Interest rates										
4.6	Bureaucracy										
4.7	Availability of resources										
	Others specify and Rank										
4.8											
4.9											
4.10											
5.0	**Project Management Strategies**										
5.1	Information and communication channels										
		1	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
5.2	Overall managerial actions in planning, organizing, leading and controlling										
5.3	Control mechanisms of sub-contractors' works										

5.4	Quality, safety, risk and conflict management systems										
5.5	Organizational structures and culture										
5.6	Progress meetings										
5.7	Contract documentation										
5.8	Transparency in awarding contracts										
	Others specify and Rank										
5.9											
5.10											
5.11											
5.12											
6.0	**Project Work Atmosphere**										
6.1	Project team members' interaction and relationship with each other										
6.2	Project team members' attitude to the work										
6.3	Continuous involvement of stakeholders in the project										
	Others specify and Rank										
6.4											
6.5											
6.6											
6.7											