Fifth International Conference on Construction in the 21st Century (CITC-V)
"Collaboration and Integration in Engineering, Management and Technology"
May 20-22, 2009, Istanbul, Turkey

Cost and Time of Construction Projects in Malaysia

Intan Rohani Endut
Faculty of Civil Engineering, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia
z_intan@yahoo.com,

Zayanna Shehu
School of Build and Natural Environment, Glasgow Caledonian University, 70 Cowcaddens Road, Glasgow,G4 0BA
zayyana.shehu@gmail.com

Akintola Akintoye
School of Built and Natural Environment, University of Central Lancashire, Preston PR1 2HE
aakintoye@uclan.ac.uk

Aini Jaafar
Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia
ainijaapar@yahoo.com

Abstract
In construction, cost and time are part of the project success indicators. Cost and time overruns are considered as common problem in construction projects. The extent to which construction projects in the Malaysian construction industry are experiencing cost and time overruns is currently unknown. An initial investigation has been undertaken by looking into the time and cost overrun of projects executed in Malaysia and to find out the relationship between the cost and time for a construction project. A questionnaire survey targeting quantity surveying consultants was conducted. The data was collected on 359 projects consisting of new build and refurbishment projects executed by the public and private sectors. The firms provide information on previous projects relating to: general information of the company, name of the projects, start and completion date, location, number of storeys, gross floor area for building projects, contractual and actual durations, pre-contract budge, contract sum and final account. The results of the data collection indicate the cost overrun of the projects ranges form -80.38% to 88.76% and time overrun ranges from -19.32% to 440%. It also suggest that time overrun in project delivery in Malaysia is more crucial than cost overrun. The relationship between time and cost for a construction project would be represented by the Bromilow equation ($T=KC^B$). The results show that for the construction projects in Malaysia there is no evidence to suggest that all the project parameters considered follow this relationship

Keywords
Construction projects, Cost, Cost overrun, Time, Time overrun

1. Introduction

Malaysia is a fast developing country in Asian region and has undergone rapid economic growth since the seventies. The construction industry (CI) has played an important role in the Malaysia economic growth. The industry has been consistently contributed approximately 3% to 5% of the national Gross Domestic Product (GDP) (Shari, 2000; Takim, 2005). The growth in construction has been increase from 6% to 15% since the seventies until middle nineties (Raftery *et al.*, 1998; Shari, 2000). There are two main sector for construction projects in Malaysia; public and private sector. Most of the public sector projects are handled by Public Works Department (PWD) and numerous public projects were offered to the contractors, together with subsidies and loan programs. In Malaysia, the Construction Industry Development Board (CIDB) is a body with the main function of developing, improving and expanding the Malaysian construction industry and is involved with the public and private sectors project development (Takim, 2005).

The construction project can be regarded as successful when the project is completed on time, within budget and with appropriate technical performance or quality (William 2003). According to Chimwaso (2000) projects completed within budget are rarely found compared with cases of projects with cost overrun. Cost and time overruns are major problems in project development and are regular features in construction industry especially for developing country. This makes projects costly for the parties involved in construction especially for contractors and clients. The same holds for time overrun. Impact of project time overrun or delays for contractors include increased costs, reduced profit margin and battered reputation. Clients are also affected by additional charges and professional fees and reduced incomes because of late occupancy. As part of the factors responsible for delays in construction completion, (Ng *et al.*, 2001) noted that most contractors assume that duration set by the client is realistic and prepare their bid accordingly. This paper presents an evidence-based analysis on the cost and time overrun and the relationship between time and cost of the public and private sector projects in Malaysia based on a questionnaire survey that covers a wider area of the Malaysian construction industry.

2. Overview of Cost and Time Overrun in Construction Projects

Construction project time overrun can be defined as an extension of time beyond the contractual time agreed during the tender and cost overrun as an extra cost beyond the contractual cost agreed during the tender. Many previous studies have identified cost and time overruns as general problems in the construction industry worldwide (Kaka and Price, 1991; Elinwa and Buba, 1993; Ogunlana *et al.*, 1996; Abd-Majid and McCaffer, 1998; Okuwoga, 1998; Ng *et al.*, 2001; Shi *et al.*, 2001; Aibinu and Jagboro, 2002; Choudhury and Rajan, 2003; Koushki *et al.*, 2005).

A study undertaken by Odeck (2004) for Norwegian Public Roads Adminstration showed that cost overruns ranged from -59% to 183% and this was more predominant on smaller projects compared with larger ones. Aibinu and Jogboro (2002) study indicated that Nigerian construction industry experienced a mean percentage cost overruns of 17.34%. Kaming *et al.* (1997) found cost overruns to be more common than time overruns on high-rise projects in Indonesia and consequently suggested a need for method studies and dissemination of the research results to both large and small firms, so that the most productive working methods can be adopted by all operatives. They saw this as a means to increase operatives output, without necessarily exerting more physical effort.

Research by Flyvbjerg *et al.*, (2002) concluded that nine out of ten transportation infrastructure projects costs are underestimated and that for all project types the actual costs are on average 28% higher than estimated costs. Forty four percent (44%) of the respondent in the research undertaken on the Nigerian construction industry by Elinwa and Joshua (2001) indicate that, time overrun often occured. Another research conducted by Barrick, cited by Elinwa and Joshua (2001) on the United Kingdom construction industry found that nearly one third of the clients complaints that their projects generally overran budget. Creedy (2004) is of the view that identification of the existence and influence of cost overrun risk factors in a project can lead to a better control on project cost overrun and also can help in proposing solutions to avoid future overruns.

Time overruns occur on the majority of major civil engineering contracts and that this is a most common problem (Scott, 1993; Alkass *et al.*, 1995; Alkass *et al.*, 1996; Abd-Majid and McCafer, 1998; Al-Khalil and Al-Ghafly, 1999). Completing projects within the time is an indicator of an efficient construction industry (Chan and Kumaraswamy 1997). According to Kumaraswamy and Chan (1995), the ability to estimate the completion time is normally dependent on the individual intuition, skill and experience of the planning engineer. Mezher and Tawil (1998) however noted that time overruns in Lebanon construction industry are costing the country a lot of money and that there is a need to find more effective methods to overcome the problem.

3. Time and Cost Relationship

A relationship between duration and cost was first mathematically established by Bromilow (1974) and subsequently updated by Bromilow *et al*., (1980); Kaka and Price (1991). For the updated relationship, the study was conducted for building projects in Australia. The relationship depicts the mean construction duration as a function of project cost as shown below.

$$T = KC^B \qquad (1)$$

Where T = Duration of construction period from the date of possession of site to substantial completion
C = Completed cost of project in millions of Australian dollars, adjusted to constant labour and material prices
K = A constant indicating the general level of time performance per million Australian dollar, and
B = A constant describing how the time performance is affected by the size of the construction project measured by its cost.

The two constants K and B are determined by using statistical verification as follows:

$$\ln T = \ln KC^B \qquad (2)$$

which is also equal to

$$\ln T = \ln K + B \ln C \qquad (3)$$

Equation 3 is a linear equation from which K and B can be determined through linear regression of the transformed data. In this analysis, the hypothesis proposed is an increase in Log T is associated with an increase in Log C. If this hypothesis is true, then the time-cost relationship of the above equation is also true for the Malaysian construction projects.

Based on prediction done by Bromilow, several studies have been performed to make similar predictions for either a specific sector of construction or construction industries, in general around the world. Ireland (1985) conducted a research to predict the construction duration of high rise commercial projects in Australia. The results gave the relationship for duration and cost with R^2 value of 0.576 and a significance level of 0.001. Kaka and Price (1991) studied relationship between value and duration of construction projects in the UK and also contribute to the similar empirical relationship. Yeong (1994) reported similar study for Australian and Malaysian building construction projects. The study includes 67 Australian government projects, 20 Australian private projects and 51 Malaysian government projects. Kumaraswamy and Chan (1995) examined the relationship between the duration and cost for Hong Kong building and civil engineering projects. They claimed that standardization in public housing projects leads to more consistency in durations of the projects. Chan (1999) did a similar study for public and private projects in Hong Kong. Chan (2001) conducted a study on public sector projects in Malaysia while Choudhury and Rajan (2003) indicate that there is a relationship between duration and cost for the residential construction projects in Texas. Ogunsemi and Jogboro (2006) conducted similar research for Nigerian building construction projects and find out poor predictive abilities using Bromilow's time-cost model. All the results from the above studies are summarized in Table 1.

Table 1: Duration and Cost Relationship

Authors	**Year**	**Country**	**Type of project**	**Cost and time mode**
Bromilow	1974	Australia	Building project (370)	$T=313C^{0.3}$
Ireland	1985	Australia	High rise building project (25)	$T=219C^{0.47}$
Kaka and Price	1991	United Kingdom	Public building (Fixed price contracts)	$T=398.8C^{0.318}$
			Private building (Adjusted price contracts)	$T=486.7C^{0.205}$
			Private buildings	$T=274C^{0.212}$
			Civil Engineering(Tendered)	$T=258.1C^{0.469}$
			Civil Engineering (Actual)	$T=245.0C^{0.432}$
			Public building	
			-Open competition	$T=407.4C^{0.293}$
			-Selected	$T=424.1C^{0.342}$
			-Negotiated	$T=367.5C^{0.272}$
Yeong	1994	Australia and Malaysia	All projects	$T=269C^{0.215}$
			Public projects (67)	$T=287C^{0.237}$
			Public projects (20)	$T=161C^{0.367}$
			Public projects (51)	$T=518C^{0.352}$
Kumaraswamy and Chan	1995	Hong Kong	Total public building projects	$T=182.3C^{0.277}$
			Public housing projects	$T=188.8C^{0.262}$
			Public building projects	$T=166.4C^{0.294}$
			Total private building projects	$T=202.6C^{0.233}$
			Private commercial projects	$T=232.7C^{0.187}$
			Private housing projects	$T=160.2C^{0.306}$
			Civil projects	$T=252.5C^{0.213}$
Chan	1999	Hong Kong	Building projects(110)	$T= 152C^{0.29}$
			Public projects	$T= 166C^{0.28}$
			Private projects	$T= 120C^{0.34}$
Chan	2001	Malaysia	Building projects	$T=269C^{0.32}$
Ng *et al*.,	2001	Australia	Overall building projects	$T=131C^{0.31}$
			Public building projects	$T=129C^{0.32}$
			Private building projects	$T=132C^{0.30}$
Choudhury and Rajan	2003	Texas, US	Residential projects	$T=18.98C^{0.39}$
Ogunsemi and Jagboro	2006	Nigeria	Building projects	$T=63C^{0.262}$

The duration and cost relationship shown in the Table indicate that the values of K and B are very difference for different type of projects and difference contracts. Where the types of projects are the same, e.g. public projects, the K and B values are still very different. Suggesting that the relationship between project duration and cost may not be stable as one would expect

4. Methodology

Data for this study were collected through a survey questionnaire to 150 quantity surveyor consultants in Malaysia. A survey packages containing a covering letter and project data collection form for the firms to provide cost and time information on up to 5 or more projects that they have undertaken. Only 8 consultants returned the questionnaire. Telephone contacts were made to the companies but still the response was poor. Given the situation personal contacts had to be made with public government officials and quantity surveyor consultants to encourage more respondents. The respondents were asked to provide information on previous projects in relation to name of project, starting and completion date, location, numbers of storey and gross floor area for building project, contractual and actual duration, pre-contract budget, contract sum and final account cost (after Pearl *et al*., 2003). Specific features of the projects such as type of project (new build or refurbishment), nature of work (sector), procurement methods, nature of works and tendering methods were also requested.

5. Data Collection

Table 2 shows the project summary and characteristics. Data were collected on 359 projects comprising very small, small, medium and large projects. The procurement methods involved are: traditional, design & build, construction management, management contracting and project management. The nature of works range from residential, infrastructure, commercial, office, educational, health, industrial and recreational. Three tendering methods were considered: open tender, selective and negotiated. All the projects were completed between years 1994 to 2005.

Table 2: Summary of Project Characteristics

Category	Classification	Number	%
Type	New Build	301	83.8
	Refurbishment	58	16.2
Sector	Public	308	85.8
	Private	51	14.2
Procurement Method	Traditional	291	81.1
	Design & Build	58	16.1
	Management Contracting	1	0.3
	Project Management	9	2.5
Nature of works	Building (residential, commercial, educational, health, etc.)	220	61.3
	Infrastructure	139	38.7
Tendering method	Open tender	176	49.0
	Selected	118	32.9
	Negotiated	65	18.1

6. Analysis and Discussion

The average cost deviation of the project was 2.08%, the minimum cost deviation being -80.38% and the maximum was 80.76%. For the time deviation, the average was 49.71%, the minimum was -19.30% and maximum 440.00% as shown in Table 3. Table 2 also illustrate that the project cost and duration are extremely low as compared with the maximum value. The minimum cost is RM 0.1 million and the duration is 2 weeks. These wide ranges in the time and cost overruns on projects in Malaysia suggest this is a major problem to the nation. However this is not unusual in the construction industry given Norwegian Public Roads Administration experienced cost overrun between of between -59% and 183% (Odeck, 2004), 17.34% mean cost overrun of Nigerian projects (Aibinu and Jogboro, 2002) and 90% cost overrun of Denmark transportation infrastructure.

Table 3: Summary of Projects' Cost and Time Overruns

	Cost (RM)		Duration (weeks)		Cost Deviation		Time Deviation	
	Contract	Actual	Contract	Actual	RM (m)	%	Weeks	%
Mean	18.46	19.17	55.66	78.81	0.71	2.08	23.15	49.71
Minimum	0.1	0.1	2	3	-16.42	-80.38	-18.00	-19.30
Maximum	563.3	567.3	229	260	128.7	80.76	156.00	440.00

Time overruns in public sector and private sector projects are shown in Table 4. The Table shows that 18.2% of the public sector projects and 29.45% of private sector projects have 0% time deviation. The Table also shows that 24.9% and 39.2% of the public sector and private sector projects respectively are completed within not more than 10% of the projects duration specified in contract suggesting that 75.1% of public sector projects and 60.8% of private sector projects are not completed at 10% time overruns. This compares with Saudi Arabia construction industry time overruns study by Zain Al-Abedien (cited by Al-Khalil and Al-Ghafly (1999)) that 70% of projects undertaken by the Ministry of Housing and Public Works experienced time overruns. According to World Bank (1990) cited by Bordoli and Baldwin, (1998), 1627 projects completed between 1974 and 1988 had time overruns of between 50% and 80%.

The Malaysian construction industry projects shows that time overruns of Malaysian projects is higher compared with cost overruns. This finding contradicts the research done by Kaming *et al.*, (1997) on Indonesia projects where it was found that cost overruns occur more frequently than time overruns on high-rise construction. This presents the need to investigate further whether the nature of the project, as the case in Indonesia, has influence on the results. In addition, the need to identify the factors influencing time overruns as shown in the level of time overruns experienced on the construction projects in Malaysia has become necessary to ensure that projects can be completed within the time frame specified and at the same time reduce the cost overruns.

Table 4: Comparison of Public Sector and Private Sector Projects Time Deviation

Range of cost deviation	Public Projects			Private Projects		
	Frequency	%	Cum. %	Frequency	%	Cum.%
<-10.1	3	1.0	1.0	2	3.9	3.9
(-5.1)-(-10)	2	0.6	1.6	0	0.0	3.9
(-0.1)-(-5)	2	0.6	2.3	0	0.0	3.9
0	56	18.2	20.5	15	29.4	33.3
5-0.1	6	1.9	22.4	1	2.0	35.3
10-5.1	8	2.6	25.0	2	3.9	39.2
>10%	231	75.1	100.0	31	60.8	100.0
Total	**308**	**100.0**	**100.0**	**51**	**100.0**	**100.0**

6.1 Relationship between Contract Time and Cost

According to Kaka and Price (1991), the form of contract, type of client and the type of project were shown to have an effect on the relationship between duration and cost of the construction projects. In this study, the relationship using ln value for the contract duration and cost is determined. Figure 1 shows the scatter graph for the relationship and Table 5 shows the correlation and regression results. This findings show that an increase in ln T is associated with an increase in ln C in the form of $\ln T = \ln K + B \ln C$ ($p<0.01$). However, this relationship is based on un-adjusted contract cost. Chan (2001) and Kaka and Price used adjusted contract cost for the relationship.

From this findings, since T = K when C =1, the expected contract construction duration in weeks for an RM1million project is given by the value of K. In other words the results suggest that the Malaysian construction project takes 216 days to complete a RM1 million contract sum project. Chan (2001) claims that a RM1 million contract sum project takes 269 days to complete based on tender price index adjusted contract cost. The relationship between the ln contract duration and ln adjusted contract cost (similar to Chan, 2001) shown in Figure 1 and Table 5 indicates that an increase in ln T is not associated with an increase in ln C in the form of ln T = ln K + BlnC. The only difference between the current and previous study is that the analysis is based on all project type, while Kaka and Price (1991) categorised the projects and Chan (2001) is based on building project.

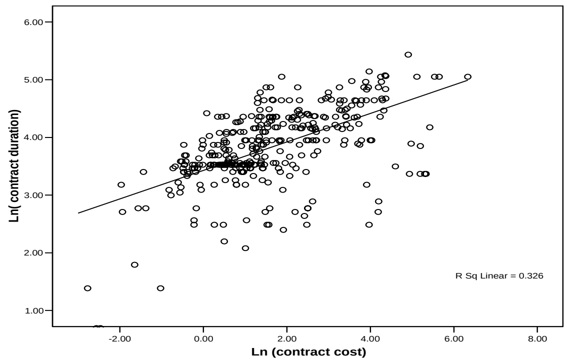

Figure 1: Relationship between ln Adjusted Contract Cost and ln Contract Duration

Table 5: Regression Analysis of the Time-Cost Relationship Based on ln Contract Duration and ln Contract Cost

Regression results	Contract duration and cost	Contract duration and adjusted cost
Ln K	3.428*	3.863
K	216	333
B	0.247*	-0.025
R	0.571	0.057
R^2	0.326	0.003
Adjusted R^2	0.324	0.00
F	172.9	1.154
Significant (F)	0.001	0.283

* $P < 0.01$

6.2 Relationship between Actual Time and Cost

Table 6 describes the relationship between the actual duration and actual cost of construction project based on ln value and shows the coefficient and regression results for the relationship. The relationship between the contact duration and cost is more significant compared with the actual duration and contract cost. The analysis shows that construction actually takes 316 days to complete a project for actual contract cost of RM1 million. It also shows that actual duration of a project will increase when the cost of the project increases according to the formula:

$$T = 316C^{0.222}$$

The relationship between the ln contract duration and ln adjusted actual cost, the coefficient and regression results, indicating a weak relationship.

Table 6: Regression Analysis of Time-Cost Relationship Based on ln Actual Duration and ln Actual Cost

Regression results	Actual duration and cost	Contract time and adjusted cost
Ln K	3.810*	4.191
K	316	463
B	0.222*	-0.015
R	0.514	0.035
R^2	0.264	0.001
Adjusted R^2	0.262	-0.002
F	128.290	0.443
Significant (F)	0.001	0.505

* $P < 0.01$

6.3 Application of Bromilow Model to Building Projects

Table 7 describes the relationship between duration and cost for contract and actual for building projects only. The findings show again that only duration with non adjusted cost is significant. The relationship between the contract duration and contract cost is denoted by:

$$T = 203C^{0.178} \text{ and,}$$

for the actual duration and actual cost as:

$$T = 303C^{0.157}$$

Chan (2001) shows that the time taken for RM1 million construction building project is 269 days using the adjusted cost with 1992 as the base year and Yeong (1994) claims that RM1 million projects takes 518 days to be completed. However, this current study of the contract duration and cost shows that it takes 203 and 303 days based on the actual and contract duration and cost respectively. The studies both by the Chan and Yeong are limited to 51 building projects only. In addition Chan's (2001) data was based on only one state in Malaysia. Table 8 shows K values for building projects in Malaysia which might suggest that K value has dropped significantly for year 1994 to 2001 from 518 days to 269 days for RM1 million projects. These results also show a big gap between the contract and actual time and cost which might suggest that either the estimation of project duration is inaccurate, or the projects progress experienced substantial time overruns during construction.

Table 7: Regression Analysis of the Time-Cost Relationship for the Building Projects

Regression result	Contract duration and cost	Contract duration and adjusted cost	Actual duration and cost	Actual duration and adjusted cost
Ln K	3.365*	3.558	3.769*	3.941
K	203	246	303	360
B	0.178*	0.011	0.157*	0.008
R	0.427	0.029	0.350	0.020
R^2	0.182	0.001	0.122	0.000
Adjusted R^2	0.178	-0.004	0.118	-0.004
F	48.481	0.184	30..390	0.087
Significant (F)	0.001	0.669	0.001	0.768

* $P < 0.01$

Table 8: K and B Values of Current and Previous Research Studies in Malaysia

Cost and time relationship research	Building projects	
	K	B
2006 research (Present study)	303	0.157
2001 survey (Chan 2001)	269	0.320
1994 survey (Yeong 1994)	518	0.352

The values for K and B for private sector projects (K=198 days and B=0.228 for actual cost and time) shows that RM1 million value of private projects are completed faster compared with the public sector projects (K=328 days and B=0.246 for actual cost and time) for both contract and actual time and cost. The studies done by Ng *et al*. (2001) for Australian construction projects, Kumaraswany and Chan (1995) and Kaka and Price (1991) also show similar pattern.

7. Conclusion

Time and cost overruns of construction projects occur as a result of many factors: some of which are related to each other. An analysis of the cost and time overruns of the construction projects in Malaysia based on cost and time mean deviation, produced an 2.08% average cost deviation compared with 49.71% average time deviation suggesting that time overrun is more critical in Malaysia construction projects. Time overrun of public projects was more critical with only 20.5% of the projects completed within the time specified in the contracts compared with 33.35% of the private sector projects. The findings suggest there is a need to investigate further factors responsible for the level of time and cost overruns of the Malaysian construction projects.

Time and cost are two major factors in construction projects. Contractors often used their past experience to estimate the project duration and the cost of a new project. In general the more time spent on one project the more cost is generated. It is a challenge to the estimators to come out with the best prediction of time and cost for the construction projects. Bromilow time and cost model is one of the model to predict time from the cost of the projects. This analysis undertaken of the Malaysian construction industry (CI) projects shows no evidence to suggest that all the project parameters considered are follow the Bromilow time cost relationship model ($T=KC^B$). The results show that the estimation of projects duration in Malaysia is below the actual duration taken to complete the project suggesting project time overrun of Malaysian construction projects.

8. References

Abd-Majid, M. Z., and McCafer, R. (1998). "Factors on non-excusable delays that influence contractors' performance". *Journal of Construction Research* , Vol. 4, No. 2, pp. 141-153.

Aibinu, A. A., and G. O. Jagboro. (2002). "The effects of construction delays on project delivery in Nigerian construction industry". *International Journal of Project Management*,Vol. 20, No. 8, pp. 593-599.

Al-Khalil, M. I., and Al-Ghafly, M. A. (1999). "Delay in public utility projects in Saudi Arabia". *International Journal of Project Management* ,Vol. 17, No. 2, pp. 101-106.

Alkass, S., Mozerolle, M., and Harris, F. (1996). "Construction delay analysis techniques". *Journal of Construction Management and Economics,* Vol. 14, pp. 375-394.

Alkass, S., M. Mozerolle, Tribaldos, E., and Harris, F. (1995). "Computer aided construction delay analysis and claims preparation". *Journal of Construction Management and Economics,* Vol. 13, pp. 335-352.

Booth, W. C., Colomb, G. G., and Williams, J. M. (2003). *The Craft of Research*, The University of Chicago Press.

Bordoli, D.W., and Baldwin, A.N. (1998) A methodology for assessing construction projects delays. *Journal of Construction Management and Economics,* Vol. 16, pp. 327-337.

Bromilow, F. J. (1974). "Measurement and scheduling of construction time and cost performance in the building industry." *Chartered Builder,* Vol. 10, pp. 57-65.

Bromilow, F. J., Hinds, M. F., and Moody, N. F. (1980). "AIQS survey of building contract time performance". *The Building Economist,* Vol. 19, pp. 79-82.

Chan, A. P. C. (2001). "Time-cost relationship of public sector projects in Malaysia". *International Journal of Project Management,* Vol. 19, No 4, pp. 223-229.

Chan, D. W. and Kumaraswamy, M. M. (1997). "A comparative study of causes of time overruns in Hong Kong construction projects". *International Journal of Project Management,* Vol. 15, No 1, pp. 55-63.

Chimwaso, D. K. (2000). “An evaluation of cost performance of public projects: case of Botswana”. *Proceeding of the 2nd International Conference of the CIB, 2000*. http://buildnet.csir.co.za /cdcproc / docs/2nd/chimwaso_dtc.pdf.

Choudhury, I., and Rajan, S. S. (2003). "Time-cost relationship for residential construction in Texa." *Construction Informatics Digital Library.*

CIDB. (2005). The Malaysian Industry Excellence Award (MCiEA 2005). *Construction Industry Development Board Malaysia*. Kuala Lumpur.

Creedy, G. D. (2004). Risk factors leading to cost overrun in highway construction projects. *Clients driving Innovation International Conference*, Australia, Australia.

Elinwa, A. U., and Joshua, M. (2001). "Time-overrun factors in Nigerian construction industry". *Journal of Construction Engineering and Management*, Vol. 127, No. 5, pp. 419-425.

Elinwa, U., and Buba, S. A. (1993). "Construction cost factors in Nigeria". *Journal of Construction Engineering and Management*, Vol. 119, No 4, pp. 698-713.

Flyvbjerg, B., Holms, M. S. and Buhl, S. (2002). "Underestimating costs in public works projects? Error or Lie?" *Journal of the American Planning Association,* Vol. 68, No. 3, pp. 279-295.

Ireland, V. (1985). "The role of managerial actions in the cost, time and quality performance of high-rise commercial building projects". *Journal of Construction Management and Economics*, Vol. 3, pp. 59-87.

Jackson, S. (2002). “Project cost overruns and risk management”. *ARCOM 20th*, http://icre-reading.org/publications.

Kaka, A. and Price, A. D. (1991). "Relationship between value and duration of construction projects." *Construction Management and Economics*, Vol. 9, No. 4, pp. 381-400.

Kaming, P. F., Olomolaiye, P. O., Holt, G. D. and Harris, F. C. (1997). "Factors influencing construction time and cost overruns on high-rise projects in Indonesia." *Construction Management and Economics*, Vol. 15, pp. 83-94.

Koushki, P. A., Al-Rashid, K. and Kartam, M. (2005). "Delays and cost increases in the construction of private residential projects in Kuwait." *Journal of Construction Management and Economics,* Vol. 23, pp. 285-294.

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

Mezher, T. M. and Tawil, W. (1998). "Causes of delay in the construction industry in Lebanon". *Engineering, Construction and Architectural Management* Vol. 5, No. 3, pp. 252-260.

Ng, S. T., Mak, M. M. Y., Skitmore, R. M., Lam, K. C., and Varman, M. (2001). "The predictive ability of Bromilow's time-cost model". *Journal of Management and Economics,* Vol. 19, pp. 165-173.

Odeck, J. (2004). "Cost overruns in road construction-what are their sizes and determinants?" *Transport Policy,* Vol. 11, pp. 43-53.

Ogunlana, S. O., Promkuntong, K., and Jearkjirm, J. (1996). "Construction delays in a fast-growing economy: Comparing Thailand with other economies". *International Journal of Project Management,* Vol. 14, No. 1, pp. 37-45.

Ogunsemi, D. R., and Jogboro, G. O. (2006). "Time-cost model for building projects in Nigeria." *Construction Management and Economics*, Vol. 24, pp. 253-258.

Okuwoga, A. A. (1998). "Cost-time performance of public sector housing projects in Nigeria." *Habitat International*, Vol. 22, No. 4, pp. 389-395.

Raftery, J., B. Pasadilla, Chiang, Y. H., Hui, E. C. M., and Bo-Sin, T. (1998). "Globalization and construction industry development: Implications of recent developments in the construction sector in Asia". *Journal of Construction Management and Economics*, Vol. 9, No. 2, pp. 131-151.

Scott, S. (1993). "Dealing with delay claims: A survey". *International Journal of Project Management*, Vol. 11, No. 3, pp. 143-153.

Shari, I. (2000). "Economic growth and income inequality in Malaysia". *Journal of the Asia Pacific Economy*, Vol. 5, No. 1/2, pp. 112-124.

Shi, J. J., Cheung, S. O., and Arditi, D. (2001). "Construction delay computation method." *Journal of Construction Engineering and Management*, Vol. 127, No. 1, pp. 60-65.

Takim, R. (2005). “A framework for successful construction project performance”. *Build and Natural Environment.* Glasgow, Glasgow Caledonian University: 1-536.

Tan, A. A. L. (1996). *Project Management in Malaysia*, Synergy Books International.

William, T. (2003). "Assessing extension of time delays on major projects." *International Journal of Project Management*, Vol. 21, pp. 19-26.

Yeong, C. M. (1994). Time and cost performance of building contracts in Australia and Malaysia., University of South Australia. M.Sc.