AN EMPIRICAL INVESTIGATION FOR EXPLORING INFORMATION TECHNOLOGY FACTORS AND FIRM PERFORMANCE IN MALAYSIAN CONSTRUCTION SECTOR.

Farag Hussan Gaith[1], Khalim A. R. and Amiruddin Ismail

Department of Civil and Structural Engineering, Faculty of Engineering,
Universiti Kebangsaan Malaysia.
43600 Bangi, Selangor Darul Ehsan, Malaysia.

[1] Corresponding author (Contact: fhgd75@vlsi.eng.ukm.my)

Abstract

This paper examines the role that investment in information technologies (IT) play in the performance of construction companies in Malaysia. IT investment by construction firms increases annually, but many of them do not have the tools with which to evaluate the returns from their investment. To achieve this, a survey was carried out on 68 firms, using the revealed preference (RP) technique. From the data obtained, correlations were done using Pearson's 2-tailed test for attitudes and perceptions. Four relationships were investigated - company performance vs. IT use, company performance vs. human resources, company performance vs. technical resources, company performance vs. business resources. It was found that IT investment had a positive impact on the firm performance and that the effect of the investment depended on the area of the investment.

Key words*: IT investment, construction firm performance, human resources.*

---

1. Introduction

This paper examines the role that information technologies (IT) play in the performance of a construction firm in giving clear information to the project manager. In addition, it shows the relationship between information technology and the firm performance as well as identifies and assesses the degree of IT use in influencing the firm's performance.

Information technology is the technology used to deliver data, information and knowledge. It is not all computers, although today these provide the most powerful solutions. Technical drawings, descriptive geometry, copying machines, telegraph, telephone, fax, etc., are information technologies as well. Today, information technology is defined as including the equipment, applications and services used by organisations to deliver data, information and knowledge to individuals and processes (Mentor, 1997).

Investment in Information technology differs in nature from other capital investments as it has a substantial human and organizational interface (Irani et al., 2003). The investment can be high risk as it often causes erratic cash flows and incurs considerable intangible costs (Milis and Mercken, 2004). Despite these potential problems, IT capital investments are frequently evaluated using the traditional appraisal techniques as in the property sector. These traditional methods are for capital investments where the fixed asset has a long term value that may even rise with inflation. For IT investments, however, the converse is true as, with technological advancement, all IT resources become obsolete eventually, often quite rapidly too (Primrose, 1991).

2. Brief Literature Review

There have been several investigations on the impact of IT investment on the performances of firms, but, so far, without any consistent relationship found between IT investment and profitability. Some have found a positive relationship and others a negative one or no relationship at all.

Cron and Sobol (1983) studied computer use on the performance of 138 medical wholesalers. Computer use was measured by the number of computer applications used, and firm performance by the return on assets, return on net worth, 5 years' sales growth and pretax profits. They found that firms with high computer use were either very strong or very weak performers.

Paopun (2000) studied the relationship between IT investment and organizational performance in 249 Thai retail firms. IT investment was considered as a percentage of the total sales. Five financial ratios were used for the organizational performance - return on investment, return on assets, return on equity, change in sales and return on sales. He also analysed the relationship between IT investment and several contingent variables environmental uncertainty, size and structure of the firm, business strategy, and human and business resources. Although there was no significant association between IT investment and financial performance, there was a significant relationship between IT investment and increased IT performance. He also found some meaningful relationships between IT investment and the firm's contextual factors. IT investment had positive relationships with environmental uncertainty, the degree of decentralized organization, and business strategies such as product innovation and cost readership. A positive correlation between human resources and financial performance was also found.

Mahmood and Man (1993) measured the organizational impact of IT investment using financial data from 100 U.S. firms. They chose five variables as measures for IT investment – the annual IT budget as a percentage of the organization's revenue, value of the organization's IT as a percentage of its revenue, percentage of the IT budget spent on IT staff, percentage of the IT budget spent on training IT staff and the number of PCs and terminals as a percentage of the total employees. They used six financial ratios as organizational performance measures - return on investment, return on sales, growth in revenue, sales by total assets, sales by employees, and market-to-book value. In they are study found that although individual IT investment variables were found to be only weakly related to organizational strategic and economic performance, they were significantly related to the performance when grouped together.

3. Methodology

This paper is confined to investigating only the construction industry, and then only the G3, G4 and G5 contractors in it which number about 1000 in the CIDB Directory 2005/2006. G3 contractors are those whose annual turnover does not exceed RM1 million, G4 not exceeding RM3 million and G5 not exceeding RM5 million (CIDB directory 2005/2006). A survey was carried out on them with the owners, project manger and general mangers interviewed. The survey was regional – only of firms in the Klang Valley.

3.1 Survey Questionnaire

A questionnaire was sent to three persons of different positions in the companies – General Manger, Senior Manager and Project Manager. The questionnaire was based on that used in the Malaysian Construction Firm Environmental, slightly modified with inputs from the Canadian context of the "IT barometer survey" designed by the Royal Institute of Technology of Sweden in 1997. The questionnaire was in six sections - general personal information, company information, computer and software use, data and communications, IT investment, overall of performance and IT effectiveness - with a total of 40 questions. The survey was conducted from January 07 to Jun 07. The questionnaire was sent to more than 500 companies in the KL and Selangor area as per their registered addresses with the Construction Industry Development Board (CIDB).

4. Results

4.1 Characteristics of Respondents

Sixty eight firms responded. Of them, 27 (39%) were G3, 16 (24%) G4 and 25 (37%) G5. Fifty (73%) of them had construction as their main business and 10 (15%) were mainly in M & E (Figure 3). Six (9%) had <RM50,000 annual turnover (Figure 4), 23 (34%) RM50,000 – 100,000, (34%) and 28 (41%) >RM200,00. Fifty (73%) were private firms, while 12 (18%) were from the public sector.

Although the respondents were the top managers, only 21 (31%) had a PhD (Figure 8) while another 19 (28%) were graduates. Based on cross reference between the top managers, executive managers and technical managers, only 6 of the executive managers (9%) had a PhD, and none of the technical managers. These findings agree with Rosziati and Jacey-Lynn (2005).

Profile of Respondent Companies *(N = 68)*

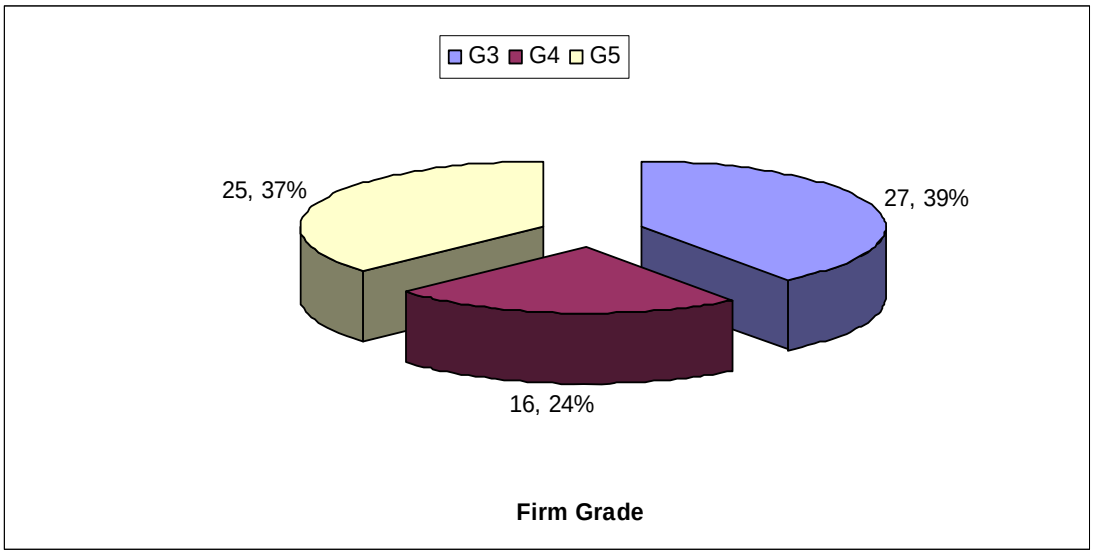

Figure 1: Firm grade

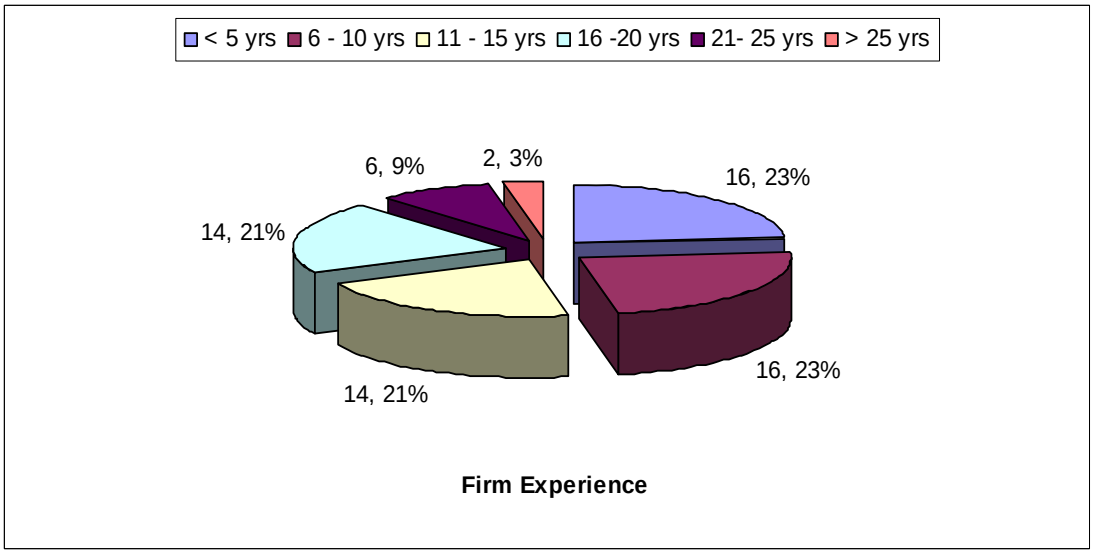

Figure 2: Firm Experience

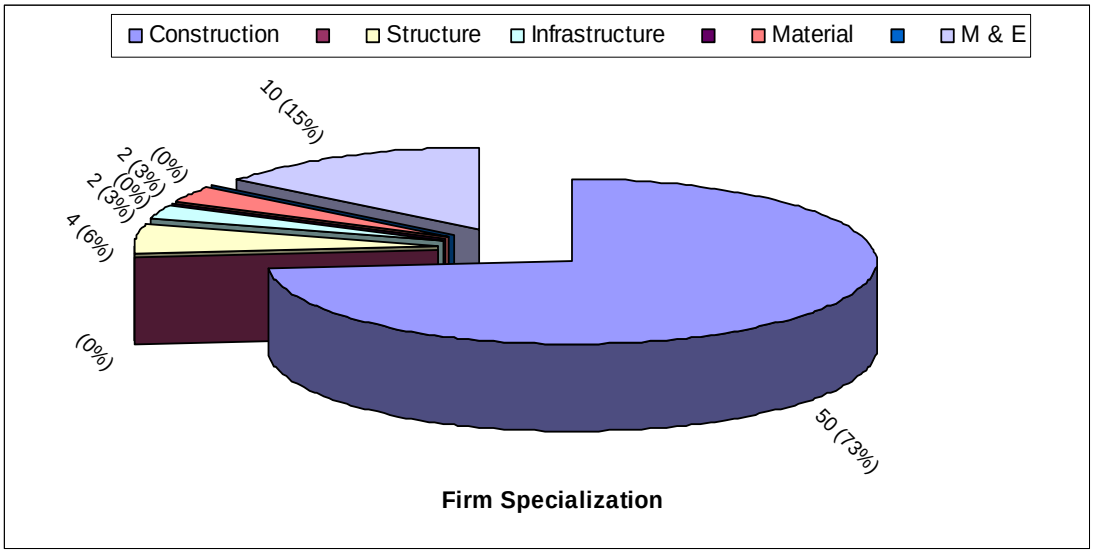

Figure 3: Firm Specialization

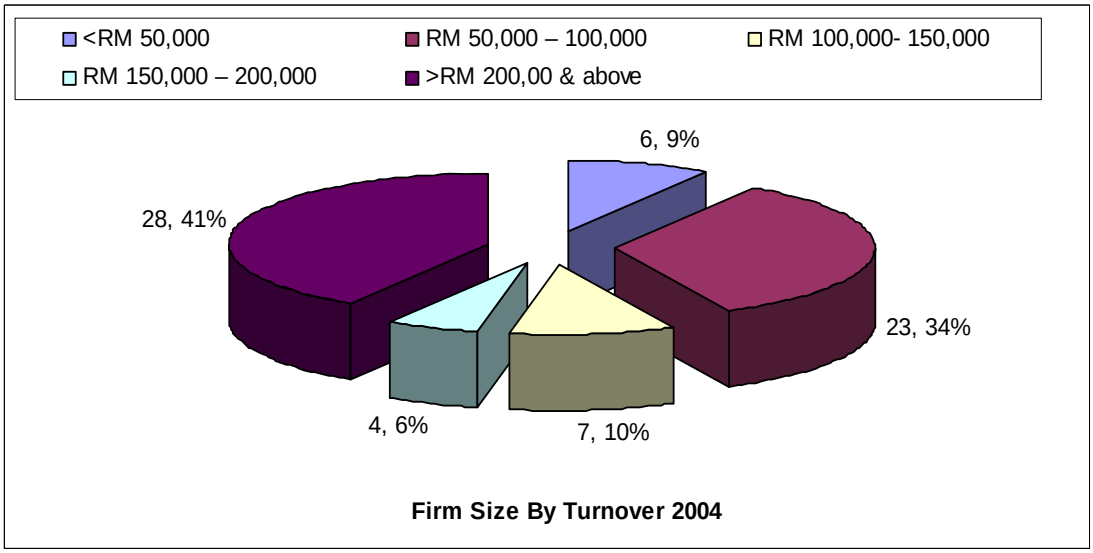

Figure 4: Firm Size by Turnover (2004)

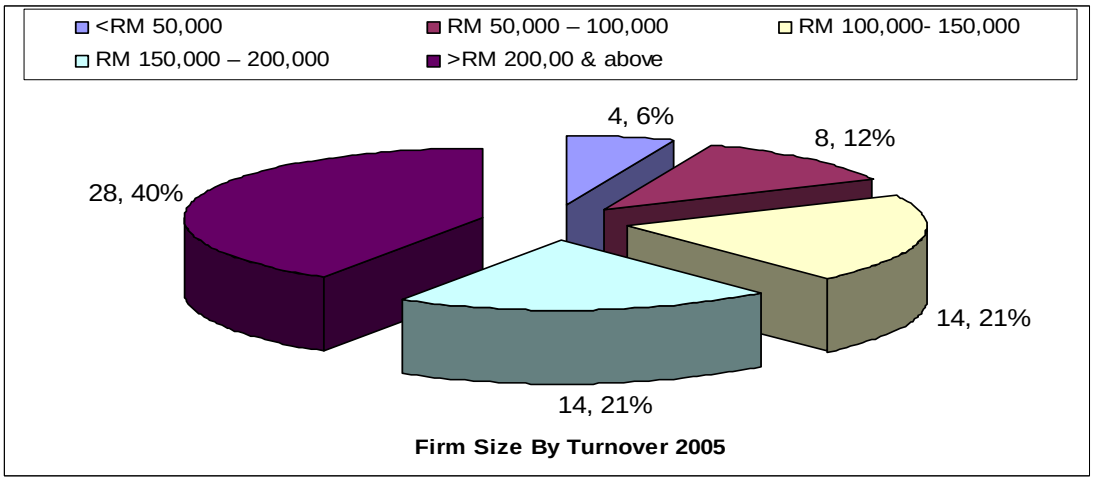

Figure 5: Firm Size by Turnover (2005)

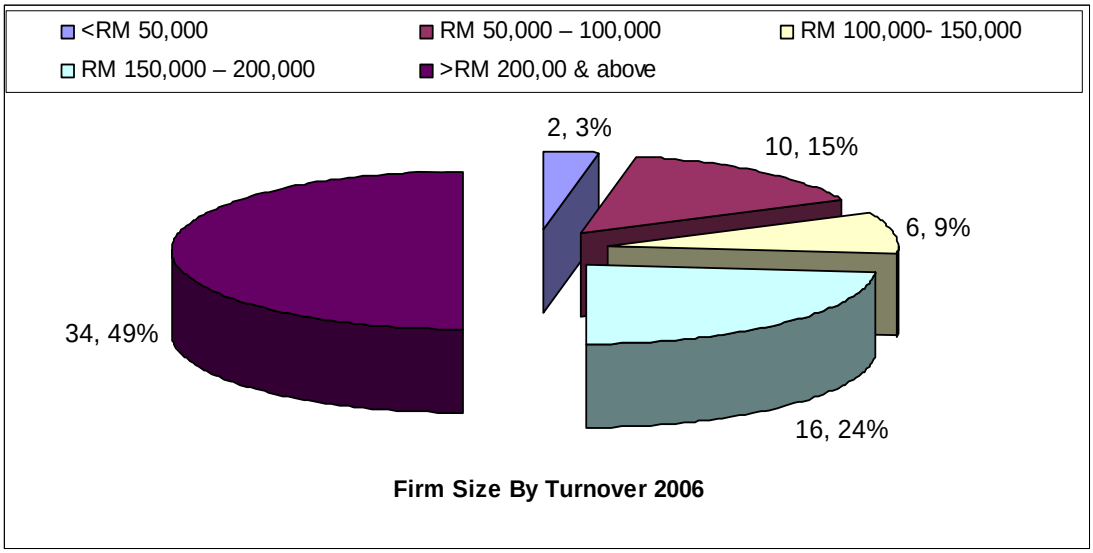

Figure 6: Firm Size by Turnover (2006)

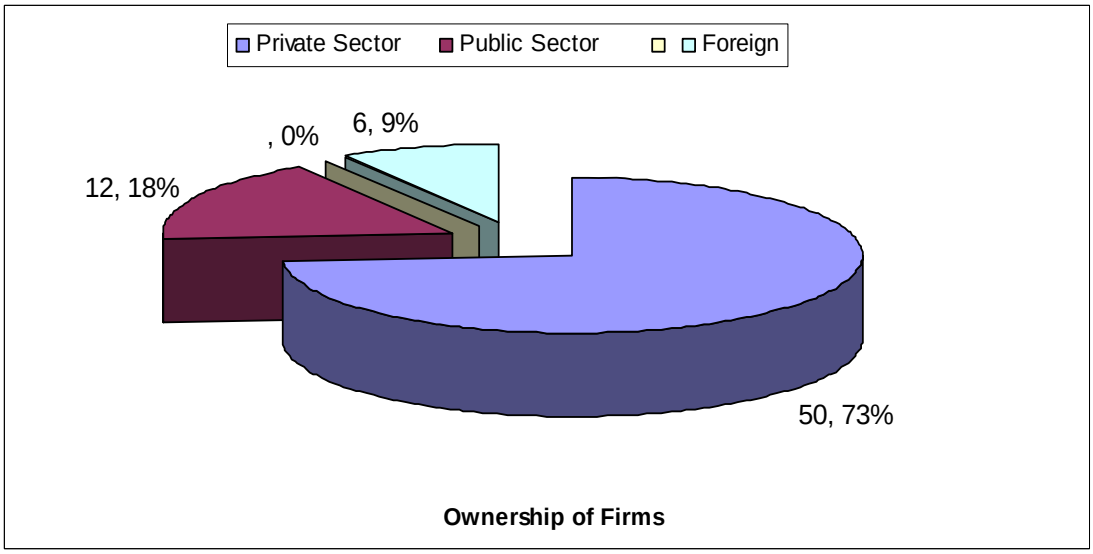

Figure 7: Ownership of Firms

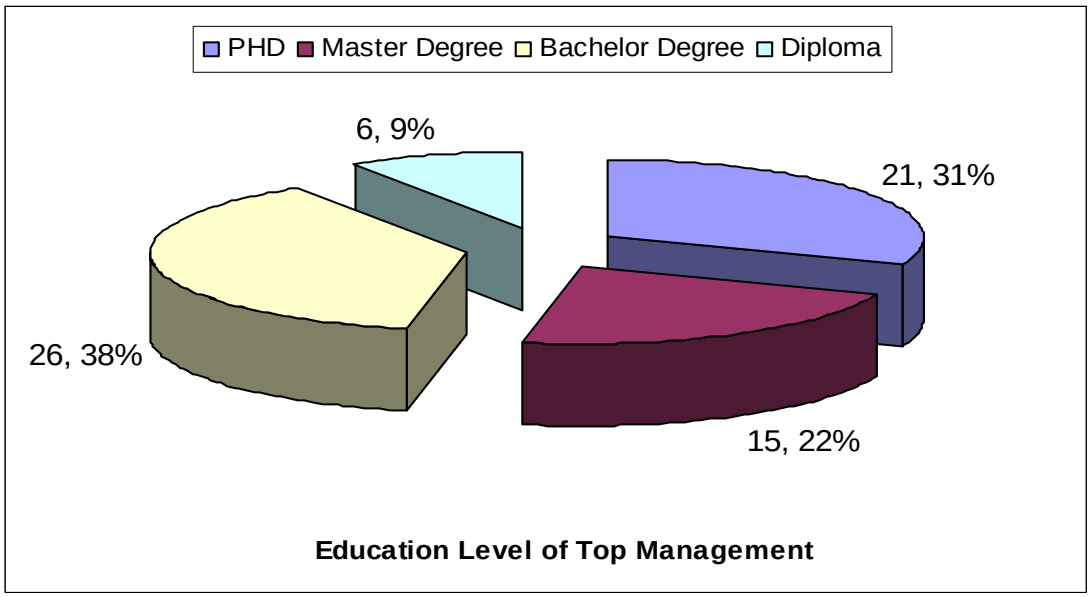

Figure 8: Education Level of Top Management

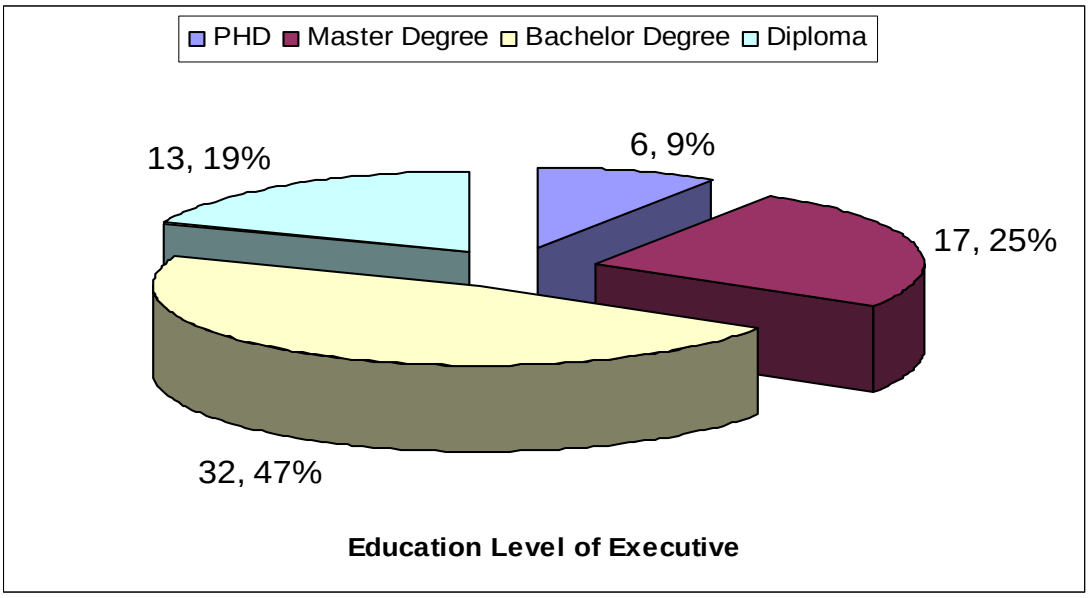

Figure 9: Education Level of executives

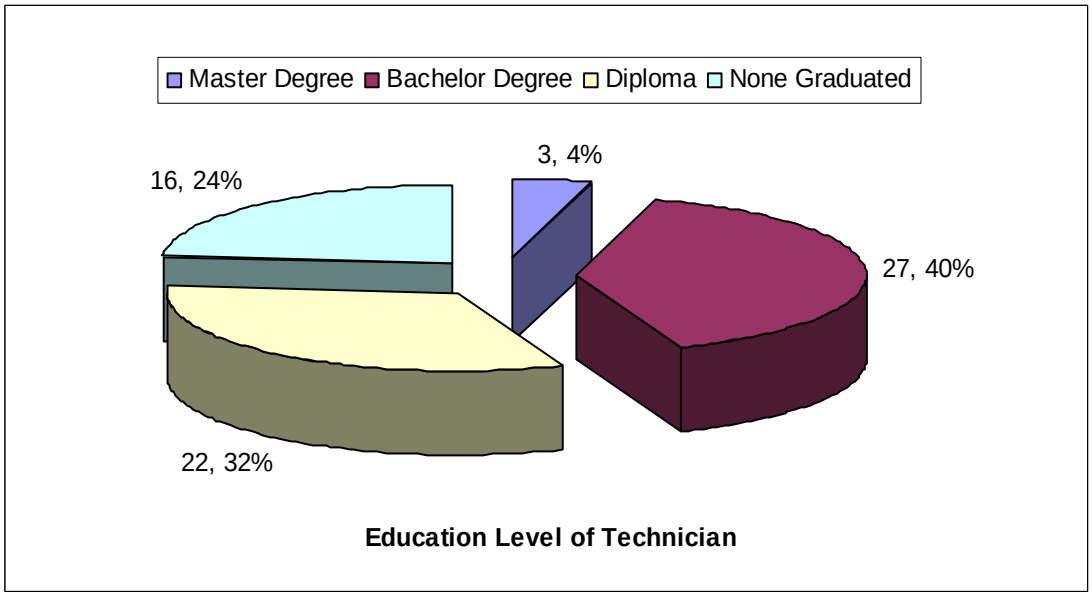

Figure 10: Education Level of technician

As discussed above, the respondents were 68 firms specializing in different types of construction (Figure 3). Table 1 shows the average IT investment by the firms (as a percentage of their annual turnover) in the various IT areas. The overall average IT investment was 12.7%. Most of the investment went into hardware purchase (3%), followed by training (2.6%), R & D (2.5%), specific labor (2.4%) and, lastly, communication (2.2%).

Table 1: Average investments in various IT categories in percentages of annual firm turnover

	2004	2005	2006	MEAN
Equipment	3 %	3 %	4 %	3 %
Communication	1.5 %	3 %	2 %	2.2 %
IT Specific Labor	2 %	2.2 %	3 %	2.4 %
R&D	1.6 %	3.5 %	2.5 %	2.5 %
IT Training	1.8 %	3.4 %	2.6 %	2.6 %
Total	11.5 %	13.5 %	14.1 %	12.7 %

4.2 Regression Results: Investment Vs Performance:

The development of an IT investment model is important as it can be used to provide a guide for IT investment. The factors affecting IT investment in the firms were identified using two research approaches - qualitative and quantitative. The qualitative approach consisted of interviews and the quantitative approach population sampling, pilot studies, collecting and analysing data and studying the results. From the qualitative approach (which included a literature review), the questionnaire was developed for the quantitative approach. The analysis performed was regressing the company performance (as dependent variable) on the IT investments in the five categories shown in Table 1. The analysis showed positive relationships between IT investment and company performance. It can therefore be concluded that IT investment improved the firms' performance and that further investment by them is possibly warranted. All the variables in the models were significant at $P < 0.05$.

- **Equipment Investment (EI) Vs: Firm Performance: Regression Analysis**

In the models, the dependent variable was "1" for Performance and "0" for Equipment Investment. The explanatory variables were: EI2004, EI2005 and EI2006. For estimation, Performance was taken as the base case. Thus, a positive coefficient for a variable in, say, Equipment Investment means that the Performance improved with the variable. The coefficients for EI2004, EI2005 and EI2006 in the model (see Equation 1) were all positive, implying that increases in them improved the firm Performance. This finding concurs with Rosziati and Jacey-Lynn (2005) who found Equipment Investment to be one of the most important determinants of firm performance.

The Model = *2.166 + 0.056 * EI 2004 +0.0977 * EI 2005 +0.077 * EI 2006.* *(1)*

In addition to the EI regression model for firm performance metrics, there were four other regression models developed to test the effects of the individual metrics on the firm performance. Equations 2 - 5 also show the number of firms used in each regression mode (Note: The 68 firms tested for the individual metrics represented different categories of the construction business).

In these models, the typical variables, such as CI, SLI, RDI and TI, were found to significantly explain the firm performance, with most of the coefficients having the expected signs. It was, therefore, possible to interpret the coefficients normally. For the models (see Equations 2 - 5) were positive, implying that any increase in them would increase the firm performance. For the CI model, the highest coefficient was 0.033 in 2005, which indicated the firm performance to be related to the investment value in CI; these results agree with descriptive results from the survey. Similar results were found in the SLI model 2005 where the highest coefficient was 0.110. The RDI model found a coefficient of 0.022 in 2005; and for the IT model, the highest coefficient found was 0.123 in 2005. These findings confirmed that firm performance was correlated with its IT investment

- **Communication Investment (CI) Vs: Performance: Regression Analysis**

*The Model = 0.665 + 0.019 * CI 2004 +0.033 * CI 2005 +0.003 * CI 2006.* *(2)*

- **IT Specific Labor Investment (SLI) Vs: Performance: Regression Analysis**

*The Model = -1.259 + 0.056 * **SLI** 2004 +0.110 * **SLI** 2005 +0.090 ***SLI** 2006* *(3)*

- **R&D Investment (RDI) Vs: Performance: Regression Analysis**

*The Model = 3.00 + 0.001 * **RDI** 2004 +0.022 * **RDI** 2005 +0.0151 *** RDI** 2006* *(4)*

- **IT Training Investment (TI) Vs: Performance: Regression Analysis**

*The Model = 1.116 + 0.060 * **TI**2004 +0.123 * **TI**2005 +0.0853 *** TI**2006* *(5)*

The regression results for the firm performance metrics (EI, CI, SLI, RDI and TI) indicated that IT investment was positively associated with performance, with coefficients of determination (R^2) of 0.667 - 0.768. Thus, 67-77% of the firm performance could be explained by its IT investment (independent variable). The F- and t-tests were used to assess the goodness-of-fit of the models and their individual parameters, respectively. Associated with each test is a p-value that expresses the probability that the results of the test are not significant. A probability of less than 0.05 is generally considered acceptable to indicate a significant difference (Fox, 1997). For the EI regression model, the p-values were 0.011 for the F-test and 0.031 for the t-test. These low probabilities allowed the null hypothesis to be excluded, and to infer that the model and parameters were adequate. For the CI model, the p-values were 0.008 for the F-test and 0.044 for the t-test, and for the SLI model, 0.000 and 0.009, respectively. For the RDI model, the p-values were 0.050 and 0.003, and for the TI regression model, 0.019 and 0.039, respectively. Thus, the null hypotheses were excluded and adequacy of the models and parameters inferred. The study makes two contributions to construction research and practice, first, the research provides empirical evidence that information technology (IT) has positive impact on the firm performance. Second contribution is significant to both construction and IT literature at large.

5. Conclusion

In Malaysia, there is no explicit understanding on how to use IT to improve a firm's performance. Today, IT has accelerated the speed of doing things in small- and medium-sized businesses, and this study has identified the IT factors influencing the firm performance based on how much IT has increased the speed of business. The results from this work may lead to the formulation of new plans for firms to improve their performance. Many factors are seen to influence a firm's performance; the resultant perception is the result of a complex interaction between these influences. Matrix correlations were performed to gauge the relationships between the variables (Equations 1 - 5). The significant variables found to increase the firm performance were investments in EI, CI, SLI, RDI and TI. The ability of the firms to improve their performance was low unless there was sufficient investment in IT. This supports Samuelson (2002) and Rivard (2000) who assessed the level of IT use across design and construction firms in Canada. The next step in this research will be to establish a performance model, then measure the proposed strategy so as to be able to formulate new policies to enhance the firm performance. Overall, this research shows positive relationships between a firm's performance and its IT investment. It is reasonable to conclude that IT investment is a strong contributor to the firm performance and that further investment would probably be justified. The problems in evaluating IT investment are complex, but it is hoped that the results from this study can provide construction companies the foundation to better understand the implications of their investment in IT. The next step in this research will be to develop a predictive model to forecast the impact of change in IT investment on the firm performance so that more steps can be taken to achieve this. The variables identified as relevant in this analysis should be included in any subsequent models

Acknowledgments

This research was financed by a grant from the Faculty of Engineering, Universiti Kebangsaan Malaysia. Mr. Farag would like to thank Associate Professors Abdulkhalim Abdulrashed and Amiruddin Ismail for their timely help and guidance.

6. References

1- Cron, W. L., & Sobol, M.G, (1983) The Relationship between Computerization and Performance: A Strategy for Maximizing the Economic Benefits of Computerization. *Information & Management*, **6**, 171-181.

2- Fox, J. (1997). Applied regression analysis, linear models, and related methods, Sage, Thousand Oaks, Calif.

3- Irani Z., Themistocleous M., Love P.E.D., (2003) The impact of enterprise application integration on information system lifecycles, *Information and Management* 41 **(2)** 177–187.

4- Mahmood, Mo Adam., and Mann, Gary J. (1993) Measuring the Organizational Impact of Information Technology Investment: An Exploratory Study. *Journal of Management Information System*, 10**,(1),**97-126,

5- Mentor Group. (1997). The role of IT in business process re-engineering. http://mentorgrp.com/pubs/mrrison.htm

6- Milis K., Mercken R., (2004). The use of the balanced scorecard for the evaluation of information and communication technology projects, *International Journal of Project Management* 22 87– 97.

7- Paopun, Veera (2000) A Study of the relationship Between Investment in Information Technology and Organizational Performance in the Thai Retail Industry. Ph.D dissertation, *Nova Southeastern University*

8- Primrose P.L., (1991).Investment in Manufacturing Technology, Chapman and Hall, UK,.

9- Rivard, H. (2000). A survey on the impact of information technology on the Canadian architecture, engineering, and construction industry. *Electronic Journal of Information Technology in Construction (ITcon), http://itcon.org,* **5**, 37-56.

10- Rosziati Ibrahim and Jacey-Lynn Minoi, (2005) Usage of Information Technologies in Malaysian Businesses*, Journal of Information Technology Impact* Vol. 5, No.**1**, pp. 5-14,

11- Samuelson, O. (2002). IT-Barometer 2000 – the use of IT in the Nordic construction industry. *Electronic Journal of Information Technology in Construction (ITcon),* http://itcon.org, **7,** 1-25.