

# Exploring the Relationship between Contextual Factors and Firm Performance: the Mediating Effect of Information Technology Effectiveness on the Construction Industry

*Dr. Farag H. Gaith<sup>1</sup> , Mohamed S. Elforgani<sup>2</sup>*

*<sup>1</sup>Dept. of Civil and Structural Engineering, Faculty of Engineering  
Universiti Kebangsaan Malaysia (UKM).*

*<sup>2</sup>Dept. of Architecture Engineering Faculty of Engineering  
Al-mergeb University*

## **Abstract:**

*This paper presents the mediating effect of information technology (IT) on the relationship between contextual factors and performance of small construction companies. A total of 200 questionnaires were distributed to Malaysian construction firms (G3, G4, and G5). The target respondents were general managers, senior managers, and project managers of construction firms and those who have considerable knowledge of IT implementation in their firms. Sixty-eight completed*

*questionnaires were collected, which indicates a 34% response rate. The three determinants used are the firm contextual factors, IT effectiveness (independent variable), and overall firm performance (dependent variable). The relationship between contextual factors and firm performance was evaluated according to two hypotheses. The first hypothesis suggested a positive relationship between contextual factors and overall firm performance, whereas the second hypothesis suggested a positive relationship between contextual factors and IT effectiveness. IT resource strategy was identified as the most important factor in firm performance. The results indicate a weak positive relationship between contextual factors and overall firm performance. The mediating effects of IT effectiveness on contextual factors and overall firm performance were insignificant.*

## **1.Introduction.**

An empirical study was conducted to assess the use of information technology (IT) in light of innovation introduced by the company and facilitated by IT. A model that describes the effectiveness of IT in construction companies is proposed to link the contextual factors of the firm to its overall performance. Kauffman and Weill <sup>[1]</sup> illustrated the effectiveness of IT as an important intervening variable that was ignored by previous researchers in explaining the relationship between investment in IT and organizational performance. In other words, IT effectiveness is considered a crucial factor that mediates the relationship between independent variables and organizational performance <sup>[2]</sup>.

Based on a survey of literature on IT use, a limited number of studies focus on this matter <sup>[3, 4]</sup>. This paper aims to examine whether IT has a mediating effect on the relationship between contextual factors and overall performance of construction companies.

## **1.1 Contextual Factors of Firms:**

Firm-level studies aim to find the reasons for the variance of IT benefits among firms. [1] emphasized the importance of the contextual factors of firms in studying IT benefits. [5] identified four contextual factors, namely, the commitment of upper management to IT, previous IT experience, user satisfaction with systems, and political turbulence. [6] developed a resource-based theoretical framework to explain variances among U.S. retail companies that use the same technology. They identified the three most important resources of a firm, namely, human, business, and technical resources. [7] found significant relationships between IT investment and the contextual factors of firms. This previous study adapted and modified the contextual factors of firms based on the studies by [7-9].

the relationship between IT investment and organizational performance. [11] reported an indirect link between IT investment and firm performance, which is due to the mediating effect and moderating variables. This current study adapted and modified the studies by [5] as well as by [9] to determine IT effectiveness.

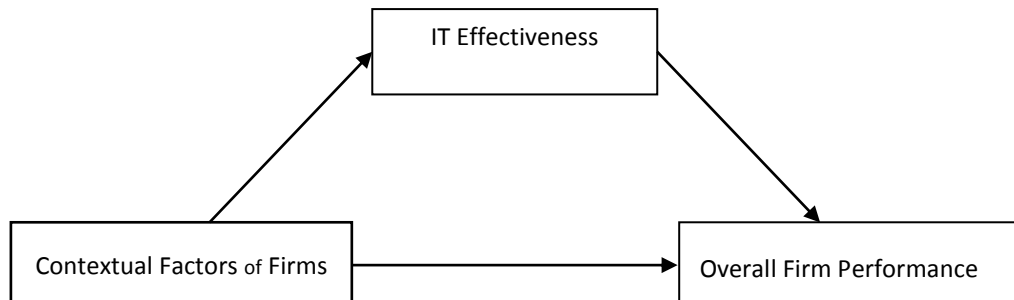
[1] stated the effectiveness of IT as an important intervening variable that was ignored by previous researchers in explaining the relationship between investment in IT and organizational performance. [2] suggested a refined model which considered IT effectiveness an important moderating variable in explaining.

## **2. IT Effectiveness:**

[10] considered intermediate variables between input and output variables to identify the benefits of IT among large corporations in the U.S. and Europe. They found that IT-related factors had significant positive

effects on intermediate-level variables but failed to find the significant effect of IT on the firm performance variables.

### **1.3 Overall Firm Performance:**



**Figure 1 Proposed model.**

The above variables were adapted from the previous study by <sup>[7]</sup>, which attempted to assess the opinions of respondents with regard to IT and financial performance. In this study, both IT effectiveness and contextual factors were considered to affect the overall firm performance.

## **2. METHODOLOGY :**

A quantitative behavioral approach and a survey questionnaire were used in this study to measure the influences of IT on the performance of construction companies.

A total of 200 questionnaires were distributed to Malaysian construction firms, which are categorized as small and medium contractors (G3, G4, and G5) based on the criteria of the Construction Industry Development Board (CIDB). Sixty-eight completed questionnaires were collected, which indicates a 34% response rate. Statistical methods were

applied to analyze the collected questionnaire data. A statistical package was utilized in this study due to its accuracy and effectiveness which are suitable for quantitative analysis.

Data collection for this study was undertaken with Malaysian construction companies. Target respondents were general managers, senior managers, and project managers of construction firms as well as people who are knowledgeable about IT implementation in their firms. This study determines the perceptions of Malaysian construction professionals because IT initiatives are ultimately undertaken to improve knowledge levels and enhance the industry capacity of local participants. Thus, individuals from host nations were considered the best respondents to evaluate the importance and effectiveness of variables that pertain to IT implementation and its potential results. As expected, an adequate number of sample participants for this study was difficult to determine. In this process, the available statistics from firms registered with CIDB were used.

### **3. Analysis and Results:**

#### **3.1 Validity and Reliability:**

##### **i. Contextual Factors of Firms:**

The factor analysis extraction for contextual factors used the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy value of 0.57, which exceeds 0.05 (i.e.,  $KMO \geq 0.05$ ). For Bartlett's Test of Sphericity Approx, the obtained values are significant at more than 0.05 ( $P < 0.05$ ). These analyses show that the overall anti-image correlation of items was greater than 0.50 and can produce communality of items greater than 0.05. The factor analysis extraction met the minimum factor loading requirement (0.59) and the highest value (0.88) among the five constructs of contextual

factors, with an eigenvalue of more than 1, as shown in Table 1. Table 1 presents the reliability of contextual factors in five components, namely, IT disadvantages, IT resource strategy, HR management decision, executive manager, and technical resources, which range from 0.67 to 0.88.

**Table 1: Analysis of the Contextual Factors of Firms**

| <b>Variables</b>       | <b>ITEMS</b>  | <b>Loading</b> | <b>Alpha</b> |
|------------------------|---|----------------|--------------|
| IT Disadvantages       | Decision-makers do not have time for IT efforts because of heavy work load    | 0.85           | 0.88         |
|                        | Risk that IT leads to inefficiency, overabundance of information              | 0.82           |              |
|                        | Difficulty in measuring profit/assessing investments                          | 0.77           |              |
|                        | Greater knowledge required from staff   | 0.77           |              |
|                        | Reduced security, insufficient interest/commitment from management            | 0.75           |              |
|                        | Continual demand for upgrading hardware and software, incompatible software   | 0.74           |              |
| IT Resource Strategy   | Preference for manual work because of lack of standards/coordination problems | 0.59           | 0.83         |
|                        | IT training   | 0.83           |              |
|                        | Top management's attitude toward IT   | 0.81           |              |
|                        | Benchmarking  | 0.77           |              |
|                        | Relationship with subcontractors and suppliers                                | 0.73           |              |
| HR Management Decision | Consensus   | 0.66           | 0.92         |
|                        | Delivery dates and priority of orders   | 0.88           |              |
|                        | Overtime to be worked at shop level   | 0.85           |              |
|                        | Dismissal of a worker   | 0.84           |              |
| Executive Manager      | Production plans to be worked on  | 0.76           | 0.81         |
|                        | Whether to employ a worker  | 0.82           |              |
|                        | Number of workers required  | 0.72           |              |
| Technical Resources    | Internal labor disputes   | 0.68           | 0.67         |
|                        | Home office   | 0.82           |              |
|                        | Methods of personnel selection  | 0.75           |              |
|                        | Communication between office and construction sites                           | 0.59           |              |
| Total Variance =       |   | <b>70.50%</b>  |              |
| Total Eigenvalue =     |   | <b>15.50</b>   |              |
| KMO =                  |   | <b>0.57</b>    |              |

**ii. IT Effectiveness**

The factor analysis extraction for IT effectiveness used the KMO measure of sampling adequacy value of 0.78, which exceeds 0.05 (i.e.,  $KMO \geq 0.05$ ). For Bartlett's Test of Sphericity Approx, the obtained values were significant at more than 0.05 ( $P < 0.05$ ). The analysis of IT effectiveness indicates that the overall anti-image correlation of items was greater than 0.50 and can produce communality of items greater than 0.05. The factor analysis extraction met the minimum requirements of three-factor loading at 0.60, with an eigenvalue of more than 1, as shown in Table 2. Three components, namely, IT advantages, IT user satisfaction, and IT capability, all have a Cronbach's alpha higher than 0.80.

**Table 2: IT Effectiveness Analysis**

| Variables            | ITEMS   | Loading        | Alpha |
|----------------------|---|----------------|-------|
| IT Advantages        | Easier to handle large amounts of data  | 0.82           | 0.88  |
|                      | Accomplish tasks faster   | 0.81           |       |
|                      | Possibility of sharing information, simpler/faster access to common information | 0.80           |       |
|                      | Makes company more attractive when recruiting staff                             | 0.77           |       |
|                      | Better work quality   | 0.72           |       |
|                      | Possibility of teleworking/telecommuting  | 0.60           |       |
| IT User Satisfaction | Information update  | 0.83           | 0.84  |
|                      | Precision of output information   | 0.82           |       |
|                      | Accuracy of output information  | 0.80           |       |
|                      | User satisfaction with information system                                       | 0.71           |       |
|                      | Relevancy of output information (to intended function)                          | 0.71           |       |
| IT Capability        | Completeness of output information  | 0.60           | 0.82  |
|                      | Possibility of reducing the staff   | 0.82           |       |
|                      | Greater flexibility for satisfying customers                                    | 0.69           |       |
|                      | Possibility of developing new products/new business models                      | 0.67           |       |
|                      | Better communications   | 0.67           |       |
| Total Variance =     |   | <b>64.65 %</b> |       |
| Total Eigenvalue =   |   | <b>10.34</b>   |       |
| KMO =                |   | <b>0.78</b>    |       |

**iii. Overall Firm Performance**

The factor analysis extraction for overall IT performance by using KMO measure of sampling adequacy value was 0.73, which exceeds 0.05 (i.e.,  $KMO \geq 0.05$ ). For Bartlett's Test of Sphericity Approx, the obtained values were significant at more than 0.05 ( $P < 0.05$ ). The factor analysis extraction for overall IT performance shows that the overall anti-image correlation of items is greater than 0.50 and can produce communality greater than 0.05. The factor analysis extraction met the minimum requirements of factor loading with two construct components. The loading values ranged from 0.66 to 0.84, with an eigenvalue of more than 1. Overall firm performance factor was measured in two components, namely, financial performance and IT performance. A Cronbach's alpha of more than 0.80 was acceptable, as shown in Table 3. The results indicate that the data collected from the survey were interrelated and that the scale was consistent with the sample. The Cronbach's alpha ranged from 0.67 to 0.92, which demonstrate the reliability of the scale used in this study [\[12-14\]](#).

**Table 3: Overall Firm Performance Analysis**

| Variables             | ITEMS  | Loading        | Alpha |
|-----------------------|--|----------------|-------|
| Financial Performance | Overall growth                                   | 0.84           | 0.84  |
|                       | Return on assets (ROA)                           | 0.83           |       |
|                       | Return on equity (ROE)                           | 0.82           |       |
|                       | Return on investment (ROI)                       | 0.72           |       |
|                       | Return on sales (ROS)                            | 0.66           |       |
| IT Performance        | IT has improved our overall performance.         | 0.84           | 0.82  |
|                       | IT has dramatically increased our profitability. | 0.79           |       |
|                       | IT has improved our competitive position.        | 0.78           |       |
|                       | IT has dramatically increased our sales.         | 0.74           |       |
|                       | IT has dramatically increased our productivity.  | 0.70           |       |
| Total Variance =      |  | <b>62.73 %</b> |       |
| Total Eigenvalue =    |  | <b>6.27</b>    |       |
| KMO =                 |  | <b>0.73</b>    |       |



An exploratory factor analysis based on the proposed model, with varimax rotation method, was conducted in this study. As shown in Tables 1 to 3, which explain each factor of the model, the required changes and regrouping were based on the loading and extracted measures.

### 3.2 Relationship between Contextual Factors and Firm Performance:

To test the relationship between contextual factors and firm performance, two hypotheses were investigated in this study. The first hypothesis suggested a positive relationship between contextual factors and overall firm performance, and the second hypothesis suggested a positive relationship between contextual factors and IT effectiveness. To examine these hypotheses, null and alternative hypotheses were assumed as follows:

- H<sub>0</sub>1: Contextual factors do not significantly affect IT effectiveness.
- H<sub>1</sub>1: Contextual factors significantly affect IT effectiveness.

**Table 4: Regression Result on the Relationship between Contextual Factors and IT Effectiveness**

| Independent Variable: Contextual Factor | Dependent: IT Effectiveness | Relevant Hypotheses |
|---|-----------------------------|---------------------|
| Standardized Coefficient (Beta)         | 0.372**                     |                     |
| R Square                                | 0.139                       | Supported           |
| Adjusted R Square                       | 0.126                       |                     |
| Sig. F Change Value                     | 10.629*                     |                     |

Note: \*\*p<.01 , \*p <.05

As shown in Table 4, the statistical test (F-test=10.629) yielded a p-value of more than 0.05. Therefore, Hypothesis 1 of this research was supported. The R-square result ( $R^2=0.139$ ) indicated that the contextual

factors were only 13.9% of the variance in IT effectiveness. The relationship between contextual factors and IT effectiveness had low correlation.

On the other hand, the result included only the standardized contextual factor which accounted for 12.6% of the variation (Adjusted  $R^2=0.126$ ). The standardized coefficient was 0.372, which explains the contribution of the contextual factors in IT effectiveness. To examine the hypothesis of this study, null and alternative hypotheses were assumed as follows:

H<sub>0</sub>2: Contextual factors do not significantly affect firm performance.

- H<sub>1</sub>2: Contextual factors significantly affect firm performance.

Table 5 shows the regression result of the relationship between contextual factors and overall firm performance to address Hypothesis 2. Based on the result, the F-test was 18.826 with a p-value less than  $\alpha$  (0.05), which indicates that Hypothesis 2 of this study was supported. The R-square result ( $R^2 = 0.222$ ) indicated that the contextual factors were only about 22% of the variance in the overall firm performance. Thus, the contextual factors have a positive relationship with the overall firm performance. In variation measurement, the result included standardized contextual factors, and effectiveness accounted for 21% of the variation (Adjusted  $R^2 = 0.210$ ).

**Table 5: Regression Result of the Relationship between Contextual Factors and Overall Firm Performance**

| Independent Variable: Contextual Factors | Dependent: Firm Performance | Relevant Hypotheses |
|--|-----------------------------|---------------------|
| Standardized Coefficients (Beta)         | 0.471**                     |                     |
| R Square                                 | 0.222                       | Supported           |
| Adjusted R Square                        | 0.210                       |                     |
| Sig. F Change Value                      | 18.826*                     |                     |

Note: \*\*p<.01 , \*p <.05

### 3.3 Mediating Effect of IT Effectiveness on Contextual Factors and Firm Performance:

Table 6 shows the hierarchical regression result of investigating the mediating effect of IT effectiveness on contextual factors and overall firm performance. The first model of the relationship between contextual factors and overall firm performance without a mediating variable was statistically significant because F (Sig.) was less than 0.05. Model 2, which indicates the regression with mediating variables, also shows a significant relationship, with F (Sig.) less than 0.05. The efficiency of fit measurement for both models can be categorized as acceptable but weakly correlated among variables in Models 1 and 2 with an R square of 0.222 and 0.260, respectively. Based on R<sup>2</sup> change, the additional explanatory power of the overall firm performance due to contextual IT is 3.8%, which indicates that IT effectiveness is a mediating variable. Based on Model 2, the mediation variable was not significant in the regression on contextual factors and overall firm performance. However, IT effectiveness exerted a mediating effect on contextual factors and overall firm performance but was not significant.

- Ho3: IT effectiveness does not mediate influences on contextual factors and firm performance.
- H13: IT effectiveness mediates influences on contextual factors and firm performance.

**Table 6: Results of IT Effectiveness towards Contextual Factors and Overall Firm Performance**

| Independent Variable | Dependent Variable: Firm Performance |               |                |                       |                |
|----------------------|--------------------------------------|---------------|----------------|-----------------------|----------------|
|                      | Standardized Coefficient (Beta )     | t-test (Sig.) | R <sup>2</sup> | R <sup>2</sup> Change | F (Sig.)       |
| Contextual factors   | 0.471                                | 4.339 (0.000) | 0.222          | 0.222                 | 18.826 (0.000) |
| Contextual factors   | 0.467                                | 4.380 (0.000) | 0.260          | 0.038                 | 11.403 (0.000) |
| IT effectiveness     | 0.194                                | 1.822 (0.073) |                |                       |                |

#### **4. Discussion:**

The relationship between contextual factors and firm performance was evaluated by developing two hypotheses. The first hypothesis suggested a positive relationship between contextual factors and overall firm performance, whereas the second hypothesis suggested a positive relationship between contextual factors and IT effectiveness.

This section highlights the prevailing contextual factors in firms and their effects on the overall performance of firms. As the contextual factors were categorized to present the different sections, this study focused on understanding the relationship between contextual factors and overall firm performance for the first hypothesis and the relationship between contextual factors and IT effectiveness for the second hypothesis. The investigated contextual factors are IT disadvantages, IT resource strategy, HR management decision, and executive manager. A better understanding

of the contextual factors may help in designing better strategies to ensure more efficient firm performance.

IT resource strategy was identified as the most important factor in firm performance, and the same findings were reported by Kauffman and Weill [1]. Weill [5] published a report that identifies four contextual factors, namely, the commitment of upper management to IT, previous experience with IT, user satisfaction with systems, and political turbulence. This previous study provided a general view of the importance of the contextual factors to the firm performance.

Results from technical resources with a mean value of 2.56 support a previous study which concluded that for U.S. retail firms, technological resources related to IT did not produce considerable performance variance [6]. They further reported that the resources of firms, namely, human, business, technology resources, that are relevant to IT are considerably responsible for producing advantages that explained significant performance variables among firms. Paopun [7] identified significant relationships between IT investment and contextual factors of firms (including environmental uncertainty, size, structure, business strategy, and human and business resources).

Hypothesis 1 of this study was supported by the statistical test, which yielded a p-value less than 0.05. The R-square result indicates that the contextual factors are only 13.9% of the variance in IT effectiveness, and the relationship had low correlation. The standardized coefficient was 0.372, which explained the contribution of contextual factors to IT effectiveness.

Hypothesis 2 was supported with a p-value less than  $\alpha$  (0.05). The R-square result indicates that the contextual factors have a positive relationship with firm performance and are about 22.2% of the variance.

These findings are similar to those of previous studies [6, 7, 15, 16]. Powell and Dent-Micallef [6] studied a resource-based theoretical framework in the U.S. Their study suggested that IT resources produced advantages that explained significant performance variables among firms. Brynjolfsson and Hitt [15] studied the benefit and influence of a decentralized organizational structure on IT firms and found that firms with a decentralized organizational structure and work structure had greater IT benefits to their productivity growth and market value. Paopun [7] identified a significant effect of contextual factors on IT effectiveness in Thailand. Devaraj and Kohli [16] identified a significant effect of contextual factors on firm performance in hospitals in the U.S.

These previous studies contrasted with the findings by Tam [17] who reported that shareholders' returns were not associated with IT investment and contextual factors in Hong Kong, Singapore, Malaysia, and Taiwan. In a study on 22 developed and 14 developing countries, Dewan and Kraemer [18] found that contextual factors have an insignificant effect on firm performance, especially in developing countries. They suggest that this insignificant relationship can be explained by numerous reasons, including different IT infrastructure levels and IT enhancing complementary factors among countries.

Model 1 of Table 6 shows a significant direct effect of contextual factors on firm performance (47.1%). Including IT effectiveness in Model 2 as a mediating variable increased the effect of contextual factors on firm performance by 3.8% from 46.7%. This result suggests that IT effectiveness is a significant variable in mediating the relationship between contextual factors and firm performance.

This finding is similar to that by [2]. They developed a model to prove the importance of IT effectiveness as a mediating variable in the

relationship between contextual factors and firm performance. [19] stated that IT plays a crucial role in generating, processing, and transmitting information. As information is considered an invaluable asset of a firm, the appropriation of IT efficiently accelerates the acquisition, assembling, and dissemination of information between and within different departments in an organization<sup>[20,21]</sup>.IT ultimately enhances coordination and harmonization in an organization.

## **5. Conclusion:**

The results of this study indicate that the contextual factors are important determinants of overall firm performance on which they have positive and significant effects. About 22.2% of the variance explained the relationship between the firm contextual factors and overall firm performance. This study proved that the IT-related resources of Malaysian construction firms significantly affect their performance (human, business, and technical resources). Furthermore, findings show that IT effectiveness mediates the relationship between contextual factors and overall firm performance. A mediation model was presented to explain the greater variances in firm performance compared with the direct effect model. IT effectiveness partially mediates the relationship between contextual factors and overall performance of Malaysian construction firms.

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