An Investigation of IT Effects on Various Aspects of Organizational Effectiveness

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ABSTRACT — By incorporating level of information technology (IT) investment, availability of hardware and software, computer efficacy of employees, and competency of IT staff in providing services in the examination of organizational IT, and by assessing organizational adaptability, productivity, integration, as well as employee cohesion and development, this study found evidence which indicates positive effects of IT on organizational performance. However, the findings suggest that the relation between IT and performance is by no means simple and straightforward. That is, the study discovered that contextual conditions of particular organizations (e.g., working culture, competing strategy) appeared to act upon their success in gaining positive IT effects and type of effects they received.

KEY WORDS — Organizational Effects of IT, IT and Organization, IT Productivity Paradox

1. Research Purpose and Importance

Apparently, IT has become an important component of organizations. However, researchers have not found an all-agreed conclusion of whether or not the IT-organizational performance relation really exists. For example, Brown et al. (1995) found that firms which were leaders in the employment of strategic information systems experienced greater profitability compared to their industrial indexes. By contrast, Kivijarvi and Saarinen (1995) did not detect significant differences in profitability between firms with varying intensities of information system investment.

This research investigates the impact of information technology (IT) on organizational performance. However, the fundamental purpose of the study is not to provide a statistically derived conclusion in regard to the relation between IT and organizational performance. Rather, its mission is to
gain further understanding to explain the inconsistency of the previous findings.

For this study, IT refers to the availability of IT resources within organizations. These resources are comprised of not only the IT tangibles (e.g., hardware, software, and telecommunication devices) but also the knowledge to effectively utilize these tangibles. In addition, unlike many previous studies within the IT-firm performance research domain, the term organizational performance will not restrictively refer to financial accomplishment of organizations. Instead, the study utilizes several effectiveness criteria to assess performance.

Previous studies defined and measured IT and firm performance constructs, and determined whether the relation was positive, negative, or nonexistent based on the observed variation (or lack of variation) in the value of the performance variable due to the change in the value of the IT variable. These studies typically involved a large number of organizations since the principal focus was on the statistical validity of the relation. As a result, these studies generally sacrificed the ‘depth’ (i.e., in-depth investigations within each organization) for the ‘width’ (i.e., number of organizations included) of their investigations.

These previous studies employed various measures and/or surrogates for IT and organizational performance constructs. However, the one most commonly used surrogate for IT was IT investment; whereas measures of performance included, almost solely, those reflecting profitability of organizations for example, return on investment (ROI) and return on asset (ROA). Collectively, previous empirical findings indicated inconsistent results. Restrictive IT and organizational performance measures may indeed contribute to the observed contradiction in the findings. That is, IT investment does not represent the complete construct of IT within organizations. For example, user IT competency and IT staff competency, which may or may not be induced by the investment, are also parts of organizational IT. Therefore, they too are likely to have substantial effects on the IT-performance relationship. Similarly, profitability cannot invariably and thoroughly reflect the performance of firms. Profitability is affected by numerous external factors (e.g., economic condition, governmental regulations), therefore it is possible that an operationally effective organization may not do well financially.

Due to these deficiencies, the study looks at IT investment, IT capacity, user computer efficacy, as well as IT staff competence to measure organizational IT. Similarly, for performance measurement, instead of using profitability indicators, this study employs four sets of criteria which reflect organizational effectiveness. These sets of criteria are adaptability, productivity, integration, and employee cohesion and development. Adaptability refers to the ability of organizations to adapt to changes. Productivity refers to organizational efficiency in work output planning and producing. Integration refers to the ability to integrate and stabilize various internal components into a collective whole. Lastly, employee cohesion and development refers to the ability of organizations to maintain morale and cohesion among the employees and to help them develop knowledge and skills.

Furthermore, the impact of IT on performance of organizations should not be studied out-of-context as many of the previous studies typically did. IT effects may vary from one organization to another since any particular organization operates within its own environmental context which differs from that of any other organization's. Hence, this research does not restrict its investigation solely to IT and performance. The study examines the environments of the organizations as well. Environmental differences may also explain the discrepancy in the previous findings.

![Figure 1. Research Model](image_url)
In a nutshell, the propositions of this research are the following:
Proposition 1 The restrictive definitions of IT and organizational performance adopted in the previous studies contributed to the inconsistency of their findings.
Proposition 2 The previous studies' omission of organizational context examination contributed to the inconsistency of their findings.

2. The Eight Case Studies

2.1 Research Approach

This research encompasses in-depth case studies of IT effects within eight organizations. These organizations are located in Bangkok, Thailand. The organizations being investigated are in the consumer products and advertising industries. All of these companies are well-known and large in size. Among these companies, the use of computers is primarily for information processing and administration. Furthermore, IT present in these companies is typically mainstream rather than high-tech. Table 1 summarizes the characteristics of the eight companies. Due to the confidentiality agreement between the companies and the researcher, the companies' names are disguised.

Table 1 Participating Companies

<table>
<thead>
<tr>
<th>Firm</th>
<th>Nationality</th>
<th>Primary Business in Thailand</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Multinational</td>
<td>Consumer Products</td>
</tr>
<tr>
<td>B</td>
<td>Multinational</td>
<td>Consumer Products</td>
</tr>
<tr>
<td>C</td>
<td>Multinational</td>
<td>Consumer Products</td>
</tr>
<tr>
<td>D</td>
<td>Multinational</td>
<td>Consumer Products</td>
</tr>
<tr>
<td>E</td>
<td>Thai</td>
<td>Power Drinks, Pharmaceutical, Consumer Products, Confectionery</td>
</tr>
<tr>
<td>F</td>
<td>Multinational</td>
<td>Confectionery, Pharmaceutical</td>
</tr>
<tr>
<td>G</td>
<td>Multinational</td>
<td>Pharmaceutical, Consumer Products, Nutrition</td>
</tr>
<tr>
<td>H</td>
<td>Multinational</td>
<td>Advertising</td>
</tr>
</tbody>
</table>

The study possesses both qualitative and quantitative characteristics. As a whole, the research is qualitative in the sense that it involves in-depth examinations of only a small number of units of analysis (i.e., organizations) and it is not aimed at statistical hypothesis testing. However, the quantitative characteristics of the study are shown in its operationalization of the IT and performance variables. That is, the study employs concrete instruments to measure these variables. Furthermore, the study utilizes some statistical analyses on the collected data. Nevertheless, as mentioned earlier, the main purpose of the study is not to draw a statistical conclusion for any particular relation. The results obtained from these statistical analyses will be coupled with the insights obtained from the in-depth exploration of the organizational conditions to produce further understanding regarding the impact of IT on organizational performance.

2.2 Research Instruments

The instruments used in this study are presented in Table 2. These instruments are packaged in two questionnaires: IT questionnaire and employee questionnaire. The IT questionnaire encompasses questions concerning IT investment and IT capacity. For each participating company, the chief information officer (CIO) was typically the respondent of the IT questionnaire. The employee questionnaire incorporates the questions regarding user computer ability, IT staff competency in providing services, and organizational effectiveness in terms of adaptability, productivity, integration, and employee cohesion and development. Within each firm, approximately 30-50 copies of this questionnaire were randomly distributed among office employees. In this study, office employees came from various hierarchical levels. However, the group did not include manufacturing labor.

soap, detergent, shampoo, toothpaste, etc
Table 2 Research Instruments

<table>
<thead>
<tr>
<th>Variable</th>
<th>Instrument</th>
</tr>
</thead>
</table>
| Investment          | [1] IT Investment per Employee  
                      | [2] IT Expense per Employee  
                      | [3] Total IT Budget per Employee (Invest.+Exp.) |
| IT Capacity         | [1] Computer per Employee Ratio  
                      | [2] Variety and Novelty of Application Software |
| User Competence     | Measured by Computer Self Efficacy Instrument (Compeau and Higgins, 1995) |
| IT Staff Competence | Measured by the Performance Compartment of SERVQUAL Instrument (Pitt et al., 1995) |
| Adaptability        | Measured by Modified Organizational Effectiveness Instrument (Rohrbaugh, 1981) |
| Productivity        | Note: The instrument includes adaptability, productivity, integration, and employee cohesion and development compartments. |
| Integration         | Employee Cohesion & Development                                               |

Nevertheless, it is not the intention of the study to only rely on the quantitative data collected via the questionnaires to determine IT and organizational performance. The study attempts to accommodate these data with more profound qualitative exploration as appropriate. Please note that the data collection period of this study began in September 1997 and ended in June 1998. During the course of the data collection, Thailand as well as many other countries in the region were facing a serious economic crisis.

2.3 Examination of Organizational Context

As mentioned earlier, this research does not study the IT-performance relation out-of-context. That is, the investigation of the relation also involves an exploration of the organizational environment in which the relation takes place. The primary purpose of the exploration is for the researcher to be aware of organizational conditions which may affect the relation. These conditions include stage of the life-cycle, current competitiveness, managerial emphases, working culture, domain of business, and so on. Though these conditions are seemingly non-IT, they too are parts of the collective organizational environment, and are likely to have influences on everything that happens within that environment.

This qualitative exploration is also intended to capture additional insights regarding IT conditions of organizations. As mentioned earlier, this additional qualitative information will be used to augment the quantitative data obtained from the questionnaires. Moreover, this qualitative exploration also enables the researcher to extend the study investigation to include other IT elements which may not be as easily quantifiable as those identified in the research model. (shown in Figure 1) Examples of these elements are tension (if any) between IT staff and users, characteristics of IT use, organization of IT department, overall configuration of IT systems, and recognized significance of IT within organizations. Semi-structured, in-depth interviews with IT and user staff, examination of documents (e.g., newscloppings, corporate documents), and direct observations are data collection techniques used in obtaining this qualitative information.

2.4 Brief Guidelines for Data Analyses

Within each company, linear regressions are conducted between the multi-valued IT variables (i.e., user competence and IT staff competence) and each of the four aspects of organizational effectiveness (i.e., adaptability, productivity, integration, and employee cohesion and development). A simple rule of thumb is that if the regression significance is less than 0.05, the regression is statistically significant. Therefore, one can conclude that the independent variables have statistical significance to predict the dependent variable. Simply put, the regression significance of less that 0.05 suggests that the independent variables (i.e., the two multi-valued IT variables) have an effect on the dependent variables (i.e., one of the four aspects of organizational performance). The observed effects (or lack of effects) of IT on particular types of performance within each company, are then explained by level of IT investment, IT capacity (i.e., availability of hardware and software), and all other IT and organizational conditions present in that company.

2 Based on the life-cycle model of Quinn and Cameron 1983
3. Results

As mentioned earlier, for each organization, the study performs linear regressions between the two multi-valued IT variables and each of the four performance aspects. The regression results are summarized in a graphical form in Figure 2.

Each quadrant represents a particular aspect of organizational performance included in the research model. That is, the top-right quadrant represents adaptability performance, the bottom-right quadrant represents productivity performance, the bottom-left quadrant represents integration performance, and lastly the top-left quadrant represents employee cohesion and development performance. The existence of a box indicates that the two IT variables, together, have statistical significance (i.e., the regression significance is less than 0.05) to predict the particular performance. In other words, the IT variables have a statistically significant effect on such performance. For example, at company H, the user competence and IT staff competence variables, together, have a statistical significance to predict only the productivity effectiveness of the company. In other words, the findings indicate an effect of IT on only the effectiveness of the company in its productivity performance. The box in the bottom-left quadrant of firm C is drawn using a dotted-line because the significance of the IT-integration performance regression of firm C is equal to 0.057. Obviously, this significance value is not less than, yet very close to, the 0.05 cut-off point.

As discussed earlier, the observed IT effects or lack of effects will be explained by IT and organizational conditions of particular companies. To make the rationalization easy to comprehend the regression results, values of IT variables, and other observed conditions are summarized and reported in Table 3. The table looks rather simple, however its content is actually a result of long and demanding research investigations.
<table>
<thead>
<tr>
<th>Firm</th>
<th>Investment (Present Year)</th>
<th>PC Software</th>
<th>User IT Staff</th>
<th>Stage</th>
<th>Outstanding Characteristics</th>
<th>Performance</th>
<th>Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>100 (60+ 40)</td>
<td>0.8</td>
<td>A 3.17</td>
<td>B 3</td>
<td>Aggressive competitor, Versatile and Initiative focused Company</td>
<td>Excellent due to aggressive marketing strategy enabled by strong financial power</td>
<td>![Effects Icon]</td>
</tr>
<tr>
<td>B</td>
<td>103 (6+ 97)</td>
<td>0.63</td>
<td>A 2.89</td>
<td>A 3</td>
<td>Persistent and Conservative Competitor, Stable rather than Versatile company</td>
<td>Starting to take a lead in certain segments</td>
<td>![Effects Icon]</td>
</tr>
<tr>
<td>C</td>
<td>114 (51+ 63)</td>
<td>1</td>
<td>A 3.72</td>
<td>B 3</td>
<td>Have a highly competitive working atmosphere</td>
<td>Facing stagnation in sales growth but having many more opportunities in the horizon</td>
<td>![Effects Icon]</td>
</tr>
<tr>
<td>D</td>
<td>100 (40+ 60)</td>
<td>0.8</td>
<td>A 3.72</td>
<td>C 4</td>
<td>Have a noticeable tension between IT and user staff</td>
<td>Notably dissatisfactory due to the difficulty in changing their trade practice</td>
<td>![Effects Icon]</td>
</tr>
<tr>
<td>E</td>
<td>27 (7+ 20)</td>
<td>0.21</td>
<td>A 3.38</td>
<td>B 4</td>
<td>Has expanded into many different business domains</td>
<td>Hindered by the current economic meltdown but still surviving</td>
<td>![Effects Icon]</td>
</tr>
<tr>
<td>F</td>
<td>108 (29+ 79)</td>
<td>0.56</td>
<td>B+ 3.49</td>
<td>B 4</td>
<td>Had a recent market repositioning of a major product</td>
<td>Somewhat hindered by the economic drop but continues to maintain a strong competitive position due to market repositioning of a major product</td>
<td>![Effects Icon]</td>
</tr>
<tr>
<td>G</td>
<td>49 (20+ 29)</td>
<td>0.58</td>
<td>A 3.39</td>
<td>B 3</td>
<td>Have significant differences in business practice across divisions</td>
<td>Having high growth in recent years but facing substantial drop this year due to governmental regulations</td>
<td>![Effects Icon]</td>
</tr>
<tr>
<td>H</td>
<td>No Data</td>
<td>0.73</td>
<td>A 3.46</td>
<td>A 4</td>
<td>Have a high concern for data confidentiality</td>
<td>Somewhat hindered by the economy but continues to maintain a strong competitive position</td>
<td>![Effects Icon]</td>
</tr>
</tbody>
</table>

**Unit:**
- Investment (present year) = thousand bath per employee
- PC (including all types of end-user computer) = computer per employee
- User = user computer competency scores (1 = inability 5 = excellence)
4. Discussion

4.1 Pattern of IT effects

Referring to Table 3, one can see that all of the companies succeed in gaining IT effects on at least one of the aspects of performance effectiveness. Evidently, the pattern of IT effects of a particular organization is generally different from that of another organization. That is, of all the eight participating companies, only two of them (i.e., A and E) obtain the same pattern of IT effects.

Most interestingly, the study finds evidence which indicates that there are associations between organizational practices, resulting effects of IT, and business performance of organizations. For example, within firm A, there appears to be an alignment between the obtained IT effects and the business emphases of the company. That is, as mentioned in the table, A is an aggressive market competitor. Furthermore, within the company, initiatives are encouraged and valued. Therefore, it is not surprising to find that within this company, IT is not used in a way that results in integration enhancement. Reasonably, integration effectiveness, which has its focus on stabilization and control, should not be of substantial interest to the company that largely values inventiveness and readiness to compete aggressively in its market.

Besides firm A, firm B is the other company that still is doing exceptionally well despite the current national economic slump. As one may see, the pattern of IT effects of firm B differs from that of firm A. For firm B, the effects are on productivity, integration, and employee cohesion and development but not adaptability effectiveness. Though both companies are doing well, they are distinctively different with regards to their competing schemes. That is, firm A is a speedy attacker; whereas firm B is a persistent player. Furthermore, these two opponent companies are also substantially different in their internal working tradition. That is, for A, cross-functional job rotation is more or less a company norm; whereas for firm B, it is rare. For example, the current HR director of firm A actually had his education in mechanical engineering and initially began his career with the company in the manufacturing function. Conversely, in firm B, it is unusual to find an...
employee with an educational background that is inconsistent with her/his job position. The HR director of firm B stated that the company believes in finding the right person with the right educational qualification for the job and once a person is appointed to a certain position within a certain function, she/he will normally be staying within that function. The difference in job rotation practices further indicates the difference in organizational characteristics between these two firms. By and large, firm A is a versatile organization; whereas B is a more stable business entity. Due to the company's marketing practice (i.e., persistent player as opposed to speedy attacker), and internal organizational characteristics (i.e., stability as opposed to versatility focus), it is not surprising that within firm B, IT is not used in a way that would result in an enhancement of the adaptability effectiveness of the firm. Again, the findings of firm B indicate an alignment between organizational practices and the resulting IT effects.

An opposite case is firm D. It is a company with an unfavorable business performance. Apparently, the present unsatisfactory performance is a result of the company's inability to effectively respond to a major change in the market environment (i.e., from traditional-trade market to modern-trade market). Evidently, the regression results of firm D indicate that there are IT effects on only integration and not any of the other three aspects of effectiveness. In other words, the detected IT effects imply that, within firm D, IT is used to enhance organizational stability and control. However, to get through this displeasing business situation, stability and control are the least important values onto which the company should hold. To survive, firm D would need to redefine its business practices and make changes instead of stabilizing and controlling existing business routine. This misalignment between the appropriate practice the company should adopt and the actual IT effects the research found may help to explain the poor business performance of the company.

The IT-performance regression findings of firm C and firm H also give additional evidence which indicates that organizational practices influence how IT is used, which in turn, determines types of IT effects organizations receive. As mentioned in the table, competition among employees within C is very intense. Therefore, it is not surprising to find no IT effect on the employee cohesion and development effectiveness of the firm. Since the employees of firm C perceive one another more or less as competitors, it is therefore unlikely for them to use IT to promote employee adherence.

Confidentiality is a central concern of firm H. As an advertising agency, it has to do all it can to protect its clients' information. A fundamental strategy of firm H is to limit access of any confidential information only to those who really need them. Therefore, there is not much information sharing across the company network. As a result, computers are generally used for producing individual work outputs such as artwork, client reports, and presentation materials. Correspondingly, the research findings indicate effects of IT only on productivity (i.e., output planning and producing) effectiveness of the company.

Referring to Table 3, one can see that firm G is the only company that succeeds in gaining positive IT effects on all of the four aspects of performance. Nonetheless, of all the eight companies included in the study, it is not the company with the best business performance. There are two main reasons for their unexpected performance. First, many of the medicine products of firm G are imported, therefore the company sales are hindered by the new governmental restriction against imported medicines. Second, one of its very successful product, baby formula, is also imported. Due to the recent devaluation of Thai baht, its costs have dramatically increased. Unfortunately, baby formula pricing is under governmental regulation. As a result, firm G cannot instantly and freely adjust the price according to the new costs. With an attempt to maintain the product presence in the market, the company decides to sell this product even at less than costs. The findings of firm G suggest that the success of an organization in gaining substantial IT effects on its performance effectiveness is definitely not an adequate determinant of its success in the business competition. Obviously, there are many more factors that can affect the business success of a firm.

By and large, the research finds that organizational characteristics, to an extent, help explain the pattern of IT effects of organizations. The phrase "to an extent" is emphasized because within this study, the researcher is able to explain patterns of IT effects of some, but not all, of the organizations. In the case of firm F, for instance, it is not obvious to the researcher why, within this company, there are no effects of IT on productivity performance of the firm. Similarly, in the case of company E where the pattern of the effects is identical to that of A, the researcher found no profound evidence to explain why the pattern is as it is. The only clue
the researcher has is that this company has been expanding into many new business domains since its establishment a century ago. This history of many domain expansions might have made integration an unimportant value to the company.

The study cannot use organizational practices to explain all of the patterns of IT effects. Yet, by and large, the evidence which indicates the association between organizational practices and IT effects is too substantial to ignore. In certain organizations where the researcher cannot relate the pattern of the effects to certain organizational factors there is perhaps no dominating characteristic. Instead, many factors might have been simultaneously and equally playing a role in shaping the company's use of IT. In such cases, it would be difficult to associate the resulting IT effects to any particular factors.

To summarize this discussion, the following suggestions are drawn:

1. Organizational practices (e.g., competing strategy, working tradition, employee disposition) influence how IT is used, which consequently determines the type of effects an organization obtains. This statement is graphically presented in Figure 3. As mentioned earlier, during the course of the data collection (from September 1997 to June 1998), Thailand was facing a critical economic setback. It is possible that this economic crisis increased the chance of this cross-sectional study to detect the organizational practices-IT use/effects association. The organizational practices-IT use/effects turnaround time might have been shortened by the urgent need to survive.

2. Misalignment between the type of performance effectiveness that IT enhances and the desired type of effectiveness the organization seeks (i.e., as found in firm D), contributes to poor business performance.

3. The success of an organization in gaining positive IT effects on its performance effectiveness is not an adequate determinant of its success in business competition. There are many more factors besides IT (e.g., product cost structure, governmental regulation, economic condition) that affect business outcomes of organizations.

4.2 Ingredients of IT Success

The study found no evidence to suggest that either IT investment, availability of user computers, or efficacy of employees in using computers alone can predict the success of organizations in gaining IT effects (see ‘investment’, ‘PC’, ‘user’, and ‘effects’ columns of Table 3). In other words, there appears to be no association between any of these variables or ingredients and the success of organizations in gaining IT effects. For example, firm A and firm D are the two firms with exactly the same level of IT investment, however they are very different in their IT success. That is, firm A receives IT effects on three of the four performance aspects; whereas D receives the effects on only one of the effects. Nonetheless, one limitation of this study is that it considers only the present year investments of the companies; whereas accumulative investments are not included in the investigation.

Likewise, neither computers per employee ratio nor employee computer efficacy is a determinant of IT success. With regard to software advancement, due to the lack of substantial differences among the firms, the study cannot draw any specific conclusion.

Interesting findings lie in the influence of quality of IT services on the effects of IT on organizational performance. The study results suggest that the quality of IT services is one ingredient that has a substantial consequence on IT effects. By comparing the seven marketing-manufacturing firms (firm A to G) with a similar nature of IT use, one can clearly see that company D has the least success in achieving IT effects. The user-perceived quality of IT services of firm D is distinctly lower than those of the other firms. It is reasonable to suggest that this deficiency of IT service quality contributes to the downfall because firm D is not
have influences on the organizations' success in gaining IT effects and type of effects they received. The evidence found implies that IT seems to have become an integral and indivisible element of a compound organizational entity. Therefore, it is noticeable that the use of IT within any particular organizations is shaped by their overall practices and behaviors.

These research findings stimulate the need to include more composite IT and performance measures and examination of contextual conditions to study the IT-organizational performance relation. The evidence found suggests that restrictive measures of IT and organizational performance, as well as omission of contextual exploration may have contributed to the discrepancy in the previous research findings.

5. Concluding Remarks

By not restricting the definitions of IT and performance to IT investment and profit attainment, the study found positive IT effects. More interestingly, the study detected that the contextual conditions of particular organizations have influences on the organizations' success in gaining IT effects and type of effects they received. The evidence found implies that IT seems to have become an integral and indivisible element of a compound organizational entity. Therefore, it is noticeable that the use of IT within any particular organizations is shaped by their overall practices and behaviors.

These research findings stimulate the need to include more composite IT and performance measures and examination of contextual conditions to study the IT-organizational performance relation. The evidence found suggests that restrictive measures of IT and organizational performance, as well as omission of contextual exploration may have contributed to the discrepancy in the previous research findings.

References


