The Impact of IT Spending for Staff Development
On Performance of the Firm

James A. Senn
Georgia State University
Atlanta, Georgia 30302-4015
(404) 651-3880 Fax: (404) 651-2804
e-mail: jsenn@gsu.edu

Jungwoo Lee
Georgia State University
Atlanta, Georgia 30302-4015
(404) 651-3888 Fax: (404) 651-3842
e-mail: cisjwblx@gsusgi2.gsu.edu

ABSTRACT
As the use of information technology continues to grow in business, coupled with ever-escalating expenditures and increasing interest in outsourcing, IT professionals are under increasing scrutiny to demonstrate an impact on business performance. However, due to the fact that information technology components are widely available, it is unlikely they are the basis for a competitive edge in business. Rather the benefits come from the manner in which IT is deployed, which in turn stem from the capabilities of the staff members of the IT group. Thus, one might ponder whether firms that invest effectively in the development of information technology’s human resource enjoy better performance than those who do not.

An analysis was performed of the three-year IT spending of a sample of Fortune 500/Service 500 firms. The results of the study show there is a highly significant and positive relation between spending for development of the IT staff and performance of the firm, measured by corporate revenue. These findings suggest a series of questions meriting additional research.

1.0 Introduction
It’s widely recognized that the information technology functions in both manufacturing and service firms are under continually increasing scrutiny [1, 2, 3, 14, 17, 18, 19], a result of the:
- Increased importance of IT to the competitiveness of the firm
- Growing size of the firm’s budget for information technology
- Widespread availability of outsourcing alternatives
- Greater understanding of the capabilities of IT by executives and line managers

Yet for all of the breakthroughs in the technological underpinnings of information technology, the real benefits of these advances only occur when the raw capabilities of IT are applied in a meaningful way. The responsibility for such application falls to the individuals and teams who deploy or facilitate the deployment of information technology in the form of information systems applications. Since there is no inherent business value in information technology, it appears that the value of IT comes from the sustained capabilities of the IT staff to develop, deploy, and manage its use. Yet the trend to outsourcing indicates, to some, that segments of the IT staff need not be retained.

Unfortunately, there is little documented understanding of the relationship between development of the IT’s human resource (i.e., the professional staff) and its impact on corporate performance. This paper reports the results of research conducted to investigate the relationship between the expenditures by leading users of information technology on staff development and...
its impact on the measurable performance of the firm. As the results show, a highly significant relationship exists between the level of funding for professional staff of high performing IT groups and the generation of corporate revenue.

The first section reviews the forces at work which are affecting information technology’s human resource and spending on IT. The next section describes the study conducted to determine the impact of spending on staff development as it relates to performance of the firm. Implications from these findings, along with suggestions for further research, are explored in the discussion section.

2.0 Background
The assumption underlying this research is that the impact of information technology in the firm is a direct result of the level of investment which executives make in their firm’s IT capabilities. Spending for ongoing development of human resources, an element of such spending, is thought to be particularly significant. Yet in light of frequent corporate outsourcing decisions [10], there is an implied assumption that both staff and IT components are to a certain extent commodities. This section outlines the apparent importance of human resources as well as the related ongoing controversy over the value of information technology in business.

2.1 Importance of IT’s Human Resources
The information technology components used in business systems are available to virtually all enterprises regardless of their size or the industries in which they compete. There is little truly proprietary information technology. Thus, the technology itself is unlikely to be the basis of advantage. Rather, the manner in which IT is deployed determines its impact on the performance of the firm—in meeting business requirements and, in turn, gaining, keeping, or loosing an edge in business. It is evident that timely and effective deployment of IT results from the insights and capabilities of the IT professional staff, i.e., information technology’s human resource component.

This view is consistent with the growing awareness that the chief ingredient for business success in general is the firm’s intellectual capital—the intangible assets of human skills, knowledge, and information [18]. Those firms classified as learning organizations [19] seek to create a culture that facilitates and then capitalizes on continual learning, regardless of the term describing it (e.g., renewal or continuous improvement).

The many firms which are so often profiled as leaders in capitalizing on their IT investments [4] have not produced their accomplishments because they had state of the art computers and communication networks. Rather, these advantages repeatedly stemmed from their IT group’s ability to combine technical knowledge, business savvy, and other related skills, to rethink business processes and opportunities, and to redeploy their IT capacities in a manner that delivers new capabilities and therein new opportunities.

At the same time, IT directors in many firms indicate they do not have the staff they need for higher level achievements, either because of a shortage of trained individuals or because they perceive that their current staff is trained in aging, even obsolete, skills. IT leaders often acknowledge they do not have the staff expertise to fully understand, prepare for, and then capitalize on the merits of new IT opportunities. Furthermore, they suggest that sufficient assistance is not available from technology vendors or consultants [20]. Others believe that university curricula are not revised often enough to aid companies in transition with their IT resources [7].

Only a limited number of IT staff development and education studies are found in the research and practice literature of the field [e.g., 6, 7, 11, 12, 14, 15, 16]. However, those
that are published collectively suggest a serious shortage of trained personnel in the areas of information technology critical for the remainder of the 1990s [12] even as they document an increasingly significant shift in the role and importance of staff members to the success of the firm [7].

The apparent importance of continued development of IT professional staff raises concern about the level of investment in the IS function as a whole. Questions about the return from such spending are at the heart of a raging controversy that involves scholars in other fields of business and economics.

2.2 Return on IT Spending
After a review of the IT spending of a broad sample of firms, Nobel Laureate economist Robert Solow concluded that “we see computers everywhere except in the productivity statistics” (a so-called productivity paradox) [in 1]. A study by Loveman [13], using data from the PIMS database, tested a hypothesis that computers add nothing to the firm’s total output. Loveman was unable to reject the hypothesis, suggesting that IT does not visibly affect the performance of the enterprise.

Similarly Stephen S. Roach, a leading and influential economist with Morgan Stanley & Company, studied the spending of firms for IT in service industries. He concluded that “The massive investments in technology simply have not improved productivity; on the contrary they have made service organizations less profitable and less prepared to compete on other fronts.” [1].

A contrasting set of views is emerging from the research community. M.I.T. economist Erik Brynjolfsson [2] also studied the productivity impact of IT investments at the firm level. His investigation concluded that information technology has “made a substantial and statistically significant contribution to the output of firms. Our point estimates indicate that, dollar for dollar, spending on computer capital created more value than spending on other types of capital…” However, he noted that (1) the relationship between IT spending and productivity is not well understood and (2) other research reports of negative productivity results may be due to measurement problems.

Other researchers [e.g., 4, 8] are also finding positive and significant relationships between the spending of firms on information technology and resulting impact on the firm. A variety of performance dimensions have been used, the principle one being reduction of operating costs.

2.3 Conversion Effectiveness
There is little doubt that firms differ in their ability to convert spending on information technology into visible differences in corporate performance. It thus follows that several firms spending comparable amounts on IT will achieve different results, even when the IT function itself is well managed. The difference in the capabilities of these firms to convert IT resources effectively is believed to be the result of staff abilities to align business strategy and IT strategy, taking into account the competitive context of the firm, and their familiarity with the very technology deployed by the firm. The importance of conversion effectiveness for IT resources is represented in Figure 1.

2.3.1 Assumptions About Outsourcing Impact
An element of conversion effectiveness is the ability of the staff to develop the firm’s IT capability in such a way that it leads to improved performance of the firm. On the other hand, the growing interest in the various types of outsourcing implicitly suggests that often large proportions of the IT staff do not add sufficient value to retain them within the organization. In effect, a decision to outsource implicitly assumes that:

1. IT Staff can be moved out of the firm without significant loss in knowledge and experience (i.e., intellectual capital)
A pivotal issue for research is to determine how much high performance firms are able to capitalize on the investment they make in their human resources to the extent that the difference is visible in the overall performance of the firm. The remainder of this paper describes the research conducted to examine this question.

3.0 Methodology

In order to gain better insight into the impact of IT on high performance firms, an investigation was conducted to determine the presence or absence of a relation between corporate revenue and the expenditure of funds on information technology’s human resources over a multi-year period. High performance firms are defined to be those companies that have been judged by their peers, using explicit quantitative and qualitative performance criteria, to deploy IT in a manner that distinguishes them from other firms in their industry.

3.1 High Performance Firms

Companies selected for inclusion in the study, members of the Fortune 500/Service 500 list, have all been identified as leaders in their industries for the use of information technology. All have undergone careful scrutiny by professional and academic experts and have been publicly recognized for their IT leadership through achievement awards from such representative organizations as the Society for Information Management (i.e., Partners in Leadership Award), CIO Magazine, Computerworld, or InformationWeek Magazine. Each firm’s recognition has been a result of its achievements in aligning IT strategy with business strategy and for effective management of the accumulated information technology investment, including hardware, software, data, infrastructure, and human resources.

Forty-two firms, 17 of whom are from service industries, are included in the analysis presented in this paper. The rationale for a select and small sample of high performing firms is as

2. Contractors can ‘do what it takes’ simply because it is a skill issue
3. Measurable partnerships can be created with outside outsourcing companies supplying IT to the extent that those firms will have the best interests of the firm at heart ([9]
4. Outsourcing companies can experience ‘organizational learning’ thereby acquiring essential knowledge of the firm [5]
2.3.2 Assumptions About Source of Business Value

The assumptions implicit in a decision to outsource contrasts visibly with the perceived wisdom in many firms that:

1. The value added by information technology does not come from the technology itself, but from the way it is deployed.
2. Decisions regarding deployment are not the responsibility of an outsourcing firm, but emanate from the internal IT staff (contractors and outsourcing agents provide operations support, not strategic or competitive insight into the deployment of IT)
3. Responsibility for generating business value from a firm’s IT investment emanates from more than just the CIO (i.e., is a product of the insights and performance of the IT staff)
follows: If a relationship exists between IT spending and organization performance, it should be visible in the performance of these firms. Likewise, if there is no relation between organization performance, a careful analysis should reveal mixed IT impact even in the leading firms.

Additionally it was surmised that any relation between performance and IT spending should be visible at the revenue level when information systems have strategic, not just operational, importance. Because of the so-called productivity paradox, mentioned earlier, we chose to avoid a classical input/output analysis and focused instead on top-line revenue. Likewise, because of the broad variety and timing of adjustments that can be made to revenue after it is created, to determine profit, we chose not to use profitability as an indicator of IT spending impact.

3.2 Research questions
The following research questions were identified at the beginning of the investigation:

- What is the level of funding for development of information technology’s human resource in high performing companies?
- What is the relation between IT spending, IT spending on human resources, and the financial performance of the firm?
- To what extent are companies developing information technology staffs as a strategic resource for the organization?

Each of these questions formed the basis for a line of analysis using the sample data.

3.3 Sample Data
Data for the 42 companies in the sample spanned the years 1991-1993. IT spending was the actual annual expenditure for information technology hardware, software, staff, and services. IT staff development was that portion of the IT budget spent directly on increasing professional staff knowledge and capabilities. (The salary of IT professionals was excluded from this data.)

The top IT executive at each firm was the primary source for all information concerning the firm’s information technology investments and capabilities. In addition, revenue information was verified from public sources (e.g., annual reports and investment reports). IT spending was reported both in terms of actual budget and as a percentage of revenue for the corporation (Table 1). Because of the cross-industry sample, a great deal of diversity was present in the data. This feature was viewed as a further challenge in demonstrating a spending/performance relationship, suggesting that any resulting relationship would be even more significant compared to a homogenous, single industry sample.

<table>
<thead>
<tr>
<th>Table 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Summary of high performance firm characteristics ($ millions)</td>
</tr>
<tr>
<td><strong>Variable</strong></td>
</tr>
<tr>
<td>IT Budget</td>
</tr>
<tr>
<td>% of Revenue</td>
</tr>
<tr>
<td>IT HR Budget</td>
</tr>
<tr>
<td>Revenue</td>
</tr>
</tbody>
</table>

**Summary by Industry**

<table>
<thead>
<tr>
<th>Manufacturing Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
</tr>
<tr>
<td>IT Budget</td>
</tr>
<tr>
<td>IT HR Budget</td>
</tr>
<tr>
<td>Revenue</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Service Firms</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mean</strong></td>
</tr>
<tr>
<td>IT Budget</td>
</tr>
<tr>
<td>IT HR Budget</td>
</tr>
<tr>
<td>Revenue</td>
</tr>
</tbody>
</table>

4.0 Significance of IT Staff Development Spending
The conservative data analysis program included standardization of data and the application of simple correlation and regression techniques.
4.1 Standardization of Data
Prior to analysis, the data was standardized in order to eliminate a scale difference among variables (i.e., difference in magnitude of revenue and IT spending). A classical standardization procedure was followed: Means were calculated for each variable and subtracted from each data point for the corresponding variable. A standard score was then determined by dividing the difference by the standard deviation. The standardization did not alter the relationships inherent in the data.

4.2 Correlation Analysis
A correlation analysis was first performed to determine the existence of a visible relation between the level of support for human resource development in the firm’s IS function and corporate revenue. Annual expenditures made for IT staff development over the three year sample period were examined in relation to corporate revenue. The correlation results varied depending on the variable of analysis (Table 2).

The analysis showed that expenditures for staff development, as a percentage of the firm’s corporate IT budget, were not significantly related to corporate revenue. However, when we examined the actual amount of the expenditure in relation to corporate revenue, a very high correlation level (r = 0.537), significant at the 0.0001 level, was found for the entire sample. These results suggest that firms investing the most in development of their IT staff, in terms of actual expenditures, also generated the highest revenue.

4.3 Regression Analysis
To investigate the nature of the relationship underlying the significant correlation results, a simple regression model was formulated. Annual IT spending for staff development was regressed on the dependent variable, corporate revenue. Results of the regression analysis, shown in Table 3, which confirm the correlation analysis, show that a positive and significant relationship exists (b=0.595, p=0.0001) between the level of spending for staff development and the annual revenue of the firm. This relationship suggests that for the firms in the sample, IT staff development expenditures and corporate revenue rise and fall in relation to one another. More specifically, for the firms included in this analysis, an additional 1 percent increase in spending for human resource is associated with a 0.6 percent increase in corporate revenue.1

4.4 Difference Between Industries
The level of IT use and ability of firms to capitalize on their IT spending, is thought to differ between service and manufacturing industries [17]. Hence a second model was formulated in order to understand the impact of developing IT’s human resource, as identified in the correlation analysis. An indicator variable was used to differentiate between service and manufacturing industry companies. When annual spending for IT staff development was regressed on annual corporate revenue for each of the 3 years in the sample, it was determined that the relationship was highly significant for each industry group (p=0.0001).

It is clear that the impact of spending on human resource development is much higher in service industries than in manufacturing firms. These results are summarized in Table 4. This finding suggests that if comparable amounts are spent on staff development in both manufacturing and service industry companies, the service companies may achieve higher returns in the form of annual revenue (i.e., the greater the aggregated spending on training the greater the increase in aggregated returns over time).

The interaction between the indicator variable and staff development expenditures is found to be not significant. This suggests that we cannot conclude that the incremental revenue generated by the incremental investment in staff

---

1One should be careful in how this conclusion is used since the adjusted R-square for the whole model is 0.35, indicating that the model explains 35 percent of the variability in the dependent variable.
development is different between manufacturing and service industry firms. However, the overall relationship between the investment in human resource development of IT professionals and corporate revenue remains significant.

5.0 Discussion
The preceding analysis and findings provide insight into human resource investment thresholds while raising other questions concerning causality. Implications for an ongoing longitudinal study also emerge from our analysis.

5.1 Investment Thresholds
It is almost intuitive to expect that when firms develop their human resources, visible improvement in performance will follow. Yet there are no previous studies documenting this with respect to the human resources of firm’s information technology groups. The analysis presented here shows the existence of that relationship quantitatively. For high performing firms who invest in information technology’s human resource, there is a clear and significant relationship between IT spending on staff development and the revenue generated by the firm. At the same time, no significant year-to-year impact was detected. This finding suggests that human resource investments must be made over a period of time, i.e., that the benefits build up as a result of accumulated investment practices.

Our analysis also shows that there is little relation between the portion of the IT budget spent on staff development and corporate performance. Rather there appear to be threshold monetary spending levels that must be met before a significant return can be expected. This finding should be interpreted to mean that the percent of the budget spent on human resource development is unimportant if the percentage does not translate into a sufficient monetary amount.

For CIOs and their staff, the findings suggest the importance of taking an investment view, not an allocation perspective, on spending for human resource development. There is no apparent linear relationship from year to year, indicating that the level of spending fluctuates with respect to staff development. Hence, the analysis presented in this paper suggests that these high performing firms take exactly that approach, investing continuously, but differently from one year to the next, seeking both to satisfy immediate needs (e.g., training) and in anticipation of more long term requirements (e.g., education and building of knowledge).

For outsourcing proponents and opponents alike, these results suggest that more thought needs to be given to the intellectual capital held by IT professional staff members. Such knowledge may go well beyond technical knowledge, to include important company and industry knowledge that will leave the firm if employees are transferred to an outsourcing company. Moreover, the IT staff which the outsourcing company assigns to the firm’s activities may not have, be able to retain, or be able to acquire such knowledge.

5.2 Causality
There are two interpretations to the predominant results from this analysis:
1. When firms invest in their IT staff, a relation between IT spending and revenue can also be found
2. When firms have sufficient revenue to invest in IT, they ensure that adequate investment is made in the human resource component of the IT function.

The analysis presented here does not provide sufficient evidence to conclude whether spending on IT in general, and on the IT staff in particular, is a cause or a result of the performance of the firm.

Similarly, this analysis did not investigate the impact of industry structure and competition on revenue generation nor did it address comparative use of information technology in the
### Table 3
Relationship between spending ($) on IT staff development and corporate revenue

**Analysis of Variance**

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F Value</th>
<th>Prob&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>1</td>
<td>36.3699</td>
<td>36.3699</td>
<td>55.971</td>
<td>0.0001</td>
</tr>
<tr>
<td>Error</td>
<td>101</td>
<td>65.6300</td>
<td>0.6498</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Total</td>
<td>102</td>
<td>102.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R-square 0.3566

Adj R-sq 0.3502

**Parameter Estimates**

| Variable     | DF | Parameter Estimate | Prob > |T| |
|--------------|----|--------------------|--------|---|
| Intercept    | 1  | 0.005230           | 0.9496 |
| IT HR Spending | 1  | 0.597133           | 0.0001 |

### Table 4
Relationship between spending ($) on IT staff development and corporate revenue (Industry segmentation)

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F Value</th>
<th>Prob&gt;F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>3</td>
<td>42.17851</td>
<td>14.05950</td>
<td>23.267</td>
<td>0.0001</td>
</tr>
<tr>
<td>Error</td>
<td>99</td>
<td>59.82149</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C Total</td>
<td>102</td>
<td>102.00000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R-square 0.4135

Adj R-sq 0.3957

| Variable     | DF | Parameter Estimate | Prob > |T| |
|--------------|----|--------------------|--------|---|
| Intercept    | 1  | -0.161888          | 0.0963 |
| IT HR Spending | 1  | 0.507426           | 0.0001 |
| Industry     | 1  | 0.437593           | 0.0070 |
| Interaction  | 1  | 0.222093           | 0.1606 |

It is not unusual for high performance communication systems. Presumably they develop these capabilities through the ability and insight of their staff members. It is also likely...
they leverage these capabilities to enhance the products and services they provide to customers or to alter the relationships with suppliers. Each may ultimately lead to revenue generation.

5.3 Longitudinal Study
A three year time-frame is a meaningful length of time to examine the impact of staff development on performance, particularly when the rate of change for tools, technologies, philosophies, and competitive applications is high. Hence, the demonstration of a performance impact in this environment is highly significant.

However, we would like to see the study span a longer period of time encompassing multiple application, business, industry, and economic cycles. Extending the study period will help shed light on areas in which an organization’s information technology infrastructure, application portfolio, and systems delivery practices are influenced by staff development. A longitudinal study will enable investigators to see the effects of several generations of staff development, thus accommodating both changes in practices and turnover in personnel. It will also afford an opportunity to gain further insight into variations in deploying information technology on behalf of the firm. And, such a study should additionally be applied to firms which decide to pursue outsourcing of information technology.

6.0 Conclusions
The most important result stemming from this research is the indication that developing information technology’s human resource is related to corporate revenue in well managed firms having high performing IT functions. Service firms are more effective in converting staff development investments into visible and measurable results. The sample included in this analysis also indicates that service firms tend to invest more in IT staff development than manufacturing firms, although this issue needs substantially more investigation.

In general, there appears to be a significant and favorable relationship between IT spending and corporate revenue. This area of investigation is continuing, as it is a critical issue which is at the heart of the controversy over the return on corporate spending for information technology.

References
8. Harris, S. E. and J. L. Katz, “Predicting Organizational Performance Using Information Technology Managerial Control


