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December 2001

Business Value of IT-Enabled Call Centers: An Empirical Analysis

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BUSINESS VALUE OF IT-ENABLED CALL CENTERS: AN EMPIRICAL ANALYSIS

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Abstract

Corporate information technology (IT) investments in customer support and service such as CRM systems have been on a steady rise. Of late, the primary interest has shifted toward assessment of returns on these investments. This research attempts to assess the value of IT investments in a customer support setting using a process-level analysis. Given the lack of academic IS research in the area of customer support and value of IT in the service context, this study aims to bridge this gap by building on prior business value of IT literature. In order to identify the contribution of IT in the context of our study, we explicitly control for personnel-specific factors and customer-specific factors. Our findings indicate that IT enabled call centers significantly improve the performance of the customer support process. Further, we also find that the benefits from IT enabled call centers may be higher when the customer-reported problems are complex and difficult to resolve. In addition, we find that both personnel-specific factors and customer-specific factors significantly influence the business benefits from IT in call center and customer support applications.

Keywords: Call centers, customer relationship management, impact of information technology, management of IT personnel.

INTRODUCTION

The profit strategies of most successful businesses revolve around providing superior customer satisfaction. It has been recognized that increases in customer satisfaction are associated with greater customer loyalty and,hence, greater long-term revenues (Fornell et al. 1996). The crucial role of service quality in customer satisfaction and firm performance (Bowen and Hedges 1993, Zeithaml et al 1990) has resulted in a shift in strategic focus of organizations toward their service arm. The significant role of call centers in the ability of firms to provide quality service has made call centers a crucial component of service investments of firms.

There is a widespread belief that information technology (IT) plays a major role in providing superior customer service. In view of this, firms have invested heavily in IT infrastructure and software related to customer service ($22 billion and growing at 14% annually since). Lately, growing costs of providing customer service have raised concerns over the return on these IT investments (see eAI Journal at eaijournal.com) and corporations have been forced to evaluate the tangible benefits derived from these investments.

Since returns from technology investments are often intermingled with those of business processes, it is often difficult to unambiguously identify the returns on the IT component of business investments. Questions over returns on IT investments in the context of customer service and call centers have not received the necessary attention in the past. With an intent to bridge this gap, this paper applies techniques prevalent in the "business value of information technology" literature and attempts to assess tangible returns on investments in call centers. Early studies attempting to measure the business value of IT investments used firms as units of analyses. These firm-level studies have provided ambiguous results (Brynjolfsson 1993; Brynjolfsson and Hitt 1996) over the returns on IT investments. Other studies, such as those of Kauffman and Kriebel (1988) and Mukhopadhyay and Cooper (1993), have suggested that intermediate levels of analysis, as opposed to firm-level analysis, may help in unambiguously identifying the impact of IT investments. Further, Mukhopadhyay et al. (1997a, 1997b) and Davamanirajan et al. (1999) suggest that by breaking down the unit of analysis into the process or application level, we can better isolate the true effects of IT on specific processes and tasks. Mukhopadhyay et al. (1997b) also recommend that processes relatively independent from other organizational processes should be chosen for such an analysis since the presence of strong coupling among processes can render the results ambiguous.

In this study, we adopt the process level of analysis to understand the impact of an enterprise-wide call center application on the customer service process of a call center. The reasoning behind the choice of this application is that adoption of such an application requires a serious commitment from all parties in the firm and has strategic implications in terms of the ability of the firm to provide high quality service. The customer support process under investigation has a clear boundary, is relatively uncoupled from the other business processes in the organization, and hence is suitable for business value analysis, as identified in earlier research (Mukhopadhyay et al. 1997a, 1997b).

To study the tangible business value of an IT application to the organization, we need to study objective measures of the business process and how the IT application(s) influences these measures. From a productivity perspective, there are several objective measures that are relevant in the context of call centers and customer support. In this study, we choose resolution time as our primary objective measure for two reasons. First, resolution time is one of the most important measures of managerial interest for call centers since it represents the rate at which representatives are able to solve customer problems and it directly influences the call center costs. Second, the speed of resolution significantly influences the perception of quality from a customer's viewpoint. Findings from earlier studies on satisfaction with the customer service process of organizations also indicate that the time taken to resolve customer problems is a key indicator of the customers' satisfaction with the service (Roslow et al. 1992). Hence, our focus on resolution time addresses the productivity and quality perspectives simultaneously. Having identified the objective measure of interest, we believe that, to truly tease out the effect of the IT application, we need to control for several other (non-IT) factors. In our research, these factors have been categorized into three types: problem-specific factors, personnel-specific factors, and customer-specific factors.

The contributions of this research to the literature are multifold. First, call centers have received little attention in the past and this research advances the understanding of assessing value of IT investments in the context of call centers and customer support. Second, we explicitly control for personnel-specific influences on the time taken to solve customer problems. While some earlier studies on business value of IT have accounted for the influence of labor hours on process output and quality (Mukhopadhyay et al. 1997b), none of the prior studies, to our knowledge, have accounted for factors such as personnel capability and experience. Third, prior research has not addressed the influence of customer-specific factors on the business value of IT and our study aims to do so. Fourth, on the methodological front, we illustrate the use of duration models in the analysis of the business value of IT. The structure of the paper is as follows. Section two describes the research model and the theory used in the model. The empirical model used in this study is discussed in section three. Section four describes the data collection process and defines the variables used in our model. The results of the analysis are discussed in section five. Concluding remarks are presented in the following section.

RESEARCH MODEL AND THEORY

The research setting is the IT division of a large academic institution. A major responsibility of this division is the management of a call center supporting the service needs of more than 35,000 users. The specific context of our study is an organization-wide customer support system that was recently adopted by this call center. This system, used by all service representatives in the call center, integrates a majority of the center's activities and standardizes the customer service process. Given the significant investment in this system, our study was initiated to assess the benefits of this investment.

The customer support system is anticipated to improve the following aspects of the customer support process: (1) task handoff among support representatives, (2) tracking of customer information and problem history, and (3) escalation of problem calls to the right personnel. The ability of the system to enable task handoff among representatives and to facilitate escalation of calls to the right personnel may increase the efficiency of the support process by improving the fit between the description of the reported problems and the ability of the service personnel to trouble-shoot them. Similarly, the ability of the enterprise application to track customer information and problem history may eliminate rework and help the service personnel in quickly establishing the context of the problem. Prior research on task-technology fit indicates that better outcomes, such as task performance, would result from the use of an information system if there is a match between the task for which the system is used and the capabilities of the specific technology (Floyd 1988; Goodhue and Thompson 1995). The three characteristics of the IT system discussed above and the corresponding requirements for the customer support process indicate a good fit between the technology and the task at hand. Hence, it is expected that the IT system would positively impact task performance and resolution time.

Despite the above-mentioned positive characteristics of the IT system, it is possible that the overhead involved in using the system for each customer call could suppress the positive impact of the system on resolution time. For instance, prior to the adoption of the IT system, the representatives might have been able to solve simple customer problems in non-standardized ways with little or no overhead. However, once the IT system is accepted, the representatives are forced to use standardized processes, which may involve increased overhead. This increased overhead could lead to an increase in the time to resolve customer problems. In our model, we intend to quantitatively determine the impact of the IT system on resolution time. Next, we discuss the other (non-IT) factors that may influence the resolution time for customer problems.

Problem-Specific Factors

Representatives spend a substantial effort in assessing the scope of the customer problem. A primary determinant of this effort is the severity of the problem from the representative's perspective. By severity, we mean the degree of difficulty in resolving a customer problem given (1) the prior experience of representative in resolving similar problems in the past and/or (2) the lack of experience/training of the representative in resolving certain kinds of customer problems. In this research, we intend to assess the influence of this severity on resolution time.

In case of customers of IT services, as in our study, the IT platforms used by customers may also play an important role in problem resolution. The IT platform can influence problem resolution in two distinct ways. First, lack of users' familiarity or experience with the IT platform may result in imprecisely described problems and longer resolution times. Second, the level of experience/expertise of the representative with the particular customer's platform may also influence resolution time. In our research site, the customers use diverse IT platforms and we expect that the customer's IT platform may significantly influence resolution time.

Personnel Factors

In addition to the influence of the IT system and problem-specific factors, the time taken to resolve customer problems may also depend on characteristics of the service personnel. There are two dimensions of personnel characteristics that may influence resolution time. The first dimension is the *capability* of the service personnel in handling customer support responsibilities. The higher the capability/skill of the representative in support-related tasks, the greater the likelihood of resolving the problem in a short duration.

The second dimension is the prior experience of the call center representatives in customer support-related tasks. When the experience of the service personnel is high, we expect that the familiarity of the representative with the nature and scope of customer problems, having solved similar problems in the past, would decrease the time taken to resolve a given problem. While there is little research evidence indicating the influence of *personnel experience* in the context of customer support and service, prior studies in the areas of software development and decision making have indicated that personnel experience positively influences task performance (Banker and Slaughter 1997; Sanders and Courtney 1985; Taylor, 1975). In this study, we control for the influence of personnel experience on the time taken to resolve customer problems.

Customer Knowledge and Usage Behavior

As noted earlier, studies on the influence of customer specific factors on the business value of IT investments are scarce. In the context of call centers, we expect that certain customer characteristics such as customer knowledge and usage behavior may influence the time taken to resolve problems. To account for this influence, we explicitly introduce a surrogate measure, named *customer type*, to identify customer-specific effects such as customer knowledge and usage behavior on resolution time. The level of knowledge about products, services, and reported problems could differ significantly from one customer to another. For example, problems reported by more knowledgeable customers have a greater likelihood of being clearly described. This clarity may help the service representative in quick problem resolution. Likewise, the product usage behavior of customers is likely to vary substantially across customer segments and indirectly influence resolution time. For instance, in our study, increased usage of the IT environment (product) by certain types of customers may increase the likelihood of only certain severe problems being reported by these customers and hence may indirectly increase resolution time.

Based on the discussion above, the conceptual model for our study and the expected directions of influence of the explanatory factors are shown in Figure 1.

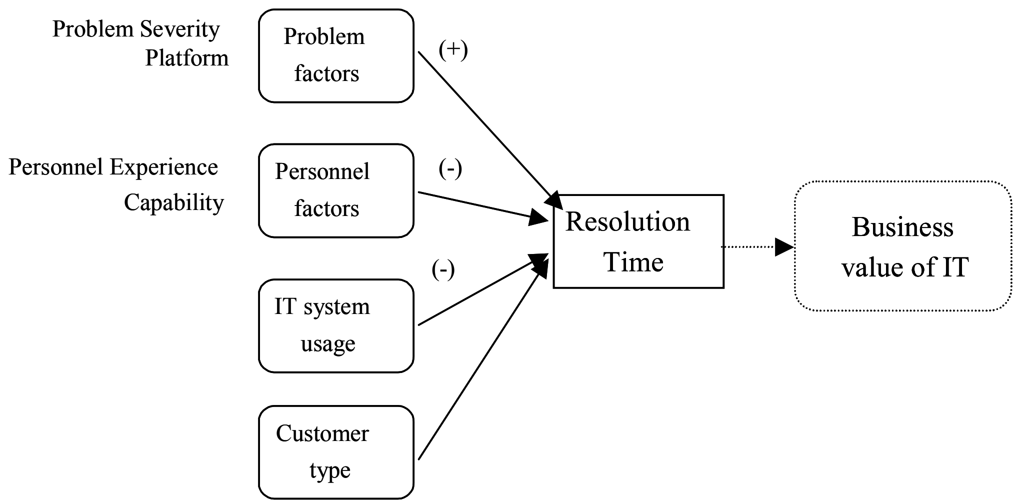

Figure 1. Conceptual Model

EMPIRICAL MODEL

Our model for resolution time is as follows:

Resolution Time = f (IT usage, Problem-specific factors, Personnel factors, Customer type)

Since the dependent variable is a duration variable, we use a hazard model and a proportional hazard specification for empirical analysis. For brevity, we do not present the details of the hazard function model (details can be found in Greene 1999). We assume that the explanatory variables do not vary within the resolution time interval. If x is used to represent the explanatory variables and β represents the coefficients of the explanatory variables, the rate at which problems are resolved at time t can be expressed as:

$$\lambda = \phi(x, \beta)\lambda_0(t) = \exp(x'\beta)\lambda_0(t) \quad (1)$$

where λ_0 is the baseline (hazard) rate of problem resolutions and ϕ is the scaling factor that represents the influence of explanatory variables on rate of resolving problems.

Since we are concerned mainly with the effects of the independent variables and we do not assume the shape of the baseline hazard function, we use the partial likelihood approach (Cox 1972, 1975) to estimate the parameters (β) for the empirical model. The durations are not censored in our model since the entire resolution time is recorded for each customer case. The information necessary to estimate the parameters of the regression is hidden in the ordering of the observed resolution durations. First, the durations are ordered as $t_1 < t_2 < ... < t_n$. For illustrative purposes, if we assume that there are no ties in the duration intervals, then the conditional probability that the i^{th} customer-reported problem is resolved at duration t_i, given that any of the n calls could have been concluded at duration t_i, is

$$\frac{\lambda(x,\beta,t_i)}{\sum_{i=1}^{n}\lambda(x,\beta,t_i)}=\frac{\phi(x_i,\beta)}{\sum_{i=1}^{n}\phi(x_i,\beta)}$$

The resulting log-likelihood function can be shown to be:

$$\ln(L)=\sum_{i=1}^{n}\{\ln\phi(x_i,\beta)-\ln[\sum_{j=1}^{n}\phi(x_j,\beta)]\}$$

The parameter estimates are obtained by maximizing the log-likelihood function. When there are ties among observations, we use the Breslow approximation (Breslow 1974) to weight each tied observation in the computation of estimates from the log-likelihood function.

DATA COLLECTION

Given our research setting, we analyze data from each customer case starting from initiation of the customer service process with a customer call and ending with the resolution of the reported problem. Data were collected for 25,195 customer calls solved by customer representatives across the pre-adoption and post-adoption phases of the enterprise-wide IT system. Of these cases, three observations in the pre-adoption stage and 16 observations in the post-adoption stage were unusable either due to non-recording of time or due to incomplete information on the explanatory variables. The remaining 25,176 cases were used to test our conceptual model. We next define the variables used in our analysis.

Resolution Time (RESTIME): The amount of time taken, in minutes, to resolve the problem reported by the customer. The problem is said to be "resolved" when a customer representative provides a solution to the customer and doesn't receive a callback regarding the same problem. This cumulative time to resolve problems is recorded using an internal timing mechanism.

IT System Usage (ITUSAGE): This is a categorical variable, which assumes one of two possible values, 0 and 1. The variable has a value of 1 for customer calls answered in the post-adoption phase of the IT system and assumes the value 0 for customer calls made in the pre-adoption phase of the system. It is to be noted that customer calls made during the first month of the post adoption phase were not considered for analysis. These calls were excluded to ensure that learning influences of the service representatives in the initial phases of adoption of the IT system would not confound the results of the analysis.

Problem Severity (PROBSEV): This is an ordinal variable on a nine-point scale. In order to maintain consistency with the severity perspectives of representatives, the anchors for this variable were based on the evaluations of an internal expert on the difficulty in solving certain categories of customer problems. A representative sample of customer problems at each level of this variable is listed in Table 1.

Platform (PLATFORM): This variable is an internal expert's evaluation of the degree of difficulty in solving problems related to specific customer IT platforms. This variable is measured on a three-point Likert scale. The ratings for this variable were based on the following factors that directly influence the effort expended by the representatives on particular customer IT environments.

(1) Continuity of manufacturer support for the specific IT platform.
(2) Historical similarity and scope of problems reported on the same platform.
(3) Availability of trained personnel in the particular platform.

A composite rating of the customer platforms was elicited from an internal expert in the organization and later verified for correctness. The ratings for different platforms and the reasoning of the expert are summarized in Table 2.

Personnel Capability (PERSCAP): This is a managerial evaluation of the overall capability of the individual representatives measured on a five-point Likert scale. This measure reflects the managerial perception of the expertise of the service representative developed over the course of the representative's job tenure at the site.

Table 1. A Sample of Problem Descriptions at Different Levels of Difficulty

Difficulty Level (max = 9)	Category/ Descriptions	Sample Descriptions
1	Unsupported Applications	• Help with own C program • Problems using WinZip
2	Network Related problems	• Mac using wrong Ethernet server info • Ethernet DNS settings
3	Other: Miscellaneous Queries	• Questions about the stat-server • Info on tape drive conversion
4	User Accounts and authentication	• Dial-in problems related to account • IMAP account deleted, error when people send mail
5	BCP Infrastructure and Web related problems	• Network printing problems • Permission to a group web page
6	Email related problems	• Wants to send a 15mb attachment. • IMAP mail recovery
7	Dial-in problems	• ADSL problems • Dialin configuration problems
8	Operating System related problems	• Trouble booting • Problems with system Locking Up
9	Virus-related problems	• Virus won't let user boot • Virus–potential break in to user's system

Table 2. Evaluation of Platform Level Difficulty

Difficulty Rating	Platform	Reasoning
1	Mac, Unix, Win9X	Continual manufacturer support/updates and similarity of problems reported among these platforms
2	Win3.X	Decreasing manufacturer support and lack of trained personnel
3	Win NT	Lack of training related to typical problems faced and the wider scope of reported problems

Table 3. Descriptive Statistics (n = 25,176)

Variable	Minimum	Maximum	Mean	Std. Deviation
RESTIME	1.00	157.00	10.488	11.556
ITUSAGE	0	1	0.525	0.499
PROBSEV	1.00	9.00	5.997	1.625
PLATFORM	1.00	3.00	1.061	0.314
PERSCAP	2.00	5.00	4.265	0.678
PERSEXP	0.17	32.00	5.385	5.534
FACULTY	0	1	0.160	0.370
STAFF	0	1	0.320	0.470
STUDENT	0	1	0.410	0.490

Personnel Experience (PERSEXP): This measure indicates the experience of the service representative, measured *in years*, in customer support-related work environments.

Customer Type: This is a set of three categorical variables indicating whether the customer belongs to the following groups: *faculty*, *staff*, and *student*. A zero value for each of these categorical variables indicates the fourth (base) group of customers: *external*. The external group represents alumni and non-university customers that are serviced by the call center. Demographic measures or behavioral measures such as gender or customers' experience in IT usage would have been better suited to assess the impact of the customer. However, since our research site does not have a policy of recording customer information to such levels of detail, this data was unavailable.

The descriptive (summary) statistics for the data collected for analysis are shown in Table 3.

DISCUSSION OF RESULTS

As noted earlier, we use the partial-likelihood approach and Cox regression to estimate the parameters of the proportional hazard model without assuming/specifying the functional form of the baseline hazard function. The parameter estimates for our empirical model are shown in Table 4. Note that since we have estimated a proportional hazard model, the direction (sign) of the influence of the explanatory variables on the expected resolution time in Table 4 has to be *reversed* to interpret the impact of the explanatory variables on resolution time. Instead, we interpret our results in terms of *rate at which customer problems are resolved*. The effect of the explanatory factors on the rate of resolving problems is indicated in the last column of the table. A multiplication factor (last column) greater than 1 implies an increase in the rate of resolving problems (shorter resolution time) while a factor less than 1 indicates a decrease in the rate of resolving problems (longer resolution time). The fourth and the fifth columns in Table 4 indicate the statistical significance of each parameter.

Table 4. Parameter Estimates for the Resolution Time Model—Cox Regression

Variable	Co-efficient (Beta)	Std Error	χ^2 (df=1)	Significance	Exp (Beta)
ITUSAGE	0.026 *	.013	4.22	.040	1.0266
PROBSEV	-0.101 **	.004	656.25	.000	.9039
PLATFORM	-0.059 **	.020	8.68	.004	.9426
PERSCAP	0.063 **	.011	32.44	.000	1.0645
PERSEXP	0.001	.001	0.30	.575	1.0007
FACULTY versus EXTERNAL	0.012	.025	0.24	.626	1.0121
STAFF versus EXTERNAL	-0.051 *	.022	5.25	.022	.9506
STUDENT versus EXTERNAL	-0.122 **	.022	32.45	.000	.8850
Overall Chi-square		786.77** (d.f. = 8)			

*indicates <5% significance
**indicates <1% significance

Impact of IT Usage

Our results indicate that usage of the customer support system improves the rate at which customer problems are solved. In numerical terms, given an average customer problem (all explanatory variables at the mean), a change from the pre-adoption stage of the system to the post-adoption stage results in a 2.66% improvement in the rate at which problems are resolved. To better understand the impact of the usage of the IT application, we plotted the integrated hazard function (Greene 1999) at the two stages of adoption of the IT system as shown in Figure 2.

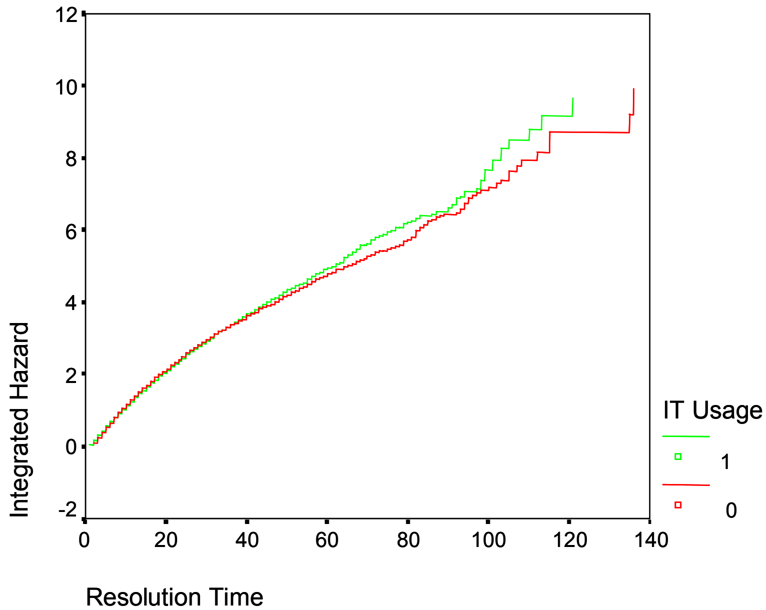

Figure 2. Plot of Resolution Time vs. Integrated Hazard

The integrated hazard plot (Figure 2) suggests that, at low levels of resolution time, there is hardly any difference between usage and non-usage of the IT system. However, at higher levels of resolution time, the impact of system usage on the cumulative rate of problem resolution is evident and significant. Certain characteristics of the system such as its ability to track customer information and problem history might have played a role in the enhanced impact of the system for complex problems. In our sample, the relatively small contribution of IT toward resolution time could be due to a higher proportion of simpler problems at our research site. On analyzing the subset of time consuming problems, we find that the contribution of IT toward resolution time is much higher. Accordingly, the impact of IT in other organizations may be higher if the proportion of complex problems reported to them is high. For less-time-consuming problems, the positive influences due to the task technology fit might have been mitigated by the increased overhead due to the usage of the system.

Problem and Personnel Factors

Results of our analysis suggest that problem severity and platform level difficulty significantly influence the rate of problem resolution. In numerical terms, an increase in the level of the problem severity by one unit (level), *ceteris paribus*, results in a decrease in the rate of problem resolution of 9.6%. Similarly, an increase in the platform level difficulty by one level results in a decline of 5.7% in the rate of problem resolution.

Our results imply that problem characteristics continue to be significant determinants of resolution time. However, this may also suggest that investments in training of service personnel in the problem domain might pay off in terms of increased personnel productivity in call centers. This follows from the argument that increased familiarity and training in the problem domain might facilitate the service representative in understanding the scope of problems and resolving them, which in turn should impact resolution time. For organizations that service IT customers, our result suggests that in order to efficiently manage the support center, the personnel expertise in the center may have to be appropriately aligned with the IT environments of the customers. This underscores the importance of the nature of problem severity in assessing the business value from call center IT investments.

For the personnel capability variable, keeping the problem constant, our results indicate that an increase in the capability of personnel by one level results in an increase in the rate of problem resolution by 6.5%. A surprising result was the lack of statistical significance of the personnel experience variable. We tested our sample for multicollinearity between the experience and capability variables and we find that the maximum variance inflation factor (2.8) is less than the critical value of 5, which suggests that multicollinearity is not a problem with our data (Greene 1999).

This result also provides certain implications for personnel hiring decisions at call centers. For instance, our results suggest that given a choice, it may be preferable to choose a person with high technical capability over a person with a high level of experience in customer support related tasks. However, it should be noted that our analysis was performed in the context of a call center servicing IT customers. A common influence on IT customers is the constant change in technology and computing environments. This continual change might have special demands on the capabilities of call center personnel, which might alleviate the importance of experience.

Customer Influence

The results in Table 4 indicate the influence of the three customer types, *faculty*, *staff*, and *student*, relative to the base category of *external* customers. With other explanatory variables held at the mean, for the problems reported by the *faculty*, there is no statistically significant difference in the rate of problem resolution in comparison to problems reported by *external* customers. A possible explanation of this phenomenon could be the university setting in our study and the implicit priority assigned to service calls from faculty. However, there are no formal priority schemes in place in the organization.

For problems reported by *staff* and *students*, the rate of problem resolution decreases by 4.9% and 11.5% respectively, in comparison to the *external* customers. Thus, with reference to the base group of *external* customers, the greatest drop in the rate of problem resolution occurs for problems reported by *students*. In our sample, a majority of the customers were students and staff. A fall in the rate of problem resolution for these two customer groups, relative to the base group, might be due to the following reasons. (1) In our research setting, the network infrastructure supporting *faculty* might be relatively more stable in comparison to the infrastructure supporting *staff*, which in turn might be more stable than that supporting *students*. (2) The potential diversity of product (IT platform) knowledge within the large student (customer) group may have affected the ability of service representatives to effectively resolve problems reported by this customer group. Thus, our findings suggest that customer-specific effects may influence returns from IT enabled call centers.

CONCLUDING REMARKS AND FUTURE WORK

Our study attempts to apply salient principles in the business value of IT literature, such as usage of process-level analysis to assess returns on IT investments in the context of call centers. The contributions of this study are several. First, we find that the usage of the customer support IT system improves the rate of resolution of customer problems and hence productivity. Our results also indicate that the benefits from IT application may depend on the problem characteristics, personnel characteristics, and customer specific factors.

In this study, we used *time to resolve customer problems* as the objective measure to measure process performance (productivity). Future work may use other complementary productivity measures at a process-level such as costs of processing a customer call, personnel utilization rates, and average queuing time that could help in analyzing the overall cost-benefit tradeoffs of IT investments in call centers.

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