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High tech, high touch: The effect of employee skills and customer heterogeneity on customer satisfaction with enterprise system support services

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Abstract

Although firms have invested significant resources in implementing enterprise software systems (ESS) to modernize and integrate their business process infrastructure, customer satisfaction with ESS has remained an understudied phenomenon. In this exploratory research study, we investigate customer satisfaction for support services of ESS and focus on employee skills and customer heterogeneity. We analyze archival customer satisfaction data from 170 real-world customer service encounters of a leading ESS vendor. Our analysis indicates that the technical and behavioral skills of customer support representatives play a major role in influencing overall customer satisfaction with ESS support services. We find that the effect of technical skills on customer satisfaction is moderated by behavioral skills. We also find that the technical skills of the support personnel are valued more by repeat customers than by new customers. We discuss the implications of these findings for managing customer heterogeneity in ESS support services and for the allocation and training of ESS support personnel.

Keywords: Software support; Customer service; Customer satisfaction; Enterprise software systems; ERP; Customer support personnel

1. Introduction

Enterprise software systems (ESS) are a complex suit of large software applications that lie at the foundation of information technology (IT) infrastructure in contemporary firms. ESS are vital to most business processes, including enterprise resource-planning (ERP), supply chain management, financials, payroll processing, human capital management, customer relationship management (CRM), and decision support systems [8,40,57]. *Fortune* 500 firms invest billions of dollars in purchasing and maintaining such enterprise systems, and market analysts predict that firms' enterprise software spending will reach as high as $70 billion in 2006–2007 [47].

Despite greater scrutiny and downward pressure on aggregate IT budgets in the wake of the dotcom bust, firm spending on ESS is on the rise. Installing and maintaining

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ESS require the commitment of significant financial and human resources. Moreover, investments in large-scale packaged enterprise systems that require business process reengineering are inherently risky in nature. Implementation failures are common because of technological uncertainty, the inability to satisfy firms' unique customization needs, and the difficulty in achieving seamless integration with the existing legacy systems. Previous studies have reported several cases of unhappy customers pulling the plug on ESS projects before completion [11,30].

From an ESS vendor perspective, understanding the antecedents of customer satisfaction for enterprise systems is important for effectively responding to the evolving needs of customers who rely on ESS to operate key business processes. First, satisfied customers are more likely to spread positive word of mouth about the efficacy of ESS, which is likely to increase future adoption of such systems and thus generate additional sales for the ESS vendor. Second, satisfied customers are more likely to renew and upgrade their licenses, thus providing a continuous stream of revenue for the software vendor [79]. Third, after-sales customer interactions provide the software vendor with the opportunity to understand its customers' unique business processes. Such interactions are particularly important for product management and product evolution in the ESS domain to design new, improved product functionality that is specific to customers [61]. Finally, because customer satisfaction is an important factor that affects a firm's market capitalization and performance [34], it is important for ESS vendors to understand the factors that affect customers' satisfaction with their offerings.

Despite the importance of customer satisfaction for enterprise software products, few studies have examined the drivers of customer satisfaction for such products. Prior software studies have examined the influence of generic software design attributes on customer satisfaction [44], but there is limited work that specifically examines the role of after-sales software support services and support personnel-related factors. This paper extends previous research on the determinants of software product customer satisfaction by considering the effect of after-sales customer service interactions on overall customer satisfaction with ESS support services. In particular, we study the relative importance of the technical and behavioral skills of customer support personnel in influencing overall customer satisfaction with ESS vendor's support services. We also explore the interaction effect between technical and behavioral skills of support personnel and model the effect of personnel technical skills across different types of customers (i.e., repeat or new customers).

This study makes two main contributions. First, from a research viewpoint, this is one of the first studies to examine the role of customer support personnel in influencing overall customer satisfaction with ESS support services. Unlike previous studies that focus on the effect of product and customer attributes on satisfaction with software [44], this research focuses on the effect of after-sales interactions. By studying the role of employee skills and customer attributes in a services setting, we contribute to both the information systems research related to customer satisfaction and the emerging discipline of services science, which lies at the intersection of information systems, services, and marketing [21,72]. We use a rich data set of real-world after-sales customer interactions to draw conclusions about the impact of customer support personnel characteristics on satisfaction across different types of customers. Second, from a managerial viewpoint, the results of this study have important implications for staffing and work allocation decisions to serve different types of customers effectively.

We organize the rest of the paper as follows: In Section 2, we review previous literature and develop our theory and hypotheses. In Sections 3 and 4, we discuss our research methodology and present the results of our analysis, respectively. In Section 5, we discuss the limitations of the study, provide suggestions for further research, and offer concluding remarks.

2. Prior literature and theory

Customer satisfaction is an important measure of a firm's success because it is a leading indicator of a firm's financial performance and shareholder value. Previous research reports that customer satisfaction has a positive influence on customer loyalty, service and product usage behavior [17,33], usage levels [18], revenues [71,73], and cash flows [38]. In addition, customer satisfaction has a negative influence on customer complaints; the cost of future transactions [69]; price elasticity [3]; the likelihood of customer defection [6]; and costs related to warranties, complaints, defective goods, field service, and retaining and attracting customers [4,33,35]. Anderson, Fornell, and Mazvancheryl [5] find that a 1% improvement in customer satisfaction for a firm with assets of $10 billion is associated with an increase in the firm's value of approximately $275 million. Finally, Fornell, Mithas, Morgeson, and Krishnan [34] find that firms with higher customer satisfaction have high stock returns with lower risk.

The implication from this rich stream of literature is that customer satisfaction can be used as an important and reliable performance indicator for ESS support

services. However, few studies examining software product management issues have used customer satisfaction as a key project performance indicator. A majority of the previous software studies have investigated other dimensions of performance, such as productivity, quality, and cycle time [10,49]. Using customer satisfaction as a performance indicator promises to yield customer-focused insights that software vendors can use to design appropriate software development and product management processes.

2.1. Customer satisfaction in the software domain

The success of ESS vendor firms is critically dependent on satisfying, retaining, and learning from current customers for at least two economic reasons: First, ESS provide three streams of revenues: the sale of original licenses, the renewal of licenses if the customer continues to use the software, and revenues generated through training and consulting services [79]. Given the competitive nature of the enterprise software market, vendors are under pressure to retain their customers to generate license renewal fees and consulting revenues. In addition, because software product development typically involves large up-front fixed costs and marginal variable costs [75], repeat sales and renewal of licenses directly affect vendors' profits.

Second, software vendors rely on learning from their existing customer base to keep their software relevant to emerging customer needs and to add functionality to their products for subsequent releases [60]. Given the network externality[3] effects present in software products [19], dissatisfied customers who spread negative word of mouth are likely to shrink the customer base, thus reducing an ESS vendor's learning opportunities, which could have adverse consequences that may lead to loss of market leadership or potential business failure.

Although there are several studies on the determinants of customer satisfaction across product categories, there is limited work that examines customer satisfaction for support services of software systems. Non-IT-related studies on the determinants of customer satisfaction span several products and services, such as automobiles [25], financial services [51], and health care services [24]. These studies focus on the effect of product quality [25], service quality [25], sales channel [25], and sales force [42] on customer satisfaction. In the IT-related customer satisfaction studies, researchers have examined the antecedents of customer satisfaction for Web development software products [52], Intranets [50], user interfaces [9], application service providers [76], Web sites [1,58], and business-to-consumer channels [23]. Finally, some studies have investigated the effect of IT investments and CRM systems on customer service processes, one-to-one marketing effectiveness, and customer satisfaction [55,57,68].

To the best of our knowledge, no study has yet examined the antecedents of customer satisfaction for ESS support services. In a previous study in the software domain, Kekre, Krishnan, and Srinivasan [44] examine the effect of software product attributes, such as capability, usability, performance, reliability, installability, maintainability, and documentation, on customer satisfaction with software. Our study complements this work by studying the effect of customer service parameters on customer satisfaction with ESS support services. We also extend previous research on the determinants of customer satisfaction in the software domain by focusing on a software vendor's after-sales interactions with its customers. Our study of after-sales interactions enables us to understand the antecedents of overall support service quality from a customer viewpoint. Specifically, we focus on effects of support personnel's technical and behavioral skills on customer satisfaction with ESS support services, controlling for the extent of after-sales support, support responsiveness, and technical features. Our approach is consistent with previous conceptual work that calls for studying the importance of the dynamic component of service quality in relation to relatively static product attributes for software products [66]. Likewise, Pitt, Watson, and Kavan [65] also call for an exploration of the relative importance of determinants of service quality to aid managerial decision making for resource allocation. Next, we discuss the theoretical basis of our research model and propose our hypotheses.

2.2. IT service quality

The customer satisfaction literature emphasizes that the quality of the offered goods or services plays a key role in influencing the end user's satisfaction [6]. Because we are interested in ESS support services, we now refer to prior work in the service quality literature. Previous service quality studies [63,64] have identified at least three unique characteristics that differentiate

[3] Network externality refers to the phenomenon in which the benefits an agent derives from a product change as the number of agents using the same product changes. ESS products deployed by a firm encompass the interface between a firm and its customers as well its suppliers. When an increased number of a firm's customers and suppliers are integrated with a firm's ESS, the benefits derived from the system increase. Conversely, if customers and suppliers of a firm react negatively to the firm's ESS, business processes are adversely affected.

services from goods: intangibility, heterogeneity, and inseparability. Because services often entail the performance of labor, they cannot be quantified precisely (intangibility). Furthermore, service performance varies from person to person and thus lacks the notion of uniform manufactured quality (heterogeneity). Finally, unlike manufactured goods, for which quality can be determined at the manufacturing plant, in the services context, quality occurs during the process of engaging with customers (inseparability). On the basis of these differences in the quality dimensions between goods and services, Parasuraman, Zeithmal, and Berry [63] develop a conceptual model of service quality that includes a measurement scale known as SERVQUAL. The SERVQUAL model encompasses broad dimensions of service attributes, including tangibles, service reliability, responsiveness, assurance, and empathy. Kettinger and Lee [29,45,46] and Pitt, Watson, and Kavan [65] adapt and extend Parasuraman, Zeithmal, and Berry's [64] generic SERVQUAL notion to the information services function.

Although our study draws its motivation from the SERVQUAL stream of research, it is different in terms of the service dimensions in focus. Specifically, we are interested in analyzing the effect of support personnel skills and customer heterogeneity (repeat or new customers) on support satisfaction. The SERVQUAL stream of research does not include customer heterogeneity in its analysis. Furthermore, support personnel technical and behavioral skills are deeply embedded in many SERVQUAL constructs, including assurance and empathy.[4] Unlike the SERVQUAL studies, the focus of this research is narrower; we explicitly explore support personnel skill and its interaction with customer heterogeneity.

2.3. Hypotheses

Previous research has acknowledged the importance of personnel capability in influencing software project performance [31,48]. Personnel capability can be classified into two types of skills: (1) skills associated with a technology artifact (technical skills) and (2) skills associated with social and interpersonal interactions (behavioral skills). Driver and Johnston [27] report the value of segregating interpersonal and non-interpersonal aspects of service by showing that customers place different emphasis on each of them, which eventually affects their perceptions of service quality.

[4] Support personnel skill dimensions form a subset of the broader constructs of SERVQUAL (see the individual questionnaire items of the information services SERVQUAL measure [44, 46]).

Technical skills of ESS support personnel are related to the capability of understanding and applying the technical paradigms, programming language, development methodology, and business functionality to satisfy customer requirements. In the ESS context, technical skills also include the ability to understand the different configurations of the packaged software system a particular customer has employed, as well as other firm-specific technical details, such as the types of legacy applications that a customer may be using [43,56]. Higher technical skill levels of support personnel lead to more effective root-cause analyses of customer problems and, eventually, to finding a solution that meets customers' requirements promptly and with the least disruption to their business. Moreover, personnel with good technical skills are likely to be able to play an important boundary-spanning role between a customer's IT staff and a software vendor's technical teams responsible for the resolution of customer problems. Thus,

Hypothesis 1. A higher level of personnel technical skills is positively associated with overall customer satisfaction with ESS support services.

Behavioral capability involves skills required for social interaction with customers and interdependent teams and for coordinating tasks among team members. Better behavioral skills of personnel are likely to contribute to overall customer satisfaction because customers infer the service quality of the product from the interactions they have with the customer support personnel. Customers are likely to furnish more relevant information to customer support personnel with better interpersonal skills. The use of such specific customer-related information may lead to better customized solutions, thus positively affecting overall customer satisfaction. Furthermore, customer support personnel with more effective interpersonnel skills are likely to be better at eliciting effective cooperation from various technical software support teams responsible for problem solving. In an analysis of more than 400 service personnel, Russ-Eft [70] finds that higher levels of basic interpersonal competencies of customer service personnel help create or maintain customer loyalty. Thus,

Hypothesis 2. A higher level of personnel behavioral skills is positively associated with overall customer satisfaction with ESS support services.

Technical and behavioral skills are likely to be complementary, and exploring interaction patterns among these skills may have implications for staffing and training resource allocation decisions [54]. Although we expect that both personnel technical and behavioral

skills improve customer satisfaction with support services individually, they may also have an interaction (i.e., multiplicative) effect on customer satisfaction. For example, although higher levels of technical skills improve the autonomous handling of development tasks that are often internal to the vendor, customer support personnel need to use their behavioral skills to gather cues for problem solving even before they put their technical skills to use. Effectively gathering customer-specific information through interactions with customer is important to understand fully a customized system environment. In addition, behavioral skills play an important role in several stages of problem resolution because they help accomplish tasks that require customer interaction, such as reviews, acceptance tests, and solution verification. Therefore, we posit an interaction effect between personnel technical skills and personnel behavioral skills that influences overall customer satisfaction with software support service encounters.

Hypothesis 3. The level of personnel behavioral skills (personnel technical skills) moderates the effect of personnel technical skills (personnel behavioral skills) on overall customer satisfaction with ESS support services.

The relationship between personnel technical skills and overall customer satisfaction with support services may also vary across repeat customers and new customers. Customers and support personnel are often not colocated, and this could affect the relationship between them during a support service interaction. Repeat customers may be more acquainted with the support personnel than new customers, and it is likely that support personnel have more background information on the problem histories of repeat customers. In addition, the implementation partner at the customer end often acts as an intermediary between the customer and the vendor's support personnel, introducing another barrier for direct interaction between new customers and ESS vendor support personnel. Because of these factors, personnel at the vendor organization may not be fully aware of a new customer's business processes and may not be fully effective in leveraging their technical knowledge to solve customer-specific problems. However, for repeat customers, customer support personnel may make better use of their technical expertise by referring to the history of problems and their solutions from CRM systems, knowledge management sources, and their own experiences [57].

Moreover, ESS customers often implement large-scale customization and personalization scenarios that modify the generic packaged software to their specific needs. These customization scenarios are embedded within the original software code supplied by the vendor and increase the structural complexity of the software code to a large extent. Support personnel who analyze such customized code for the first time may encounter difficulties in comprehending the code, which can lead to significant delays in the support process. Unlike new customer cases, support personnel who interact with repeat customers could refer to their prior experience and tap their familiarity in the specific customization scenarios to respond quickly and efficiently. Thus, we posit that customer type (repeat or new customer) moderates the effect of personnel technical skills on customer satisfaction.

Hypothesis 4. The effect of personnel technical skills on overall customer satisfaction with ESS support services is greater for repeat customers than for new customers.

We account for alternative and complementary explanations by including several control variables in our model. For example, we include the overall work experience of support personnel in our models and thus control for the intangible characteristics of support personnel that we do not explicitly measure but could potentially influence customer satisfaction. Our next control variable, responsiveness, represents customer support personnel's willingness to help customers and provide prompt service. Responsiveness is an important dimension that shapes service quality and may influence other critical software project indicators, such as project completion time. Because ESS form the foundation of firms' information processing infrastructures, any problems affecting the smooth functioning of such systems have the potential to disrupt customers' normal business and may even bring their operations to a complete halt. It is important for the software vendor to respond promptly to any reported problems with the software by providing bug fixes, service packs, and service consultation to help a customer's IT team quickly restore its systems. Prompt response to customer queries might lead to higher perceived service quality and thus to improved overall satisfaction with the software.

Because services are intangible products, peripheral cues that stem from the processes associated with delivery of the core offering are likely to heavily influence customers' evaluations of services [62]. In this context, it is useful to distinguish between *services* and *service*. As Parasuraman [62, p.310] notes, "While *services* are intangible products,… *service* is basically a supplement that accompanies the core offering regardless of whether the core is tangible or intangible."

Because support for software systems is part of *services*, it may be viewed as having a core offering that is intangible but enacted using tangible tools and processes. Thus, in addition to the previously discussed measures, we also control for the extent of after-sales support the software vendor provides and the "net-enabled" product feature.

The control variable, the extent of after-sales support the vendor offers, captures the customer's perceived satisfaction with the degree of support activities during implementation and production maintenance. The role of after-sales service in influencing overall product satisfaction has been well established for both products and services [41]. Similar to prior studies, we expect that satisfaction with the extent of after-sales support the software vendor offers is positively associated with overall customer satisfaction with ESS support.

Availability of net-enabled support depends on the architecture of the software product, and this may influence overall customer satisfaction with support services because certain ESS products offered by the vendor at our research site were built on technologies that enable the easy integration of Internet applications within the system. In contrast to systems that are not net enabled, these systems offer superior search facilities, easy remote management, and easy integration with third-party tools. Thus, we expect that support tools can be easily integrated into these net-enabled products, and support activities can be much more easily managed through Web-based monitoring and interaction. This might improve service productivity and quality and thus might improve the customer's overall perceived satisfaction with ESS support services.

Finally, we control for customer-specific characteristics that may influence a customer's satisfaction score by including the customer company size and the number of enterprise system modules installed. Fig. 1 depicts our conceptual research model.

3. Research site and data collection

We collected archival data related to after-sales customer service encounters from a leading ESS vendor. Our research site employed about 28,000 personnel in more than 50 countries at the time of data collection. The company ranks among the top three independent packaged software suppliers in the world. The company has 35 years of expertise in supplying multiple modules of ESS globally and offers integrated industry best-practices modules across multiple industries. We collected customer service-related data from 170 unique installations of packaged enterprise resource-planning and CRM system products, including a business intelligence decision support systems module that the company developed.

Installation procedures for large enterprise systems are complex and involve extensive customization [74]. Independent software service firms that act as installation partners carry out the installation and customization of packaged software the firm has developed. The customer selects installation partners to analyze their business processes and suggest appropriate customization of the products. However, the development and support teams of the ESS vendor provide support during installation and customization. Errors and correction procedures during the post-installation period were supplied using service packs.

The research firm we study communicates with its customers through an electronic medium called "customer support network." All software product installations and maintenance services are monitored regularly using this electronic medium. All project milestones,

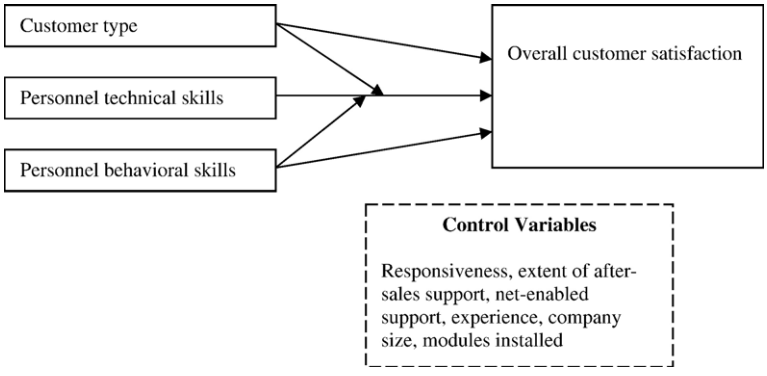

Fig. 1. Research model.

installation notes, and error reporting are logged in this system. Typically, all correction procedures and support packages are uploaded to this system so that customers can download them. Software developers at the research site can remotely manage a customer's systems if the systems are net-enabled. Installation is deemed to be complete after a customer has switched to the production environment in the enterprise software and the software vendor has issued service packs to ensure smooth customer operations. At this stage, customers need to change the status of the project or maintenance service to "complete" in the online system. Whenever an artifact status is changed to "complete" in the customer support network system, customers are requested to fill in a customer satisfaction survey.

The firm first pilot tested its survey instrument with internal divisions of the firm and then with a randomly selected group of pilot customers before rolling it out to all its current customers. The first draft of the survey instrument had multiple items for each of the personnel technical and behavioral skills, responsiveness, and extent of after-sales support constructs. Detailed feedback collected from the pilot customers indicated that a majority of pilot customers believed that answering multiple items for a single construct was redundant. Itemwise non-responsiveness was high in the pilot study. Because the survey was to be used on each service encounter, customers also believed that it could be time consuming, indicating a possible increase in survey non-responsiveness. For the second draft of the survey instrument, to obtain a higher response rate, the firm designed the survey instrument to be shorter by using single-item constructs. Academic research also shows that questionnaire length may have a negative effect on the quality of survey data because of respondent fatigue, low survey response, and item non-response [14]. To avoid ambiguity, each of the single-item constructs was explained through explanatory hypertext pop-ups that could be activated by clicking on the highlighted keyword or mouse rollover. Recent research has provided a justification for the use of single-item constructs in comparison to multiple-item constructs, particularly when single-item constructs are relatively unambiguous and additional items are likely to be correlated with each other [28]. As we noted previously, survey questions are issued electronically through the customer support system network immediately after the customer changes the artifact status to "complete." To increase the response rate, the customer support network issues pop-up reminders every time the customer logs back into the customer support network to prompt them to complete the survey. Staff in the marketing and sales department also contact customers several times if they still do not fill the survey. Thus, the response rate in our survey is high. For example, at the time of our data collection, of 250 completed projects, 192 customers responded, for a response rate of 77%. An analysis of non-response based on customer firm size or modules did not suggest any significant differences between respondents and non-respondents.

Appendix 1 provides the details of the questions and the explanatory notes used in the survey instrument. All the survey responses were filled in by the key manager at the customer site on a scale ranging from 1 to 10. We also obtained archival data on customers and product information from the product management department at the vendor site.

3.1. Variables

3.1.1. Dependent variable: overall support satisfaction

Our dependent variable captures overall customer satisfaction with the support services associated with ESS, such as installation, production ramp-up, and after-sales product support.

3.1.2. Independent variables

3.1.2.1. Personnel technical skills. Software development and maintenance is knowledge intensive, and superior technical skills are critical for achieving better project performance. We measure the perceived ability and knowledge of the vendor's personnel through a single-item survey question that the customer's manager answered.

3.1.2.2. Personnel behavioral skills. Implementing and customizing ESS consist of interdependent tasks that require interaction among several development teams as well as with end users. Administrative and expert coordination of these interdependent tasks are key to achieving good project performance and meeting customers' requirements. We measure the perceived behavioral skills of the vendor's personnel using a single-item survey that the customer's manager answered.

3.1.2.3. Extent of after-sales support. The extent of support extended to the customer after purchase of ESS is a key factor in influencing customer satisfaction. The actual extent of support from a vendor that the customer uses depends on the nature of contracts, the degree to which the customer uses its own consultants, and implementation partners. We measure the perceived satisfaction

with the extent of vendor support for installation, production ramp-up, and post-installation services using a single item assessed on a ten-point scale.

3.1.2.4. Net-enabled. The vendor's ESS are developed on a proprietary framework. Originally, these proprietary frameworks were not enabled to integrate with other Internet applications due to security reasons or because of technology constraints. However, recent versions of the framework employ standard Web browsers as the application interface, and end users can integrate third-party Internet applications along with the enterprise systems. Furthermore, any support personnel can remotely log in from any other computer on the Internet to fix potential errors. Thus, net-enabled products might aid in faster response from support personnel. We categorize ESS as net enabled or not using a binary variable (1 = net enabled).

3.1.2.5. Responsiveness. Problems and queries with the product sold to the customer are reported to the vendor through the customer support network system. The vendor then assigns these problems to individual developers. We measure responsiveness in solving customer-reported issues through a single-item survey question that the customer's manager answered.

3.1.2.6. Customer type. We use a binary variable (1 = repeat customer) to distinguish new customers from repeat customers.

3.1.2.7. Experience. We include number of years of work experience of the support personnel involved in the service as a control variable.

3.1.2.8. Company size. Enterprise application vendors service various customers in several industry domains. To control for the customer heterogeneity that the service vendor encounters, we include the customer company's size in terms of the annual sales revenue as a control variable.[5]

3.1.2.9. Modules. The different types of enterprise information systems modules installed at the customer's site may influence the extent and the effectiveness of the support services a customer receives. Our data set includes support data from four different types of modules, including materials management, financials, human capital management, and customer relationship activity management. To control for this, we include the number of modules installed for the customer. Furthermore, other than the differences in the operating business domain, all the modules involve the same technological platform. As mentioned previously, we account for the technological platform difference through the inclusion of the net-enabled variable, which differentiates modules that were built on Internet-enabled platforms from others.

[5] We thank an anonymous referee for this suggestion. We also tested other measures of firm size, such as the number of employees, and the results were robust, independent of the size measure we used in the model.

Table 1
Summary statistics (N=170)

Variable	M	SD	Minimum	Maximum
Overall customer satisfaction	6.81	1.90	1	10
Personnel technical skills	8.16	1.76	1	10
Personnel behavioral skills	8.28	1.85	1	10
Extent of after-sales support	7.18	1.72	1	10
Net-enabled support	0.09	0.28	0	1
Responsiveness	7.35	2.58	1	10
Customer type	0.17	0.37	0	1
Personnel technical skills × Personnel behavioral skills	70.25	25.60	1	100
Personnel technical skills × customer type	1.418	3.27	0	10
Experience	5.04	1.49	3	8
Company size (in billion of dollars)	110.44	119.67	0.04	370.7
Modules	1.51	0.93	1	4

Table 1 provides summary statistics for the variables we used in the study. Table 2 provides pairwise correlations among variables.

3.2. Customer satisfaction model

We use a linear estimation approach to relate overall ESS support customer satisfaction with support services to focal customer service variables, and we control for other variables that may influence this relationship. We first specify an additive model, as shown in Eq. (1):

$$\begin{aligned} \text{OVSAT} = {} & \beta_0 \\ & + \beta_1 \text{PERSONNEL TECHNICAL SKILLS} \\ & + \beta_2 \text{PERSONNEL BEHAVIORAL SKILLS} \\ & + \beta_3 \text{CUSTOMER TYPE} \\ & + \beta_4 \text{EXTENT OF AFTER} - \text{SALES SUPPORT} \\ & + \beta_5 \text{NET} - \text{ENABLED} \\ & + \beta_6 \text{RESPONSIVENESS} \\ & + \beta_7 \text{EXPERIENCE} \\ & + \beta_8 \text{COMPANY SIZE} \\ & + \beta_9 \text{MODULES} + \varepsilon. \end{aligned} \tag{1}$$

Table 2
Pair-wise correlations among variables

		1	2	3	4	5	6	7	8	9	10	11	12
1	Overall customer satisfaction	1.00											
2	Responsiveness	0.45	1.00										
3	Personnel technical skills	0.49	0.58	1.00									
4	Personnel behavioral skills	0.55	0.49	0.81	1.00								
5	Extent of after-sales support	0.68	0.48	0.47	0.49	1.00							
6	Net-enabled support	−0.05	−0.05	0.04	−0.017	0.04	1.00						
7	Customer type	0.07	0.04	0.04	0.06	0.09	0.03	1.00					
8	Personnel technical skills × Personnel behavioral skills	0.56	0.56	0.94	0.94	0.51	−0.00	0.06	1.00				
9	Personnel technical skills × Customer type	0.14	0.11	0.15	0.14	0.14	0.04	0.97	0.16	1.00			
10	Experience	0.20	0.06	0.08	0.13	0.13	0.16	0.64	0.10	0.61	1.00		
11	Company size	0.07	0.05	−0.05	−0.05	0.03	−0.23	−0.37	−0.06	−0.35	−0.35	1.00	
12	Modules	0.13	−0.02	0.03	0.06	0.11	0.58	0.43	0.04	0.43	0.69	−0.39	1.00

All correlations with absolute value greater than 0.35 are statistically significant at $p<0.05$.

Next, we add interaction terms to this model and specify the full model with interaction terms, as shown in Eq. (2):

$$\begin{aligned}\text{OVSAT} = {} & \beta_0 \\ & + \beta_1 \text{PERSONNEL TECHNICAL SKILLS} \\ & + \beta_2 \text{PERSONNEL BEHAVIORAL SKILLS} \\ & + \beta_3 \text{CUSTOMER TYPE} \\ & + \beta_4 \text{EXTENT OF AFTER} - \text{SALES SUPPORT} \\ & + \beta_5 \text{NET ENABLED} \\ & + \beta_6 \text{RESPONSIVENESS} \\ & + \beta_7 \text{EXPERIENCE} + \beta_8 \text{COMPANY SIZE} \\ & + \beta_9 \text{MODULES} + \beta_{10} \text{CUSTOMER TYPE} \\ & \times \text{Personnel TECHNICAL SKILLS} \\ & + \beta_{11} \text{Personnel TECHNICAL SKILLS} \\ & \times \text{Personnel BEHAVIORAL SKILLS} + \varepsilon. \end{aligned} \tag{2}$$

4. Analysis and results

The results of ordinary least squares estimation of the models specified in Eqs. (1) and (2) appear in Table 3. For both the models shown in Table 3, we tested for the assumptions of linear regression. We tested for multicollinearity by analyzing the variance inflation factor (VIF) [13]. The highest VIF was 3.9, and the mean VIF values in both the restricted and the full models were 2.4. These values are lower than the threshold specified in the literature, indicating that multicollinearity is not a serious concern in our analysis [13]. We corrected for heteroskedasticity by estimating the Huber–White standard errors [37]. The parameter estimates with corrected standard errors appear shown in Table 3. The explanatory power of our models in terms of R-square values ranges from 0.567 to 0.585; this compares well with similar models used in previous studies. Furthermore, as Table 3

Table 3
Parameter estimates of the overall customer satisfaction models

		Model (1)	Model (2)
		Overall customer satisfaction	Overall customer satisfaction
Personnel technical skills	β_1	0.011	−0.028
		(0.458)	(0.395)
Personnel behavioral skills	β_2	0.190**	0.258***
		(0.022)	(0.005)
Customer type	β_3	− 0.795**	−1.03***
		(0.013)	(0.003)
Extent of after-sales support	β_4	0.617***	0.607***
		(0.000)	(0.000)
Net-enabled support	β_5	−0.811*	−0.781*
		(0.053)	(0.056)
Responsiveness	β_6	0.065*	0.061
		(0.093)	(0.102)
Experience	β_7	0.209**	0.253***
		(0.028)	(0.01)
Company size	β_8	0.002**	0.002**
		(0.025)	(0.018)
Modules	β_9	0.289*	0.267*
		(0.082)	(0.094)
Customer type × personnel technical skills	β_{10}		0.362*
			(0.055)
Personnel technical skills × Personnel behavioral skills	β_{11}		0.039**
			(0.014)
Constant	β_0	0.411	0.213
		(0.261)	(0.368)
Observations		170	170
Adjusted R-square		0.567	0.585
F		25.53***	22.65***
		(0.000)	(0.000)
Test of the interaction model			
$F(2, 158)=4.56$** (0.012)			

Note: $N=170$, Heteroskedasticity corrected p-values are in parentheses; we performed the estimation after centering the personnel technical skills and personnel behavioral skills variables.
*** Significant at $p<.01$; ** Significant at $p<.05$; * Significant at $p<0.10$.

shows, the test of acceptance of the full model with interaction terms rejected the null hypothesis at a 5% level, indicating that our interaction model is appropriate. We also tested for outliers and influential observations in our sample using both residual-leverage plots and Cook's distance statistic, and we did not detect any significant problems. To check the robustness of the results further, we relaxed the continuous variable assumption underlying our dependent variable (i.e., overall customer satisfaction) and estimated the empirical equations using the ordered logit regression method. The ordered logit results did not significantly vary from the ordinary least squares results in Table 3.

Hypotheses 1 and 2 predicted a positive association between two key customer service parameters, support personnel technical skills and behavioral skills, and overall customer satisfaction of support services. The results in Table 3, Model 1, indicate that though personnel technical skills have no statistically significant direct effect on overall customer satisfaction with support, personnel behavioral skills have a statistically significant, positive effect on customer satisfaction. Note that Model 1 does not account for the interaction effects. To discuss the results in the presence of interaction patterns, we refer to Table 3, Model 2.

Hypothesis 3 predicted the presence of an interaction effect between personnel technical skills and personnel behavioral skills on overall customer satisfaction. Positive, statistically significant interaction terms of personnel technical skills and personnel behavioral skills (Table 3, Model 2: $\beta_{11}=0.039$, $p=0.014$) suggest that the effect of personnel technical skills (personnel behavioral skills) on customer satisfaction varies across the range of personnel behavioral skills (personnel technical skills). Fig. 2 shows this interaction pattern between personnel technical and behavioral skills, holding other variables at their mean levels and customer type as new. In addition, we do not find any statistically significant direct effect of personnel technical skills on customer satisfaction. This suggests that personnel technical skills, in and of themselves, do not affect customer satisfaction for new customers at the mean value of behavioral skills. Overall, the presence of a significant interaction effect between personnel technical and behavioral skills suggests the importance of deploying support personnel with a mix of both good technical and behavioral skills to improve customer satisfaction with software support services.

Finally, Hypothesis 4 posited a greater effect of personnel technical skills on customer satisfaction for repeat customers. The negative, significant coefficient for the customer-type variable (Table 3, Model 2: $\beta_3=-1.03$, $p=.003$) indicates that in our sample, repeat customers are less satisfied than new customers. A positive, significant coefficient (Table 3, Model 2: $\beta_{10}=0.362$, $p=.055$) of the interaction term involving personnel technical skills and customer type implies that repeat customers are more likely to value personnel technical skills. Note that although repeat customers are more difficult to satisfy than new customers, such customers tend to value personnel technical skills highly in their evaluation of overall customer satisfaction with support services. Fig. 3 shows this interaction pattern between personnel technical skill and customer type, holding personnel behavioral skills at the mean level.

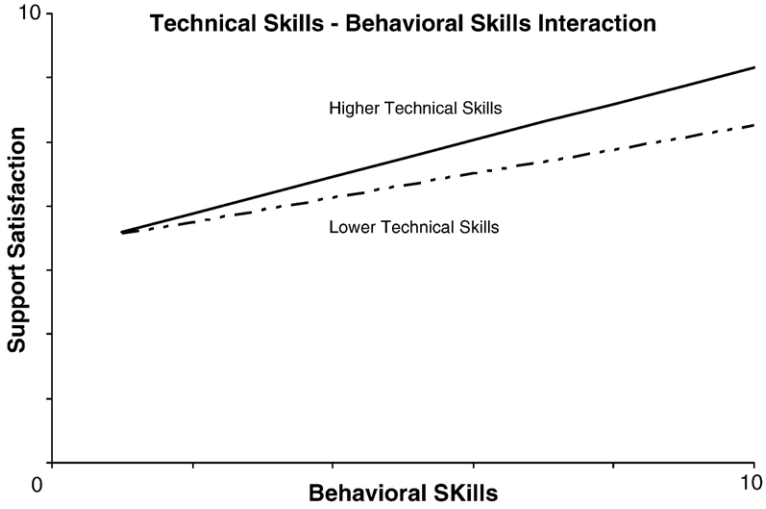

Fig. 2. Interaction between personnel technical and behavioral skills.

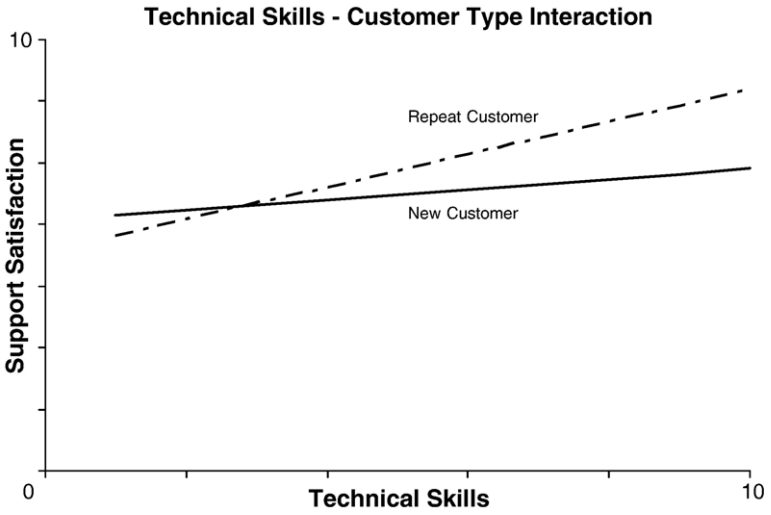

Fig. 3. Interaction between personnel technical and customer type.

Among the control variables, we find that the extent of after-sales support extended to the customer is highly influential on customer satisfaction ratings. This indicates the need for a judicious balancing of resources across new application development and installed base support activities by a vendor. A reason we observe only marginal significance or non-significance of the relationship between responsiveness and customer satisfaction at the 5% level in our models may be because of the role of implementation partners that was not specifically modeled. Because the implementation partner forms an intermediary between the vendor and the customer, the implementation partner may have handled problems that required an urgent solution. As such, even if the ESS vendor did not respond to customer queries quickly, any such delays had little effect on overall customer satisfaction with the support services for the ESS product. Previous research examining relationships between service and customer satisfaction in the software domain have also reported similar results for responsiveness [20].

5. Discussion

ESS, such as ERP and CRM systems, have been widely adopted, and interest in the next generation Web services-based ESS continues to grow. Our goal in this research was to study the relative importance of personnel technical and behavioral skills in determining customer satisfaction with ESS support services across new and repeat customers. The results of this study suggest that technical skills contribute to improved customer satisfaction only when they are coupled with a high degree of behavioral skills. Furthermore, technical skills are more important for repeat customers than for new customers in improving their customer satisfaction with ESS support services.

Our research findings are important and provide new insights. Prior research on service encounters has focused predominantly on the influence of interpersonal interactions between the customer and the contact employee, mostly in the context of traditional firms, such as restaurants, hotels, and airlines [15,16]. In this research, we examined service encounters in the context of a large-scale software product firm. Even in the software context, in which technical skills are highly sought after, we find that behavioral skills of employees involved in service encounters have a critical influence on customer satisfaction. Although this result is consistent with findings from the service encounter literature, it differs from some of the prior findings in the systems development literature. For example, Green [36] reports that end users of information systems attribute greater importance to the technical skills of system analysts. In addition, other studies analyzing the requisite skill sets necessary for software personnel report a variation in the agreement among experts about the relative importance of technical and non−technical skills [53,77,78]. This indicates that there is a considerable difference in the user perceptions of the job skills required for employees across the software development and the software support contexts.

Furthermore, similar to the studies exploring customer heterogeneity in service management [2,22], the results of our study indicate that segmenting customers in service environments is worthwhile. We find that new and repeat customers have differential valuations for the technical and behavioral skills of software personnel involved in service encounters.

These results have important implications for human resources practices, such as staffing, hiring, and training, of ESS product firms. For example, firms may find it beneficial to augment the behavioral skills of their customer support staff through investments in training programs. It may also be useful to deploy employees who are more technically proficient to handle repeat customers' service calls. Augmenting recent research findings [7,12,21,26,32,39], our research also provides insights into the types of personnel skills that are likely to be valued highly in the emerging service economy and can be used to prepare knowledge workers, including IT professionals, for the new environment. Finally, these findings have implications for curriculum redesign and for tailoring educational programs to IT professionals. Given that a threshold level of technical skills are present, if behavioral skills act as a differentiating competitive advantage to IT professionals, by enhancing these skills, IT professionals can make their jobs less vulnerable to service disaggregation, as other researchers have also argued [39,59].

We note two limitations of this research. First, our data set is limited to customers of the ESS vendor located within United States. Although such a research design has the strength of minimizing differences among customers due to national cultures or business practices in different parts of the globe, there is a need to exercise caution in generalizing these results to customers of other countries or product settings. Second, we relied on audited survey archival data from the vendor site for our analysis, which limits generalization beyond the context of the service encounters found at the research site. Our empirical models should be verified across different support organizations and service provisioning settings, such as colocated and onsite support, outsourced and remote support, and so on, before the findings of this study can be confidently generalized.

We suggest three opportunities for further research. First, this study could be extended to understand how software personnel allocation can be managed between an ESS vendor's new application development and after-sales support services activities. Specifically, the study of knowledge-transfer mechanisms between the development and the support services teams and their impact on overall customer satisfaction is a fruitful avenue for future research. Second, although this study establishes complementarities between personnel behavioral and technical skills in terms of customer satisfaction, it would be useful to investigate how firms reward employees who possess higher levels of both behavioral and technical skills and if there are any salary premiums that such complementary skills enjoy. Third, it would be useful to extend our research framework to investigate how global disaggregation of support services affects customer service outcomes in the ESS domain and to examine the specific skills necessary for ESS support personnel to operate effectively in a distributed support services environment. This would complement recent research that suggests that occupations requiring both high skills and high information intensity are less vulnerable to service disaggregation [59] and that geographic dispersion of software services might have a detrimental effect on performance outcomes if such dispersions are not accompanied by suitable investments in process standardization and learning activities [67].

To conclude, on the basis of an analysis of archival customer satisfaction data from 170 real-world customer service encounters of a leading ESS vendor, this study suggests that technical and behavioral skills of customer support personnel play a major role in influencing overall customer satisfaction with ESS support services. We find that the effect of support personnel technical skills on customer satisfaction is moderated by their behavioral skills level. We also find that support personnel technical skills are valued more by repeat customers than by new customers. These results point to the important role of managing after-sales customer interactions and support personnel skills for satisfying and retaining customers in the ESS domain. Our research provides empirical support for the observation that in an increasingly competitive service economy, firms and professionals need to complement high tech with high touch to serve their customers effectively and to achieve a competitive advantage.

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Appendix A. Appendix 1: Survey questionnaire

Please complete the following questionnaire on a scale ranging from 1 to 10. Note that a rating of 10 stands for *highly satisfied* and 1 stands for *not satisfied*

Construct	Questionnaire item	Explanatory note for highlighted keyword
Overall satisfaction	Please rate your overall satisfaction with the XYZ[6] product support being used by you.	None
Responsiveness	Please rate your satisfaction with the message **processing time** taken by XYZ for development requests, correction requests, and queries in the project.	Time taken by the processor to react and reply to your message by giving an estimate of solution time and when requested services will be performed.
Personnel technical skills	Please rate your satisfaction with the **technical skills** of XYZ developers involved in the project.	Skill level of processor relating to programming, software process, methodology, business process, and functional knowledge.
Personnel behavioral skills	Please rate your satisfaction with the **behavioral skills** of XYZ personnel involved in the project.	Skill level of processor relating to courteousness, friendliness, and ability to operate with your best interests in mind.
Extent of after-sales support	Please rate your satisfaction with the **extent of support** received from XYZ during the installation, customization, and production ramp up.	The degree to which XYZ support resources were available to you.

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