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The Effect of Service Experiences over Time on a Supplier's Retention of Business Customers

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This paper examines the link between a supplier's marketing and service operations and its business customers' subsequent repatronage behavior. We develop a dynamic model of service contract renewal for an individual firm, at the contract level, recognizing interdependencies among service contract renewal decisions due to the firm's purchase of multiple contracts from the same supplier. The decision to renew a service contract is modeled as a function of service quality and price, where service quality is measured by the supplier's service operations metrics over time. By incorporating longitudinal data about the supplier's service operations, this study investigates how average service levels, variability in service levels (especially extreme outcomes), and timing of service delivery influence firms' service contract renewal decisions. The study context is support services for high-technology systems in business markets in Germany and the United Kingdom, where service operations metrics over time typically have skewed distributions. Firm behavior is represented by a binary choice model at the contract level, estimated as a binary response model with a complementary log-log link function incorporating random intercepts. The study shows that a firm that has a few extremely favorable experiences for a given service contract is more likely to subsequently renew that service contract, after controlling for average service levels. Firms weigh recent experiences (i.e., within the past year)—rather than earlier experiences—when deciding whether or not to renew, so the timing of service experiences may be critical to the survival of buyer-seller relationships. Overall, the study suggests that models of customer retention should incorporate the extent, variability, and timing of a supplier's service delivery over time at the contract/product level.

Key words: customer retention; dynamic models; services marketing; buyer-seller relationships; extreme outcome; service quality; service operations
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Introduction

Consider the following scenario: A firm owns expensive capital equipment such as information technology; engineering, medical, or manufacturing equipment; or financial or energy management software. The equipment is critical to firm operations, so the firm has purchased contracts for maintenance and support. Each contract is uniquely associated with a piece of equipment, so the firm holds many such contracts. A typical contract has a fixed price and entails a promise from the supplier to provide service on a specific item for a given time period. Over the contract's duration, the firm utilizes services as needed. At the end of each contract, the firm decides whether or not to renew the contract, making separate (but not necessarily independent) decisions regarding each contract it holds.

What factors influence the firm's service contract renewal decision? Clearly, the firm's decision will depend on the expected value of the contract—i.e., the benefits to be derived from the supplier weighed against the contract price. Unlike an initial purchase decision, this decision is much less likely to depend on contract specifications or marketing communications from suppliers (Ganesh et al. 2000, Kalwani and Narayandas 1995). Instead, the firm's assessment of the value of the renewed contract is likely to depend on its prior service experiences under the old contract for the same piece of equipment—or on prior service on similar contracts for other equipment. Understanding contract renewal decisions is critical in today's markets because finely tuned relationships between firms and their suppliers are necessary for total quality management, process reengineering, just-in-time delivery, and other activities coordinated across the entire value chain. This research also has strategic implications for suppliers focused on improving service delivery (Anderson et al. 1997), and for buying firms who want to encourage "lean" suppliers (MacDuffie and Helper 1997). Lastly, it provides guidance to service suppliers attempting to exploit their knowledge of business customers to increase customer retention and improve firm performance, especially in high-technology markets (Heide and Weiss 1995).

This paper models firms' repatronage behavior for service contracts. Our approach is different from prior research in three ways. First, this study develops a dynamic model of service contract renewal for an individual firm, at the contract level, that recognizes interdependencies among service contract renewal decisions due to the firm's purchase of multiple contracts from the same supplier. In contrast, prior studies of business-to-business (B2B) relationships typically have estimated static models at the firm level that compare different relationship stages (Cannon and Perreault 1999, Dwyer et al. 1987, Heide and Weiss 1995). Second, a firm's decision to renew a service contract is modeled as a function of service quality and price, where service quality is measured by the supplier's service operations metrics over time. Prior studies of B2B relationships have typically relied on key informants' perceptions of the supplier and industry. Third, by incorporating longitudinal data about supplier service operations, this study is able to investigate how average service levels, variability in service levels (especially extreme outcomes), and timing of service delivery influence firms' renewal decisions. We find, for example, that a firm that has a few extremely favorable experiences for a given service contract is more likely to subsequently renew that service contract, after controlling for average service levels.

Literature Review and Model Development

Prior research concerning customers' evaluations and purchases of services indicates that service value depends upon quality and price. We distinguish between two dimensions of service quality: quality that meets customer needs and quality that results from freedom from deficiencies (Anderson et al. 1997, Juran and Godfrey 1998). The first dimension, *design quality* ($DesignQ_t$), focuses on the elements of the product or service that the customer expects to receive based on the services or benefits promised by the supplier or stated in the contract. The second dimension, *experience quality* ($ExperienceQ_{t-1}$), focuses on the customer's prior experience with each element of the product or service. Price (*Price*) includes monetary and nonmonetary costs (Heide and Weiss 1995, Zeithaml 1988).

Design Quality. In studies of B2B relationships, relational norms have been shown to influence exchange relationships between firms (Heide and John 1992). A firm's norms about design quality and price (as stipulated in the contract) will primarily influence its initial purchase of a service contract—but may also influence repeat purchase. Due to differing system requirements, there may be heterogeneity across firms with respect to their need for design quality. We examine the effect of contract service delivery specifications ($DesignQ_t$) and price specifications ($Price_t$) on contract renewal. Mittal et al. (1999) showed that the importance of service attributes increases over time, whereas the importance of design attributes decreases. Ho and Zheng (2004) suggest that delivery time commitment may influence customer perceptions. Thus, although we expect that design quality will have some influence on retention (especially price), we expect the effects of experience quality to be stronger.

Experience Quality. Organizational norms about the quality of service also evolve through ongoing interactions and are products of the past (Coleman 1990). The firm has opportunities to assess service quality during its interactions with suppliers, and thereby to make more effective purchase decisions (Sinkula 1991). Prior research has consistently found that perceptions of service quality are positively correlated with retention (e.g., Boulding et al. 1993). We also expect this to be the case in our model. Thus, average prior levels of service ($ExperienceQ_{t-1}$) will be included in the model as covariates.

Variability in Service Quality over Time. Over and above average service levels, we investigate how variability in service levels (especially extreme outcomes) and timing of service delivery influence firms' renewal decisions. Reliability or consistency in resource deployment over time plays a role in the success of B2B relationships (Dwyer et al. 1987, Tsikritsis and Heineke 2004). Increases in variability in service quality over time should decrease the value of a service contract and (consequently) the likelihood of the firm renewing a contract. This phenomenon has been partially integrated into a mathematical model of consumer (not organizational) purchase behavior. Rust et al.'s (1999) Bayesian model predicts that reducing a consumer's uncertainty regarding perceived product quality increases subsequent-purchase likelihood. However, they were unable to eliminate a natural confound between changes in the mean and variance of perceived service quality over time. In their second experiment, they attempted to resolve this issue by studying cross-sectional variation rather than variation over time. In this study, we examine variability in service levels over time, after controlling for average service levels.

Bayesian approaches assume that service quality over time is normally distributed, where variability is a surrogate for uncertainty. In contrast, many service operations metrics (employee labor, resources allocated, response or resolution time) are characterized by skewed distributions. Their distributions are characterized by a lower boundary of zero, a majority of observations within a certain range, and a few extreme outcomes. For example, a supplier can usually deploy a single technician to deliver a Service X—given certain resources—within 24 hours of a firm's request. However, the supplier may sometimes need to allocate additional resources, such as deploying an expert engineer, to deliver the same Service X. We investigate how infrequent, but extremely high (or low) levels of delivered service influence contract renewal. There is substantial evidence from the judgment and decision-making literature that variability over time creates experiences that can be encoded favorably or unfavorably (Loewenstein and Prelec 1993) where losses typically loom larger than gains (Kahneman and Tversky 1979). Buying firms' decisions (based on organizational norms) are likely to be equally sophisticated, especially in technology-intensive markets (John et al. 1999). Firms are likely to consider higher moments of the service quality distribution (i.e., beyond mean levels).

A natural extension of loss aversion is that options with extreme values within an offered set will be relatively less attractive than options with intermediate values (Tversky and Simonson 1993). People use a weighted average of transactions to form judgments based on past experiences, so that extreme outcomes (positive or negative) can be very influential. Fredrickson and Kahneman (1993, p. 46) suggest, "we favor a special case of the averaging model, in which most moments of an episode are assigned zero weight in the evaluation, and a few select 'snapshots' receive larger weights." Thus, exposure to an option with a favorable (or unfavorable) extreme outcome may lead firms—managed by people—to prefer (or become averse to) that option in future service renewal decisions. How do extreme values influence the firm's contract renewal decisions? Service contracts usually specify upper (or lower) bounds on certain aspects of service delivery, and service suppliers manage operations to achieve targeted levels within these bounds (Holcomb 1994). However, there will be variability in actual experienced service levels over time for a given firm. For example, a support supplier might offer a (fixed-price) contract that promises to send a technician within four hours of a request. The majority of firms receive a visit from a technician that resolves the problem, but some requests require a visit from a team, including an engineer, to resolve the problem. The visit involving the team may be more favorably evaluated because it indicates that the supplier has provided exceptional service—i.e., the supplier is willing to go the extra mile by sending extensive resources to fulfill its service promise within the context of the contract. The firm request is the same in both cases (requesting support to solve a specific problem), but it is the additional allocation of resources by the service supplier that we hypothesize influences the firm's evaluation of the experience and subsequent contract renewal decision. When service contracts specify upper or lower bounds, we believe a disproportionate frequency of extreme experiences relative to the targeted service level will influence the individual firm's subjective expected value for a service contract.

Hypothesis 1. *Favorable (unfavorable) extreme outcomes experienced over prior time periods ($Extreme_{t-1}$) will positively (negatively) influence firms' renewal decisions for service contracts at time t, after controlling for average service levels.*

The Influence of the Timing of Service Interactions. Experiments that manipulate perceived quality in the laboratory may mask effects arising from the timing of service experiences across natural purchase intervals. However, such timing may critically influence subsequent decisions. For example, if a supplier allocates significant resources (e.g., engineer minutes) to a firm early in the relationship, will this affect the firm's decision to renew a contract differently than if the supplier allocates such resources late in the relationship—close to the renewal decision? Recent experimental results indicate that the order or timing of service experiences has an important influence on reference points and that people shift their reference points after a stimulus is presented (Loewenstein and Prelec 1993). There is also empirical evidence that reference points (i.e., expectations) regarding key marketing variables influence firm performance (Glazer et al. 1989). Hence, we investigate whether the timing of service experiences influences firms' decisions regarding service contracts. We consider two equations that describe the formation of firm's assessments of experience quality—an averaging model and a deviations model—based on different theories about how information is used within the firm. First, following Boulding et al. (1993), we can represent the firm's predictive expectation for the experience quality associated with a contract by an averaging model, in which experience quality at time t is a weighted average of past (actual) service experiences (Q_{mt}), summed over service attributes $m = 1, \ldots, M$.

Hypothesis 2A (H2A).

$$ExperienceQ_t = \sum_m Q_{mt-1} + \omega(Q_{mt} - Q_{mt-1}) \quad t > 1,\ 0 < \omega < 1. \quad (1a)$$

Equation (1a) is a flexible specification that subsumes three special cases of how the timing of service experiences influences experience quality: (i) a *prior-based model* ($\omega = 0$) in which the firm's assessment of experience quality is completely dependent on information obtained at time $t-1$ (Q_{mt-1}); (ii) a *recency model* ($\omega = 1$) where current information obtained at time t (Q_{mt}) completely supersedes prior information; and (iii) an *equal weighting model* ($\omega = 0.5$) in which current and prior information are equally important. Second, firms' assessments of experience quality may be influenced by trends (up or down)—deviations from past experience—as predicted by prospect theory (Kahneman and Tversky 1979). Loss aversion has been shown for consumer decisions regarding services (e.g., Bolton and Lemon 1999), but prior research has not investigated whether deviations in service operations over time influence firm behavior.

Hypothesis 2B (H2B).

$$ExperienceQ_t = \sum_m \alpha(Q_{mt} - Q_{mt-1}), \quad t > 1. \quad (1b)$$

We investigate whether the firm's renewal decision is best explained by an averaging model (where $\omega = 0$, $\omega = 0.5$, and $\omega = 1$) or a deviations model of experience quality formation. Hence, we test H2A and H2B by calculating a value for experience quality based on Equation (1a) or (1b) and substituting it into a general model in which the firm's renewal at time t depends on its assessment of experience quality at time $t-1$.

Model Specification

The firm faces a choice among two alternatives—to renew or not renew a contract. The firm's decision regarding a service contract from a current supplier depends on whether the contract's value exceeds a threshold that justifies repurchase. Firms hold multiple contracts, and thus make multiple renewal decisions. Firms with different characteristics and needs will value each contract differently. It is important to account for this intrafirm association and potential heterogeneity across firms; we do so in two ways. First, multiple observations (contracts) are clustered within a larger context (each firm), so we employ a random-intercepts model. Second, we include firm-level characteristics in our model.

The probability that a firm (N) renews contract (c) can be modeled as follows:

$$\Pr(\text{renew contract } c \mid \text{firm } N) = \Pr(U_{nc} > 0), \quad (2)$$

where

$$U_{nc} = V_{nc} + \varepsilon_{nc}, \quad (3)$$

$$V_{nc} = \mu_n + \beta' x_{nc}, \quad (4)$$

in which the variables associated with the fixed parameters are denoted by vector x_{nc} (with parameters β). The vector x_{nc} includes both contract-level and firm-level variables. We assume that the random intercepts (μ_n) follow a univariate normal distribution across firms (with mean μ and estimated variance σ^2). Thus, the random-intercept variance term represents the amount of intrafirm correlation. Rodriguez and Goldman's (1995) results demonstrated that failing to account for high intraclass correlation in binary response models can result in biased and less-conservative coefficient estimates. Thus, a random-intercepts model provides a stronger test of our hypotheses. In addition, it allows for a varying number of observations (contracts) for each firm.

We further assume that the error term ε_{nc} is an independently and identically distributed extreme value. This leads to the complementary log-log model:

$$\Pr(\text{retention of contract } c \text{ by firm } n) = 1 - \exp[-\exp(V_{nc})], \quad (5)$$

where as noted above in (4), $V_{nc} = \mu_n + \beta' x_{nc}$.

Method

The Study Data Base

The model is estimated with data describing large firms who purchase system support services from a global supplier. System support contracts consist of a complex bundle of services. Firms buy multiple service contracts if they own multiple systems, purchasing a separate contract for each system. They may decide not to purchase support for some systems (providing internal support or doing without), or may purchase contracts from several suppliers. Contracts range in price from \$15,000 to \$300,000. Service promised by the support contract can be low, medium, or high, where higher levels correspond to incremental increases in bundled services. Support is provided for two aspects of systems—hereafter Technology A (Tech A) and Technology B (Tech B). Examples of different technologies within a single system include voice and data lines within telecom systems, and hardware and software within computer systems. Each technology has different incidences of requests and is supported through distinct service delivery mechanisms. All support contracts promise 24/7 support with guaranteed response within two hours. Contracts do not promise to resolve requests within a

Table 1 Constructs, Measures, and Descriptive Statistics

Construct	Measure*	Value
Contract-level covariates		
Extreme outcomes within the focal contract (Hypothesis 1)	Number of incidents in which Tech A engineer work minutes exceeds 240	0.09 (0.40)
	Number of incidents in which Tech B engineer work minutes exceeds 120	0.11 (0.46)
Average extreme outcomes across other contracts (Hypothesis 1)**	Number of incidents in which Tech A engineer work minutes exceeds 240 minutes, averaged across other contracts	0.11 (0.14)
	Number of incidents in which Tech B engineer work minutes exceeds 120 minutes, averaged across other contracts	0.25 (0.28)
Experience quality for the focal contract (Hypothesis 2)	Average Tech A engineer work minutes for a support request	19.46 (40.58)
	Average Tech B engineer work minutes for a support request	6.0 (18.69)
Experience quality across other contracts (Hypothesis 2)**	Average Tech A engineer work minutes for a support request, averaged across other contracts	7.9 (9.65)
	Average Tech B engineer work minutes for a support request, averaged across other contracts	5.8 (6.49)
Design quality	Contract type—dummy variables for medium and high	Med: 0.15 (0.35); High: 0.03 (0.18)
Price norm	List price (divided by 1,000)	5.28 (6.62)
Deviation from price norm	Discount off list price (percent)	0.20 (0.20)
	Dummy variable for missing discount information	0.15 (0.35)
Firm-level covariates		
System characteristics	Average number of Tech A requests across contracts	2.6 (35.76)
	Average number of Tech B requests across contracts	0.16 (0.16)
	Number of contracts: 0–10	46%
	11–20	27
	>20	28

*The last column shows mean and standard deviation across all observations for 1997 and 1998. The model was operationalized with either 1997 values (prior-based model) or 1998 values (recency model). **The measures of these constructs are subject to one of the four transformations described in the text.

certain time frame; instead, they promise to escalate the handling of highly critical support requests by devoting additional resources. A key feature of this supplier's support contracts is that a firm pays a fixed amount for support over a specified time period; contract price is not dependent on usage levels. A firm's usage of support is triggered by a system request, but not necessarily a system failure. The incidence of system requests is not (typically) within the control of the firm or the support supplier; it is influenced by exogenous factors.

Our data set was constructed by drawing a stratified probability sample from the cooperating supplier's list of large-business customers. Large-business customers are a market segment comprised of firms that operate certain enterprise-level systems. The data set describes 143 firms from Germany and the United Kingdom that purchase system support services.[1] The average duration of a supplier-firm relationship is seven years, and the average renewal rate across the sample is 88%. Within Europe, firms face the same competitors; firms simultaneously hold service contracts (on average) from nine suppliers. The mean total support dollars (values are scaled to preserve confidentiality of a cooperating supplier) spent by each firm in the sample (across all suppliers) is \$704 K (UK) and \$870 K (Germany). We obtained firms' annual billing records describing contracts held in 1998, and then tracked whether they repurchased these contracts in 1999. We also obtained monthly service operations records for 1997–1998 describing interactions between each firm and the supplier (from the supplier's information system). These time-series data were reported at the contract level. The database provides an unusually complete description of the B2B relationship as it incorporates cross-sectional and time-series observations at the contract and enterprise level. Thus, we are able to model the firm's contract renewal decisions in 1999 (yes/no vis-à-vis 1998) as a function of its experiences in the previous two years (1997–1998).

Measurement of Model Constructs

The measures of each model construct and descriptive statistics appear in Table 1. We determined whether or not a firm renewed a contract by comparing billing records for 1/1999 versus 1/1998. A service contract for a given system is considered to be renewed if: (1) the firm purchases a new contract at the same service level, or (2) the firm upgrades by purchasing a new contract at a higher service level. We include upgrades within renewals because they entail the repurchase of the same set of bundled features plus

[1] We also estimated the model including dummy variables for country, but found no significant effects.

additional features. We do not observe any instances in which firms downgrade.

Design Quality, Experience Quality, and Price. Design quality (*DesignQ*) specified in the service contract can be jointly represented by dummy variables indicating whether the contract provides low, medium, or high levels of support. The contract's price (*Price*) is the list price, plus discount (if any). The supplier offers discounts to some customers—where discounts are typically higher when list prices are higher (and competition is more intense). We translated customers' perceptions of system support quality into objective, concrete measures derived from the service operations database (Acosta-Mejia 1998), following well-established procedures (Kordupleski et al. 1993). Our analyses indicated that *average engineer work minutes per contract* for Tech A and Tech B were two managerially actionable service operations measures that represented system support quality—specifically, experience quality—and could (potentially) predict service contract renewal. There are separate measures of engineer work minutes per contract for Tech A and Tech B, respectively (average Tech A engineer minutes per contract: 28; average Tech B engineer minutes per contract: 15). Engineer work time per contract is not equivalent to response time or resolution time per contract (averaged across requests for a given contract). The supplier's response to a request for support is typically logged by a service representative who forwards the request to a service technician and (as appropriate) an engineer may be involved in resolving the request. Hence, engineer work time is not related to response time, resolution time, service technician time, or usage of total resources—in the same way that the time a doctor spends on a patient's case is not related to the patient's waiting time, total time elapsed to obtain a diagnosis (including time spent with technicians), or usage of total resources (e.g., X-rays, lab tests). Engineer minutes represent the time spent by an engineer trained specifically on the technology (A or B) and do not reflect time spent by technicians or other nonengineers on system support or waiting time (Kumar et al. 1997). Thus, firms' service experiences ($ExperienceQ_{t-1}$) are represented by two variables: average engineer work minutes per contract for support for Tech A and Tech B. Instead of estimating ω, we measured $ExperienceQ_{t-1}$ using the average value for 1997 (prior-based model), 1998 (recency-based model), average of 1997 and 1998 (equal-weight model), or difference between 1997 and 1998 (deviations model).

Extreme Outcomes. In preliminary qualitative research, firm managers and technical end users reported favorable responses to support incidents in which the supplier exceeded industry norms in its allocation of resources. This preliminary research suggested industry norms such that an engineer could resolve a Tech A request in four hours and a Tech B request in two hours. Hence, we derived measures of extremely favorable outcomes by identifying incidents in which engineer work minutes for a Tech A support request exceeded 240 minutes and incidents in which engineer work minutes for a Tech B support request exceeded 120 minutes. The supplier's service operations records indicate that 13% of Tech A support incidents exceeded the norm, and 11% of Tech B support incidents exceeded the norm. Hence, we measured favorable extreme outcomes ($Extreme_{t-1}$) for a particular service contract by counting (separately) the number of support incidents above these cutoff values for Tech A and Tech B over the past two years (Extreme values Tech A: Range 0–5; Extreme values Tech B: Range 0–7).

Treatment of Multiple Contracts. The preceding paragraphs describe two measures of experience quality and two measures of extreme outcomes for a *focal* contract (c). Because any firm may hold multiple contracts, firms' assessments of experience quality and favorable extreme outcomes for *other* contracts provided by the same service supplier may also influence its focal contract renewal decisions. Thus, it is relevant to calculate four similar measures to characterize the firm's average experience quality and extreme outcomes for the other contracts. For each measure, we average across the other contracts, $p = 1, \ldots, p_i$ (where p is not equal to c), thereby creating an additional four measures of experience quality and extreme outcomes (e.g., if a firm has four contracts, each contract is—in turn—the focal contract with its own unique variables, with average values calculated across the other three contracts the firm holds).[2]

Covariates. We incorporate the frequencies of Tech A and Tech B support incidents as covariates into Equation (4), measured as the average number of incidents calculated across *all* support contracts between a particular firm and this service supplier (contracts with A incidents: 23%; B incidents: 18%). Both covariates are statistically significant ($p < 0.05$). Following Bolton and Drew (1994), we also conducted analyses to see whether specific characteristics of the service request—such as type of support requests, severity of the problem, or average amount of downtime minutes per contract—should be included as covariates in the model. Statistical tests indicated that none of these variables had a statistically significant effect ($p > 0.05$) after incorporating the frequencies of Tech A and Tech B support incidents as covariates.

[2] This approach does not consider possible cross-contract interactions; we leave this issue for future research.

Results

Estimation Procedure

We estimated the random-intercepts model with marginal maximum-likelihood estimation, utilizing a Fisher-scoring solution, using MIXOR (Hedeker and Gibbons 1996). Eighty four percent (120) of firms purchase more than five contracts. We estimate the model based on 2,442 observations or contracts (about 20 contracts/firm). Firms make the renewal decision in time t, based on information from time $t-1$. A complete list of variables is found in Table 3.

Model Comparisons and Model Fit

Table 2 shows test statistics for models that incorporate alternative time frames as described in H2A and H2B—i.e., reference points based on prior experiences, recent experiences, equal weighting of experiences, or deviations from prior experiences. The test results are for models with a linear transformation of extreme outcomes. The model incorporating *recent* service experiences dominates—and this result holds for all transformations that we investigated (see below). The order of the two tests—i.e., alternative reference points or alternative transformations—does not affect any of our results.

We initially specified the subjective expected-value Equation (4) to be linear additive. In the linear additive specification, counting the number of extremely favorable outcomes implicitly assumes that the firm gives equal weight to all extreme outcomes associated with the same contract. The firm's subjective expected value for the service contract might be nonlinear with respect to extreme outcomes. For example, there might be diminishing marginal returns from favorable extreme outcomes. Hence, we estimated four models that incorporated alternative transformations of the $Extreme_{t-1}$ variables: (1) a conventional linear additive term ($Extreme_{t-1}$), (2) a quadratic term only ($Extreme_{t-1}{}^2$), (3) a natural logarithm transformation ($\ln(Extreme_{t-1})$), and (4) reciprocal transformation ($1/Extreme_{t-1}$). To be conceptually consistent, the same transformation was performed on all four $Extreme_{t-1}$ variables. Note that for logarithmic and reciprocal transformations, when $Extreme_{t-1} = 0$, we add a small positive constant to each value of x prior to estimation. Log-likelihood function values for the recency model with these transformations are very similar: linear (−699), quadratic (−704), natural logarithm (−696), and reciprocal (−698). These values are directly comparable because the number of variables in the model does not vary. Based on the similarity of these values (as well as adjusted rho-squared, Akaike Information Criterion, and Schwartz Criterion), we believe that there is insufficient empirical justification for a departure from the standard linear model (which is most parsimonious). Hence, we report the linear model results. Results for other transformations were consistent with the linear model.

Table 3 displays the final model that incorporates recent experiences and the four measures of $Extreme_{t-1}$. The model fits the data reasonably well, with a pseudo-R^2 (or rho-squared) value of 19%. Unlike ordinary least squares, the pseudo R^2 is calculated by comparing the estimated model with an equal probability model. Hence, the pseudo R^2 value for the model is satisfactory. The hit rate (87%) compares favorably with Morrison's (1969) proportional chance criterion (78%). Because this hit rate was calculated on the entire sample, we also calculated the hit rates using split sample methods. The model was estimated on a random sample of 75% of the observations, and predictions were made for the corresponding holdout sample (i.e., the remaining 25% of the observations). This procedure was repeated three times to evaluate the model's predictive ability. The hit rates for the three holdout samples were 86%, 81%, and 87%. These values also compare favorably with the proportional chance criterion. In addition, the random-intercepts variance term is statistically significant ($z = 14.116$, $p < 0.000001$), suggesting that the random-intercepts model is appropriate (Rodriguez and Goldman 1995).

Table 2 Hypothesis 2: Comparison of Models with Alternative Reference Points

Reference point	Log likelihood	Akaike information criterion	BIC (Schwartz criterion)
H2A: Prior-based model: firm relies on 1997 experiences only	−775.68	1,585.4	1,684.0
H2A: Recency model: firm relies on 1998 experiences only	−699.85	1,433.7	1,532.3
H2A: Equal weight model: firm relies on both 1997 and 1998 experiences	−734.25	1,502.5	1,601.1
H2B: Deviations-only model: firm compares 1998 with 1997 experiences	−747.76	1,529.5	1,628.1
Model with maximum-likelihood value	H2A supported (Recency model, $\omega = 1$)		

Note. All models have the same number of exogenous variables, so log-likelihood values are directly comparable. These results are for a model with a linear transformation of $Extreme_{t-1}$, but a recency model dominates for the three other transformations.

Hypothesis 1: Extreme Outcomes. Hypothesis 1 predicts that favorable extreme outcomes will increase the likelihood of contract renewal. Favorable extreme outcomes are measured by the count of incidents with extremely high engineer work minutes over a two-year period. This hypothesis is supported: Favorable extreme outcomes in Tech A (within the focal contract) significantly increase the likelihood of renewal

Table 3 Parameter Estimates Based on Recent Experiences, Linear Transformation of ($Extreme_{t-1}$)

Construct	Measure	Exp. sign	Coefficient (std. error)
Hypothesis 1: extreme outcomes within contract	Number of incidents in which Tech A engineer work minutes exceeds 240 minutes, in 1997–1998	+	+1.512** (0.723)
	Number of incidents in which Tech B engineer work minutes exceeds 120 minutes, in 1997–1998	+	−0.459* (0.343)
Hypothesis 1: extreme outcomes across other contracts	Number of incidents in which Tech A engineer work minutes exceeds 240 minutes, in 1997–1998	+	−1.445 (1.062)
	Number of incidents in which Tech B engineer work minutes exceeds 120 minutes, in 1997–1998	+	−0.743 (0.600)
Hypothesis 2: experience quality for focal contract	Tech A engineer work minutes per request in 1998	+	+0.004 (0.007)
	Tech B engineer work minutes per request in 1998	+	+1.013*** (0.167)
Hypothesis 2: experience quality for other contracts	Tech A engineer work minutes per request in 1998	+	+0.085*** (0.018)
	Tech B engineer work minutes per request in 1998	+	+0.136*** (0.030)
Design quality	Contract type—Medium	+	+0.163 (0.284)
	High	+	−0.224 (0.425)
Price norms	List price	−	−0.080***
Discount from normative (list) price	Discount off list price	−	−0.838 (0.816)
	Discount missing	N/A	+3.555*** (0.298)
Firm-level covariates: system characteristics	Average number of Tech A requests across contracts	N/A	+0.092*** (0.024)
	Average number of Tech B requests across contracts	N/A	−8.823*** (1.151)
Constant			0.118***
Random-intercepts variance term (standard deviation)			0.071*** (0.005)
Log-likelihood	−699.85***	Hit rate	87%
Pseudo R^2	19%	Mean absolute deviation	0.13

*$p < 0.10$ one-tailed tests, **$p < 0.05$, ***$p < 0.01$.

(Table 3, $p < 0.05$). Thus, the results indicate that exceptional efforts by the supplier are recognized and valued by firms. Interestingly, the effect is not significant for other contracts, suggesting that extreme outcomes on other contracts do not influence renewal on the focal contract. We suggested that the firm's subjective expected value for the contract might be nonlinear with respect to extreme outcomes. Given that we find no real difference between the linear model and other transformations, we do not find evidence for such nonlinearity. The significant role of extreme outcomes in service contract renewal decisions is consistent with prior cross-sectional research concerning managerial decision making. In a B2B context, the mere labeling of performance as positive or negative has been found to affect perceptions of risk by top management (Sitkin and Pablo 1992) and to affect organizational action (Neale et al. 1986). Incidents with extremely high engineer work minutes are beyond industry norms for support, as well as reference points set by firms' own recent contract experience, and are viewed as positive or favorable.

Hypothesis 2: Formation of Assessments of Experience Quality. H2A and H2B are competing hypotheses about how firms assess experience quality with four possible alternatives. The alternatives were assessed by comparing test statistics shown in Table 2. The recency model has the best fit. This result implies that average service operations experiences are evaluated directly, rather than as deviations from earlier experiences. Timing is also important—recent experiences weigh more heavily than early ones. The dependence of the renewal decision on recent service operations is consistent with prior research (Loewenstein and Prelec 1993) that shows that people give more weight to experiences at the end of a series, and with Hansen and Danaher's (1999) finding that judgments of service quality and purchase intentions are driven more by performance of the final event than the initial event. In sum, H2A is supported, with assessments of experience quality based on recent experiences.

Specifically, the effect of average engineer work minutes per request for Tech A for the focal contract is not significant (Table 3, $p > 0.05$). However, the effect of average engineer minutes per request for Tech B for the focal contract is significant and positive (Table 3, $p < 0.01$). Thus, after controlling for the average number of service requests for Tech A and Tech B, when engineer minutes are high for Tech B, contract renewal is likely. Average engineer minutes for Tech A and Tech B service requests on other contracts also influence the renewal decision. Both coefficients are positive and statistically significant (Table 3, $p < 0.01$). When engineer minutes are high for Tech A or Tech B for other contracts held by the firm, contract renewal is likely. Firms prefer higher utilization levels of such services because they pay a fixed price, rather than a variable usage-based rate (Bolton and Lemon 1999).

Design Quality and Price. Variables indicating support level are not statistically significant (Table 3, $p > 0.05$). Repatronage behavior of firms does not depend on contractual terms. Renewal does depend on price; higher-priced contracts are less likely to be renewed (Table 3, $p < 0.01$). Discount off of list price is negative but not significant, probably because list price and discount are correlated at 0.33 ($p < 0.01$).

Model Robustness. Both firm-level covariates are statistically significant ($p < 0.01$), indicating that the firm's number of requests for support influence contract renewal. To determine if we have omitted other pertinent service quality variables, we conducted additional analyses examining the effects of other potential indicators of service quality on contract renewal. We estimated the model with the following contract-level variables: resolution time (in hours), response time (in hours), nature of the request, average number of responses per contract, and appropriate extreme value measures. We added each additional variable to the model separately, either as a single variable (focal contract only) or as a pair of variables (focal/other contracts). We also tested several enterprise-level covariates (beyond number of service requests for Tech A and Tech B). None is statistically significant in predicting contract renewal, suggesting that engineer minutes serve as a signal of experience quality for these contracts.

Sensitivity Analysis

Because the dependent variable is binary, it is useful to interpret the results in terms of the effect of changes in the predictor variables on the probability that the firm renews the contract, as well as on revenue (Table 4). We begin with a base scenario (B). The firm holds a single contract, purchased at average list price for the sample, with typical experience quality levels (engineer work minutes for Tech A and Tech B for the focal contract equal to sample averages), and typical system characteristics (covariates set to sample

Table 4 Managerial Interpretation of Model Results

Scenario	Probability of renewal	Change in probability vs. base scenario	Change in number of contracts (revenue**) per firm	Change in revenue** across 143 customers ($)
Base scenario: firm holds a single high support contract, list price = $5,300,* engineer work minutes for Tech A and Tech B for focal contract = sample averages, no extreme outcomes, covariates = sample averages	0.892			
Scenario 1: base scenario, plus firm holds other contracts with engineer work minutes for Tech A = sample averages	0.948	0.056	0.97 ($5.16)	737
Scenario 2: base scenario, except firm has no experience on the focal contract	0.680	−0.212	−3.69 (−$19.55)	−2,796
Scenario 3: base scenario, plus firm holds other contracts with engineer work minutes for Tech B = sample averages	0.948	0.056	0.96 ($5.10)	729
Scenario 4: base scenario, plus extreme outcomes for Tech A for focal contract = sample average	0.905	0.013	0.22 ($1.19)	170
Scenario 5: base scenario, plus one extra mile experience for Tech A for focal Contract	0.974	0.082	1.42 ($7.52)	1,074
Scenario 6: base scenario, plus list price decreases by 5%	0.973	0.081	1.40 ($7.07)	1,011

*Throughout the analyses reported in this paper, price has been adjusted by a constant scale factor to preserve the confidentiality of the supplier's data.
**Revenue expressed in 1,000s of dollars.

averages). There are no extreme outcomes. In B, the renewal probability for a single typical service contract is 0.89. Scenario 1 (S1) is similar to B except that the firm holds other contracts with typical experience quality levels for Tech A (engineer work minutes for Tech A for other contracts set to sample averages). In S1, the probability that the firm will renew the focal contract, one of many similar service contracts provided by the supplier, is 0.95. Experiences with other supplier contracts spill over and dramatically affect the firm's probability of renewing the focal contract. In Scenario 2 (S2), the firm holds other contracts with typical experience-quality levels, but has no prior service experiences for the focal contract. The probability that the firm will renew the focal contract, given no experience, is much lower: 0.68.

In Scenario 3 (S3), the firm holds other contracts with typical experience quality levels for Tech B. The probability that the firm will renew the focal contract in this case is similar to S2, at 0.95. Scenario 4 (S4) is similar to B, except that the firm has experienced a typical number of extreme outcomes for Tech A on its focal contract. In S4, the probability that the firm will renew the focal contract is 0.095—only slightly higher (0.013) than B. In S5, when the firm experiences *a single extra-mile experience* for Tech A on the focal contract, the probability of renewing the focal contract is 0.974—an increase of 0.082. The influence of a single extra-mile experience on the probability of the firm's contract renewal is larger than the influence of holding many other similar contracts. Thus, comparing these scenarios demonstrates the powerful effect of an extra-mile experience—and how its effect is diluted if there are recurring extreme outcomes on the same contract. Scenario 6 (S6) examines the effect of a change in price. S6 is similar to B, except that the firm experiences a 5% decrease in list price. This increases the renewal probability to 0.973.

The two right-hand columns of Table 4 show the revenue implications. We calculate the change in the number of contracts held by the firm by multiplying the change in the probability of contract renewal by the average number of firm contracts. We calculate the change in revenue by multiplying the change in the number of contracts by the average list price ($5,300, where list price has been scaled to preserve confidentiality). We calculate the change in revenue for the supplier by multiplying by 143 (firms in the European data set). These scenarios are (necessarily) somewhat artificial: The base scenario describes a firm with a single contract, not all firms have this profile, and the supplier has many more customers than 143. However, the projected dollar values are substantial, and give some notion of revenue implications of the scenarios we prepared for managers of the cooperating supplier. For example, the revenue implications suggest that the revenue increase from one extra-mile experience is very similar to the effect of a 5% price decrease. The biggest negative revenue impact results if firms have no experience on a contract. These projections provide powerful evidence that the supplier can reallocate resources across contracts and firms over time to maximize revenue and renewal. Some firms and contracts are receiving multiple extra-mile experiences, whereas other firms and contracts are receiving none. We believe that the supplier should consider proactively creating a single extra-mile experience for each of the neglected contracts and firms, while reducing the average number of extreme outcomes across contracts.

Contribution to Theory

We believe that this study is the first attempt to model the influence of firm-supplier interactions over time on the firm's repatronage decision, and the first attempt to examine the effects of extreme outcomes in service delivery over time on this decision. This study contributes to our understanding of customer retention in several ways. First, we find that modeling the renewal decision at the individual contract (rather than overall firm) level provides new insights. Second, we show that firms attend both to their normative expectations of the service contract (list price) and their experiences with the service contract over time (experience quality) when deciding to renew a contract. Third, we show that extreme outcomes over time have a significant effect on renewal. A few instances of delivering exceptional quality can have a significant, positive effect on the decision. Recent experiences are particularly important. Overall, this research suggests that firms determine whether or not to renew a contract by evaluating the extent to which their experience with the supplier over time (on several dimensions, considering distinct reference points) delivers value.

Enterprise vs. Contract Level. Recent research suggests that general relationship constructs may not explain firm behavior well (Reinartz and Kumar 2000). Our results suggest that specific, experience-based constructs measured at the contract or product level are critical factors. We find that firms utilize information regarding both the focal contract and other contracts held by the firm in their decision of whether to retain the focal contract. This suggests that it is important to model B2B relationships at the contract, product, or site level, rather than the enterprise level, to ensure appropriate resource allocation.

Experience Quality: Extreme Outcomes and Timing. Service contract renewal is directly influenced by past experiences—not contract specifications or deviations from norms. Firms were more likely to renew contracts for which there were higher levels of resources allocated to support services—and a few incidents of extremely high resource levels. Surprisingly, a few favorable extreme outcomes per contract positively influence retention, especially on the focal contract. However, experiences of extreme outcomes on other contracts did not have such an effect. This suggests that understanding a firm's decision context is critical to managing service request responses and the firm-supplier relationship. Further, firms gave more weight to recent experiences when deciding whether or not to renew a contract, suggesting that timing of experiences is critical. Identical support incidents may be evaluated very differently, depending on whether they occur early in the contract relationship or closer to the renewal decision.

Managerial Implications

This study has implications for suppliers seeking to maximize customer retention, and suggests strategies for allocating resources over the duration of firm-supplier relationships. Currently, firms often focus on managing variability *across* contracts and customers, rather than variability *within* contracts. However, certain customers may be systematically underserved because conventional quality control mechanisms fail to recognize or create solutions for this within-customer issue. It is normally assumed that variability is "bad" in a service quality context; our results show that managers may be myopic in this view and should examine more carefully the nature of the variability, as it may lead to positive outcomes. The results suggest that suppliers managing relationships with firms that hold multiple contracts should carefully manage the amount and timing of resources allocated to each contract to deliver value.

Sufficient Utilization of Each Contract. Failure to ensure adequate utilization of support services, within and across the portfolio of contracts held by a firm, is likely to lead to decreases in customer share—and ultimately to relationship termination. The results suggest that when fixed-price contracts for support services are underutilized, firms are averse to renewing them. In our sensitivity analysis, the probability that a firm renewed a contract when it did not utilize supplier services for the focal contract was 68%, substantially lower than if it had typical contract utilization levels—and the revenue implications are substantial. The renewal probability was even lower if the firm did not hold other contracts. Suppliers typically reactively allocate resources in response to customer requests. Suppliers should consider proactively allocating resources within and across all contracts to increase retention.

At Least One Extra-Mile Experience. Favorable extreme outcomes increased contract renewal, supporting the idea that organizational memory recalls service over time in terms of snapshots of extreme service experiences. This suggests that suppliers should look for opportunities to deliver exceptional service to each firm—occasionally exceeding upper bounds for expected levels of service. The current rule of thumb in service delivery is underpromise, overdeliver (Ho and Zheng 2004). This heuristic fails to identify the firm to whom the supplier should deliver exceptional service, when the service should be delivered, and how often. It does not recognize that firms adapt to overdelivery (i.e., multiple extreme outcomes on a contract), reducing its impact. To address this, a supplier might ensure that its engineers spend sufficient time on each contract to effectively handle each request, rather than delegating requests to less-effective service technicians. In the short run, additional resources are allocated to each request; in the long run, multiple extreme outcomes should become infrequent. The supplier could also make proactive support calls to firms who hold contracts on which they do not request support over a specified time period, perhaps in the form of a maintenance visit scheduled strategically before contract renewal.

Use Service Operations Data to Improve Customer Retention. The model suggests that it is critical to incorporate service operations metrics into models of retention. The results suggest that it may (ultimately) be possible to predict retention behavior solely from internal records (e.g., CRM systems, operational data bases), without utilizing perceptual measures as mediators, and provide direction for which metrics the firm should (and potentially does not need to) measure. Suppliers may be able to implement successful retention programs if they keep accurate records of individual firm experiences (at the contract level), and update relationship strategies for individual customers as circumstances change.

Limitations, Conclusions, and Directions for Future Research

In this research, we have examined antecedents of the service contract renewal decision utilizing a longitudinal, multicountry, cross-sectional data base. We have examined this model in one industry—high-technology support services. Future research should extend the research to other product categories. For example, we believe that this type of dynamic model could be very useful in computer-mediated environments that provide customer-specific service experiences. We suggest that extreme outcomes are important in the decision because firms may not follow a strict temporal integration model in making decisions about service contracts—they may use a weighted average of prior transactions in which extreme outcomes or snapshots are highly influential. Another explanation for the influence of extreme outcomes on the decision is provided by attribution theory, in particular, control bias (Narayanan and Lehmann 1998). Within the firm, managers' need for control and attributions regarding extreme values may lead them to value a contract more (or less). Extreme outcomes in service experiences provide opportunities for managers within firms to make causal attributions towards service suppliers that may lead to favorable (or unfavorable) renewal decisions. In other contexts, the decision maker's attributions about locus (i.e., experience attributed to supplier or firm) and controllability (i.e., experience preventable or not) might vary. Alternatively, customer expectations theory (e.g., Johnson et al. 1995) suggests that consumers may update expectations over time, but the results reported here suggest that extreme outcomes may not result in such updating, but rather serve as a quality cue that influences firm decisions. We believe that more research is needed to understand the process by which these extreme values affect decision making.

Conclusion. Firms have invested extensive resources into CRM systems to track interactions at the customer level over time. Our model provides some insights into how to exploit this information. Our study highlights the importance of developing dynamic models of customer decision making. We find that the extent and timing of the supplier's interaction with a firm influences decision making. Therefore, ignoring such dynamic effects may result in incorrectly specified models of firm behavior, and suboptimal allocation of resources. As we seek to deepen our understanding of buyer-seller relationships, understanding the effects of marketing, operations, and service decisions over time will be imperative.

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