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The degree and determinants of source loyalty in the purchase of industrial components by an advanced electronics firm are examined through the application of multiple regression and discriminant analysis to data obtained from company records and interviews.

Industrial Source Loyalty

INTRODUCTION

The degree of customers' loyalty to brands and stores and the correlates, or determinants, of this loyalty are of major importance in designing marketing strategies in both consumer and industrial markets. Yet whereas wide interest converted this area into one of the principal areas of marketing, in which rigorous theoretical and a variety of empirical approaches have been brought together to study consumer loyalty behavior and its determinants [2, 3, 6, 7], no attempt has previously been made to examine the loyalty of industrial buyers.

The present study attempts to fill this gap by analyzing source loyalty by a West Coast electronics firm. In particular, it examines the purchase of industrial components and the various factors which influence source loyalty. In the purchase of industrial components the buyer (purchasing department) selects a source (a manufacturer, distributor, or even a machine shop within his company) to supply the needed parts specified, by brand or detailed specification, by the R & D engineer or production control manager.

The study was conducted in two phases [9]. A preliminary investigation developed a number of research hypotheses. This phase consisted of a number of interviews with, and protocols from, various organizational members who make or influence purchase decisions. The findings of this phase were summarized in a model of source loyalty and number of hypotheses, which were tested in the second phase by multiple regression and discriminant analyses of data collected from company records and interviews with members of the firm.

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A MODEL OF INDUSTRIAL SOURCE LOYALTY

The model developed in the first phase (the figure) hypothesizes that source loyalty in the purchase of industrial components is a function of four major sets of variables:

1. The "traditional" task variables of price, quality, delivery, quantity and service, commonly considered in the purchasing literature to be the sole determinants of decisions.
2. The buyer's past experience with the various sources, assumed to be summarized in his attitudes toward the various sources.
3. The organizational variables, reflecting the effect of the specific organizational setting on the buyer's decisions and behavior.
4. The factors perceived by the buyer to simplify his work.

One other possible set of variables—the special relations of a buying firm with a given supplier (standing supplier contracts and reciprocity)—was not included in the model. Controls were exerted by excluding from the analysis all those cases in which standing supplier contracts existed. Reciprocity, the policy of buying from the company's customers, may of course affect the results, but since buyers were reluctant to talk about it, it was excluded from the model.

Each of the remaining four sets of variables and their hypothesized relationships to source loyalty are next described.
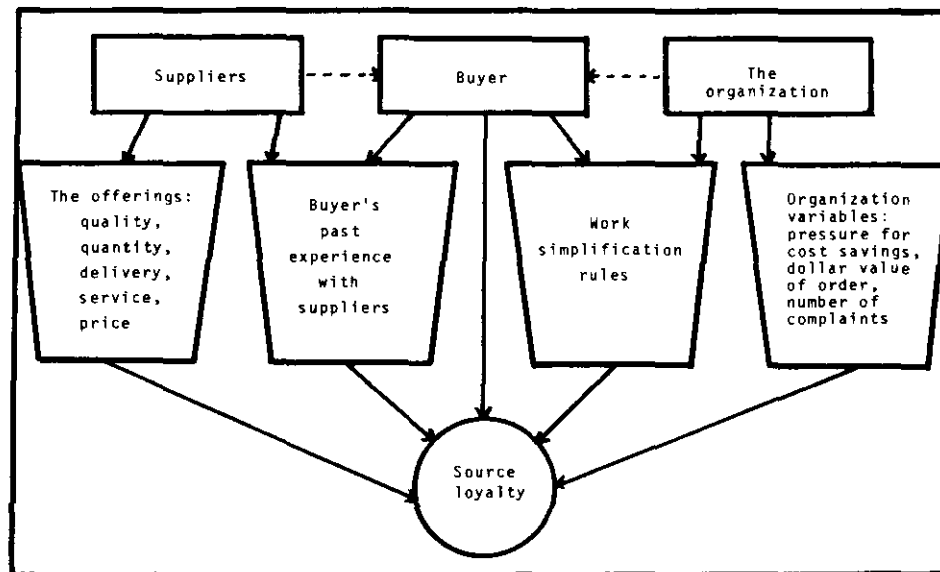
The Traditional Task Variables

Traditionally, the quality of products, the availability of the appropriate quantity, and the capacity to deliver at the right time have been viewed as key factors in determining source selection. Yet these requirements do

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A SIMPLIFIED MODEL OF INDUSTRIAL SOURCE LOYALTY

not determine which suppliers will be selected and are therefore not significant determinants of source loyalty. Consequently, price was the only traditional task variable included directly in the model. Specifically, it was hypothesized that the greater the discrepancy between the price of the current source and others, the greater the probability of changing a source and the greater the discrepancy in prices of the current source over time.

The Organizational Variables

A buyer's past experience, which is likely to influence his loyalty, will tend to be reflected in (and can be measured by) his attitudes toward the source [10]. Source loyalty is hypothesized, therefore, to be greater the more favorable the buyer's attitudes toward a source.

Although most studies on industrial buyer behavior have not been concerned with organizational variables, the exploratory study suggested that these have an important influence. In particular, following the author's reward-balance model [11], it was hypothesized that the organizational setting affects the buyer via the pressure exerted on him for cost savings, the dollar value of the order, and the number of complaints from the using departments. The greater the pressure for cost savings, the larger the value of the given order, and the more complaints are transmitted, the greater the probability of switching to another source. It is expected, therefore, that these organizational variables will be inversely related to source loyalty. In addition, two other factors stemming from the organizational environment, the recommendation of a sole brand by the user and the identity of the buyer, were also expected to affect the degree of source loyalty.

Work Simplification Variables

Industrial buyers are in most cases under tremendous pressure to complete their routine of selecting and contacting sources of supply in a given period of time. Therefore, they tend to prefer alternatives that might simplify their work and save them extra effort and time. This phenomenon of work simplification is the industrial buyer's equivalent of the consumer's tendency to increase his shopping convenience [5]. It is thus hypothesized that:

1. Buyers tend to prefer sources which are located geographically closer to them, since this simplifies communication.
2. Buyers tend to remain with their favorite source as long as no strong pressures are exerted for a shift. A new order to the established source requires less effort than looking for a new source.

VERIFYING THE MODEL

The Data

The data for this study were derived from three major sources:

1. *The purchase history cards of components bought by an advanced electronics firm.* The sample of components was drawn from all components for which there were no standing supplier contracts and with at least seven purchases each. The total number included in the sample were about 1,200 for determining the degree of source loyalty, 314 for the first regression runs, 80 for the fresh set of data to test the model arrived at in the first runs, and 120 for the discriminant analysis. These cards provided information on the vendor selected, the

date of purchase, other feasible suppliers, the quantity ordered, price, identity of the buyer, the brand recommendation if any, the location of the vendors and the terms of each purchase. These data provided the information needed for the construction of all variables, with the exception of the pressure for cost savings and attitude variables.

2. *The cost savings weekly memo.* This memo, distributed weekly to all purchasing agents, specified the cost saved by each division during the foregoing week. These data were used to construct the measures of pressure for cost savings.

3. *Data on the buyers' attitudes toward the various sources of supply.* These data were derived from an attitude study using the semantic differential scales.

The Research Approach

Before undertaking the quantitative analysis, measures for the dependent and independent variables had to be defined. Since there are no a priori criteria on the appropriateness of each measure, a number of alternative measures were tested in a series of regressions. From this the most appropriate measures of the dependent variables and the corresponding independent variables comprising the best regression equation—with the highest statistical explanatory power—were determined. In all, six measures of source loyalty were examined; of these, four were selected for further analysis. The definitions of these variables are given in the Appendix. Two other measures were eliminated, since their results were consistent with the other four and did not add to understanding of the initial 45 independent variables (5 of price, 11 of buyers' attitudes, 4 of dollar value of order, 17 of cost savings, 3 additional organizational variables, and 4 work simplification variables). Eleven independent variables were found to compose the best regression equation for three measures of source loyalty and nine for the fourth equation. These variables and the hypothesized direction of their relation to source loyalty are summarized in the Appendix. The selected variables were then tested on a fresh set of data using both regression and discriminant techniques [8].

The Findings

Does source loyalty exist? The purchase history cards indicated clearly that there is a high degree of source loyalty for both fabricated and standard industrial components. Only about 6% of the purchase history cards reported an instance of an isolated source (granted only one order). Thus, even on these grounds alone, some degree of loyalty is apparent.

The determinants of source loyalty. The four sets of variables hypothesized in the model were examined by multiple regression and discriminant analysis. The objective of the multiple regression was to estimate the strength of the relationship between source loyalty and the hypothesized explanatory variables. The discriminant analysis was designed to test the power of the se-

lected variables in predicting the various degrees of source loyalty.

The regression analysis showed a significant relationship between the various measures of source loyalty and the four sets of independent variables with an R^2 ranging from .94 for the equation with SL_1 as the dependent variable to .73 for SL_4. The results thus tend to support the model. There were, however, substantial differences in the relative explanatory importance of the various independent variables.

Since the dependent and independent variables were in different dimensions, prices, attitudes, etc., the partial regression coefficients could not be compared directly. A standardized parameter estimate [4][1] was therefore computed to analyze the relative importance of each variable. The first column of Table 1 shows the standardized coefficients for the equation with SL_1 as a measure of source loyalty. The equations with SL_2 and SL_3 as dependent variables showed a slightly lower explanatory power overall, but led to similar conclusions and are not discussed separately. An examination of these partial coefficients suggested that not all variables used in the regression were significant. Further testing on a trial and error basis enabled the elimination of certain variables without reducing the explanatory power of the equation. The resulting equation is presented in the second column of Table 1. It shows that a small number of key variables representing the four sets of variables explain source loyalty almost as well as the whole equation. In particular, cost savings (CS_1), price (P_2), and the dollar value of the order (DLV_1) emerged as the most important single determinants of source loyalty. Attitude (A_2), recommendation of a brand (ORG_1) and previous purchase history (WS_2) were slightly less significant.

The regression with SL_4 as dependent variable showed a similar tendency for a few variables to explain source loyalty, although in this case different variables were significant. The results of the equation with the nine selected variables as well as the best regression equation for a subcombination of these variables are listed in Table 2. These show that four variables alone account for an R^2 of .7295 with an F-value of 21.32.

Cost savings were the most important single explanatory variable with SL_4 as a measure of source loyalty. When both measures of the set—CS_4 and CS_3—were in-

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[1] The standardized parameter estimates were derived by converting each variable into units of standard deviation. The computation of the standardized coefficient (β) and its relation to the regression coefficient (b) are indicated by the following equation:

$$\beta_{yi \cdot j} = b_{yi \cdot j} \frac{s_i}{s_y},$$

where
β = standardized regression coefficient
b = regression coefficient
S = standard deviation
y = dependent variable
i = the specific independent variable studied
j = all other independent variables.

cluded, they had the highest and second highest standardized b, respectively. Following, but quite a bit behind, was A_3, the better of the two attitude measures examined in the second regression study. Of smaller importance, but still significant, were the dollar value, price, and work simplification variables.

The major findings of the analysis were such that all four sets of variables had a statistically significant effect on source loyalty, irrespective of the specific measure of loyalty used. All variables were related linearly to source loyalty and in the direction hypothesized by the model. The only exceptions were the few cases regarding the measure of dual loyalty. An analysis of the effect of each of the independent variables on source loyalty showed that some measures had more explanatory power, in particular P_2, DLV_1, CS_1, A_2, and WS_2, in explaining source loyalty as measured by SL_1, SL_2, and SL_3, and CS_4, A_3, DLV_2 and P_3 as the major explanatory variables of SL_4.

Apart from the customary problem of causality inference in a regression analysis, the findings are subject to a number of limitations due to the nature of the data. First, there was some heteroscedasticity and multicollinearity in the data, so that the statistical significance of

Table 1
REGRESSION STANDARDIZED COEFFICIENTS, t, F, AND R^2 VALUES FOR SL_1

Independent variables[a]		Number of purchases from favorite source as percentage of total number of purchases from all sources (SL_1)	
		Best model	Best reduced model
Price:	P_1	−0.0215	—
		(−0.447)	
	P_2	−0.2069	−0.3154
		(−2.971)	(−3.078)
Attitude:	A_1	−0.0068	—
		(−0.125)	
	A_2	0.1058	0.1910
		(2.038)	(3.734)
Organizational:	DLV_1	−0.2146	−0.2235
		(−2.378)	(−2.681)
	CS_1	0.2626	0.3429
		(3.505)	(4.535)
	CS_2	−0.1582	—
		(−1.909)	
	ORG_1	0.1145	0.2036
		(2.208)	(3.815)
	ORG_2	0.0074	—
		(0.170)	
Work simplification:	WS_1	0.0399	—
		(0.947)	
	WS_2	0.1162	0.1310
		(2.504)	(2.593)
	R^2	.9412	.9409
	F	48.039	70.269

[a] Definitions are summarized in the Appendix.

Table 2
REGRESSION STANDARDIZED COEFFICIENTS, t, F, AND R^2 VALUES FOR SL_4

Explanatory variables[a]		The relationship between source decision at time $t-1$ and time t (SL_4)	
		Best model	Best reduced model
Price:	P_3	−0.1165	0.1210
		(1.500)	(1.509)
Attitude:	A_3	−0.2041	−0.2154
		(−2.609)	(−2.640)
	A_4	0.0285	—
		(0.044)	
Organizational:	DLV_2	0.1955	0.1899
		(2.528)	(2.293)
	CS_3	−0.2892	—
		(−3.708)	
	CS_4	−0.4290	−0.5300
		(−5.553)	(−6.486)
	ORG_1	0.0122	—
		(−0.163)	
	ORG_3	0.0628	—
		(0.830)	
Work simplification:	WS_3	0.1144	—
		(1.544)	
	R^2	.7171	.7295
	F	13.553	21.327

[a] Definitions are summarized in the Appendix.

some of the regression coefficients may therefore have been overstated. Second, a number of variables expected to influence source loyalty, such as complaints about the buyer's performance, promotion activity, and persuasiveness of certain salesmen, were not included in the model. Their effects will therefore be distributed among the other variables and result in some spurious association between them and source loyalty. Finally, the data related only to components purchased by a highly advanced electronics firm, within a price range of $.07 to $117.00. Hence the findings, while believed representative for this type of firm and components, may not apply to other types of components, other types of firms, or components outside this price range.

The discriminant analysis [9] was intended to test the ability of the four sets of variables to discriminate between cases of perfect source loyalty $(SL = 1)$ and some other degree of source loyalty $(SL < 1)$ and between $SL > .5$ and $SL \geq .5$.[2] In both cases the variables were

[2] The dividing line between loyal (but not $SL = 1$) and nonloyal is arbitrary. There is no theoretical justification for classifying these cases, and as loyalty is a matter of degree, it was decided that if 50% or more of all purchases were made from one source, these sources would be classified as having a high degree of loyalty. On the other hand, if less than 50% of all purchases were bought from any one source, this product was said to have a small degree of loyalty (a quasi-nonloyalty). Further study in this direction of determining an operationally significant boundary line between high and low source loyalty is required.

able to discriminate effectively, although less effectively between $SL > .5$ and $SL \leq .5$ than between $SL = 1$ and $SL < 1$.

The discriminant function for $SL = 1$ and $SL < 1$ had a D^2 of 10.746 with an F-value of 29.781, implying a high degree of statistical significance. The function also exhibited a high predictive power, since it classified approximately 85% of the cases into the correct loyalty group. An examination of the ability of each individual set of variables to discriminate between $SL = 1$ and $SL < 1$ showed a clear superiority of the organizational variables over the others. Their discriminatory power was, however, lower than that of all four sets of variables taken together.

The D^2 of the discriminant function for $SL > .5$ and $SL \leq .5$ indicates that while the four sets of variables had some ability to discriminate between the two groups, it was less than in the case of perfect source loyalty. Similarly the ability of separate sets of variables to discriminate was smaller. In this case the attitude variables had a slightly higher discriminatory power than the organization or work simplification variables.

Thus it may be concluded that the four sets of variables taken together can discriminate effectively between $SL = 1$ and $SL < 1$ and somewhat less effectively between $SL > .5$ and $SL \leq .5$.

The interpretation of the results of the discriminant analysis should take into account, however, the limitations due to the nature of the data used and the relatively small sample size.

CONCLUSIONS

The preceding analysis provided substantial evidence of the existence of source loyalty in the purchase of industrial components by an advanced electronics firm. Furthermore, it indicated that the four sets of variables, suggested in the industrial source loyalty model, are important determinants of source loyalty, explaining on the average about 80% of the variance in source loyalty at a high level of statistical significance. While the variables included in the model are by no means the only ones which may affect industrial source loyalty, and while no one set of variables can be considered as the only or major determinant of source loyalty, the organizational variables were the single most significant set in both the regression and discriminant analyses.

Further research is needed to validate the results of this study. It does, nonetheless, suggest a number of managerial and research implications. The managerial implications, which should be viewed more as hypotheses for further research than as direct guidelines for action, are:

1. In designing the marketing strategies aimed at buyers of industrial components, one should take explicitly into account the organizational characteristics of the buying firm. In the specific firm studied,

the effect of the organizational setting was through the pressure for cost savings and the dollar value of the order, although these variables might not be important in other organizations. One should assess the ways in which the organization affects the buying process.

2. Establishing only the statistical association between a number of variables and source loyalty provides no conclusions as to the specific causes of changes in sources of supply (lack of source loyalty). It may be inferred, however, that a change in a source is less likely to occur (high degree of source loyalty is strongly probable) when some or all of the following conditions are met:
   a. The price of a given source at time t is lower than it was at $t - 1$. The buyer achieves his desired cost savings without engaging in a search for alternative ways to save. Hence he has no apparent motive to be disloyal to the given source.
   b. The dollar value of the order is small. No significant cost savings are expected, and hence the buyer would tend to prefer not to change the source, since that would involve costs which are not likely to be offset by the expected savings.
   c. The past cost savings of the given division are high (above their long-run average savings in relation to other divisions), reducing the current pressure for cost savings. Hence there is less motivation to engage in a search for cost savings that might lead to a change in source.
   d. The specific brand is recommended by the user. In most cases the user specifies either no specific brand or a number of possible brands. In those few cases in which he specifies a particular brand, the buyer tends to accept his judgment and remain loyal to this source.

In addition to these substantive conclusions, the study suggests a number of important implications for further research in industrial marketing:

1. The industrial buying process can be studied. Even complex variables such as the organizational effect can be studied and quantified.
2. The data for studies of industrial buying behavior can be generated quite easily both from the people involved (buyers, users, purchasing managers, and salesmen) and from records of the buying firm. The latter source is of great importance and simplifies, to some extent, studies of industrial buying behavior.
3. Among the data collection methods the protocol technique [1] has been most fruitful in providing insights into the organizational buying process. In this method the relevant organizational members who have something to do with purchase were asked to think aloud [12].
4. Quantitative techniques such as multiple regression and discriminant analyses can be utilized in the study of industrial buying behavior. There is no need to limit the study of industrial buying behavior to descriptive studies which avoid the use of multivariate statistical techniques.

In short, whereas the study of industrial buying behavior has lagged behind that of consumer behavior in both the number of studies and the research methods employed, the present study demonstrates the possibility of conducting a quantitative rigorous study of industrial buying behavior. It is thus hoped that this modest start will encourage further studies of industrial buying behavior.

APPENDIX

DEPENDENT AND INDEPENDENT VARIABLES INCLUDED IN THE MODEL

I. *The Dependent Variables*

SL_1 = Number of purchases from favorite source as percentage of total number of purchases from all sources.
SL_2 = Number of purchases from the two most favorite sources as a percentage of the total number of purchases from all sources.
SL_3 = Number of source shifts as a percentage of the total number of purchases.
SL_4 = The relation between source decision at times $t - 1$ and t.

II. *The Independent Variables*

A. *For Regression Equations with SL_1, SL_2, and SL_3*

Variables	Definition	Direction of hypothesized relationship with source loyalty
P_1 = Price of favorite source relative to others.	$$\frac{\dfrac{P_F}{AP_t} + \dfrac{P_F}{AP_{t-1}} + \cdots + \dfrac{P_F}{AP_{t-n}}}{n + 1}$$ where: PF = Price of favorite source AP = Average price of all other relevant sources (excluding F at trial t).	Minus
P_2 = Price at time t relative to previous price.	$$\frac{\dfrac{p_t}{p_{t-1}} + \dfrac{p_{t-1}}{p_{t-2}} + \cdots + \dfrac{p_{t-n}}{p_{t-n-1}}}{n + 1}$$	Minus
A_1 = Attitude toward a given source relative to the ideal source (i.e., the buyer's dissatisfaction gap).	$$\sum^{k} (aW_I - aW_F)$$ where: a = Buyer's attitude toward a given source k = Number of attributes of the buyer's attitude W = Weight of each attribute—its relative importance for the buying decision I = Ideal source F = Favorite source.	Minus
A_2 = Attitude toward a given source relative to other sources (i.e., buyer's relative dissatisfaction gap).	$$\frac{\sum^{k} (aW_I - aW_F)}{\sum^{k} (aW_I - aW_{SF})}$$ where: SF = The second favorite source.	Plus
DLV_1 = Dollar value of an order.	$$\begin{bmatrix} PQ_t \geq 100 \to 1 \\ PQ_t < 100 \to 0 \end{bmatrix} + \begin{bmatrix} PQ_{t-1} \geq 100 \to 1 \\ PQ_{t-1} < 100 \to 0 \end{bmatrix} + \cdots$$ $$\cdots + \begin{bmatrix} PQ_{t-n} \geq 100 \to 1 \\ PQ_{t-n} < 100 \to 0 \end{bmatrix}$$ where: P = Price per unit Q = Quantity ordered 100 = Value of order in dollars, e.g., \$100.	Minus

Variables	Definition	Direction of hypothesized relationship with source loyalty
CS_1 = Divisional cost savings relative to cost savings of other divisions.	$$\cfrac{\cfrac{DIVCS_{t\,1-1w}}{TCSO_{t\,1-1w}}\left\lvert\cfrac{AVDIVCS_t}{AVTCSO_t}\right. + \cdots + \cfrac{DIVCS_{tn-1w}}{TCSO_{tn-1w}}\left\lvert\cfrac{AVDIVCS_t}{AVTCSO_t}\right.}{n}$$ where: $DIVCS_{t\,1-1w}$ = Divisional cost savings at the week prior to the given trial t $TCSO_{t\,1-1w}$ = Total cost savings of all other divisions $AVDIVCS_t$ = Average weekly divisional cost savings for the whole period $AVTCSO_t$ = Average weekly total cost savings of all other divisions for the whole period $\dfrac{AVDIVCS_t}{AVTCSO_t}$ = Surrogate for a standard acceptable performance of the division.	Plus
CS_2 = Cumulative divisional cost savings relative to cumulative cost savings of all other divisions.	$$\begin{aligned}&\cfrac{DICVCS_{t\Delta1-2w}}{CCSO_{t\Delta1-2w}} - \cfrac{CDIVCS_{t\Delta1-w} \le 0 \to 1}{CCSO_{t\Delta1-1w} > 0 \to 0}\\[2mm]&\quad + \cdots + \cfrac{CDIVCS_{t\Delta K-2w}}{CCSO_{t\Delta K-2w}} - \cfrac{CDIVCS_{\wedge\wedge-1w}\ 0 \to 1}{CCSO_{t\Delta w-1w}\ 0 \to 0}\end{aligned}$$ where: $CDIVCS$ = Cumulative divisional cost savings $CCSO$ = Cumulative cost savings of all other divisions Δ = Change in source.	Plus
ORG_1 = Recommendation of brand by user.	Measured as a dummy variable that takes the value of one—if a specific brand is recommended, zero—if no brand or more than one brand is recommended.	Plus
ORG_2 = Identity of buyer.	Number of times a buyer changed when a source was changed.	Minus
WS_1 = Movement to a geographically closer source.	WS_1 was defined as the following dummy variables that equal one—if the first change in source was to a source that is geographically closer to the buyer, zero—if it was not.	Plus
WS_2 = Previous purchase history.	$\dfrac{\text{Average length of source run for FS}}{\text{Average run length of all other sources}}$ where: FS = Favorite source. Length of source run = number of consecutive purchases from the same source. For example, in the sequence $XXXYY$ there are two runs—a run with 3 purchases (length 3) of Source X and 2 purchases (length 2) of Source Y.	Plus

B. *For Regression Equation With SL_4*

P_3 = Price of preferred source relative to the average price of all other feasible sources at time $t - 1$.	$\dfrac{P_{S_{t-1}}}{AP_{t-1}}$	Minus
A_3 = Relative dissatisfaction gap.	$\dfrac{\sum\limits^{k} aw_F}{k} \bigg/ \dfrac{\sum\limits^{k} aw_{SF}}{k}$	Minus
A_4 = Relative dissatisfaction gap.	$\dfrac{\sum\limits^{k} aw_{St}}{k} \bigg/ \dfrac{\sum\limits^{k} aw_{St-1}}{k}$	Plus

Variables	Definition	Direction of hypothesized relationship with source loyalty
DLV_2 = Dollar size of order.	DLV_2 is a dummy variable that takes the value of one when $PQ_t \geq 100$ and zero when $PQ_t < 100$ where: \$100 is assumed to be the critical value above which change in source is more likely to occur.	Plus
CS_3 = Divisional cost savings relative to cost savings of all other divisions in same time period.	$$\dfrac{DIVCS_{t-1w}}{TCS_{t-1W}}$$	Plus
CS_4 = Cumulative divisional cost savings relative to cumulative cost savings of all other divisions, based on standard of divisional cost savings.	$$\dfrac{CDIVCS_{t-1W}}{CCSO_{t-1W}} \Big/ \dfrac{ACDIVCS_t}{ACCSO_t}$$	Plus
WS_3 = Length of source run.	This equals the number of source runs greater than one, when a run is defined as a consecutive sequence of purchases from the same source.	Plus
ORG_3 = Identity of buyer.	This was defined as a dummy variable that takes the value of one if a buyer changed when a source was last changed, and a value of zero if not.	Plus

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