

Internet Supply Chain Management: Identifying Success Factors

Track: Electronic Commerce Applications

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Abstract

This study examines the ways in which companies utilize the Internet to streamline their purchasing process. A survey of 416 customers of a major internet retailer of commodity office supplies reveals important relationships between website design, employee work environments, internet strategy and purchasing performance. Our sample of companies consists of firms that have ordered office supplies at least once using the internet. Our data indicate that companies do realize performance benefits from utilizing the internet as a purchasing tool. Furthermore, the data suggest factors that facilitate purchasing process improvements. These factors can be utilized by both buying and selling companies to improve their proprietary processes to maximize the benefits of e-commerce as a purchasing tool.

Introduction

This study will examine the ways in which purchasing agents employ the Internet to reduce cost, improve quality and speed up deliveries. Numerous advocates have prophesized the benefits of Internet purchasing for both business-to-consumer applications (i.e. Etoys or Amazon) and business-to-business applications. In recent months, the biggest area of discussion and growth for Internet business is these B2B applications. Various estimates for the exchange of goods and services online range from \$2.7 trillion (Segal, 2000) to \$7.29 trillion in 2004 (Orenstein, 2000). E-hubs, or stand-alone electronic business-to-business exchanges are predicted to streamline procurement in their respective markets (Kaplan and Sawhney, 2000). Leading companies such as Ford, GM and DaimlerChrysler (automobiles); Sears and Carrefour (consumer goods) and Chevron and Wal-Mart's McClane division (convenience-store distribution) have all announced major initiatives within the last two months (Gurley, 2000). Clearly, the B2B electronic marketplace is booming, the main questions are (1) how much will this sector grow and change the way corporations do business and (2) what are the operational processes that most effectively utilize this technology?

Research Plan

The popular press has certainly jumped on the internet bandwagon, with hundreds or even thousands of stories and articles published each month describing the wonders of e-commerce, the phenomenal growth in sales and the numerous corporate ventures formed to exploit this technology. During the first half of 2000, hardly a day passed without the announcement of some new B2B venture. In a time of such phenomenal change the focus tends to be on the large picture. Many details of how a new technology should be or is employed tend to be unknown or ignored. Yet, as the technology matures and stabilizes one of the primary factors that separates winners from losers is the way in which the technology is implemented and operated on a daily basis. This study examines the ways in which companies utilize the Internet to streamline their purchasing process.

Rick Adams, Vice President of Logistics Grainger, a major clicks and mortar MRO supplier, recently estimated that approximately 40% of the cost of purchasing indirect materials is the cost of processing orders. Grainger estimates that online purchasing has the potential to reduce this cost by 50%, thus reducing the overall cost of indirect materials by 20% (Adams, 2000). It is this "potential" cost saving that we seek to verify and measure. We will examine the actual processes used by companies purchasing online from an established and well-known company - Office Depot.

Office Depot is a leading retailer of office supplies, with 825 office supply super stores in 46 states and \$5.7 billion in sales for 1999 (Office Depot, 2000). More importantly, for the purposes of this study, Office Depot is also a leader in Internet sales with both a relatively lengthy (for Internet companies) and successful track record. They have been selling online for four years and have annual internet sales of \$349.7 million for 1999, on which they actually make a profit unlike the vast majority of internet only startups (Office Depot, 2000). Office Depot is widely considered to be the leader in the online office supplies market (Gulati and Garino, 2000; Troy, 1999; Warner, Roth, Schonfeld & Gunther, 1999). Their goal is to move 30% of the orders from its business services division to the net.

The main goal of this research is to examine the ways in which e-commerce can streamline the purchasing operations of companies that buy supplies online. We seek to identify areas where online commerce is quicker, more accurate, less time consuming or provides better quality service. We also examine techniques or factors that influence the success of online commerce, such as strategic goals, level of technology knowledge and internet site design. The objective is to profile the benefits companies obtain by conducting purchasing over the internet and to identify some of the factors that influence the success or failure of these activities.

Research Questions

This study seeks to explain the factors that lead to performance improvement when employing the internet as a purchasing tool/technology. Our research questions are organized according to our general theoretical model, as shown in Figure 1. This model predicts that there are two broad groups of factors that predict performance improvements resulting from internet applications. Each of these groups is examined in more detail below.

INSERT FIGURE 1 ABOUT HERE

Purchasing Company Factors

Figure 1 outlines our belief that there are two groups of factors within the purchasing company that affect both its intention to adopt the internet as a purchasing tool and its relative performance with these tools. The first of these factors, strategy, is based on a long stream of research in operations strategy that suggests that companies pursue different competitive priorities.

The second set of purchasing company factors pertains to the environment employees work in. Specific environmental factors that are believed to facilitate new technologies include technology champions, training, a high degree of comfort with computers and good technical support. Research on advanced manufacturing technologies has indicated that having a champion who strongly promotes a particular technology may foster similar support by others and create an environment more conducive to success (Chen & Small, 1996; Hottenstein, Casey & Dunn, 1997; Zhou & Co, 1997). More details regarding purchasing company factors are available in the complete paper, available from the authors.

Internet Factors

Figure 1 shows two groupings of internet factors thought to affect performance when employing the internet for purchasing. Internet specific factors are underlying components that assess the respondent's general perceptions of internet purchasing. These factors include perceived ease of use, perceived usefulness and attitude, all of which our adopted from Davis & Bagozzi and Warshaw's (1989) Technology Acceptance Model. We also seek to measure specific aspects of Office Depot's website. The belief here is that the particular website design is an important factor in predicting both usage and success (Meister, Patel and Fenner, 2000). Specific features of a website that we believe affect usage include the ease of use, the accuracy of information on the site and the reliability of transactions.

3.3. Research Questions – Performance

We examine two types of performance – transactional and system. Transactional performance measures the ease and accuracy with which day-to-day purchasing transactions are conducted by employing the internet in place of traditional purchasing methods (phone, fax or mail). System performance assesses a more macro level, system wide performance with respect to the cost of purchasing activities and the accuracy/availability of billing and supplies. Measuring performance at two different levels is a common approach in operations management research, since operations typically has a fairly direct effect on daily transactions (i.e. transactional performance) and a positive, but more indirect effect on business level or system wide performance (Boyer et al., 1997; Miller and Roth, 1994). We therefore seek to test the effects of the purchasing company and internet factors described above on two sets of performance measures – transactional and system wide. The following questions will be addressed:

- Q1A: Specific strategic for utilizing internet purchasing are positively correlated with improved transactional performance.
- Q1B: A working environment that supports computer and internet usage is conducive to improved transactional performance.
- Q1C: Internet specific factors such as perceived ease of use, perceived usefulness and attitude are correlated with improved transactional performance.
- Q1D: Site specific factors particular to an individual website are associated with improved transactional performance.

Research Methodology

Data Collection

Data was collected from customers of Office Depot that had placed at least one order using Office Depot's website within the prior year. Our initial database of contacts consisted of approximately 65,000 customers from Office Depot's Business Services Division. Since they had fairly extensive internally collected data regarding their larger customers, Office Depot asked us to focus on smaller companies of 100 or fewer employees. The resulting initial database represented a very high quality sample since all of the companies had current mailing information and a fairly substantial amount of descriptive information, including the total dollar volume of business done with Office Depot over the past year, the total dollar volume of internet orders, the number of orders and the number of orders placed over the internet. This information was used to design a stratified sample of customer contacts. Our first step was to compute an internet usage variable (percent internet orders) by dividing the number of internet orders over the past year by the number of all

orders per year. We then randomly sampled to select firms in several categories. Table 1 shows the categories selected and their representative proportions. Table 1 outlines the categories and the criteria used to select companies.

INSERT TABLE 1 ABOUT HERE

The full survey was conducted using two methods. First, approximately 60% of the sample was contacted with a traditional printed survey (4 pages in length), accompanied by a cover letter explaining that we would provide participants with a survey summary and a \$15 rebate bonus. The cover letter also explained that we would keep all results anonymous and only report aggregate findings. Office Depot also provided a letter stating their interest in the study and explaining that the authors were acting as independent, non-biased third party researchers. The second data collection method involved using a computer survey program named Sensus. This program allows a written survey instrument to be coded on a floppy disk using fairly simple programming rules. The advantages of a computer-administered survey include the ability to add more detailed descriptions to questions, tailor the questions more precisely (for example we used 7 point Likert scales that allowed respondents to answer in half point increments), add pictures and color formatting, and, most importantly, Sensus records the data directly on the disk. The data can then be read directly into any database program such as Excel or SPSS.

The final tally consisted of 416 usable responses out of 1,045 total surveys, representing a 39.8% response rate. The response rates for the printed ($261/631 = 41.4\%$) and computer version of the survey ($155/414 = 37.4\%$) were almost identical. The overall response rate is higher than that seen in similar studies (Boyer, Ward, Leong & Krajewski, 1997; Duray, Ward, Milligan & Berry, 2000; Kathuria, 2000). Table 2 provides an overview of the respondents.

INSERT TABLE 2 ABOUT HERE

Scale

This section describes the scales used to measure the various components of Figure 1. We used existing scales where possible, but also tried to develop customized scales where appropriate to capture the dynamic and customized nature of the internet. Each of the factors shown in Figure 1 is described below, while Table 4 gives the means, standard deviations and cronbach's alphas (for the entire data sample and separately for the computer/printed versions). The individual items included in each scale are shown in Appendix A. All final scales are formed by computing the mean of the items comprising that scale. NOTE: A complete copy of scales and descriptions of the scales used is available from the study authors.

INSERT TABLE 4 ABOUT HERE

Results

Table 5 shows the correlations between each of the scales described in the previous section. The strategy, environmental, site specific and internet specific scales are used as independent

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variables in stepwise regressions to predict each of our three performance variables. We utilize stepwise regression to select the independent variables that have the greatest impact on each dependent variable because there is a high degree of collinearity and most of the independent variables are significantly correlated to the performance variables.

Research Question 1 – Assessing Transactional Performance

As shown in Table 5, all fifteen of our independent variables (including Strategy, Environmental, Site Specific and Internet Specific factors) are significantly correlated with our measure of transactional performance – INTIMPRV. The highest correlations are for ATTITUDE (0.57), SYSTEM (0.53) and perceived usefulness (PERCUSE = 0.50). As noted above, we want to obtain the strongest predictors of INTIMPRV while accounting for collinearity effects, thus we employ stepwise regression. The stepwise regression is computed by entering all 15 independent variables into the SPSS software with the rule that a variable entering the regression equation must have a p value less than 0.05 and that variables that have a p value > 0.10 after other variables are entered will be removed from the final equation. Table 6 shows the final regression model with beta coefficients and significance values for each variable.

INSERT TABLE 6 ABOUT HERE

The regression model shown in Table 6 predicts INTIMPRV very well, with an $R^2 = 0.45$ and an F value of 57.29 ($p < 0.01$). Overall, the model shown in Figure 1 is a good predictor of transactional performance as measured by INTIMPRV. It is interesting to note that all of the factors shown in Figure 1 are represented: Strategy (GOALS and DELIVERY), Environmental factors (CHAMPION), Site Specific factors (ACCURACY) and Internet Specific (ATTITUDE). Thus, it appears that it is important to pay attention to several areas that affect performance. For example, a company on the buying side can control whether there is a strong champion for using the internet and can control the objectives the company sets. On the selling side, a company such as Office Depot can control the design of their website to make it accurate and can, to some degree, work to modify more general internet factors such as attitude.

Discussion

The explosion of e-commerce over the past five years has been nothing short of phenomenal, both in terms of the speed and the scope of change. There has literally been a stampede of advocates, promoters, visionaries and true believers rushing to jump on the internet bandwagon. However, after an initial period of turmoil and chaos, we are now experiencing a settling out or weaning period in which the wheat is being separated from the chafe, the hype separated from reality and winners culled from the losers. This pattern of tremendous, chaotic change is typical for a revolutionary change in the business world. Yet, the historic pattern is for revolutions in thought to either quietly peter out and fade from memory, or for the revolution to firmly entrench itself in the general populace and undergo a more gradual refinement. At this point, the focal point for research gradually shifts from theory building to theory testing (Glaser and Strauss, 1967). The current study offers a test and refinement of internet purchasing theories that to date have neither been well formulated or tested.

The primary factor in determining e-commerce success/failure over the next five to ten years will be the degree to which this new tools can be seamlessly integrated into the supply chain to

provide streamlined purchasing, operations, and fulfillment. This study offers three fundamental insights and refinements of existing conceptual theories. First, the assessment of three performance measures indicates that internet purchasing generally leads to improvements. The respondents to our survey, all of who had placed orders over the internet, generally believed that the technology lead to improvements in transactional performance (time to place an order, thoroughness of order documentation, reliability of delivery). Furthermore, the respondents also generally believed that internet purchasing facilitated improved system performance, in terms of both reduced costs and improved accuracy. Thus, the data supports the general belief of internet proponents that it can help streamline the supply chain (see Table 4).

The second set of findings addresses the more complex question of how companies should harness the power of the internet. Figure 1 provides a model of two sets of factors believed to influence purchasing performance. These factors were separated into purchasing company factors and internet specific used to predict both transactional and system performance by means of stepwise regression. The results provide strong support for hypotheses 1 and 2 (parts A-D) since almost all of the independent variables shown in Figure 1 had significant, positive correlations with the three measures of performance (see Table 5). Furthermore, the stepwise regressions demonstrate a potent relationship between the various independent variables and performance.

Managers of companies involved with internet initiatives on the sales side can learn some powerful lessons from this data. First, from the perspective of a company seeking to reach out to customers, the data suggest several actions that can be taken to influence the adoption and use of a sales website. A fundamental, yet often neglected step is to make the website simple to use and functional. Both SITEEASE and SYSTEM are highly correlated with all three measures of performance. Individual items that comprise these two constructs include questions relating to system response time, ease of use, ease of navigations, and time to load the site. Actual physical delivery of products is also addressed. Other site specific factors include ACCURACY – which measures the accuracy of web page content and TRANSACT – which measures the ease of conducting specific transactions. Both of these variables also correlate highly with the performance measures. In short, the data offers a compelling message to managers along the lines of the old KISS principle – Keep It Simple Stupid! The beauty of the internet is simplicity – sure it can do amazing things with pictures, sounds and graphics, but when conducting business, particularly with commodity products, lean and mean carries the day. The other compelling message is that companies must also deliver in terms of accurate data and transactions.

E-commerce has blown through the business world like a tsunami, bringing change on a scale unseen since the early days of the twentieth century and the beginnings of mass production. While there has certainly been a huge amount of hype and false promises, the tools and methods underlying e-commerce have now reached a level of maturity where researchers can begin testing and refining previously fuzzy theories. We believe that this study has provided an important first step in measuring performance outcomes and factors that facilitate effective use of internet purchasing. Future research must seek to refine these techniques and apply them to a broader sample of companies. We view the state of e-commerce as being similar to the early generations of Henry Ford's high volume Model-T production line – there have been some impressive gains in efficiency, quality and flexibility, but there are years of refinement ahead. Researchers must seek to analyze and catalog different methods of utilizing the internet in order to gradually expand the base of knowledge.

References: Available with complete copy of paper from authors.

Table 1. Initial Contact Sample

Category	Number of Companies in Initial Database	Number of Companies in Contact Sample	Percentage of Contact Sample	Notes
A	4,238	300	15.0%	<ul style="list-style-type: none"> • Single orders over internet • Multiple Office Depot orders • Small % of internet orders • > \$100 per order
B	32,210	300	15.0%	<ul style="list-style-type: none"> • Single internet orders • No other Office Depot orders
C	2,461	300	15.0%	10-25% internet orders
D	2,211	300	15.0%	25.1 - 50% internet orders
E	3,864	300	15.0%	50.1 - 75% internet orders
F	2,985	250	12.5%	75.1 - 99% internet orders
G	17,438	250	12.5%	<ul style="list-style-type: none"> • 100% internet orders • More than 1 order
TOTAL	65,407	2000	100.0%	

Table 2. Profile of Survey Respondents

	Mean	Standard Deviation	Median
Total Employment	202.9	1103.1	13
Purchasing Employment	3.3	17.4	(97.8% < 10)
Years in Workforce	16.8	10.9	15.0
Years with Current Company	6.0	5.9	4.0
Years in Current Position	4.8	4.8	3.5
Business located in:			
Single Location	276	68.8%	
Multiple Locations	125	31.2%	
Total	401	100.0%	
Education Level			
High School	131	32.7%	
Two Year Degree	102	25.4%	
Four Year Degree	114	28.4%	
Graduate Degree	54	13.5%	
Total	401	100.0%	

Table 4. Descriptive and Reliability Data for Scales

	Mean	Std. Dev.	Cronbach's α		
			All	Print	Computer
STRATEGY					
GOALS	5.72	1.13	0.63	0.63	0.64
ADMIN	5.04	1.37	0.79	0.79	0.81
DELIVERY	5.69	1.28	0.80	0.80	0.80
ENVIRONMENTAL					
COMFORT	5.16	1.24	0.90	0.89	0.92
TECHSUPPORT	4.76	1.95			
CHAMPION	2.70	1.95	0.85*	0.92*	0.74*
Computer Hours per Week	29.96	11.54			
Training Hours per Year	8.42	23.95			
SITE SPECIFIC					
SITEEASE	5.37	1.18	0.89	0.90	0.87
ACCURACY	5.36	1.08	0.87	0.81	0.84
TRANSACT	5.34	1.27	0.65	0.70	0.56
SYSTEM	5.25	1.08	0.87	0.87	0.88
INTERNET SPECIFIC					
PERCUSE	4.93	1.49	0.96	0.96	0.97
PERCEASE	5.36	1.32	0.93	0.94	0.91
ATTITUDE	5.44	1.33	0.89	0.88	0.90
PERFORMANCE					
INTIMPRV	4.57	1.53	0.90	0.91	0.82
COSTPERF	4.14	0.81	0.42*	0.50*	0.29*
PERFACC	4.53	0.88	0.50*	0.47*	0.57*

NOTE: * Represents a scale with only two items. Cronbach's α is not applicable, so these are correlations.

Table 6. Stepwise Regression for INTIMPR

Variable	b	t
Constant	-1.59	-3.86**
ATTITUDE	0.48	9.85**
DELIVERY	0.23	4.14**
CHAMPION	0.11	3.66**
ACCURACY	0.17	2.90**
GOALS	0.17	2.72**
$R^2 = 0.45$		$F = 57.29^{***}$

Notes: n = 363

* p < 0.05

** p < 0.01