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DECISION CRITERIA IN THE ADOPTION OF EDI

Lyne Bouchard
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ABSTRACT

Electronic data interchange, or EDI, has been discussed in literature as a technology that can provide a strategic advantage to its adopters, like other interorganizational information systems. However, its actual rate of adoption is nowhere near the predictions. Authors are now reconsidering their assessment of EDI's advantages and its role in organizations' strategies. However, using works found in critical mass theory, and through results gathered with the survey, case study and computer-supported interviews, this paper shows that organizations are acting strategically when deciding to not adopt EDI. They base their decisions on what their business partners are doing with respect to EDI, and on whether the actual and potential businesses they represent justify the investment required in EDI. The implications of the results for the study of innovation diffusion are discussed.

1. INTRODUCTION

The information systems community has given significant attention to computerized systems that link organizations with their environment. Several authors have argued that these systems can play a key role in an organization's strategy (Ives and Learmonth 1984; Johnston and Lawrence 1988; Johnston and Vitale 1988; Porter and Millar 1985). Electronic data interchange (EDI) represents one type of interorganizational information systems, for the transmission of documents such as purchase orders and invoices between business partners, using computers and standard transaction formats. The Gartner Group estimated in 1989 that one-third of all business documents would be sent using EDI by 1995 (US Analyzer 1989). Phyllis Sokol, a well-known EDI consultant, went even further and predicted that by 1992, 70% of all U.S. companies would be making significant use of EDI: "By every indicator, EDI is taking the business community by storm" (Sokol 1989).

EDI's actual rate of adoption, however, can hardly be described as "stormy." The consulting firm, EDI, Spread the Word! (1992-1993), estimates that 40,000 companies worldwide (about 25,000 in the U.S.), from all business sectors, use EDI. By comparison, there are more than 5 million businesses operating in the U.S.

Why have so few companies decided to use EDI? Blame is either attributed to (1) the technology itself which, according to Benjamin, de Long and Scott Morton (1990), can provide little, if any, competitive advantage for most users, or (2) to the users themselves, particularly business managers who are accused of being opposed to change and ignorant of the potential of EDI (Pastore 1992). Still, large organizations continue to seek strategic advantages from the adoption of EDI. Unfortunately for them, their implementation of EDI requires collaboration from their business partners. Beyond speculation, what do we know of the reasons why these partners have chosen not to answer the EDI call? In terms of the specific research question addressed here, what decision criteria are used when organizations consider whether to adopt EDI? Do organizations see EDI as part of their strategy?

This paper reports the results of a study of retail suppliers' decisions to use EDI, based on works found in innovation diffusion (Rogers 1983) and critical mass (Oliver, Marwell and Teixeira 1985) literatures. Briefly, these results show that market demands and long-term concerns dominate organizations' decisions to adopt EDI, and that for the majority of organizations, the strategic option is to wait until the technology is widespread enough to justify its implementation costs.

The paper is organized as follows. Section 2 presents the relevant aspects of the two theoretical foundations and states the research hypothesis. The research design, based on the survey, case study, and computer-assisted interview methods, is described in section 3, and section 4 presents the results. A discussion of the findings and their implications follows in section 5. Section 6 discusses the limitations of the study, and the last section concludes the paper.
2. THEORETICAL PERSPECTIVES AND HYPOTHESIS

Several perspectives have been used to investigate why innovations are adopted. Two of these perspectives are particularly relevant for this study. First, there is the traditional innovation diffusion literature, as reviewed in Rogers (1983). There, Rogers notes that five characteristics have been found to be the most important in explaining adoption by individuals or other adoption units. The first characteristic, relative advantage, is "the degree to which an innovation is perceived as better than the idea it supersedes." Compatibility is "the degree to which an innovation is being consistent with the existing values, past experiences, and needs of potential adopters." Complexity is "the degree to which an innovation is perceived as difficult to understand and use." Trialability is "the degree to which an innovation may be experimented with on a limited basis." Finally, observability is "the degree to which the results of an innovation are visible to others" (Rogers 1983, 15-16). Innovations that are perceived by receivers as having greater relative advantage, compatibility, trialability, observability, and less complexity generally diffuse more rapidly than other innovations (Kimberly 1981; Rogers 1983).

The second perspective relevant to this study is the one proposed by critical mass theorists, concerned with collective actions and innovations. These are innovations that are collectively provided (Hardin 1982): they require collaboration among potential adopters if any adopter is to receive any benefit. Work related to collective actions and innovations are known in economics under the labels of the "prisoner's dilemma" (Samuelson 1954) and "demand externalities" (Allen 1988; Artle and Averous 1973), and in sociology under the labels of "critical mass theory" (Oliver, Marwell and Teixeira 1985), the "logic of collective action" (Olson 1965), and "threshold models of collective behavior" (Granovetter 1978). The actors of a collective action can either be persons or organizations (Fireman and Gamson 1979). The expression "critical mass theory" is used in this paper to refer to this work. Critical mass theory has been applied in IS to the study of communication media adoption (Gurbaxani 1990; Markus 1987, 1990).

Critical mass theorists argue that actors' decisions to participate in a collective action is based on their perceptions of what the group is doing. Their decisions are influenced by how many others have already participated, how much others have contributed, and/or who has participated (Allen 1988; Artle and Averous 1973; Granovetter 1978; Markus 1987, 1990; Oliver, Marwell and Teixeira 1985; Olson 1965). In contrast to innovation diffusion theorists, researchers concerned with collective innovation argue that attitudes toward innovations, while important, are insufficient to explain behavior. Granovetter, in particular, writes that "it is hazardous to infer individual dispositions from aggregate outcomes or to assume that behavior was directed by ultimately agreed-upon norms" (p. 1420). Two groups with identical attitudes may behave differently due to the dynamics of their particular situation. The difference lies in how individual preferences interact and aggregate, since the decisions to adopt or participate are dependent on what others do.

The two perspectives above attribute different interests to adopters. In the perspective of innovation diffusion theorists, these adopters are "inward" oriented. They are interested mostly in the innovation itself, in how it would fit within the existing system of the innovator. In the critical mass theory perspective, potential adopters are "outward" oriented, interesting in how the system that surrounds the innovator reacts to the innovation. Because of interdependencies, actors' decisions to innovate and the time they choose to innovate are based on a dynamic weighting of what the group is doing. This weighting is dynamic because their decisions occur over time, as actors join in or stop using the innovation, thereby changing the payoff for each possible adopter. For collective innovations, therefore, we have to enlarge the definition of relative advantage as given in Rogers. A collective innovation does not provide advantages, per se, to its adopter: it is in the reciprocation by others that the innovation becomes advantageous. Consequently, then, we can expect that:

"Actors' decisions to participate in a collective innovation are primarily based on what their collectivity is doing, and not on the characteristics of the innovation itself."

In the case of EDI, the relevant collectivity is the business partners with whom a potential adopter could use EDI. Therefore,

"Organizations' decisions to use EDI are primarily based on what their business partners are doing, and not on the characteristics of EDI."

This is the hypothesis tested here. We now turn to the research design.

3. RESEARCH DESIGN

The unit of analysis for the study was the organization, since EDI is adopted by organizations and not individuals. The principal research strategy chosen was the survey method, because of the interest in testing existing theories.
As Tornatzky and Klein (1982) noted, surveys provide a basis for generalizing, allow for replicability, and permit some degree of statistical power. However, case studies were also conducted as a complement to the survey in two selected organizations, to study the influence of the environment on an organization's decision to adopt EDI. Richer descriptions are one of the main strengths of the case study method (Miles and Huberman 1984; Yin 1989). Finally, half of the respondents (randomly selected) were sent a diskette in addition to the questionnaire as a possible substitute for the free space provided at the end of the instrument. The diskette included a file, saved in several word processor formats, asking questions related to topics such as the sources of information on EDI and their trustworthiness, and the effect on suppliers of retailers' and competitors' positions with respect to EDI. Note that the research question investigated and the findings reported here represent a subset of a broader research project (see Bouchard 1992).

This section of the paper presents first the industry and participants selected. The survey instrument is discussed next, followed by a brief description of the two organizations studied.

3.1 Industry and Participants Selection

Suppliers of the retail industry were used to test the hypothesis. The slow economic recovery brought retailers to examine every aspect of the distribution pipeline to find ways to shorten the distribution cycle and to improve profitability. Computer and telecommunications technology, particularly EDI, is seen as a means to improve responsiveness to consumer trends, lower costs, and quicken replenishment. Large retailers have actively promoted EDI among their business partners, sometimes organizing seminars (Achabal and McIntyre 1987; Booker and Fitzgerald 1990; Salmon 1989; Standard and Poor's 1990, 1991a, 1991b, 1992a, 1992b; Zinn et al. 1990). For these reasons, the adoption of EDI by retail suppliers appears highly justified on purely rational grounds. However, their rate of adoption has been far short of the predictions. Therefore, the selection of suppliers of the retail industry was particularly appropriate: these suppliers could belong to any of the twenty manufacturing industries (SIC codes).

Participating organizations were selected from the list of U.S. manufacturers that were members of the Uniform Code Council, Inc. (UCC). The UCC is a not-for-profit organization that manages and administers the Universal Product Code (UPC; commonly called "bar code"), and three major EDI communication standards: VICS EDI (Voluntary Interindustry Communication Standard EDI), used by the general merchandise retail industry and the most popular standard among retailers (Deloitte & Touche 1992); UCS (Uniform Communication Standard), used primarily in the grocery industry; and WINS (Warehouse Information Network Standard), used by public warehouses and their depositor customer. The selection of the individual respondents was based on two criteria. First, respondents had to have been involved in their organization's decision to adopt the innovation (Tornatzky and Klein 1982). Second, respondents had to act as boundary personnel (Aldrich and Herker 1977) and be in a position that enabled them to adopt an organizational perspective, as opposed to a technical one. Therefore, respondents were the functional managers identified as contacts in the UCC EDI membership directory. These were taken from a random sample of 500 manufacturers out of the 969 U.S. manufacturers listed in the directory and using the EDI standards VICS EDI or UCS.

3.2 Survey Instrument

To assess whether adopters of EDI are motivated by the characteristics of the technology or the behavior of the collectivity, respondents were asked to indicate the level of importance of each of thirteen characteristics in their organization's decision to use EDI; answer choices ranged from 1 (not very important) to 7 (very important). The five characteristics found to be more important in explaining adoption rates were used: relative advantage, compatibility, complexity, trialability, and observability (Rogers 1983). The relative advantage of EDI was operationalized using criteria from critical mass theory, that is, how many retailers were or would soon be using EDI, the percentage of manufacturers' transactions soon to be handled with EDI, and the likelihood that manufacturers' business partners were or would soon be using EDI. Complexity was broken into two categories, business and technical complexity, given that EDI can have impacts at the organizational level in addition to being a technology. Because EDI can represent an increased risk if people believe that it is not possible to stop using EDI without major investment, "discontinuation" (Rogers 1983) was also added to the list. Finally, it is often argued that the existence of adequate standards is a requirement for a widespread adoption of the technology; therefore, the characteristic "existence of EDI standards" was added.

Three characteristics were also added: the costs of EDI compared to the alternatives to EDI, business partners' requirements that manufacturers use EDI, and business partners' benefits from manufacturers' use of EDI. Table 1 presents the thirteen characteristics used in the study, in the same order of presentation as in the questionnaire. Each
Table 1. Characteristics Used in the Study

<table>
<thead>
<tr>
<th>Theoretical foundation</th>
<th>Characteristic</th>
</tr>
</thead>
<tbody>
<tr>
<td>From the innovation diffusion perspective:</td>
<td></td>
</tr>
<tr>
<td>• Relative advantage</td>
<td>• Cost of EDI compared to the alterantives to EDI.</td>
</tr>
<tr>
<td>• Compatibility</td>
<td>• Compatibility of EDI with manufacturers’ business and technical operations.</td>
</tr>
<tr>
<td>• Complexity</td>
<td>• EDI’s understandability and usability from a business perspective.</td>
</tr>
<tr>
<td>• Visibility</td>
<td>• EDI’s understandability and usability from a technical perspective.</td>
</tr>
<tr>
<td>• Discontinuation</td>
<td>• Availability of EDI standards.</td>
</tr>
<tr>
<td>Trialability</td>
<td>• Ability to experiment with EDI on a limited basis.</td>
</tr>
<tr>
<td>Observability</td>
<td>• Visibility of EDI’s results.</td>
</tr>
<tr>
<td>Discontinuation</td>
<td>• Ability to stop using EDI without major investment.</td>
</tr>
<tr>
<td>From critical mass theory:</td>
<td></td>
</tr>
<tr>
<td>Relative advantage:</td>
<td></td>
</tr>
<tr>
<td>• How many participated</td>
<td>• Total number of manufacturers’ business partners using or soon to be using EDI.</td>
</tr>
<tr>
<td>• Who participated</td>
<td>• Likelihood of manufacturers’ key business partners using or soon to be using EDI.</td>
</tr>
<tr>
<td>• How much was contributed</td>
<td>• Percentage of manufacturers’ transactions soon to be handled with EDI.</td>
</tr>
<tr>
<td>• Business partners’ requirement that manufacturers use EDI.</td>
<td></td>
</tr>
<tr>
<td>• Business partners’ benefits from manufacturers’ use of EDI.</td>
<td></td>
</tr>
</tbody>
</table>

characteristic corresponded to a single-item in the questionnaire. Special attention was given to the wording of the characteristics in the questionnaire, based on the recommendations of Ajzen and Fishbein (1980; see also, from the IS diffusion literature, Davis, Bagozzi and Warsaw 1989; Moore and Benbasat 1991).

To better explain the results, respondents were asked to indicate their organization’s overall assessment of EDI’s advantages at the time it decided to adopt EDI, using a scale of 1 (not at all advantageous) to 7 (very advantageous). They were also asked their level of agreement with a list of statements representing their organization’s evaluation of EDI at the time it decided to adopt the technology. These statements corresponded to the characteristics listed in Table 1, with the exception that the characteristic “business partners’ requirement that manufacturers use EDI” was not listed, since it does not classify as an advantage of EDI. These questions used a scale of 1 (strongly disagree) to 7 (strongly agree). Additional questions concerned the percentage of organizations’ paperwork accounted for by their largest and four largest business partners, and the percentage of organizations’ transactions performed through EDI. Finally, demographic questions on the organizations and their use of EDI, and on the respondents, completed the survey.

3.3 Procedures for Testing the Hypothesis

As noted above, respondents were asked to assess the relative importance of the innovation’s characteristics versus the group behavior in the decision to adopt EDI. Answers were analyzed using the randomized block design (RBD) ANOVA procedure and Tukey’s honestly significant difference (HSD) post-hoc comparison test (Kirk 1982). The RBD ANOVA procedure is used to isolate or partition out variations due to differences between subjects or
respondents, differences that inflate the error variance and
decrease the ability to find a treatment effect. Randomized
block designs share with other ANOVA procedures the use
of the F-test, which is quite robust against deviations from
normality and homogeneity of variance when the number of
subjects within each cell is equal. Tukey’s honestly signifi-
cant difference (HSD) test was used to evaluate all pairwise
comparisons among the means of the treatment levels and
find which characteristics were perceived as significantly
more important than the others.

In the present study, the levels of treatment corresponded to
the thirteen characteristics, and the blocks corresponded to
the subjects. The dependent variable (or each cell in the
matrix) was the perceived importance of the characteristic
in the organization’s decision. For the hypothesis to be
supported, results of the pairwise comparison tests had to
indicate that the characteristics taken from critical mass
theory had received scores significantly higher than those
associated with the characteristics of EDI.

3.4 Instrument Validation and Administration

The questionnaire was pre-tested among information sys-
tems colleagues at UCLA, the EDI director of an interna-
tional department store based in the United States, the EDI
directors of two retail suppliers, and an EDI consultant.
Content validity (see Kerlinger 1983) is claimed on theore-
tical grounds, given that the questions and answer choices
are drawn from a long, and proven, tradition of research,
and on practical grounds, given the pre-test. Additionally,
this research represents the test of two rival perspectives
(innovation diffusion versus critical mass), which also helps
to improve the credibility of the results by providing
alternative explanations (Lee 1989; Yin 1989).

A total of 500 questionnaires were mailed in a package also
containing a personalized letter from the researcher, the
computer disk (for half of the sample), and a pre-addressed,
postage-paid return envelope. Respondents and their
organization were promised confidentiality in the letter.
Two weeks after the mailing, a follow-up post-card was
sent to all respondents, thanking them for returning the
questionnaire (and disk, if applicable) if they had already
done so, or asking them to do so otherwise. These proce-
dures correspond to recommendations in Dillman (1978).

3.5 Case Studies

Two case studies were also conducted as part of this
research, to investigate in further depth the role, impor-
tance and relevance of the external environment of suppliers in
their development of attitudes toward, and their adoption of,
EDI. The case study method leads to richer descriptions
and explanations of phenomena (Miles and Huberman
1984; Yin 1989). The two organizations selected had
received notices from some of their business partners
mandating their adoption of EDI. Therefore, they represent
the majority of organizations faced with the decision to
adopt EDI. The first organization was selected for its
refusal to adopt EDI, even if this meant losing business
partners. This supplier, MClothing (a pseudonym), is a
small business that sells children’s clothing. The second
case study, MJewelry (a pseudonym), represents an organi-
zation in the process of implementing EDI with its first
EDI business partner. This family-run organization designs,
manufactures and sells jewelry. All face-to-face and
telephone conversations were recorded, and the inter-
viewees received a copy of the transcript for verification.
Transcripts were analyzed using techniques discussed in
Miles and Huberman. A complete discussion of the case
study results appears in Bouchard and Markus (1993).

4. RESEARCH RESULTS

4.1 Response Rates and Participating Organizations

A total of 175 questionnaires were returned, for a response
rate of 35%. One questionnaire was returned uncompleted,
and two came from organizations that had decided not to
use EDI (and, therefore, completed the demographic section
only). This left 171 questionnaires for analysis. Respon-
dents returned 46 diskettes; only ten were actually com-
pleted.

Sixteen of the twenty possible manufacturing industries
(SIC codes) were represented in the sample. However,
45% of the respondents were primarily involved in the
Food and kindred products industry (SIC 20), or the Ap-
parel and other textile products industry (SIC 22). In terms
of annual sales volume, 47% of the sample had annual
sales of less than $100 million, while 13.5% sold more than
$1 billion of products. About half of the organizations had
less than 250 employees, while a third had more than 100
employees. Of the organizations responding, 60% had
between two and nine locations.

Table 2 presents the percentage of the participating organi-
zations’ paperwork accounted for by their largest and four
largest business partners, notwithstanding their use of EDI.
In general, the largest business partner accounted for less
than 20% of the paperwork, while the four largest business
partners accounted for 40% or less of the paperwork for
64% of the organizations. These results contradict the
popular belief that organizations’ largest business partners
also represent their biggest source of paperwork.
Table 2. Percentage of Paperwork Accounted for by Business Partners

<table>
<thead>
<tr>
<th>Percentage of Paperwork</th>
<th>Largest Business Partner</th>
<th>Four Largest Business Partners</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Frequency</td>
<td>%</td>
</tr>
<tr>
<td>0-20%</td>
<td>115</td>
<td>70.1</td>
</tr>
<tr>
<td>21-40%</td>
<td>32</td>
<td>19.5</td>
</tr>
<tr>
<td>41-60%</td>
<td>9</td>
<td>5.5</td>
</tr>
<tr>
<td>61-80%</td>
<td>7</td>
<td>4.3</td>
</tr>
<tr>
<td>81-100%</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Total</td>
<td>164</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 3. Percentage of Transactions Performed with EDI

<table>
<thead>
<tr>
<th>Transaction</th>
<th>Percentage of organization's transactions performed with EDI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>Freq</td>
</tr>
<tr>
<td>Purchase orders</td>
<td>12</td>
</tr>
<tr>
<td>Purchase order acknowledgments</td>
<td>70</td>
</tr>
<tr>
<td>Ship notices</td>
<td>109</td>
</tr>
<tr>
<td>Invoices</td>
<td>41</td>
</tr>
<tr>
<td>Payments</td>
<td>160</td>
</tr>
<tr>
<td>Sales information</td>
<td>105</td>
</tr>
<tr>
<td>Other</td>
<td>143</td>
</tr>
</tbody>
</table>

Most of the participating organizations decided to use EDI after 1986. Of the organizations, 80% began to use EDI after one of their business partners required them to do so. A total of 81% of the organizations have linked their EDI transactions electronically with other applications. Table 3 presents the percentage of organizations’ transactions performed through EDI. For example, 22.8% of the organizations used EDI to send or receive between 21% and 40% of their purchase orders. Purchase orders represent the most frequently exchanged document, while payments represent the least used transaction.

Finally, 87% of the respondents had been involved directly in the final decision to use EDI or in the final decision on technical or business specifications. Most of them (72%) were EDI directors or high level managers.

4.2 Descriptive Results

Table 4 presents the importance of each characteristic in the decision to use EDI. Characteristics related to group behavior (the bottom part of the table) were considered, on average, as more important than the intrinsic characteristics of EDI. The level of agreement in respondents’ evaluations was also higher, as indicated by the smaller standard deviations.

Table 5 shows the means and standard deviations for respondents’ overall and detailed assessments of the advantages of EDI at the time their organizations decided to use EDI. Results indicate that organizations, on average, were seeing EDI as presenting some positive advantage overall. However, among the intrinsic characteristics of EDI, only
Table 4. Importance of Each Characteristic in the Decision to Use EDI

<table>
<thead>
<tr>
<th>EDI Characteristic</th>
<th>N</th>
<th>μ</th>
<th>σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of EDI</td>
<td>171</td>
<td>3.99</td>
<td>1.88</td>
</tr>
<tr>
<td>Compatibility</td>
<td>171</td>
<td>4.38</td>
<td>1.76</td>
</tr>
<tr>
<td>Complexity - business perspective</td>
<td>170</td>
<td>4.34</td>
<td>1.69</td>
</tr>
<tr>
<td>Complexity - technical perspective</td>
<td>171</td>
<td>4.14</td>
<td>1.68</td>
</tr>
<tr>
<td>Adequate EDI standards</td>
<td>171</td>
<td>4.52</td>
<td>1.71</td>
</tr>
<tr>
<td>Trialability</td>
<td>171</td>
<td>3.85</td>
<td>1.65</td>
</tr>
<tr>
<td>Observability of results</td>
<td>171</td>
<td>4.39</td>
<td>1.67</td>
</tr>
<tr>
<td>Discontinuation of EDI use</td>
<td>164</td>
<td>2.99</td>
<td>1.57</td>
</tr>
<tr>
<td>Majority of business partners on EDI</td>
<td>169</td>
<td>5.38</td>
<td>1.53</td>
</tr>
<tr>
<td>Important business partners on EDI</td>
<td>170</td>
<td>6.19</td>
<td>0.99</td>
</tr>
<tr>
<td>Large percentage of transactions on EDI</td>
<td>171</td>
<td>5.80</td>
<td>1.49</td>
</tr>
<tr>
<td>Business partners’ requirement to use EDI</td>
<td>171</td>
<td>6.33</td>
<td>1.18</td>
</tr>
<tr>
<td>Use of EDI beneficial to business partners</td>
<td>171</td>
<td>5.35</td>
<td>1.47</td>
</tr>
</tbody>
</table>

Table 5. Evaluations of EDI’s Advantages at the Time of the Decision

<table>
<thead>
<tr>
<th>EDI Characteristic</th>
<th>N</th>
<th>μ</th>
<th>σ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall assessment</td>
<td>171</td>
<td>4.71</td>
<td>1.72</td>
</tr>
<tr>
<td>Cost of EDI</td>
<td>170</td>
<td>4.11</td>
<td>1.78</td>
</tr>
<tr>
<td>Compatibility</td>
<td>171</td>
<td>3.87</td>
<td>1.71</td>
</tr>
<tr>
<td>Complexity - business perspective</td>
<td>171</td>
<td>3.81</td>
<td>1.55</td>
</tr>
<tr>
<td>Complexity - technical perspective</td>
<td>171</td>
<td>3.66</td>
<td>1.61</td>
</tr>
<tr>
<td>Adequate EDI standards</td>
<td>170</td>
<td>3.92</td>
<td>1.68</td>
</tr>
<tr>
<td>Trialability</td>
<td>171</td>
<td>3.58</td>
<td>1.69</td>
</tr>
<tr>
<td>Observability of results</td>
<td>170</td>
<td>3.65</td>
<td>1.58</td>
</tr>
<tr>
<td>Discontinuation of EDI use</td>
<td>159</td>
<td>3.17</td>
<td>1.60</td>
</tr>
<tr>
<td>Majority of business partners on EDI</td>
<td>169</td>
<td>4.66</td>
<td>1.56</td>
</tr>
<tr>
<td>Important business partners on EDI</td>
<td>170</td>
<td>5.75</td>
<td>1.30</td>
</tr>
<tr>
<td>Large percentage of transactions on EDI</td>
<td>170</td>
<td>4.34</td>
<td>1.51</td>
</tr>
<tr>
<td>Use of EDI beneficial to business partners</td>
<td>170</td>
<td>5.54</td>
<td>1.30</td>
</tr>
</tbody>
</table>
Table 6. Importance of Each Characteristic in the Decision to Use EDI
Randomized Block Design ANOVA Procedure

<table>
<thead>
<tr>
<th>Source</th>
<th>Sum of squares</th>
<th>Degrees of freedom</th>
<th>Mean sum of squares</th>
<th>F value</th>
<th>Prob. &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristics</td>
<td>1785.9570</td>
<td>2</td>
<td>148.8297</td>
<td>86.99</td>
<td>0.0001</td>
</tr>
<tr>
<td>Subjects</td>
<td>1992.2419</td>
<td>170</td>
<td>11.7191</td>
<td>6.85</td>
<td>0.0001</td>
</tr>
<tr>
<td>Error</td>
<td>3471.3956</td>
<td>2029</td>
<td>1.7109</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>7250.7464</td>
<td>2211</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 7. Importance of Each Characteristic in the Decisions to Use EDI
Paired Contrasts — Tukey's HSD Test of Significance at .05 Level*

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
<th>(9)</th>
<th>(10)</th>
<th>(11)</th>
<th>(12)</th>
<th>(13)</th>
</tr>
</thead>
<tbody>
<tr>
<td>μ (Table 4)</td>
<td>2.98</td>
<td>3.85</td>
<td>3.99</td>
<td>4.14</td>
<td>4.34</td>
<td>4.38</td>
<td>4.39</td>
<td>4.52</td>
<td>4.80</td>
<td>5.35</td>
<td>5.38</td>
<td>6.19</td>
<td>6.33</td>
</tr>
</tbody>
</table>

| (1) Discontinuation of EDI use | —   | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| (2) Trialability      | Yes | —   | No  | No  | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| (3) Cost of EDI       | Yes | No  | —   | No  | No  | No  | No  | Yes | Yes | Yes | Yes | Yes | Yes |
| (4) Complexity - technical perspective | Yes | No  | No  | —   | No  | No  | No  | No  | Yes | Yes | Yes | Yes | Yes |
| (5) Complexity - business perspective | Yes | Yes | No  | No  | —   | No  | No  | No  | Yes | Yes | Yes | Yes | Yes |
| (6) Compatibility     | Yes | Yes | No  | No  | No  | —   | No  | No  | No  | Yes | Yes | Yes | Yes |
| (7) Observability of results | Yes | Yes | No  | No  | No  | No  | —   | No  | No  | Yes | Yes | Yes | Yes |
| (8) Adequate EDI standards | Yes | Yes | Yes | No  | No  | No  | No  | —   | No  | Yes | Yes | Yes | Yes |
| (9) Percentage of transactions on EDI | Yes | Yes | Yes | Yes | No  | No  | No  | —   | Yes | Yes | Yes | Yes | Yes |
| (10) Use of EDI beneficial to business partners | Yes | Yes | Yes | Yes | Yes | Yes | Yes | —   | No  | Yes | Yes | Yes | Yes |
| (11) Majority of business partners on EDI | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  | —   | Yes | Yes | Yes | Yes |
| (12) Important business partners on EDI | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | —   | No  |
| (13) Business partners' requirements to use EDI | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | No  | —   |

* Yes = the perceived importance of the two characteristics is significantly different.
No = the perceived importance of the two characteristics is not significantly different.
the cost of EDI was judged, on average, to be positive, although only slightly so. Evaluations were more favorable for the characteristics associated with the behavior of the collectivity (the bottom part of the table). The statement “Our most important business partners were or would soon be using EDI” received the highest average score (5.75 out of 7) with the lowest standard deviation (1.30).

4.3 Hypothesis Testing

Table 6 presents the results of the RBD ANOVA test for the importance of the characteristics in the decision to use EDI. The model was significant at the .0001 level and explained 52% (R square) of the variability in perceived importance. This means that the characteristics were not seen as equally important in the decision. Results of all paired contrasts appear in Table 7. These results indicate that:

- the characteristic “ability to stop using EDI without major investment” was not an important one in the decision;

- the next seven characteristics, associated with the innovation diffusion literature, had a similarly moderate importance in the decision to use EDI. Also of moderate importance was one characteristic associated with critical mass theory: a large percentage of EDI transactions soon to be handled with EDI;

- the decision to use EDI was primarily based on two characteristics, associated with critical mass theory: “likelihood of key business partners using or soon to be using EDI” and “business partners’ requirement that you use EDI.” The decision was secondarily based on another set of characteristics, also associated with critical mass theory: “total number of business partners using or soon to be using EDI” and “your business partners’ benefits from your use of EDI.”

These results tend to support the hypothesis. Organizations’ decisions to use EDI is primarily based on what their business partners (their EDI collectivity) are doing.

5. DISCUSSION AND IMPLICATIONS

We now know more about the decision criteria used when organizations consider whether to adopt EDI or not. First, the decision is not based primarily on short term, visible benefits. This is quite understandable when the results shown in Tables 2 and 3 are taken into consideration. Even though organizations use EDI with their largest business partners, little of their paperwork is accounted for by these partners (Table 2) and, consequently, few of their transactions are handled through EDI (Table 3). Therefore, the benefits directly related to the adoption of EDI (e.g., reduced processing and labor costs, timely and accurate information, and improved business efficiency) are not significant enough to justify adoption. Furthermore, the characteristic “percentage of transactions soon to be handled with EDI” did not rate as significantly different from other, more intrinsic characteristics of EDI.

These survey results are reinforced by comments from M.Jewelry’s controller, one of the persons interviewed for the case studies: “I don’t get 400 orders each week from Sears, I don’t get 400 orders from anybody each week. If I did, EDI would have been on after the first couple of months, because it would have paid for itself.” Later, the controller came back to the cost of implementing EDI, which he qualified as being “awfully high with respect to the software.” Is it an expense that small businesses are not used to spending? “It’s not that we’re not used to it. It’s something that we’re not used to putting out for something that does not have immediate response, as far as advantages to us.”

If EDI does not represent tangible benefits for most organizations when they adopt the technology, why do they adopt it? Results from the survey indicate that organizations’ decisions are based on whether their important business partners are using EDI, and on whether these partners mandated adoption. It would be a mistake, however, to conclude that organizations simply react to their environment. If the decision to adopt EDI were solely based on business partners’ requirements, one characteristic would have stood out in importance: “business partners’ requirement that you use EDI.” While it is true that this characteristic was rated, on average, as the most important characteristic, it is not significantly different statistically from the importance of another characteristic of the collectivity: “likelihood of key business partners using or soon to be using EDI.”

The case studies are particularly helpful in understanding the rationale behind organizations’ decisions to use EDI. First, and foremost, organizations do have the choice between adopting EDI or rejecting the technology, just as they have the choice whether to engage or not in business relationships with other organizations. The most important criterion is the importance of the business partner mandating EDI use. At M.Clothing, the decision to reject EDI was made after one of its customers, a leading retailer in the U.S., required the company to start using EDI. How-
ever, this customer was not a major business partner for MClothing, and was not a regular one either. By comparison, its number one account did not request EDI usage, and was not even considering it. At MJewelry, all of the major customers requested EDI use. Because their businesses were important to MJewelry, the decision was made to use EDI: “I looked at it and said, ‘Well, if you’re going to continue to do business with Sears and other major accounts, it will pay for itself’. It’s fine. I can live with that. It’s an additional asset. We’ll depreciate it over time.”

Long term considerations were also highlighted by respondents who returned the diskette completed, and who indicated that it is important for manufacturers to be aware of where their industry is going with respect to Quick Response (not EDI), the equivalent of the Just-In-Time concept in retailing. Quick Response, currently used by very few retailers and some of their suppliers, is a long term priority in the industry. This also explains why, contrary to press coverage and popular belief, organizations that implement EDI seek to integrate it with other business applications, as 80% of the organizations in the sample did. The percentage of transactions handled with EDI by most organizations does not justify the cost of such integration. EDI software, running on a front-end, independent PC, can be purchased for a few hundred dollars, while the cost of integration runs over $10,000, mostly in programming time. This investment, however, will turn out profitable if the volume of transactions handled increases, or if Quick Response is implemented.

In summary, suppliers’ decisions to use EDI are not primarily based on the characteristics of EDI itself. Their decisions depend on whether their major business partners are using EDI. Because of the significance of this relationship, suppliers are willing to implement EDI and amortize the cost over several years. A requirement to use EDI from a business partner forces an organization to make a decision, but does not necessarily imply adoption. Organizations do make EDI a part of their strategy, where strategy means long term positioning. After all, strategic decisions are not made in a vacuum, but by taking into account the environment. Wittreich (1962) noted that not all organizations seek to be industry leaders, but Porter (1983, 1985) reminds us that organizations’ choices impact their own value chain and their position in the overall value system. With respect to EDI, the decision is based on the nature of the actual and desired relationship between business partners, and includes deciding whether to cease or continue this relationship. So far, long term considerations have been neglected in traditional innovation diffusion research, and in analyses of the diffusion of EDI.

6. LIMITATIONS

There were two notable limitations with the study. First, it focused on only one set of industries (retail suppliers), and it remains to be seen if the results apply to other industries as well (e.g., automotive suppliers). Second, there were limitations with the questionnaire used. In particular, the questions used single items and the list of characteristics presented to respondents was not randomized. These last limitations may not be significant, though, as the case studies and computer-supported interviews led to the same findings.

7. CONCLUSION

This paper focused on the decision criteria used by organizations when considering whether to adopt EDI. Results from the survey, case studies and computer-supported interviews all concur: organizations’ decisions are based on what their major business partners are doing, not on the characteristics of EDI. It may be true that the vast majority of organizations would benefit if they would all adopt EDI. However, the decision to adopt a collective innovation is not collectively made, and given that only a minority of organizations actually use EDI, a rapid adoption of the technology remains unwarranted for most organizations.

Therefore, our understanding of organizations’ innovation-adoptions behaviors needs to be improved by taking into account organization-level characteristics, such as those pointed out by critical mass theory, which goes one step further than the traditional innovation diffusion perspective in granting collective actors the faculty of “strategic thinking” and making this a central concept in understanding their behaviors. Otherwise, we have to conclude that organizations are irrational when they decide to adopt a technology which does not represent significantly perceived advantages compared to its costs. Blaming the technology, or the individuals, in order to explain organizations’ decisions to not adopt an innovation negates what is so fundamental in our discipline: the system. This article is a plea for the consideration of system-level characteristics in future diffusion research, whether it be the adoption of word processors, transaction processing applications, client-servers, or interorganizational information systems.

8. ACKNOWLEDGMENTS

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9. REFERENCES


10. ENDNOTE

1. See Tornatzky and Klein (1982) and Zaltman, Duncan and Holbek (1973) for a more detailed review of innovations' characteristics.