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FACTORS INFLUENCING ADOPTION AND DIFFUSION OF BUSINESS-TO-BUSINESS ELECTRONIC COMMERCE MARKETPLACES

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Abstract

Business-to-business (B2B) electronic commerce (EC) marketplaces offer an array of benefits including: cost savings, increased operational efficiency, and improved information. However, achieving these benefits requires a critical mass of buyers and sellers use the marketplace. This dissertation investigates what facilitates B2B EC marketplaces in achieving critical mass and being used. First, we use ethnography and a literature review to develop a two-stage model of factors facilitating: (1) a marketplace achieving critical mass, (2) a marketplace being used, and (3) organizations using the marketplace. We then use ethnography, unstructured interviews, and structured interviews to refine our model. Our investigation includes four B2B EC marketplaces, four organizations participating in each B2B EC marketplace, and one organization that chose not to participate in each marketplace.

Keywords: Electronic commerce, success, marketplace

Introduction

Research Questions

Organizations trying to implement business-to-business (B2B) electronic commerce (EC) marketplaces have been on a roller coaster ride since 1998, when most organizations began their marketplace endeavors. At first, forming and joining EC marketplaces seemed necessary to stay abreast of current trends. The trade press, consultants, partners, and investors were all questioning, “What is your EC strategy?”. This lead companies to think they had to do something about EC.

One strategy for getting into the EC game was forming or joining a B2B EC marketplace. Zwass’ (1999) defines a B2B EC marketplace as a network facilitated by telecommunications created to enable multiple buyers and suppliers to exchange information and complete transactions. There is some confusion on the distinction between B2B EC marketplaces and B2B EC exchanges, with some authors (Memishi, 2001; Tumolo, 2001) applying this same definition to B2B EC exchanges. To clarify, Kaplan and Sawhney (2000, p.98) define an exchange as a type of marketplace particularly “a vertical market that enables spot sourcing of manufacturing inputs”. For the purpose of this article, we will use the term B2B EC marketplace. However, in explaining others’ work we will use the term the authors used. Some authors use the term exchange to refer to what we define as a B2B EC marketplace.

The advantages of joining B2B EC marketplaces include: sharing development risk with other companies, as many companies felt they did not have the expertise to implement EC; streamlining business practices, reducing procurement costs by having a central place where all business can be transacted; lowering the price of goods, as the Internet allows easy price comparison; and improving information flow.

However, in implementing B2B EC marketplaces, getting a critical mass of organizations to join and use the marketplace is a challenge. Getting a critical mass is difficult for several reasons. Organizations that are traditionally competitors have trouble

collaborating. Suppliers do not want to participate since marketplaces facilitate easy price comparison. Getting organization that joined the marketplace to use it is also difficult since, in many cases, the marketplace's technology is based on a person shopping a catalogue. This is often less efficient than the organization's existing procedures.

Given this situation, this dissertation using qualitative methods to investigate the following questions:

1. What factors enable a B2B EC marketplace to achieve critical mass?
1. What factors enable a B2B EC marketplace to be used?
3. What factors enable an organization participating in a B2B EC marketplace to use the marketplace?

Question two focuses on marketplace factors making use feasible for all organizations involved in the marketplace. This may include how easy the marketplace technology is to use. Question three focuses on factors within each organization enabling the organization's use of the marketplace. For example, whether the organization's top management is in favor of using the marketplace.

Expected Contributions

In response to Straub and Watson's (2001) request for externally directed perspectives and research that transforms firms into successful net-enabled organizations, our research is one of the first academic papers to look at facilitators of critical mass and use for B2B EC marketplaces. Second, our paper answers Damsgaard and Lyytinen's request (1998) that researchers use multiple levels of analysis by considering use facilitators for the same system at both interorganizational and organizational levels. Third, by studying both adoption and diffusion of B2B EC marketplaces, our research follows Cooper and Zmud's (1990) recommendation that researchers study various stages of innovation. In addition, the focus on both adoption and diffusion is unique, as Premkumar et al. (1997) noted that most studies focus on one stage or the other. And finally, our research expands knowledge of critical mass and use facilitators.

Given that: a recent study found 50% of B2B EC marketplace participants are unhappy with their marketplace endeavors (Clark, 2001); for every successful marketplace, analysts predict ten failures (Bannan, 2001); and of the existing 1,300 marketplaces, Forester Research expects only 180 by 2003 (Krovi, 2001); our research has several practical contributions. Our research will aggregate perspectives among marketplaces and enhance communication between parties in a marketplace on what facilitates critical mass and marketplace use. This will help marketplaces and participating organizations determine where to focus attention and resolve implementation issues in order to survive. This is important since marketplaces offer a number of benefits including: cost savings, increased operational efficiency, and improved information. And, some predict marketplaces will result in 7% to 30% annual cost savings (Tumolo, 2001), reaching \$1 trillion by 2010 (Memishi, 2001).

Research Model and Literature Review

Since a marketplace is a type of interorganizational information system (IOIS), we rely on two articles (Cavaye and Cragg, 1995; Reich and Benbasat, 1990) in this literature to frame our research and develop our research model. See Table 1. Both articles divide the process of developing IOIS into a number of stages. Our model also breaks the process of developing a marketplace into stages but only focuses on adoption and diffusion stages. We chose this focus since our ethnographic studies and the trade press indicates that these stages are where marketplaces are struggling.

Cavaye and Cragg and Reich and Benbasat use the system as the unit of analysis. Our research model uses the system as the unit of analysis in the adoption and use stage. However, in the use stage we also include the participant organization as the unit of analysis. This is appropriate because our ethnographic research indicated that different organizations adopting the same marketplace have different levels of use. Our model posits that certain factors present or not present in different organizations facilitate the same system achieving different use levels in different organizations.

Dependent Variables

Like Cavaye and Cragg and Reich and Benbasat, our research model has several stages with different independent and dependent variables for each stage. The adoption stage has critical mass as the dependent variable and the diffusion stage has marketplace use and organization use of the marketplace as the dependent variable.

Lee and Clark's (1996) work on EC markets supports achievement of critical mass as the dependent variable. They explained that without critical mass usage is unlikely to spread and may end. The necessity of achieving critical mass for an innovation to be used is also mentioned in other information systems literature.

Using critical mass as the dependent variable is in line with critical mass theory, which posits that if a network cannot obtain an installed base equal to the largest equilibrium network size, it will have to exit from the market if it cannot surpass the critical mass and become self-sustaining. Achievement of critical mass will be measured by asking respondents the following questions.

1. How will you know when you have achieved critical mass?
2. How many organizations need to be part of the marketplace to achieve critical mass?
3. How many organizations are currently part of the marketplace?

This strategy is based on Reich and Benbasat's work (1990), which relies on the company's targets to measure adoption rate.

System use as a dependent variable has a long history in information systems literature; for a review see (Delone and McLean, 1992). We adopt Trice and Treacy's (1986) definition of use as the "degree to which the marketplace is routinized into standard operating procedures". We will investigate how the organization is using the marketplace and measure use by the frequency with which the organization uses the marketplace. For marketplaces we use cross case analysis to determine what factors discriminate between high use and low use marketplaces. In analyzing different organization's use of the same marketplace we will gather use levels from four organizations within each marketplace and one organization that chose not to adopt the marketplace. We will then use ethnography, unstructured, and structured interviews to see what factors discriminate high users from low users and non-users. This will refine our model regarding what facilitates different organizations achieving different use levels within the same marketplace.

Independent Variables

Our model, Table 1, proposes several independent variables, potentially facilitating achieving critical mass, marketplace use, and organization use of the marketplace. Because a similar study of B2B EC marketplaces has not been conducted, our model's variables come from several sources: (1) prior research in information systems success, technology adoption, and technology diffusion; (2) trade press articles; and (3) our ethnographic studies.

A complete explanatory model would include an unmanageable number of variables. Therefore, the model's variables are a combination of general consensus variables in the literature and variables that repeatedly surfaced in our ethnographic studies. We understand our model's facilitators may need revision and design data collection to allow discovery of new and modification of existing facilitator variables.

Factors Influencing B2B EC Marketplace Adoption

A number of variables facilitate B2B EC marketplaces being adopted and thus achieving critical mass, the specific facilitators in our model include: marketing the system, key player involvement, industry support, independent ownership structure, external pressure, and relative advantage.

In the paragraphs below we define each facilitator. Since some facilitators can be measured in multiple ways, refer to our interview guide for more detail on how we measure these facilitators. Because little empirical work exists on B2B EC marketplaces and a B2B EC marketplace is a type of IOIS, which includes EDI, and a form of EC, we allowed factors proven in these contexts to serve as empirical support for our model.

Many authors (Cavaye and Cragg, 1995; Hope, et al., 2001; Iacovou, et al., 1995; Reich and Benbasat, 1990; Runge, 1985; Runge, 1988) have mentioned system marketing as a facilitator of adoption and/or critical mass. System marketing refers to efforts made toward other organizations that the marketplace is intended to encompass. These efforts include making target organizations aware of the marketplace and aware that the marketplace would like these organizations to be a part of the marketplace.

Tumolo's (2001) B2B EC exchange article explained that most exchanges that have failed did not have equity participation of key industry players. Given this assessment combined with observations from our ethnographic studies, our model posits key player involvement facilitates a marketplace achieving critical mass. We define a key player as an organization in the top twenty-

five percent of organizations in the industry in terms of sales or an organization with few competitors in either production or consumption of industry goods.

Our ethnographic data indicated that competitors have a hard time coming together to join a marketplace. Memishi's (2001) thoughts support this noting that a problem with exchanges is bringing together a group of rivals that do not trust one another. Given this, our model posits industry support facilitates a marketplace achieving critical mass. We operationalize industry support by trade organization support of the marketplace.

Memishi (2001) proposed that for an exchange to succeed the founding companies have to distance themselves from the exchange since organizations will be hesitant to join an exchange created by their competitors. Memishi's observation paired with our ethnographic observations lead to our model positing that an independent ownership structure facilitates a marketplace achieving critical mass. We operationalize independent ownership structure as having a separate governance process and a management team not currently employed by industry organizations.

Many authors (Cavaye and Cragg, 1995; Chwelos, et al., 2001; Crook and Kumar, 1998; Damsgaard and Lyytinen, 1998; Iacovou, et al., 1995; Premkumar and Ramamurthy, 1995; Premkumar, et al., 1997; Reich and Benbasat, 1990) have linked external pressure to varying stages in IOIS adoption. Our model defines external pressure as a business environment encouraging B2B EC marketplace involvement and or participant organizations requesting that trading partners join the marketplace. We operationalize a business environment encouraging marketplace involvement by seeing when the marketplace was formed and looking for comments like "organizations thought they had to get into marketplaces because everyone else was" and "Wall Street was more favorable to organizations with e-business strategies". We determine the presence of trading partner request as a facilitator of B2B EC marketplace adoption by looking for comments like "participant organizations required trading partners to join the marketplace".

Our model posits a relationship between perceived relative advantage and marketplaces achieving critical mass. Several studies (Cavaye and Cragg, 1995; Chwelos, et al., 2001; Iacovou, et al., 1995; O'Callaghan, et al., 1992; Reich and Benbasat, 1990) link perceived relative advantage to system adoption. And Premkumar et al.'s study (Premkumar, et al., 1994) links relative advantage to use. Rogers defines perceived relative advantage as "the degree to which an innovation is perceived as being better than the idea it supersedes" (Rogers, 1983, p.213). We elaborate Roger's definition by defining relative advantage as the degree that a B2B EC marketplace's value proposition fills a need within organizations or improves existing organizational operations.

Factors Influencing B2B EC Marketplace Diffusion

A number of conditions facilitate B2B EC marketplace diffusion. We define diffusion as the innovation being widely used. We broke these facilitators into factors facilitating the marketplace being used and factors facilitating an organization using the marketplace. While these concepts are interrelated, they are also different. A marketplace could be used extensively but a particular organization, that is a marketplace member, may use the marketplace only minimally. As such, we break use facilitators into facilitators of the marketplace's use and facilitators of a participant organization's marketplace use.

Our model includes the following facilitators of a marketplace's use: compatibility, uniform standards, and trust.

Rogers (1983, p. 223) defines compatibility as "the degree to which an innovation is perceived as being consistent with the existing values, past experiences, and needs of the potential adopter". We make this definition more specific by defining compatibility as the degree to which the B2B EC marketplace integrates with organization's existing operating procedures. Specifically, does the technology integrate with existing systems? Does the marketplace's business practices integrate with existing business practices? Several studies (Han and Noh, 1999-2000; Premkumar, et al., 1994; Tumolo, 2001) link compatibility to system use.

Uniform standards refers to having a standard way of describing products. We include uniform standards as a facilitator of marketplace use because several authors (Krovi, 2001; Lee and Clark, 1996; Memishi, 2001) note that currently each company and each industry has a unique way of describing products. And, since marketplaces are based on purchasing products without physically seeing them uniform standards would make purchasing products over the marketplace less risky.

Our model posits that trust facilitates marketplace use. Trust refers to a reliance that the promises made by the marketplace will be kept. These promises include on-time delivery, adequate product quality, and privacy.

Our model includes the following facilitators of a participant organization's marketplace use: top management support, champion existence, and adequate resources.

Our model defines a participant organization as an organization that has agreed to buy products, sell products, provide information, or gather information via the marketplace. Since this section focuses on a particular organization's marketplace use, we expand our literature review to include single organization systems as well as IOIS.

In our model, top management support refers to whether, in the period after deciding to join the marketplace, top management takes an interest in favor of the organization using the marketplace. Top management support has been linked to adoption and diffusion of technology .

Our model posits champion existence facilitates an organization using a B2B EC marketplace. Champion existence refers to whether there is someone in the organization consistently pushing for the organization to use the marketplace. Studies have linked champion existence to technology adoption and diffusion.

Our model posits adequate resources facilitate an organization's marketplace use. We define adequate resources as dedicating time and money to incorporate the marketplace into the organization's existing processes. Several studies have lined adequate resources to technology adoption and diffusion.

Some references link top management, champion existence, and adequate resources to system adoption. We agree there is a relationship between these facilitators and adoption but our ethnographic data and several studies link these facilitators to system use. As such our model proposes a relationship between an organization's use of the marketplace and top management support, champion existence, and adequate resources.

Table 1. Research Model

STAGE	INDEPENDENT VARIABLES	DEPENDENT VARIABLES	RESEARCH METHOD
ADOPTION	MARKETPLACE <ul style="list-style-type: none"> • Marketing the system • Key player involvement • Industry support • Independent ownership structure • External pressure (including business environment encouragement and trading partner request) • Relative advantage 	Critical Mass	Ethnography, unstructured, and structured interviews of 4 marketplaces
DIFFUSION	MARKETPLACE <ul style="list-style-type: none"> • Compatibility • Uniform standards • Trust 	Marketplace Use	Ethnography, unstructured, and structured interviews of 4 marketplaces
	PARTICIPANT ORGANIZATION <ul style="list-style-type: none"> • Top management support • Champion existence • Adequate resources 	Organizational Marketplace Use	Ethnography, unstructured, and structured interviews of 4 organizations participating in each marketplace and 1 organization that chose not to participate

Research Method

Figure 1 illustrates our research method, which includes: ethnography, a literature review, unstructured interviews, and structured interviews.

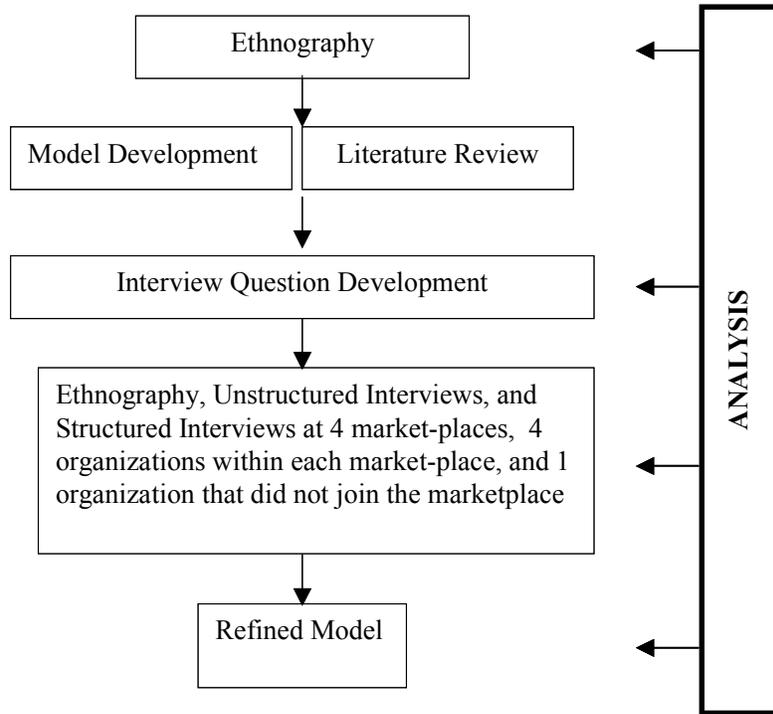


Figure 1. Research Design

This research began in August 2000 with ethnography. Initially, ethnography was most appropriate since when we started this project, organizations were just beginning marketplace endeavors and therefore little research existed. We gained access to a marketplace in the convenience store industry in August 2000 and visited the organization eight times; visits were approximately ninety minutes. In December 2000, we gained access to one of twenty-one utilities in the United States that banded together to form a marketplace. We had eight field visits; each approximately six hours. We also visited an organization in the lubricants business participating in several marketplaces. Visits included meetings and interviews about each organization’s efforts with the marketplaces.

Findings from our ethnographic research lead to our initial research model and our more focused research questions.

- What factors enable a B2B EC marketplace to achieve critical mass?
- What factors enable a B2B EC marketplace to be used?
- What factors enable an organization participating in a B2B EC marketplace to use the marketplace?

Once we developed these more focused research questions and a preliminary research model, we began our literature review to see if there was support for the model in the literature. There was scant empirical support for the model in the context of B2B EC marketplaces. However, we did find some support for different components of the model in the IOIS literature and the B2B EC marketplace trade press.

Since we found limited academic research on facilitators of B2B EC marketplace adoption and diffusion, stage three of our research consists of ethnography, unstructured interviews and structured interviews further refining our research model. Strauss and Corbin (1998) advocate using case research to explore situations like this, where existing literature is limited. Phase three involves observations at and face-to-face interviews of representatives from: four different marketplaces, four companies within each marketplace, and one company that chose not to join the marketplace. We will interview atleast one representative from each organization but depending on the organization’s culture, we may interview multiple people, including focus groups. We plan to interview the person in each marketplace most closely associated with getting others to join and use the marketplace. We plan to interview the person in each participant organization most closely associated with getting the organization to use the marketplace. In best-case scenarios, this will include the person using the system and the person in management that introduced the system.

Because of the difficulty of “getting into” organizations to collect data, in choosing marketplaces, we used the same selection criteria as Reich and Benbasat (1990). A convenience sample generated from industry contacts. However, for our participant organization we are trying to use theoretical sampling choosing organizations that are as different as possible with regard to their role in the marketplace. Within each marketplace, our sample will include two organizations using the marketplace for purchasing and two organizations using the marketplace for selling. We will select organizations with high marketplace purchase levels, low marketplace purchase levels, high marketplace sales volume, and low marketplace sales volume. We will also include one organization that chose not to adopt the marketplace.

Criteria for the number of cases was based upon Eisenhardt’s work (1989), which suggested that the ideal number of cases in case study research be between four and ten so as not to get so few cases that work is unconvincing while not getting so many that data volume makes analysis impossible.

Table 1 links our research model to our methods. In conducting the case studies, we are following Yin’s (1994) structured methodology. We will begin with a research model, collect data, and use cross-case analysis to analyze the data. We consulted Reich and Benbasat’s (1990) instrument to prepare our interview guide.

Current Status of the Project and Preliminary Findings

Given that our research model, Table 1, was developed based on ethnographic studies and the literature and we have just started our structured interviews to enhance the model, our findings to date add depth to the model. In the following paragraphs we add depth to some of the facilitators in our model.

In the adoption stage, our model posits critical mass as the measure of success. Our ethnographic and case studies included one marketplace in a competitive industry (C-Store Exchange) and one marketplace in a regulated industry (Utility Marketplace). Since we were involved in both of these marketplaces since their inception we were able to capture more information than one-time structured interviews would capture. We found that the marketplace in the regulated environment was formed with involvement from twenty-one utilities in the industry. The marketplace in the competitive environment tried to get the entire industry involved but nearly two years later only has five companies, from a population of at least 100 companies, in the industry involved. Other organizations in the competitive industry created similar marketplaces with limited involvement. After following up on this, we concluded that **noncompetitive environment** seems to facilitate critical mass. Organizations in noncompetitive environments are used to sharing information with one another and working together and thus were able to easily come together and form marketplaces; whereas organizations in competitive environments are suspicious of one another and reluctant to join forces.

In looking at **external pressure** as a facilitator of critical mass, our field notes indicated that in 2000 mass media and Wall Street created considerable pressure for organizations to get involved in EC. Respondents from all organizations in our study explained that they got involved in marketplaces because they didn’t want to be left out of the EC game. Their stakeholders, who were hearing the buzz, were pushing them to get into EC. However, after the dot.com crash in early 2001, there was less pressure to be involved in EC, and at least two organizations in our study debated whether to continue their marketplace endeavors.

Our data also showed that involvement of **key players** facilitated critical mass as key players had the power to sponsor, encourage, and coerce their weaker trading partners to participate in the marketplace. One organization was trying to require organizations that wanted to do business with them to conduct that business over the marketplace. This same organization sponsored some of their weaker trading partners in joining the marketplace.

As we conduct interviews and analyze our data, this dissertation will provide more deep insight into facilitators of critical mass and use for B2B EC marketplaces.

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