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**E-Procurement Technologies:
Why They Show Different Adoption Patterns?**

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Abstract

The faster pace of technological evolution has made adopting new technologies, such as those used for electronic procurement, a common practice. But not all firms uniformly adopt all technologies. We explore differences in adoption patterns among firms and technologies by evaluating two e-procurement methods. We compare how similar factors affect the adoption of EDI (electronic data interchange; a more established method of conducting e-procurement) and OLFA (online forward auctions; a more novel method). Reasons behind the differences are hypothesized and explained using Transaction Cost and Resource Dependency theories. Methodology and research design for testing the hypotheses is outlined.

Key words

Technology adoption, e-procurement, EDI, online auctions

Introduction

“It’s a fantastic tool,” says Michael McGaugh, senior market supply manager for Dow Chemical, in describing the company’s online auction technology. “It allows us to create a dynamic marketplace for selling and we can do it in a matter of hours instead of weeks” (Gaudin, 2000; pg 91). Bob Breakstone, the president of Equipment Exchange Company of America (EECA), has a different opinion of online auctions. “It was another avenue of marketing our goods. It [was nice that it] wasn’t that work-intensive. It just wasn’t active” (Gaudin, 2000; pg 92). Breakstone’s company sold four items in the five months that it held online auctions. Without buyers, the company stopped its attempts shortly thereafter.

In general, e-procurement tools (such as EDI; electronic data interchange and online auctions) help reduce transaction costs and purchasing cycle times. Companies that use e-procurement technologies report savings of 42 percent in purchasing transaction costs (Davila 2003). The savings are associated with less paperwork, fewer human mistakes and more efficient purchasing processes. With e-procurement, price negotiations are condensed from months to hours, saving substantial time and organizational effort (Emiliani 2000). In addition, faster purchasing cycle times provide companies with increased flexibility and more accurate information when placing orders (Davila, Gupta, & Palmer, 2003; Min & Galle, 2003).

Nevertheless, the question remains: Why do companies such as Dow Chemicals and EECA experience such differences in the use of their e-procurement tools? Better yet what made their buyers respond so differently? Research on technology adoption has stimulated an assortment of models in explaining why some firms are more willing to adopt some technologies. Factors that may enhance the likelihood of technology adoption include organizational structure (Kimberly &

Evanisko, 1981), size (Davila et al., 2003), functional differentiation (Baldrige & Burnham, 1975), improved benefits (Premkumar & Ramamurthy, 1995), top management advocacy (Srinivasan, Lilien, & Rangaswamy, 2002), inter-organizational relationships and competitive pressures (Premkumar et al., 1995; Wu, Mahajan, & Balasubramanian, 2003). These are typically classified into three categories: the organization's motivational factors, the organization's readiness factors and external factors (Grewal, Comer, & Mehta, 2001; Iacovou, Benbasat, & Dexter, 1995; Mehrtens, Cragg, & Mills, 2001). Research on technology adoption by individuals takes a similar form: with focus on individual user characteristics, motivation and ability influence the adoption of the new technology (Grover, 1993).

With faster pace of technological evolution (Nault & Vandenbosch, 2000) adoption of new technologies becomes an expected and habitual practice for many organizations. As such, the *type* of technology can be a key consideration in its adoption. Although studies have looked into reasons for why a specific technology is adopted, cross-comparisons of technologies are less prevalent. We hope to extend our understanding of technology adoption factors through simultaneous comparison of technologies and factors that influence their adoption. We view the type of technology as the main consideration and other adoption factors (i.e. the three categories noted above) to influence the effects of the chosen technology. Comparing and contrasting factors that influence the adoption of different technologies can enhance our understanding of relationships between each of the technologies and each of the three elements of motivation, readiness and external influence. Relating the types of technology and their adoption to theoretical underpinnings can also enhance our understanding of reasons for adoption.

We focus on two specific e-procurement technologies: online forward auctions (OLFA), a new method of inter-organizational technology and electronic data interchange (EDI) a more established method. OLFA employs Internet based exchange of information to allow on-line buyers to compete in real time for goods by raising their price offers as they see the other bids. EDI refers to the computer-based exchange of standardized business-related information between buyer and supplier firms. Despite their similarity in purpose, the two impact supply chain members and their relationships differently. As such, their adoption may also be different. Next, we provide theoretical explanations on how e-procurement can enhance firm performance, followed by a more specific discussion of the literature pertinent to each of the chosen technologies.

Theoretical Support

Transaction Cost Theory (TCT; Coase, 1937; Williamson, 1975) distinguishes transactions as those managed internally or conducted external to firm boundaries. Transactions that are prone to uncertainty, that require substantial investments or that is difficult to deploy elsewhere, are conducted inside firm boundaries. In contrast, transactions that are subject to lower uncertainty and that involve general-purpose investments are more likely to be conducted in the outside marketplace. E-procurement technologies are enhanced medium for conducting transactions. Their key benefit is to reduce the associated transaction uncertainty thereby allowing them to be conducted outside firm boundaries and in the marketplace.

Resource Dependency Theory (RDT; Emerson, 1962; Pfeffer & Salanick, 1987; Ulrich & Barney, 1984) provides an alternative perspective. RDT suggests that an organization's environment is inherently unstable. However, organizations can act to reduce the instability by making their external constituents (i.e. buyers or suppliers) more dependent. The degree to which others are

dependent on an organization is determined by the importance of the resource held by the organization, the organization's discretion over the resource, and the extent to which there are alternative resources to choose from (Handfield, 1993). For example, firms that choose to narrow their supply base may become more vulnerable to the bargaining power of those remaining suppliers (Porter, 1980), an inherent deterrent to possible to a reduction in a supplier base.

Implementing e-procurement technologies can be justified based on reduced transactions costs (in line with TCT) and increased inter-dependence between organizations (in line with RDT).

Companies may find a technology easier to implement, and thus be more willing to adopt it.

Others may find themselves more ready to accept an alternate technology and thus more readily adopt it instead. Such factors may influence the effects from different technologies differently.

Through a side-by-side comparison of the adoption factors for the two e-procurement technologies and using a parallel pair of theoretical lenses, we intend to better detail organizational adoption patterns. Assuming that there is a distinction between these inter-relationships, persuading firms to adopt certain technologies may require different approaches.

Literature Review

Electronic Data Interchange (EDI)

Fulfillment of a typical transaction requires a consecutive series of steps. Tendering the bid, inspection and receiving of the contract and submittal of payment are more commonly noted steps.

An early approach to electronic facilitation of transactions was the use of Electronic Data Interchange. EDI is a communication standard that supports inter-organizational electronic exchange between buyer and seller organizations. EDI consists of three elements: First is a standard form (EDI Standards) which provides an agreed upon formatting and syntax among users.

The American National Standards Institute (ANSI) standard on EDI was one of the first adopted by many organizations. Second is a translation capability (EDI software), which allows for company specific data to be placed into EDI standard format for transmission. Third, a mail service (EDI network) allows for the transmission of documents using third party or direct electronic network connections (Monczka, Trent, & Handfield, 2002).

EDI adoption has been the topic of review and analysis for many years. The multitude of factors influencing EDI adoption have been categorized into motivational, readiness and external categories (Chwelos, Benbasat, & Dexter, 2001; Iacovou et al., 1995; Mehrtens et al., 2001). Firms have to be motivated to implement EDI. End user (i.e. purchasing agent and supply personnel) satisfaction, costs of implementation and ongoing upkeep expenses (Saunders & Clark, 1992) are factors that can augment the motivation of a firm. Firms should be ready for implementing EDI. Those who have supportive financial and information technology resources are better prepared to adopt EDI (Premkumar, Ramamurthy, & Nilakanta, 1994) as do firms that carry top management support (Premkumar, Ramamurthy, & Crum, 1997). A proactive technological orientation and an organizational internal push for the system (Grover, 1993) can also help facilitate EDI adoption. Lastly, environmental factors (Bensaou & Venkatraman, 1996) such as competitive needs (Crook & Kumar, 1998; Grover, 1993), competitive pressure (Ramamurthy & Premkumar, 1995), power and trust (Hart & Saunders, 1997; Premkumar et al., 1995) also influence EDI adoption.

Auctions & Electronic Marketplaces

The increased appeal of the Internet as a medium for conducting business has ushered e-commerce to become a popular method for completing transactions. Using the Internet for purchasing and selling is appealing as it can accommodate the gathering of a considerable number of buyers and

sellers in an electronic marketplace. This has led to many market entrants, resulting in a series of specializations among providers (Azadegan & Ashenbaum, 2008). Kaplan and Sawnehey (2000) classify electronic marketplaces into four categories based on the type of purchased item and the sourcing method. Purchased items are noted as either manufacturing or operating items.

Manufacturing items are raw materials and components used in the finished product or process. In most cases manufacturing items require specific suppliers and logistics systems. Operating items, which are not part of the finished product, are low value items with relatively high transaction costs and are often referred to as MROs (maintenance, repair and operating items). Operating and manufacturing items can be sourced systematically or on the spot. In spot sourcing the intent is to satisfy an immediate need at the lowest possible cost, whereas in systematic sourcing negotiated contracts and involved discourse set the stage for a more long term relationships.

Online auctions fulfill immediate needs and are mainly used for MROs (Davis, 2001; Stockdale & Standing, 2002) through spot sourcing. An online forward auction uses Internet based information exchange technology to allow on-line bidders to compete in real time. Bidders are, however, unable to identify their competitors in the online auction. OLFA's are categorized under B2B (Business to Business) electronic commerce. Unlike B2C (business to customer) commerce where buyers and sellers' relationship are temporary and short lasting, B2B commerce participants are representatives of larger organizations and require the consideration of more long term and relationship-based elements of an exchange.

There are three main categories of B2B online auctions. The first is *independent auctions*, where both seller and buyer companies rely on a third-party auctioneer to manage the site and sell the goods. Products from different companies are sold by the auction site and the site receives a

commission or fee for each item that is sold (Fickel, 1999). The second is *commodity auctions* where buyers and sellers come together at a third-party web site. Unlike independent auctions, commodity auctions are conducted at the last minute, close to when the use of the item will expire. The final type is *private auctions* where companies usually offer their own excess inventory from their own auction sites directly to other businesses. Buying firms are invited by the host (seller) firm to participate in these private auctions (Fickel, 1999). An example of a private forward auctions is Dellauction.com where Dell, the large computer manufacturer auctions leased computers (Pinker, Seidmann, & Vakrat, 2003). Sites such as eBay and DoveBid also provide companies with infrastructure needed to privately conduct OLFA.

Online auctions can make procurement less costly and more effective (Emiliani, 2000). They eliminate travel expenses, making the buying and selling process more convenient for both parties (Fickel, 1999), while allowing them to participate in several auctions at one time (Parente, Venkataraman, Fixel, & Millet, 2001). They create opportunities for participants to benefit from the gained reduction in costs through automated transactions (Monczka et al., 2002). Some online auctions have shown to extend a company's customer or supplier base by orders of magnitude (Fickel, 1999). Given their successful track record, we leverage OLFA as our second choice of a technology to analyze.

Model Description and Methodology

Perceived Benefits

Ultimately, organizations adopt a new technology only if it offers notably improved benefits, at a reasonable price tag, than the technology they already use (Premkumar and Ramamurthy 1995). Proactive adopters invest because they expect to gain significant returns from being first movers

(Davila 2003). The comparative advantage of the technology as perceived by the user is an important aspects that influence adoption decisions. In other words, to motivate the organization to make a proactive decision to adopt the technology, the technology must provide solutions to existing organizational issues or open new opportunities.

Users' attitudes and resistance to change is a significant factor in lowering the perceived benefits and thus deterring technology adoption. For some, e-procurement technologies are still risky since there are no accepted standards for its adoption and use. Others are afraid of buying into a technology that may be "closed" or limiting. Such perceptions of risks can act as barriers to the adoption of a technology. Specifically, incompatibility of the innovation with current value systems or work procedures may foster negative attitudes and increase users' resistance (Premkumar et al., 1995). Companies described as more conservative adopters perceive such issues to be more significant than those described as aggressive adopters (Davila 2003). The conservatives are concerned with potential escalating costs in support of the new technology. They question whether the technology would create sufficient returns to validate the investment.

How organizations assess risks and benefits is equally dependent on the type of technology. For example, convenience and support issues in OLFA adoption have a temporal immediacy element that is innate to their success. Auction convenience (suitability for seller's purposes) and support (providing for necessary accommodations) are factors that help reduce the perceived risks and increase the perceived benefits. Prompt bid acceptance (Gaudin 2000) and reduced complexity in proprietary software requirements are examples of convenience. The ability to purchase a package of items in one or few transactions, availability of monetary financing options and unbiased product information from third parties are examples of support. Convenience and support are less

critical to EDI adoption. Instead, efficient processing and high frequency of transaction execution become more important to both the seller and the buyer (Iskandar, Kurokawa, & Blanc, 2001). In a typical EDI implementation process, standardization of the system and efficient processing of common transactions take precedence over flexibility and system convenience for a unique firm.

Security concerns also differ between using OLFA and EDI. Online auctions are conducted via the Internet: a “penetrable medium” according to Liao & Hwang (2001). This makes addressing security issues and protection assurance of sensitive commercial information a necessary mandate for successful adoption of OLFA (Stockdale et al., 2002). As noted above, EDI is typically conducted over secure virtual private networks (VPN’s) which are sheltered pipelines for information sharing.

Online auctions provide buyers with better availability and more choices of goods at a relatively low cost. Buying firms have immediate access to current inventory instead of having to contact the supplier via phone and wait for a new list of current inventory (Fickel, 1999). Thus, the *importance* of the items purchased to the buying firm and the *size of transactions* in monetary terms (Gottschalk & Abrahamsen, 2002) impact the buyer firm’s perceived benefits of OLFA (Iskandar, Kurokawa, LeBlanc 2001). In contrast, in EDI, the number of transactions processed, as opposed to monetary value or item importance, compels adoption tendencies. EDI transactions are based on mutual agreements of long-term and sustainable exchange of information, in line with resource dependency theory. Auction transactions tend to be single event transactions with no long term commitment bind. Since the nature of auctions implies competition and lowered emphasis on cooperation, auction transactions tend focus on immediate gains by one organization and less on long term benefits to multiple organizations. In this context, transaction cost theory may provide a

more appropriate perspective on the nature of relationship behind OLFA. It should be noted however that, similar to EDI where cooperation and mutual long term benefits are a key outcome, the sustainability of OLFA adoption requires long term mutual benefits to all participants. Without mutual agreement and perceived long term relationship-based benefits by the seller and buyers, the OLFA may not maintain long term participation.

In short, to adopt OLFA, organizations need further explanation of the risks, rewards and security concerns. Furthermore, the size of transactions and importance of the item play a larger role in their decision to adopt OLFA. As compared to EDI, more emphasis on the immediate and long term benefits of the technology seems necessary for OLFA adoption. Therefore:

H1- A buyer firm's perceived benefits in adopting technologies will have more influence on the adoption of OLFA as compared to EDI.

Buyer Readiness

An organization's readiness to adopt a new technology may be evidenced by its level of internal capability in accepting a new technology. Readiness is affected by *organizational inertia*: the intensity of reaction to change. Organizational inertia can inhibit implementation intent by slowing the pace of *change* (the analysis and redesign process) or by underutilizing the system when implemented (Cooper, 1994). Readiness is also affected by *resistance to innovation*: the act of opposing or hindering the implementation of a change in the existing system (Ram & Jung, 1991; Sheth, 1981). Resistance to innovation can interfere with the intended implementation process, modify a technology during implementation or use the technology in ways that may be in conflict with existing infrastructure. Together, organizational inertia and innovation resistance impact

organizational culture (Harper & Utley, 2001; Srinivasan et al., 2002) which can influence the potential for technology adoption (Cooper, 1994).

The majority of the design and analysis in OLFA implementation is undertaken by the supplying firm. OLFA adoption by the buying firm entails less complicated restructuring, redesign or re-training. The initial investment required for online auctions is also less substantial. The initial investment for online auctions is less than \$125,000, considerably lower as compared to other e-procurement technologies (Davila, 2003). Compared to EDI, the level of organizational change required by OLFA is expectedly less. With lower level of expected change, the intensity of reaction against the change is also reduced. Thus resistance to innovation, and organizational inertia should have less impact on the adoption.

Organizational resources include accessible finances and level of information technology sophistication (Chwelos et al., 2001) These can impact organizational readiness. Financial resources include capital funding for new equipment purchases, budgetary line items for training, and operational funding for added human resource needs. As the required financial outlay for a technology drops, the importance of available financial resources also drops. Technological sophistication includes available support, depth of understanding, and number of accessible information technology tools. As the required level of technological sophistication for a technology drops, its importance is also reduced. OLFA requires lower necessary infrastructure, financial outlay, training and modification requirements (Stockdale et al., 2002) than other e-procurement technologies. Thus an organization's readiness which includes the effects of *organizational inertia* and *resistance to innovation*, *technology sophistication* and the availability

of *finances* in adopting new technologies should be less influential in opposing the adoption of OLFA as compared to EDI.

H2- A buyer firm's readiness to adopt technologies will have less influence on the adoption of OLFA as compared to EDI.

External Factors

External factors can also influence the adoption of technologies. Trust, competitive pressure and market uncertainties can have notable impacts on the adoption of EDI and OLFA. However, a key element in buyer-supplier relationships is the role of a firm's dependence on another and thereby the implied power of the other party. Relationships between firms can be different when using online auctions as compared to traditional negotiations. For instance, in more traditional transactions the supplier may have an advantage over the buyer in terms of market knowledge because the supplying organization usually specializes in a particular product or service. An effectively managed online auction may have an impact on altering the relationship by shifting the power advantage from the supplier to the buyer. In studies related to online reverse auctions, Beall, Carter et al. (2003) show that reverse auctions can impact the power balance and even destroy the trust and mutual interdependence that has been previously developed between the buying company and an important supplier.

Hart and Saunders (1998) discuss power in terms of persuasive and coercive powers. Persuasive power focuses on rewards and benefits of making a change (such as adopting EDI). For example, assisting in the set-up and arrangement of the EDI system or providing training on the use of EDI are examples of persuasive power. Persuasive supplier power in EDI adoption is best used when

the supplier pool is small and the supplier's cost of adopting EDI is prohibitive. The use of persuasive power is best from a long term, inter-organizational perspective.

Coercive power, on the other hand, focuses more on penalties as opposed to incentives. A powerful supplier threatening to end ongoing business transactions with a non-conforming buyer is an example of coercive power. Coercive power is often used to influence EDI adoption when the supplier pool is large and reselection costs are low. The use of coercive power implies that the business is expendable (Hart et al., 1997). Walmart's use of coercive power in pressuring their suppliers in implementing EDI is a well known example of its successful use.

Earlier, we noted the lower adoption costs associated with OLFA. Lower adoption costs of OLFA by the *buyer* imply the expendability of the relationship from the *buyer's* perspective. Considering the supplier capabilities as a resource, the lowered dependence reduces reliance and increases its expendability. At the same time, the need for an enduring relationship from the seller increases dependency on the buyer. The lowered dependency by the buyer in OLFA in comparison to EDI (Iskandar et al., 2001) implies a reduced effectiveness of the use of coercive or persuasive power in OLFA adoption.

H3 – Use of power (coercive or persuasive) by the supplier will have the same or less influence on the adoption of OLFA by the buyer as compared to EDI.

Figure 1 provides an outline of the proposed study.

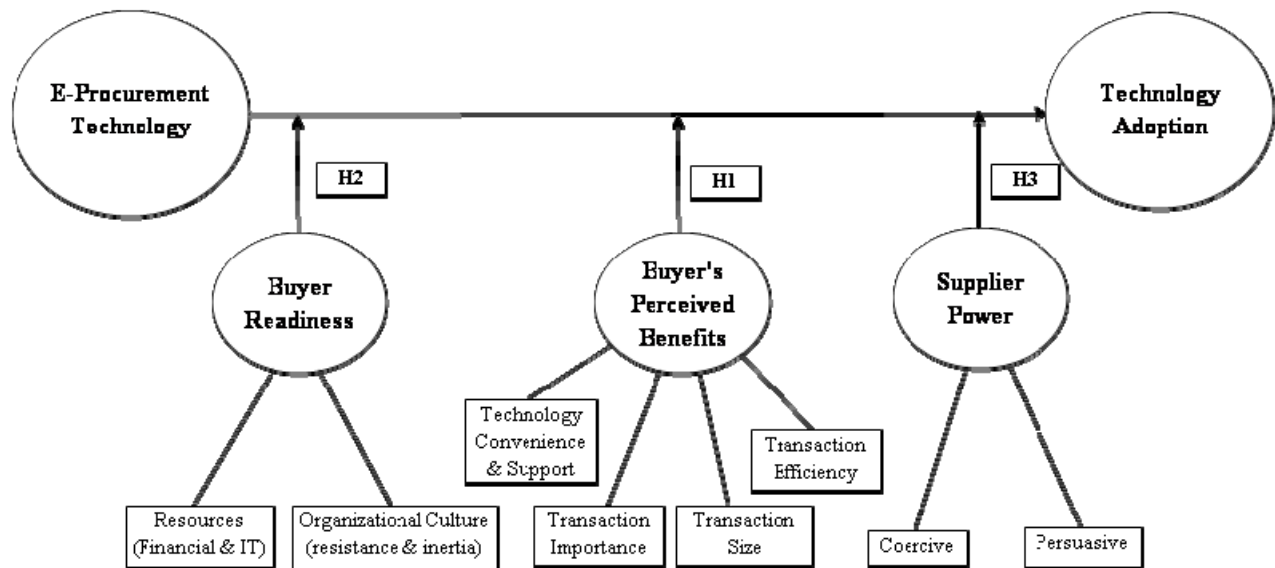


Figure 1: E-Procurement Technology Adoption Model

Methodology – Research Design Discussion

We plan to empirically test the accuracy of the hypotheses noted above. We intend to do so using a three step process. First, a qualitative approach will be used to verify that the suggested research hypotheses are not only valid, but are focused on the more important influences of technology adoption. Through the assistance of the Institute for Supply Management (ISM) a small primary group of 20-25 manufacturing organizations will be selected from a large pool of available organizations (i.e. relevant population). Institute for Supply Management is a not-for-profit association with a membership base of more than 45,000 supply management professionals and a network of domestic and international affiliated associations. Unit of analysis for the study will be the buyer firm. The select organizations will be chosen based on a quadrant of four possibilities as suggested by Voss, Tsikriktsis, & Frohlich (2002). On one axis will be EDI adoption with two choices - adopted or not - and on the other axis will be OLFA (or intent of) adoption with two choices - adopt or not. Buyer firms within each quadrant will be chosen and the replies used to verify the internal validity of the hypotheses with consideration to some longitudinal limitations:

Buyer firms should have (a) implemented or updated their EDI process during the past 5 years and (b) have implemented an OLFA system within the past 2 years or intend to implement OLFA in the next 2 years. Pertinent suggestions made by Miles and Huberman (1994) on assortment of groups will be incorporated as follows. The selected buyer firms will include representative firms that are of three types (1) those representative of the hypotheses suggested above (2) those that may be disconfirming of the model (e.g. have higher coercive and persuasive power influencing their adoption of OLFA versus EDI) and (3) those that have sharply contrasting characteristics (smaller organizations versus large Fortune 500 organizations, high operational performance firms “best in class” versus low performing firms using the same EDI and/or OLFA systems, organizations in high technology industries versus those in lower technologies). An interview protocol with the intent to verify and confirm the validity of the proposed hypotheses in this report will be generated and the company representatives will be contacted via phone or met in person. Time permitting, a list of preliminary survey questions will be included as part of the interview. The interviews will be semi-structured and will be typed, coded and reviewed by a pair of researchers. Based on these interviews, the hypotheses noted above will be modified as appropriate.

One concern at this point is on the importance of *power* versus other external factors (such as *trust* or *competitive pressure* or *environmental uncertainty* and even a *perceived shift in power in the supply chain* on adoption behavior). The secondary environmental variables (trust, competitive pressure, uncertainty) will be controlled for in the study. In addition direct interviews with third party firms to verify adopting firm characteristics will be conducted and coded. Third party organizations, also known as online auction intermediaries, are different from traditional intermediaries in that they provide the infrastructure to directly connect buyers and sellers.

Generally, intermediaries match buyers and sellers, facilitate the exchange of information, goods, services, and payments, and provide infrastructure that enables the efficient functioning of the online auction (Bakos, 1998). One company already identified for the secondary verification purpose is Norman Levy Associates from Southfield Michigan. The company has auctioned surplus industrial equipment for firms such as DaimlerChrysler and Boeing for many years but has just recently launched an independent auction site (Fickel 1999). The company has found that delivering the products to the customer quickly and efficiently can be a delicate task and that there is may be a broad learning curve associated with the use of online auctions. Norman Levy Associates have reported losses in operating their independent auction site, partially as a result of sellers' asking for unrealistic fair market values. The company intends to help sellers learn how to adjust their asking prices to allow buyers to find bargains. Verification of the research plan with these intermediaries should assist in enhancing the face validity and the general quality of the information expected to be collected as well as the reduction of common method bias.

Once the model has been reassessed a survey questionnaire will be generated and distributed to a larger number of ISM members from the same population but without including the primary group. Buyer firms who have implemented EDI in the past will be questioned on possible influences that may assist or divert them from implementing OLFA related technologies. Surveys will be targeted to multiple raters (2-3 per organization) from the purchasing and information technology departments of each organization. Inter-rater reliability will be tested using the ICC method (Boyer and Verma 2000). The anticipated sample size will be between 200-350 firms and the survey will include between 30 to 35 questions. Careful attention will be given so as to ensure sample heterogeneity in terms of the size of the organizations, industry types, levels of technological sophistication and the breadth of uses in the intended technology to enhance external validity

(Cook & Campbell, 1979). For both the survey questionnaire and the interview questions (above), Babbie's suggestions on survey preparation, including the formatting, prioritization, wording, item ambiguity, positive and negative wording, and biased terminologies will be incorporated in the survey question design. Pre-notices, pre-paid postage and multiple waves of mailings (2-3) with increasingly firm reminders will be used as appropriate to increase the response rate of the surveys (Frohlich 2002). A variety of control variables to rule out alternative explanations will be included in the study. Dummy variables for organizational size (total employment), recent growth in sales (five-year), firm-specific risk (beta), participant job level and tenure, organizational culture and top management advocacy along with exogenous variables such as market uncertainty and competitive pressures and will be included in the survey.

Finally, approximately 120 days past the date of the original survey mailer distribution, a select group of the surveyed organizations (20-25) will be contacted via phone. Identical questions to the ones on the mailer will be asked of this group. This retest and triangulation method should enhance the reliability and construct validity of our findings. Also, although there is minimal concern with our item loading, CFA test will be performed (Babbie 2004) to ensure proper loading and another (of all the measures in the study) to ensure discriminant validity among the different constructs.

Further specific methodology concerns are addressed below:

Statistical & Internal Validity Discussion

Statistical conclusion validity will be tackled through the use of a large sized sample with random and unstandard characteristics. In addition, deliberate sampling for heterogeneity should provide for further statistical validity. It is expected that the use of the four quadrant selection method outlined above (firms that intend to and do not intend to adopt either technology) for phone

interviews can enhance internal validity and enhance increased systematic variance. Describing the dependent and independent constructs to key informants from the preliminary group of organizations and requesting for comments should assist with face validity. In addition, some concerns regarding the historical aspect of the study may be worth of considering. Some firms may have implemented EDI a few years back. As historical implications may lessen the validity of the results, the survey questionnaire will include specific requests for the length of time since adoption of EDI or OLFA and for any significant organizational changes since the adoption to control for questioning will control for length of time past since implementation of technology. This should control for extraneous variance. Other control variables are noted later in this report.

Scale Development, Construct and External Validity Discussion

Mono-operational and mono-method bias will be compensated with direct interviews with firms directing OLFA's, to verify adopting firm characteristics alongside the use of a two step process in gathering survey information (phone interviews and survey data). Furthermore, each construct will include a minimum of four specific questions to minimize single indicator concerns. As noted previously, the four pertinent constructs for this study include the *perceived buyer firm benefits*, *buyer firm readiness* and *supplier power* as independent variables. The dependent variable is *technology adoption*. Figure 1 provides an outline of the relationship of the constructs. The three independent variables are derived from extant literature and thus the measurement plan will be to use existing scales, appropriately modified for the study for the survey. With regards to the dependent variable, adoption, the scale will include number of buyer firms successfully adopting and actively utilizing the technology for a period longer than one year and the level of transactions conducted using a technology. Similar scales in the level of use of EDI have been developed by Masetti (1991).

A unidimensional scaling (Likert 7 response scale) will be the format of the questionnaire for all constructs. To maintain the conciseness of this report, the list of questions related to each construct is removed, however, the line of questioning for each construct is as outlined below:

- Scale items for firm's perceived benefits construct: (a) convenience of the technology, (b) support of the technology, (c) importance of the transaction, (d) size of transaction and (e) efficiency of transaction (in terms of time and man-hours). Source: Two different extant studies on technology adoption. (Deeter-Schmelz, Bizzari, Graham, & Howdyshell, 2001; Iskandar et al., 2001)
- Scale items for firm's readiness construct: (a) buyer firm's financial resources (b) buyer firm's informational technology sophistication (c) organizational resistance to change (b) organizational inertia. Source: Three different extant studies on technology adoption. (Harper et al., 2001; Sheth, 1981; Srinivasan et al., 2002)
- Scale items for supplier's power construct: (a) influence in use of coercive power by supplier (2 questions. (b) influence in use of persuasive power by supplier (2 questions). (Anderson & Narus, 1990; Gaski, 1984; Hart et al., 1997)
- Scale items for the adoption construct: (a) buyer firms who have adopted EDI/OLFA (b) buyer firms who are actively utilizing EDI/OLFA (c) relative and exact amount of transactions conducted using EDI/OLFA (d) relative and exact ratio of items purchased using EDI/OLFA. Similar scales in EDI use are developed by Masetti (1991).

Pre-testing of the survey questions with preliminary group (phone interviews) is expected to reduce any threats to construct validity. During the phone interviews the interviewees will be asked to identify any of the questions than may be ambiguous or that have unclear meaning. Care will be

taken to ensure that none of the items contain double barreled or negatively worded (or reverse coded) questions. Multiple response formats and scattering of questions related to a construct throughout the survey will also be used to enhance construct validity. Purposeful attempt at a heterogeneous sample in both the preliminary phone interviews and the survey questionnaire submittals should minimize concerns with regards to generalizability. Non-response bias will be reviewed by comparing the survey respondents and non-respondents. The responses will also be randomly split and the results compared to identify any response bias. It is a goal of this study to ensure applicability and generalizability of the findings to firms beyond the fortune 500. The large sample of firms available via ISM should help in that regards. Throughout the design of this research project, focus on clear constructs, sampling and design control is made to ensure maximization of systematic variance. Similarly, the random sampling and statistical controls should enhance the control of extraneous variance while the use of existing measures (more valid measurements) and controlling for other factors should minimize the error variance of the experiment.

Limitations and Contributions

One possible limitation of this study may be in the history and maturation of the data. Some firms have adopted EDI a few years back, influencing the respondent's experiences and perspectives on their firm's readiness, perceived readiness and supplier power. Limiting the study to firms that have an adoption date of less than five years should minimize this issue. Although the unit of analysis is the buyer firm and all of the observations involve single organizations, ultimately the choice of technology adoption is a dyadic supply chain relationship.

One perspective is to review the technology adoption based on this dyadic relationship as opposed to individual adopting firms. An even more intriguing future study could be the review of technology adoption on a transaction level, where each purchasing transaction is reviewed for effectiveness, importance and the type of supportive technology for the purpose is compared to other technologies. It should be noted that the adoption of EDI and OLFA are not mutually exclusive. Some organizations do infract adopt both technologies and utilize them simultaneously and for similar or differing purposes. Also, this study uses a comparative analysis between two distinct technologies. Future studies may consider the inclusion of numerous inter-organizational technologies for more generalizable results or the inclusion of additional influential factors for possibly more fine-grained results.

The expected contribution of this preliminary paper is to highlight the omitted dissimilarities between technology adoptions. Inclusion of different technologies on a side-by-side comparison is a notable strength of this study. To the best of our knowledge no study has focused on technology adoption in this frame. While a number of variables impacting inter-organizational technology adoptions have been investigated, factors specific to the types of technologies are yet to be explored. Using this alternative approach, it is hoped that more applicable and relevant findings are shared with the research and practitioner management communities. As noted previously, if the motivations and perceptions in adopting past technologies are not the same as for new ones, established approaches in persuading firms in adopting certain new technologies may not be valid and require revisiting.

References

- Anderson, J.C. & Narus, J.A. 1990. A model of distributor firm and manufacturing firm working partnership. *Journal of Marketing*, **54**, 42-58.
- Azadegan, A. & Ashenbaum, B. 2008. E-Procurement in Services: The Lagging Application of Innovation. *International Journal of Procurement Management*, **1** (4), (In Press).
- Bakos, Y. 1998. The Emerging Role of Electronic Marketplaces on the Internet. *Association for Computing Machinery. Communications of the ACM.*, **41** (8), 35-46.
- Baldrige, V.J. & Burnham, R.A. 1975. Organizational Innovation: Individual, Organizational and Environmental Impacts. *Administrative Sciences Quarterly*, **20** (2), 165-176.
- Beall, S., Carter, C., & Carter, P. 2003. The Role of Reverse Auctions in Strategic Sourcing, *CAPS Research Focus Study*. Accessed January 22, 2008 via <http://capsresearch.org/Publications/pdfs-protected/beall2003ecom.pdf>.
- Bensaou, M. & Venkatraman, N. 1996. Interorganizational relationships and information technology: A conceptual synthesis and research framework. *European Journal of Information Systems*, **5** (2), 84-91.
- Chwelos, P., Benbasat, I., & Dexter, A.S. 2001. Research report: Empirical test of an EDI adoption model. *Information Systems Research*, **12** (3), 304-321.
- Coase, R.H. 1937. The Nature of the Firm. *Economica*, **4** (16), 386-405.
- Cook, T. & Campbell, D. 1979. Quasi-experimentation design & analysis issues for field settings. Boston, MA, Boston, MA: Houghton Mufflin Company.
- Cooper, R.B. 1994. The inertial impact of culture on IT implementation. *Information & Management*, **27** (1), 17-31.
- Crook, C.W. & Kumar, R.L. 1998. Electronic data interchange: A multi-industry investigation using grounded theory. *Information & Management*, **34** (2), 75-89.
- Davila, A., Gupta, M., & Palmer, R. 2003. Moving procurement systems to the internet: The adoption and use of e-procurement technology models. *European Management Journal*, **21** (1), 11-23.
- Davis, B. 2001. Under the Hammer. *Professional Engineering*, **14** (3), 45-47.
- Deeter-Schmelz, D.R., Bizzari, A., Graham, R., & Howdyshell, C. 2001. Business-to-business online purchasing: Suppliers' impact on buyers' adoption and usage intent. *Journal of Supply Chain Management*, **37** (1), 4-10.
- Emerson, R.M. 1962. Power-dependence relations. *American Sociological Review*, **27**, 31-41.
- Emiliani, M.L. 2000. Business-to-Business online auctions: key issues for purchasing process improvement. *Supply Chain Management*, **5** (4), 176-186.
- Fickel, L. 1999. Bid Business. *WebBusiness Magazine of CIO.com*, **06-99** (01).
- Gaski, J.F. 1984. The theory of power and conflict in channels of distribution. *Journal of Marketing*, **48** (9), 9-29.
- Gaudin, S. 2000. *Auction Action*. Network World, 9, Feb 28, 91-95.
- Gottschalk, P. & Abrahamsen, A.F. 2002. Plans to utilize electronic marketplaces: The case of B2B procurement markets in Norway. *Industrial Management + Data Systems*, **102** (5/6), 325-331.
- Grewal, R., Comer, J.M., & Mehta, R. 2001. An investigation into the antecedents of organizational participation in business to business electronic markets. *Journal of Marketing*, **65** (3), 17-33.
- Grover, V. 1993. An empirically derived model for the adoption of customer-based inter-organizational systems. *Decision Sciences*, **24** (3), 603-640.

- Harper, G.R. & Utley, D.R. 2001. Organizational culture and successful information technology implementation. *Engineering Management Journal*, **13** (2), 11-14.
- Hart, P. & Saunders, C.S. 1997. Power and Trust: Critical Factors in the adoption and use of electronic data interchange. *Organizational Science*, **8** (1), 23-42.
- Iacovou, C.L., Benbasat, I., & Dexter, A.S. 1995. Electronic data interchange and small organizations: Adoption and impact of technology. *MIS Quarterly*, **19** (4), 465-485.
- Iskandar, B.Y., Kurokawa, S., & Blanc, L.L. 2001. Adoption of Electronic Data Interchange: The role of buyer-supplier relationships. *IEEE Transactions on engineering management*, **48** (4), 505-517.
- Kaplan, S. & Sawhney, M. 2000. E-Hubs: The new B2B marketplaces. *Harvard Business Review*, **78** (3), 97-103.
- Kimberly, J.R. & Evanisko, M.J. 1981. Organizational Innovation: The influence of individual, organizational and contextual factors on hospital adoption of technological and administrative innovations. *Academy of Management*, **24** (4), 689-714.
- Liao, G.-Y. & Hwang, J.-J. 2001. A trustworthy Internet auction model with verifiable fairness. *Internet Research*, **11** (2), 159-166.
- Masetti, B.L. 1991. The effects of electronic data interchange on corporate organizations. *Doctoral Dissertation, Florida State University*.
- Mehrtens, J., Cragg, P.B., & Mills, A.M. 2001. A model of Internet adoption by SMEs. *Information & Management*, **39** (3), 165-176.
- Min, H. & Galle, W.P. 2003. E-purchasing: Profiles of adopters and nonadopters. *Industrial Marketing Management*, **32** (3), 227-233.
- Monczka, R.M., Trent, R.J., & Handfield, R.B. 2002. Purchasing and Supply Chain Management, Southwestern.
- Nault, B.R. & Vandenbosch, M.B. 2000. Research report: Disruptive technologies - Explaining entry in next generation information technology markets. *Information Systems Research*, **11** (3), 304-319.
- Parente, D.H., Venkataraman, R., Fixel, J., & Millet, I. 2001. B2B online reverse auctions: what's new? *Decision Line*, **July**, 13-15.
- Pfeffer, J. & Salancik, G.R. 1987. The External Control Of Organizations: A Resource Dependence Perspective. New York, Harper and Row.
- Pinker, E.J., Seidmann, A., & Vakrat, Y. 2003. Managing Online Auctions: Current Business and Research Issues. *Management Science*, **40** (11), 1457-1483.
- Porter, M. 1980. Competitive Strategy: Techniques for Analyzing Industries and Competitors. Free Press, New York.
- Premkumar, G., Ramamurthy, K., & Nilakanta, S. 1994. Implementation of Electronic Data Interchange: An innovative diffusion perspective. *Journal of Management Information Systems*, **11** (2), 157-186.
- Premkumar, G. & Ramamurthy, K. 1995. The role of interorganizational and organizational factors on the decision mode for adoption of interorganizational systems. *Decision Sciences*, **26** (3), 303-336.
- Premkumar, G., Ramamurthy, K., & Crum, M.R. 1997. Determinants of EDI adoption in the transportation industry. *European Journal of Information Systems*, **6** (2), 107-121.
- Ram, S. & Jung, H.-S. 1991. "Forced" Adoption of Innovations in Organizations: Consequences and Implications. *The Journal of Product Innovation Management*, **8** (2), 117-126.
- Ramamurthy, K. & Premkumar, G. 1995. Determinants of outcomes of electronic data interchange diffusion. *IEEE Transactions on Engineering Management*, **42** (4), 332-333.

- Saunders, C.S. & Clark, S. 1992. EDI adoption and implementation: A focus on organizational linkages. *Information Resources Management*, **5** (1), 9-19.
- Sheth, J.N. 1981. Psychology of Innovation Resistance: The less developed concept (LDC) in diffusion research. In J. Sheth (Ed.), *Research in Marketing*, 4th ed.: 273-282: JAI Press.
- Srinivasan, R., Lilien, G.L., & Rangaswamy, A. 2002. Technological opportunism and radical technology adoption: An application to e-business. *Journal of Marketing*, **66** (3), 47-60.
- Stockdale, R. & Standing, C. 2002. A framework for the selection of electronic marketplaces: a content analysis approach. *Internet Research-Electronic Networking Applications and Policy*, **12** (3), 221-234.
- Ulrich, D. & Barney, J.B. 1984. Perspectives in organizations: Resource dependence, efficiency, and population. *The Academy of Management Review*, **9** (3), 471-481.
- Voss, C., Tsikriktsis, N., & Frohlich, M. 2002. Case research in operations management. *International Journal of Operations & Production Management*, **22** (2), 195-219.
- Williamson, O. 1975. *Markets and Hierarchies: Analysis and Antitrust Implications.*, Free Press, New York.
- Wu, F., Mahajan, V., & Balasubramanian, S. 2003. An analysis of e-business adoption and its impact on business performance. *Journal of the Academy of Marketing Science*, **31** (4), 425-447.