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Mimetic Isomorphism and Technology Evaluation: Does Imitation Transcend Judgment?

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ABSTRACT

Although contemporary technology adoption theories incorporate societal norms or peer references, it is unclear to what extent these factors influence choices. In this research, we apply institutional theory and the concept of mimetic isomorphism as peer influences to the technology evaluation process to determine the degree to which managers conform when selecting between competing information technologies. More specifically, we test if peer influence is sufficient to overcome a product evaluation where the choice is believed to be inferior. An experiment is conducted using the World Wide Web and a national sample of 348 senior information technology and business decision makers. Significant effects are found where inferior technologies are selected if respondents are informed that competitors have selected them. Further research is warranted to investigate the presence and extent of these effects but overall implications are that product evaluations may be more ornamental than substantive.

Keywords: Institutional theory, mimetic isomorphism, technology selection, technology evaluation

I. INTRODUCTION

Technology adoption has received considerable attention from the IT community and academic researchers but relatively little theory and few methodologies have been developed to explain the

industrial technology selection decisions of early adopters, despite the fact that information technology is vital to competitive advantage [McRary 1995] and accounts, on average, for more than a third of all business spending [Bakos 1998]. The decision to invest in new technology—to acquire and apply new technical knowledge and capabilities—is among the most important competitive decisions that managers must make [Clark 1987].

Making a selection between competing technologies is a difficult and uncertain managerial choice [Powell 1992]. Many of the modern complex technologies that underlie several of the systems and services in common use today result from bitter and acrimonious standards battles [Shapiro and Varian 1999] and selecting technologies that fail to achieve market acceptance can result in a costly conversion effort, a reliance on stranded or obsolete technologies, and reduced competitive advantage.

Evaluating any investment can be difficult but technology decisions have been found to be different from other strategic investments and particularly troublesome because of the high risk and stochastic nature of technology evolution [Choi 1994], the rising switching costs of many technologies [Beggs 1989], and the presence of network effects and increasing returns for many technologies that increase rather than decrease the utility of subsequent adoptions [Arthur 1987].

With the exception of overall selection matrices and product evaluation criteria, which practitioners have been found to generally ignore [Riddle and Williams 1987], research has found that many firms have not formalized the technology acquisition processes [Durrani et al. 1998, 1999].

This lacuna may result from the relatively pedestrian nature of this task. Griffith and Zammuto [1999], for example, find that the design of information and technology solutions are considered challenging and creative, while other phases are considered "unsexy afterthoughts" and "second-class jobs that 'fit-in' with the rest of the process" even though evaluation and acquisition are prerequisite activities.

The purpose of this paper is to improve the understanding of early adopter technology selection decisions by applying institutional theory to decision and cognitive models. Institutional theory is an applicable and appropriate theoretical perspective for technology evaluation and selection because it explicitly addresses uncertainty and ambiguity, characteristics that are salient during selection and evaluation, and its application has been suggested to reduce contradictions and to improve the quality of information systems theory development [Robey and Boudreau 1999]. In contrast to existing decision models which have tended to emphasize the internal subjective norms of subordinates and superiors, neoclassic institutional theory emphasizes the importance of external influences and provides a mechanism, *mimetic isomorphism*, for firms to reduce decision ambiguity and uncertainty by copying the decision choices made by others [DiMaggio and Powell 1983; Meyer and Rowan 1977].

In this research, we argue that the technology selection process is highly ambiguous for early adopting firms. Selecting between competing but similar technologies before the market has signaled or dictated a winner is a difficult, high-risk, and expensive (if wrong) decision that is nevertheless necessary for many firms. Early evaluation is fraught with high uncertainty because choosing technologies that do not survive in the marketplace is expensive in terms of both money and time, can affect a firm's competitive premise and economic viability, and can have industrial and societal implications with respect to other innovations that may be crowded out [Rogers 1995]. To reduce this uncertainty, we posit that institutionalism, through a process of mimetic isomorphism, affects the technology selection decision process for early adopters such that the decisions made by referent organizations are more salient for decision makers and they replicate the selection decisions of other firms even if they believe the copied choices to be inferior or suboptimal.

In *The Protestant Ethic and the Spirit of Capitalism*, Max Weber argued that competition was the most important force for businesses and that the rationalist order had become imprisoned in an "iron cage" of competition and bureaucracy. However, building upon the work of DiMaggio and Powell [1983],we argue that this is no longer the case during technology selection and that technology decisions are not necessarily made for competitive differentiation but may transcend rational competitive or individual evaluation by mimicry. We summarize and outline the evaluation and acquisition literatures, briefly review adoption models and increasing returns, institutional theory, and uncertainty avoidance. We develop a conceptual model that relates constructs of uncertainty avoidance and innovation to mimetic isomorphism of technology selection, present the results of an initial experimental test of our hypotheses, and discuss findings and opportunities for future research.

II. LITERATURE REVIEW

TECHNOLOGY EVALUATION AND ACQUISITION

Technology investment has been found to be more difficult than other decisions because the costs and benefits are hard to identify and quantify, and the intangible factors are significant [Powell 1992]. This has been supported by Dixit and Pindyck [1994], who found that emergent information technologies require substantial commitment because of the rising levels of switching costs, and by Peet [1998], who suggested that the extreme uncertainty of technology selection has resulted in increased analytical and financial rigor by practitioners.

Despite these difficulties, with the exception of relatively simple overall selection matrices consisting of two dimensional weighted criteria, many firms have not formalized the technology acquisition or evaluation process [Durrani et al. 1998, 1999], and research has generated little theory and few methodologies as to how information technology acquisition decisions are made [Griffith and Zammuto 1999].

In teams that use a mixture of subjective and quantitative measures to complete information technology (IT) acquisition, Powell [1992] found that the lead or most influential member had a disproportionate role in influencing the other members of the group. Industrial purchasing decisions consist of rational and emotional economic elements [Kelly and Coaker 1976] and include both technical and political factors [Riddle and Williams 1987]. However, quantitative evaluative analysis is considered more procedural and ornamental than effective in that practitioners have been found to either ignore the process or conduct one-off *ad hoc* evaluations [Riddle and Williams 1987], particularly at the infrastructure level [De Jong 2000].

GENERAL THEORIES OF COGNITIVE ACTION

In this research, we investigate managerial identification and selection between competing choices and use decision or cognitive models as our underlying framework. While the decisions themselves are implemented at the level of the firm, individual decision and adoption models are appropriate in this research for three reasons.

(1) The lead or most influential person has been found to have a disproportionate role in decision making [Kelly and Coaker 1976].

(2) Selection decisions can have considerable negative consequences if they are subsequently determined to be suboptimal, particularly for the decision maker [Shapiro and Varian 1999].

(3) Mixed level methodologies are appropriate if the phenomena under evaluation have both micro and macro implications [Markus and Robey 1988].

Although other models exist, because a great deal of the information systems research has been based on the theory of reasoned action (TRA), we use TRA as a starting point in our research. TRA, which originated from social psychology [Fishbein and Ajzen 1975; Taylor and Todd 1995], is a very broad model that can be applied to a wide cross-section of human behavior [Davis et al. 1989] and posits that attitude (A) and subjective norms (SN) determine behavior intention (BI) to perform an actual behavior.

The technology acceptance model (TAM) [Davis 1986] adapts TRA specifically to model user acceptance of information systems. A key purpose of TAM is to trace the impact of external factors on internal beliefs, attitudes, and intentions and, as such, TAM is aimed primarily at end-user acceptance based upon ease of use and usefulness rather than the selection or acquisition decisions. TAM is relevant however in that acquisition precedes usage (cf. Fichman and Kemerer 1999) and is, therefore, a salient criteria for managers.

The theory of planned behavior [Ajzen 1985] is an extension to the TRA dealing with the behavioral limitations over which people have limited volitional control and providing greater specificity in both prediction and explanation [Ajzen 1991]. According to the theory, performance of a particular behavior is a function of intentions and perceived behavioral control that includes the construct of self-efficacy. The explicit inclusion of subjective norms makes this a useful model for information systems in areas where social effects (i.e. , pressure toward compliance or homogeneity) that are not directly linked to job-related outcomes could cause unique variance [Mathieson 1991]. The decomposed theory of planned behavior (DTPB) expands the TPB by including constructs from the diffusions of innovation (DOI) perspective and more explicitly expanding subjective norms to superior, peer, and subordinate influences, although these are predominantly internally focused. These inclusions provide many of the advantages of TAM by recognizing that normative beliefs are not monolithic but result in a more complex and less parsimonious model [Taylor and Todd 1995].

The diffusion of innovation perspective is a much-studied area for both consumer and industrial marketing and dates from the Ryan and Gross study of hybrid corn in Iowa [Rogers 1995]. More recently, DOI's five-stage model (attention, interest, evaluation, trial, and adoption) has been variously adapted and modified by others to include initiation, adoption, adaptation, acceptance, routinization, and infusion [Agarwal 1999]. Although DOI research has been criticized as lacking a theoretical foundation and consistently defined and discriminant constructs to provide requisite validity and reliability [Moore and Benbasat 1991], DOI contributes to this work with its description of innovativeness as the degree to which an individual or other unit of adoption is relatively earlier in adopting new ideas than other members of a social system, and segmentation of the bell-shaped adoption curve into adoption groups (or the S-shaped curve when plotted on a cumulative basis).

We posit that although subjective norms, the influence of social pressure or normative beliefs to perform or not perform a certain behavior, are known to be salient in technology related decisions [Moore and Benbasat 1991], the predictive or explanatory power of adoption models would be increased if they were more broadly and externally defined, rather than their existing characterization as internal or within a manager's direct operating environment or purview. We propose to address this deficiency by incorporating institutional theory into a technology selection model and explicitly including less visible or latent external influences and describing an influence process.

INSTITUTIONAL THEORY

Institutional theory arose in Germany during the late nineteenth century as a by-product of the debate over the scientific method. Arguing that man was not a "lightning calculator of pleasures or pains," early institutional economists such as Thorstein Veblen, John Common, and Westley Mitchell challenged the idea that economics could be reduced to a set of universal laws and unrealistic assumptions and that, rather than atomistic behavior, conduct or behavior was affected by a person's habitual relations to others and their institutions [Scott 1995].

Undergoing a revitalization and renaissance in the 1970s as a reaction to the excesses of the behavioral revolution, institutional theory sought to reestablish the importance of normative frameworks and rule systems in guiding, constraining, and empowering behavior and departed from those of the mainstream neoclassicists in four ways:

- *Indeterminacy versus determinacy*: Where the orthodox model assumed perfect competition and unique equilibria, institutionalists pointed to pervasive market power and indeterminacy, even under competition.

- *Endogenous versus exogenous determination of preferences*: Neoclassical theorists posited individual preferences or wants whereas institutionalists argued that such preferences were shaped by social institutions and that their operation should be the subject of economic analysis.

- *Behavioral realism versus simplifying assumptions*: Institutional theorists argued that economists should use more pragmatic and psychologically realistic models of economic motivation rather than naive utilitarian assumptions.

- *Diachronic versus synchronic analysis*: Rather than the timeless and placeless assumptions of neoclassical theorists, institutionalists argued that economists should ascertain how the economy acquired its features and conditions that cause time and place variance.

The reemergence of sociological institutionalism, which differs from institutional economics by focusing on issues of legitimacy and constraint caused by structures rather than issues of transaction costs and market hierarchies, can be traced to two key articles. Meyer and Rowan's [1977] groundbreaking paper suggested that legitimacy may be a greater organizational force than economically predicted, particularly as an organizational field is structurated; and DiMaggio and Powell [1983] wondered not why organizational forms vary but why they are so similar.

Emphasizing the manner in which organizations adopt structures, procedures or ideas not based on efficiency but rather on external definitions of legitimacy [Meyer and Rowan 1977], recent reviews of institutional theory [DiMaggio and Powell 1983; Greenwood and Hinings 1996; Scott 1995] distinguish between old and new streams of institutional theory. Old institutionalism emphasizes issues of conflicting interests, coalitions and competing values, and power and influence at the community level, while the new institutionalism is associated with legitimacy and the embeddedness of organizational fields, the centrality of classification and schema, and action oriented toward conformity, isomorphism, and homogeneity.

While variants of institutional theory exist and there are conflicting positions as to whether or not the end result is homogeneity or heterogeneity because similarities can be window dressing that hides increased process variance [Donaldson 1995; Greenwood and Hinings 1996]; according to the new

theory, organizations consist of cognitive, normative, and regulative structures,and activities that provide stability and meaning to social behavior. Although constructed and maintained by individual actors, institutions assume the guise of an impersonal and objective reality and operate at multiple levels of jurisdiction with behaviors transported by various carriers—cultures, structures, and routines.

Rather than Weber's [1952] belief that competition and the need for efficiency are the key drivers of structural change in organizations, DiMaggio and Powell posit that an organization's iterative and ongoing relationships with other organizations, the quest for legitimacy, and the process of structuration makes them more similar but not necessarily more efficient [Donaldson 1995]. Over time, in a structured field, organizations constrain themselves by their choices in that practices can become infused with value beyond the technical requirements at hand and strategies that are rational for individual organizations may not be rational if adopted by large numbers. Similarity increases rather than decreases as an organizational field emerges.

Building upon Hawley's [1968] definition of isomorphism as "a constraining process that forces one unit in a population to resemble other units that face the same set of environmental conditions," DiMaggio and Powell identified two forms of isomorphism: *competitive* and *institutional*.

Competitive isomorphism relates to population ecology models and operates at the level of selection. Homogeneity, or the reduction in variation, results as nonoptimal forms are selected out of a population to improve survivability or because organizational decision makers learn appropriate responses and adjust their behavior accordingly (Lamarckian evolution) [Baum 1996; Hannan and Freeman 1984].

Institutional isomorphism, on the other hand, reflects forces such as those of competitors and other organizations and occurs later in the life of an organizational field as it becomes structured. Three mechanisms or processes that lead to this outcome are:

- *Coercive isomorphism*, which stems from political influence and the problem of legitimacy. This results from both formal and information pressures exerted upon an organization by other organizations upon which they are dependant and may be felt as force, persuasion, or invitations to collusion but can also result from the need to fit in with entrenched standards [DiMaggio and Powell 1983; Donaldson 1995].

- *Mimetic isomorphism* results from standardized responses to uncertainty and refers to the imitation of one organization seen by another as more legitimate or successful [DiMaggio and Powell 1983]. Under mimetic isomorphism, causality is shifted from technical efficiency toward ideology [Donaldson 1995] and although conformity results and imitation is encouraged, innovation may result from imperfect copying and adaptation and is often facilitated by consulting companies [Greve and Taylor 2000].

- *Normative isomorphism* is associated with professionalism, the "collective struggle of members of an occupation to define the conditions and methods of their work, to control the 'production of producers' and to establish a cognitive base and legitimation for their occupational autonomy" [DiMaggio and Powell 1983]. Related to education that homogenizes the administration, it has two sources:
  - — formal education and of legitimation in a cognitive base of university specialists
  - — elaboration and growth of organizationally spanning professional networks where diffusion occurs and a pool of fungible individuals is created that possess a socially derived similar disposition and orientation

Although each of these mechanisms is related, difficult to isolate, and difficult to analytically define and measure [Mizruchi and Fein 1999], DiMaggio and Powell considered them orthogonal and arising from differing causes. While they have not, to our knowledge, been previously explored in a technological setting, mimetic adoption has been studied from an economic perspective [Levin et al. 1987; Mansfield 1961], and Fligstein [1991] has applied mimetic isomorphism to mergers and acquisitions and identified that imitating others has been practiced in many industries with banking and other regulated and technology intensive industries found to have a particularly high level of isomorphism [Deephouse 1996].

UNCERTAINTY AVOIDANCE

The managerial reduction of uncertainty, the lack of knowledge as to a decision or event outcome, is well rooted in decision models [Abrahmson 1991; March and Olsen 1976], is related to ambiguity, and historically has been considered a major criterion for management action [Cyert and March 1963]. Applied to technology, it refers to the degree to which it is difficult for an organization to determine the reliability, capacity, and precision of a new technology, and whether a newer technology will soon appear to make it obsolete [Gerwin 1988].

First appearing in the work of Cyert and March [1963], uncertainty avoidance has been defined as the extent to which the members of a culture feel threatened by uncertain or unknown situations and readily applies to technology selection [Hofstede 1991]. Rogers [1995], for example, notes that computer and technology related innovations have particular difficulties because the level of uncertainty with non-incremental or quantum changes create the most disruption.

From a practical perspective, when faced with the technological uncertainty of selecting between competing technologies, firms have a number of possible strategies. The first, to wait until they believe that more information will be available or that the better decision will be more clearly visible, is by definition not a strategy that can be followed by a firm that has to make an early adoption decision. Similarly, the more active option of gathering more information under the belief that it will reduce decision ambiguity is premised on the unproven notion that more information ameliorates the decision process [Ackoff 1967] and is a rational efficiency theory, which assumes that organizations chose to adopt an innovation that is diffusing based on updated information about its technical efficiency or returns [Abrahmson and Rosenkopf 1993]. Other implementation-oriented strategies are hedging one's position by implementing both technologies concurrently until the superior choice is visible or deciding between the choices based upon the information available. Hedging, which can be an effective strategy to mitigate the risk for many firms, has the disadvantage of potentially duplicating the effort and resources required. Hedging might not be available to smaller firms that are resource constrained and can result in complex configurations as a result of supporting technical incompatibilities. Although the strategy chosen by a firm will be contingent on a number of factors such as competitive pressure, available resources, technological characteristics, managerial preferences, and corporate strategy, in this research we focus on the last option where managers are not able to defer decisions and select a single choice between competing options because this poses the greatest amount of uncertainty for early adopters. Decisions made by early adopters have supranormal influence in that their choices can result in path dependence [Arthur 1987] or they may act as an information source for later adopters [Abrahmson and Rosenkopf 1993].

III. HYPOTHESES AND PROPOSITIONS

HYPOTHESES AND CONCEPTUAL MODEL

This research extends the economic study of mimetic adoption [Levin et al. 1987; Mansfield 1961] to technology by investigating the effect of external subjective and social norms on the technology evaluation process of early adopters. We propose that selection between similar but incompatible emergent technologies is a nondeterministic and highly ambiguous process characterized by high uncertainty [Arthur 1987]. Under these conditions, we propose that institutional factors will reduce the saliency of traditional product evaluation and overcome otherwise rational decision making. Specifically, we posit that firms will exhibit isomorphism, stemming from the desire to reduce uncertainty, by copying the decisions made by others even if they are believed to be inferior or suboptimal.

While acknowledging that each of the forms of isomorphism are intertwined and separation may be somewhat analytic, we consider that each of the three definitions arise and are present at different times during a particular technological life cycle. Considering the technology adoption curve [Rogers 1995], we posit that when competing fungible but incompatible technologies are first introduced (e.g., Cisco and WellFleet router technology circa 1989), the high level of selection uncertainty results in mimetic isomorphism as firms copy others to reduce their uncertainty. Over time, as the technology diffuses, and a particular standard becomes entrenched, coercive isomorphism becomes more salient and mimetic less so as early adopters exert pressure upon dependant others to comply with their choices. Finally, as supporting organizations such as training and education centers emerge and professionals move within the tiers of successively later adopters, mimetic isomorphism is further reduced and coercive is subsumed into normative isomorphism. In this structure, isomorphism is a second order construct but each of the formative sub-constructs has a different temporal primacy.

Our conceptual model suggests that selection of an inferior product following a traditional product evaluation occurs as a result of the degree of referent influence and that the level of innovation is negatively correlated to the level of uncertainty avoidance. Firms that are early adopters of technology must make decisions characterized with ambiguity.

For early adopters under conditions of high uncertainty and when selecting between competing technological choices with no referent influences, we propose that decision makers will make selection decisions that are consistent with traditional multidimensional product evaluations. When presented with competing selections, they will choose the one that is believed to be superior as indicted by the highest score in a qualitative and quantitative analysis. However, in the presence of a potential referent to mimic and when a decision maker is aware that the referent has selected a technology that is considered to be inferior, it will result in the reduced saliency of the traditional technological product evaluation, an increase in mimetic isomorphism, and the product that has not received the highest qualitative and quantitative score from the product evaluation will be selected.

We propose three constructs:

- *Level of Innovation.* This is a measure of the overall level of innovation or propensity to adopt a new and unproven technology present in the firm, and an antecedent to the level of mimetic isomorphism. Level of innovation has a negative correlation with uncertainty avoidance. Therefore, the more innovative a firm, the less it will exhibit mimetic isomorphism. Conversely, the less innovative a firm, the more it will exhibit mimetic isomorphism.

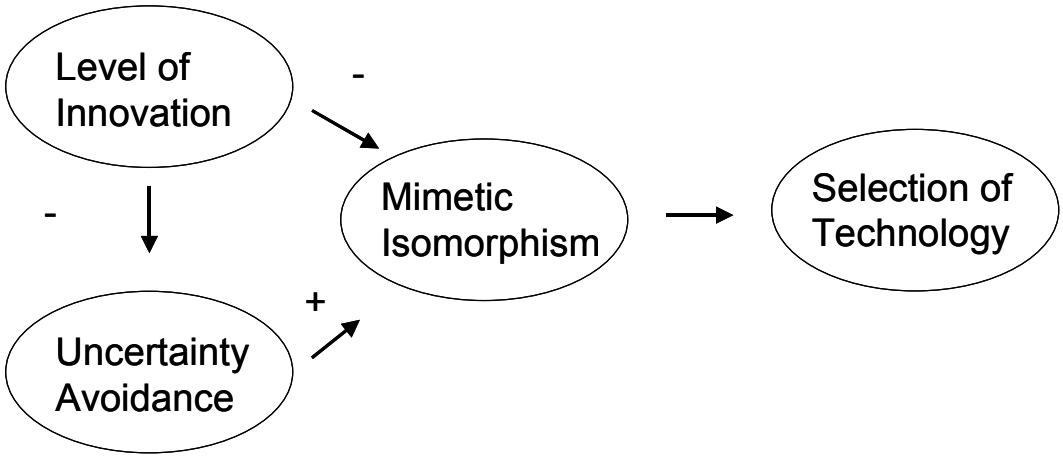

Figure 1. Conceptual Model

- *Uncertainty Avoidance.* This is the extent to which a firm feels threatened by the uncertain or unknown consequences of selecting a particular technology. This antecedent has a positive correlation to mimetic isomorphism: the higher the level of uncertainty avoidance, the higher the level of mimetic isomorphism.

- *Mimetic Isomorphism.* The degree to which the early adopter selection decisions a firm makes resemble those of other firms as a response to the uncertainty of competing choices.

The relationship between these propositions and constructs is shown in Figure 1.

HYPOTHESES AND RESEARCH MODEL

Our hypotheses and research model simplify our conceptual model to validate our general theory. We test three hypotheses related to referent quality and the presence of mimetic isomorphism and rely on subsequent research and scale development to address the relationship between innovation and uncertainty avoidance.

Stated formally, the hypotheses are:

H1: *In the absence of a referent group to mimic, decision makers will select the product that receives the highest score in a traditional product evaluation process.*

H2: *The presence of a referent that has selected the inferior product will reduce the saliency of scores from a traditional product evaluation and result in selection of the inferior product.*

H3: *The selection of a product that receives a lower evaluation will be positively correlated to the level and quality of an endorsement to that product by a referent.*

IV. RESEARCH METHOD

METHODOLOGY AND DESIGN

Because the objective of this research was to determine the effect of normative influence in early-stage technology selection, a process that can have idiosyncratic elements and is difficult to observe and measure in field research, we conducted an experiment [Behling 1980; Bikhchandani et al. 1998; Weick 1965] where respondents were advised that we were conducting a survey of evaluation criteria and a Web-based case study evaluation delivered over the Internet.

Based upon the in-depth input of two practitioners and two academics not associated with the research, respondents were presented with a series of criteria frequently cited in technical evaluations and asked to indicate on a Likert-type scale the relative importance they gave to each item when choosing between technologies (this aspect of the research was used mainly as context for the experimental treatment by raising the saliency of these criteria and are listed in Appendix A).

After completing this section and a validated measure of their general level of innovation [Parasuraman 2000], respondents were presented with a hypothetical comparison of two products, "spq" and "xyz," and asked to consider that the comparison had been completed by their own organizations. This evaluation was based upon the previously described criteria and consisted of a summary rating where one product received a rating of 156 out of a possible 225 while the other received a rating of 161. Although very similar to each other and summarized rather than individually detailed, this format was selected after consultation with both academics and practitioners because we considered that decision makers would otherwise adjust the weighting factors based upon their own preferences and confound or compromise the purpose of the research. In that the intent was to consider decision choices under uncertainty, it was important that the two choices be substantially similar. Aside from the fact that it is often easier to select between two products that are quite different, the choices were proposed as essentially fungible or interchangeable yet incompatible. Based upon this, the evaluations were set as being within a few points of each other: within the margin of evaluation error but consistent with the objectives of experiment and considered representative by our pilot practitioners. A large margin could signal our experimental objective while a small difference would be more indicative of increased competition [Baum and Haverman 1997; Hannan and Freeman 1977] and consistent with our presentation: if we argue that the choice is between similar products, it follows that the products would have similar total evaluations.

This experiment required respondents to chose between two emergent competing technologies with the implication that only one would ultimately prevail (suggested through the use of VHS and Beta as a research metaphor in the survey solicitation). We reasoned that normative isomorphism would not be present in that the case study excluded supporting professional or administrative structures for either of the competing choices. Coercive isomorphism could be similarly discounted because the technological choice was characterized as emergent with no standards yet established and the technologies had been described as incompatible. As such, endorsement statements stimulating mimetic isomorphism by identifying the adoption of the lower rated technology by a referent could be added to the case study. As a result, one of three statements that consisted of varying levels of endorsement were dynamically added to the evaluation and decision text and took one of the following forms:

0 [Control Group] No treatment.

1 [Low] At a trade show, you were recently informed that a competitor has selected [the lower scored technology].

2 [Moderate] At a trade show, you were recently informed that a high performing competitor has selected [the lower scored technology].

3 [Reverse] At a trade show you were recently informed that a competitor selected the alternative and rejected [the higher performing technology]. (Because there are only two selections this statement is essentially identical to the low treatment but was framed as a negative endorsement by the earlier social psychology work of Kahneman and Tversky [1973, 1979], which found that the way a statement was coded can have significant effects upon how the question is answered.)

Data were collected during June and July, 2001, from a custom-built Website based upon active server pages, server-side Java, and tables driven by a Microsoft Access database. Hosted in a commercial ISP environment because of its higher availability, redundancy and load-sharing configuration, the site required 12 days of design effort from the primary researcher, approximately 200 hours of professional analysis and coding, 25 hours of database administration, 10 hours of graphic art and branding, and 20 hours of project management.

All pages in the Website had a consistent look and feel with brand graphics and colors provided by the researchers' university (sample screen images are included as Appendix B). With the exception of the demographic page, none of the screens required scrolling on a full-sized window. The Website had seven logical stages or sections.

1. **Home page.** A URL, **www.TechnologySelectionResearch.org**, was selected to provide a relevant and easy to remember location rather than one that had multiple extensions or that was prone to typographic errors (e.g., www…..ca/survey/selection).

2. **Consent.** This page, displayed after the respondent logged in, detailed the ethical policy of the researchers' university, the commitment to confidentiality and privacy, the planned usage of the data, and noted that respondents could decline to answer any question or have their responses deleted even after completion. Acceptance of this policy was required in order to proceed. Using Java, this screen also assigned a consecutive numeric treatment identifier between one and eight that was used by the Website to assign the treatment (stage 5).

3. **Research Description.** This page provided respondents with a sense of survey length and progress by describing the main sections of (1) survey questions, (2) case study, where they would be requested to place themselves in the role of decision maker (this section contained the experimental treatment), and (3) demographic questions.

4. **Questionnaire.** Respondents completed survey questions using radio buttons on Likert-type scales. Responses were forced in that all questions had to be answered before proceeding to the next page, although a decline to state option for each question was included.

5. **Treatment.** Based upon the sequential random number assigned during login, respondents were presented with one of four scenarios that contained modified text which had been inserted during

page generation and asked to make a selection between the choices. The choices were randomly assigned to the right and left side of the screen to obviate position bias and the options themselves were replicated and the names of the choices reversed to obviate name or selection bias (resulting in eight groups).

6. **Demographics.** This section contained approximately 20 questions such as age, gender, experience, and industry.

7. **Acknowledgement.**

In addition to dynamic page creation, positioning of responses, and generation of treatments within the Website, we also captured technical information on the respondents' browser type and version. This allowed checking for respondent bias against the total Internet population by a comparison of the sample to published browser market share data and was compared to the information stated by the respondents (at the time of the collection, Netscape Navigator accounted for approximately 11 percent of our sample, a figure comparable with published estimates).

SAMPLE AND DATA COLLECTION

The sampling frame consisted of a subset of the mailing list of a national Canadian information technology magazine aimed at executives, a sample well suited to the medium [Bauman and Airey 2000]. Following pretesting of the Website by 22 part-time MBA students, whose involvement was limited to systems testing and not included in the analysis, and initial design assistance with industry experts, recipients were randomly selected from the mailing list. A total of 3,426 personalized but otherwise identical solicitations [Babbie 1990] were sent. The solicitations included 448 two-page letters on university letterhead and 2,978 e-mails. The solicitations, containing a description of the study, privacy policy, and personalized credentials, were sent in two phases, the first 200 letters and 200 e-mails in July of 2001, and the remainder (248 letters and 2,778 e-mails), 14 days later. A single e-mail reminder was sent to all non-respondents 44 days after their initial solicitation. Respondents were asked to complete the survey within a week of receiving the solicitation; data were collected for 50 days in total, a deadline imposed by our research agenda. Four respondents that did not indicate that they had a role or responsibility for technology acquisition completed the survey and instrument but were excluded from analysis. A total of 348 usable responses were received and tested for solicitation medium, timing, and naming, biases, none of which were detected. Aggregate response rate was 10.15 percent (46 letter responses [10.26%] and 302 e-mail responses [10.14%]). Research on Web survey response rates is somewhat equivocal with some research suggesting increased response from improved design, better targeting of desired respondents, and identification of interested or affected parties [Swoboda et al. 1997; Yun and Trumbo 2000], while other research indicates that higher response results are a novelty and will ultimately decline [Klassen and Jacobs 2001] or that Web surveys inherently have lower response rates [Yun and Trumbo 2000]. Although 10.2 percent was relatively low by some standards, it needs to be considered in the context of the audience, time-constrained senior information systems decision makers, the time-frame of the solicitation (the research was conducted during the summer vacation period), the use of e-mail as the primary communication medium (research has suggested that up to 12 percent of e-mail addresses may be out of date even in lists believed to be current [Smith 1997]), the use of a single reminder, and

the fact that no direct or fiscal compensation was provided to the respondents (although they did receive summaries of the evaluation results).

The demographics of the sample were compared to those of the magazine and found to be similar with no over-weighting along any dimension. The sample is described in Table 1, Respondent Position, Table 2, Respondent Industry, and Table 3, Respondent Gender and Tenure.

Table 1. Respondent Position

Position	%	Number
VP/Director – MIS	48.2	168
VP/Director – Business Unit	18.4	64
CIO	9.2	32
CEO	8.3	29
CFO	1.1	4
Other	14.6	51
Total	99.8 (due to rounding)	348

Table 2. Respondent Industry

Industry	%	Number
Government	13.5	47
Consulting	10.9	38
Computing	8.9	31
Manufacturing	8.6	30
Telecommunications	5.5	19
Education	4.9	17
Insurance	4.0	14
Banking	3.7	13
Transportation	3.2	11
Other	36.7	128
Total	99.9 (due to rounding)	348

Table 3. Respondent Gender and Tenure

	%	Number
Gender		
Male	85.9	299
Female	14.1	49
Total	**100**	**348**
Tenure		
Less than 1 year	9.5	33
2-4 Years	29.9	104
5-7 Years	13.5	47
8-10 Years	7.5	26
10 + Years	39.3	137
Decline to State	0.3	1
Total	**100**	**348**

V. RESULTS

Data from the experiment were coded as either 1, where the respondent selected the technology that received the higher scored evaluation (i.e., the expected selection based upon individual rational choice arguments), or 0, where the technology that received the lower scored evaluation was selected by the respondent. Because the decision choice was dichotomous, Chi-square tests were used in the analysis.

Initial output from the experiment consisted of two sets of four treatments that were mirror images of each other ("spq versus xyz" and "xyz versus spq") for each of the treatments. Statistical tests were run to verify that no naming bias existed prior to aggregating these groups into the four treatments ($p > .901$, Pearson Chi-square = .015, df = 1, n = 348). Once aggregated, similar SPSS tests were executed to verify the absence of media solicitation bias in the letters and e-mails ($p > .361$, Pearson Chi-square = .835, df = 1, n = 348) and nonresponse bias using late responses [Armstrong and Overton 1977]. None were found. ($p > .804$, Pearson Chi-square = .062, df = 1, n = 348).

After aggregation, the groups were labeled as 0 or control to indicate the absence of an influence statement, 1 or unspecified competitor to indicate the lower form of the referent statement ("at a trade show you were recently informed that a competitor had selected the [lower scored] product"), 2 or high performing competitor to indicate the higher form of referent statement ("at a trade show you were recently informed that a high performing competitor had selected the [lower scored] product"), and 3 or reverse/negative, a statement equal to the low treatment but negatively framed. These treatments are listed in Appendix C and the results are summarized in Table 4.

Table 4. Effect of Competitor Adoption-Endorsement Statement

Hypotheses	Groups	Low-Choice Score	%	High-Choice Score	%	N	Significance (Pearson Chi-square)
1	0 No Endorsement	8	9.2	79	90.8	87	19.361***
2,3	1 Unspecified Competitor	25	27.9	68	73.1	93	9.391**
2,3	2 High Performing Competitor	36	37.1	61	62.9	97	19.647***
2,3	3 Reverse/Negative Endorsement	18	25.4	53	74.6	71	7.423**
	Total	87		261		348	

***p < 0.001, **p < 0.01, *p < 0.05 .

The first hypothesis was supported. In the absence of a referent group to mimic, decision makers selected the higher-rated technology 90.8 percent of the time. While eight respondents (9.2 percent), counter to rational expectation theory, selected the lower rated technology, this is believed to result from a combination of experimental noise and pursuit of a differentiation strategy. Postexperimental discussions with individuals that selected the lower technology indicated a desire to "root for the underdog since the differences were not that great" and, consistent with differentiation and contingency strategies [Baum and Haverman 1997; Hotelling 1929; Miller and Chen 1996; Porter 1980], a purposeful desire to chose against the mainstream in pursuit of competitive advantage, that is, a respondent indicated that their firm believed that "competitive advantage could only come from either superior execution of a common strategy or differentiation."

The second and third hypotheses were also supported. The group that received the low endorsement selected the higher evaluated technology 73.1 percent of the time, declining to 62.9 percent of the time in the presence of moderate endorsement, increasing to 74.6 percent of the time in the presence of a reverse endorsement.

VI. DISCUSSION AND IMPLICATIONS

The results from this experiment, although consistent with earlier reports that the actions or endorsements of one set of economic decision makers often influence the reaction and purchase of others [Bikhchandani et al. 1998] extend existing research in a number of key areas.

Because the experiment provided managers with product evaluation information in an environment of decision uncertainty, our research focuses on mimetic isomorphism and suggests that this is not solely a low-cost heuristic used by managers in place of their decision-making processes [March and Olsen 1976; Staw and Epstein 2000], but can interact with and transcend what might otherwise appear to be independent rational choices. In our experiment, despite limited indication of the veracity of the referent statements, decision makers mimicked the choice of another firm even though these selections were contrary to extensive evaluations conducted by their own staff that showed these selections to be inferior.

There are a number of possible explanations for these results. The first is that the output of product evaluations, although intended by practitioners to provide an unequivocal indication of a superior product or to surface important information about a product under consideration, could instead be ornamental or ritualistic, aimed at signaling decision-making rigor, or a delaying tactic.

An alternative explanation is that decision makers, recognizing that many technologies benefit from increasing returns and network effects, consider selection as a game of mutual dependence and alter their opinions not on the basis of their own completed evaluation but on the basis of what they expect other, less well-informed, rational actors to do. In this scenario, decision makers might recognize that even though they have conducted an evaluation and do not copy other firms, as a low-cost decision heuristic, others will and this could result in widespread adoption of the inferior choice as the error prone choices of a few early individuals create path dependence [Arthur 1996; Beggs 1989; Bikhchandani et al. 1998]. On this basis, the decision maker would choose the inferior technology in order to not waste their vote [Granovetter 1978] or in the belief that the inferior choice will be the inevitable herd selection. This is consistent with population ecology theories [Astley and Fombrun 1983; Hannan and Freeman 1984], where it has been posited that when managerial decisions are viewed as individually impotent, collective action may instead be taken, but differs from traditional game theory models, which assume that actors make their decisions simultaneously and that no one's decision is contingent on the previous decision of anyone else [Granovetter 1978; Luce and Raiffa 1957]).

These explanations, and the mimetic influence of copying other firms, are not mutually exclusive and, like the three processes of isomorphism, are intertwined and difficult to separate. In this paper, our objective was to raise the saliency of subjective norms in the technology selection process and to illustrate how an organization might interact with the presence of a conflicting decision made by a peer. However, this is a complex and iterative process that is affected by prior action within the firm and the expected future action of the actors. Of particular significance, for example, is the ongoing interaction between the analyst and the decision maker, and the organizational norms where the decision was counter to that expected by the analyst. Where this has occurred, it is reasonable to expect that the future evaluation process and outcome will be modified to address expected dissonance.

This research is consistent with fashion and fad literature [Abrahmson 1991, 1996; Abrahmson and Fairchild 1999] but differs in two areas. First, it differs in terms of orientation. Rather than an antecedent adoption position caused by external influences, our research focuses on the choice and selection process following the decision to adopt from a variety of competing but incompatible options. Second, and more importantly, while the fashion and fad literature suggests that pressures may drive technically inefficient adoption in later stages of diffusion and early stages are driven more by rational choice, our findings indicate that early stage technologies may be more susceptible to strategies that appear nonrational and that the decision process is inherently nonindividual.

There are both research and practitioner implications from this research. For researchers, the findings suggest that in addition to known internal subjective norms of peer, subordinate, and

manager influences, external and institutional forces have significance in the selection and adoption of technology and that adoption models could be improved if explicit consideration were given to these influences.

This is an important area of research in that many technologies benefit from network effects and increasing returns and in exchange for the high risk and ambiguity of technological selection the decision process of early adopters can create path dependence and stifle innovation by creating positive feedback loops and animate cycles where the number of adopters create stronger pressures to adopt [Abrahmson and Fairchild 1999; Abrahmson and Rosenkopf 1993; Mansfield 1961]. Because of their key position as gatekeepers of technology selection, further research should focus on these firms.

This research also has implications for practitioners. While we do not necessarily advocate this position, for manufacturers, it suggests that product placement at a prestige account becomes paramount when their technology is perceived as inferior—a testament to the widely held principle of technology evangelism [Davidow 1986; Kawasaki 1990].

On the reverse side, firms that are evaluating competing technologies and are subsequently advised that competitors have selected a particular product would be well advised to investigate the evaluation process undertaken by reference firms before choosing to ignore their own due diligence. Under certain conditions, it is likely that some manufacturing or supplying firms might make the economic decision that the marginal utility of an endorsement statement from a prestigious or premier firm has increased or faster utility than product improvements. A similar caution and concern is the apparent implication that so many managers were willing to make a decision inconsistent with the results of their own staff's extensive evaluations after a relatively weak and unverified endorsement. This is troubling in terms of the authenticity and validity of evaluations and the degree of confidence that is invested in the judgment of their staff. Firms performing evaluations should carefully consider the implications of selecting a technology that was not recommended by their evaluation committees and the weight that will or should be given to reference accounts. While it may be convenient to dismiss this as an experimental aberration, discussion with one respondent indicated that this is not an unusual practice.

Suppliers of technology should also note that the use of negative endorsements in a two-choice model led to increased selection at a significant level but were not as successful as either a weak or moderately positive endorsement from a stronger referent. As a result, they might wish to consider the consequences of negative messages in their communication campaigns.

IX. LIMITATIONS

There are several limitations in the execution of these findings. The first is in the operationalization and isolation of mimetic isomorphism, a construct that is complex and not monolithic [DiMaggio and Powell 1983; Mizruchi and Fein 1999]. Because of this difficulty, we designed an experiment to minimize and isolate confounding effects and also to highlight the main focus of mimetic rather than coercive or normative isomorphism, the uncertainty surrounding new technology decisions [Levin et al. 1987; Mansfield 1961].

The second is the internal and external validity issues that are invariably present with trade-offs between field-work and experiments. Based upon our research objective, we believed that an experiment would be the most appropriate method of developing and testing our theory [Behling 1980; Weick 1965], selected the sample frame to provide adequate representation of the desired population

(i.e., information technology decision makers and executives), and designed the (disguised) experiment with the assistance of practitioners.

A third exposure is that the treatment was obvious or that respondents surmised the research objective. This was addressed by the use of disguise in the purpose of the research, a Website design that prevented deep-linking or skipping ahead, and embedding the treatments within the overall evaluation statements rather than giving them undue emphasis. While we did not conduct random interviews with the respondents, we received approximately 75 unsolicited respondent e-mails or telephone messages. None mentioned the presence of the endorsement statements. We have had extensive follow-up conversations with nine respondents and none identified the endorsement statement as a key message in the description of the evaluation, yet all commented on the validity and difficulty of the selection with one respondent noting "*I can tell that you used to be in IT; this is typical: there is not enough information to make an informed decision.*"

Finally, the sample may not be representative of the broader population, and is exacerbated by the high nonresponse rate. Specifically, particular groups, such as technology laggards, who are likely to copy other firms, could be overrepresented and others underrepresented. However, the main purpose of the research was not generalizability, but theory development and validation. Analysis of the respondent industries and firm size did not indicate concentration in a single area. In addition, unknown and transparent to the respondents, we detected their browser configuration during completion of the survey and compared the version and manufacturer frequency with that reported in the popular press. No one browser or version used to access our Website was overrepresented. While the response rate is lower than what is reported for many experiments, nonresponse bias was tested using the process outlined by Armstrong and Overton [1977]. The sample has high external validity and may more reflect time constraints and the attention deficit behavior of the respondents coupled with the timing of the data collection (during the summer) rather than systemic bias.

X. FUTURE RESEARCH

This research suggests that external references and subjective norms may be a large influence factor for the selection and adoption of technology. These decisions may be more complex than originally conceptualized. They may be made in consideration of the actions of other actors and may not be individually rational in the traditional sense. Future research to extend and confirm these experimental findings coupled with scale development to measure the constructs used in this experiment would assist with theory development and practice.

Scale development to measure innovation has typically focused on the adoption of particular technologies, although more recently the technology readiness index (TRI) [Parasuraman 2000] has been developed to measure innovation at the firm level. Similarly, although several measures exist for uncertainty avoidance, we were only able to find one measure that had been tested for technology avoidance and that was in a retail purchase environment [Achrol and Stern 1988]. No scales were found for isomorphism despite an extensive computerized search and a request posted to the ISWorld listserv that drew 12 responses. Because organizations have been shown to differ in that some are conformist and compete in conventional ways acting much like their competitors, while others are iconoclasts and adopt competitive practices that deviate from industry norms [Miller and Chen 1996], a measure of isomorphic tendency coupled with measurement of the regulatory level of the firm would allow greater research and allow testing of Deephouse's [1996] proposition that highly regulated industries are more likely to conform.

A second and larger extension of the research would include further experimentation that manipulates multiple independent variables such as the evaluation criteria and the level of the treatment, while controlling for relative innovativeness of the adopting firm and their industry. While it is somewhat axiomatic that once a technology or standard is entrenched, improvements or changes are difficult because of switching costs and other externalities (e.g., QWERTY [David 1985; Garud and Kumaraswamy 1993]), in the early stages of adoption, it would seem intuitive that there is a lower limit or minimum quality and feature level that is required to gain adoption. The development of sensitivity models would provide insight into the determination of the relative trade-offs that firms make in their technology selection. Further research could also control for the reputation of the evaluating firm to test if the alternative game-theory hypothesis discussed earlier is valid in that one would expect that higher reputation firms would be less likely to copy others once they have completed their evaluation but would be more likely to undertake signaling behavior [Spence 1974].

A third area of future research might focus on how evaluations are conducted and how relative weights and values are assigned to each of the criteria either consciously or subconsciously. For example, while it is intuitive to expect that highly isomorphic firms place greater weight on market share or adoption criteria, all else being equal, do they subconsciously provide higher evaluations in unrelated criteria to products that they are aware have been adopted by leading firms?

Finally, we note that many technological choices are embedded within and constrained by prior existing choices: the past casts a long shadow on the present and managers do not have unconstrained ability to effect change [Lawrence 1999]. However, while a large proportion of technological choices may be path dependant and a firm that has made one set of choices may not be able to mimic another that has made different ones, occasionally discontinuities and other technological changes result in the presence of strategic windows of managerial or other intervention and these present opportunities for change [Ciborra and Hanseth 1998]. Further research into how mimetic behavior can either be encouraged for superior upstart technologies or discouraged by inferior entrenched incumbents will have broad policy implications for both suppliers and purchasers and government support of innovation and regulation.

Robey and Boudreau [1999], reviewing the inconsistencies of prior information systems research, have suggested that rather than a matter of flawed methods, perhaps the contradictions are inherent in the phenomena under consideration. To address this, they suggest the application of different theories that incorporate a logic of opposition and opportunities for diametrically opposed forces rather than the historic orientation of technology as deterministic. By applying institutional theory to technology evaluation and adoption, we take up their challenge and improve our understanding of this phenomenon. Technology selection has been a persistent and puzzling problem for information systems researchers. While adoption theories have gone a long way toward explaining the dynamics of individual choice, they fall short when considering these decisions in the context of a firm, with all of its competitive imperatives.

Institutional theory has been advanced as one possible approach to understanding organizational behavior in its total context. In the case of technology selection, institutional theory might allow researchers to derive meaningful insight. This research, and its use and introduction of mimetic isomorphism to the problem of technology selection, begins to address these needs.

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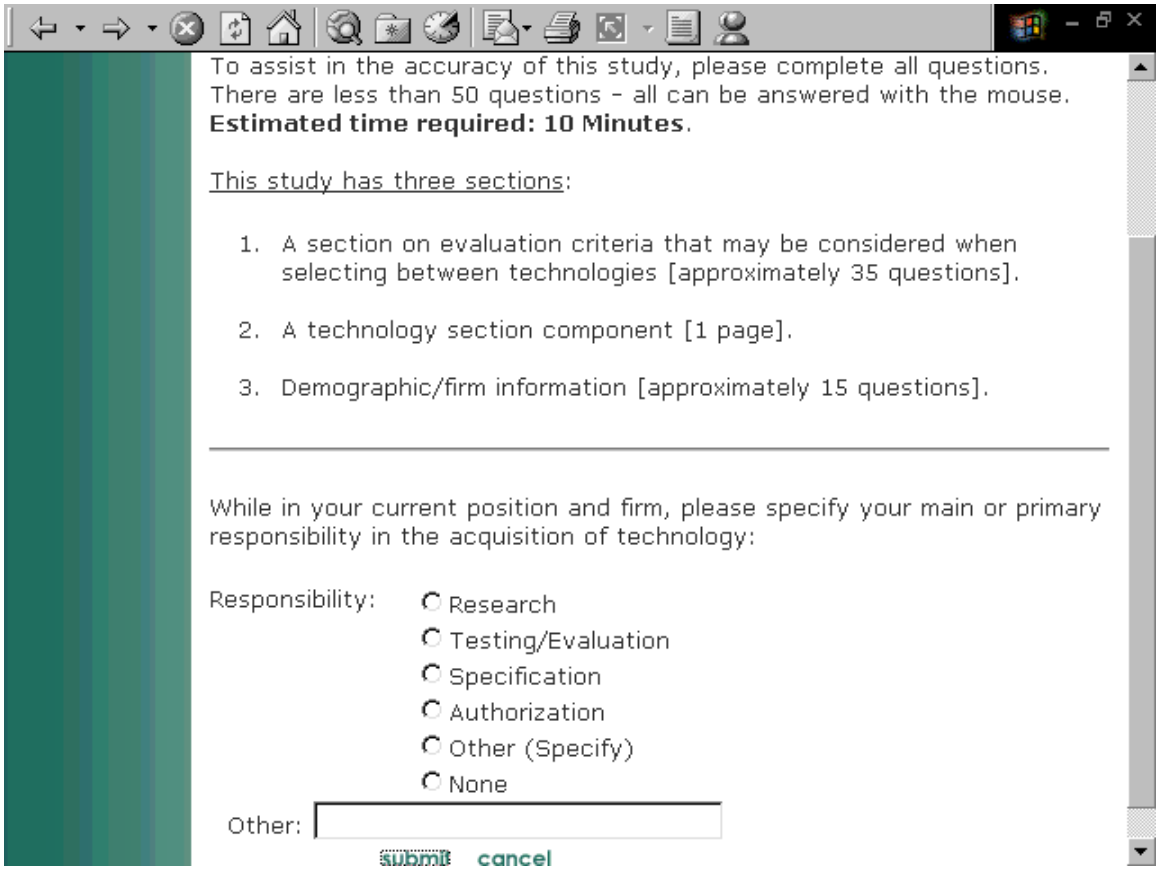
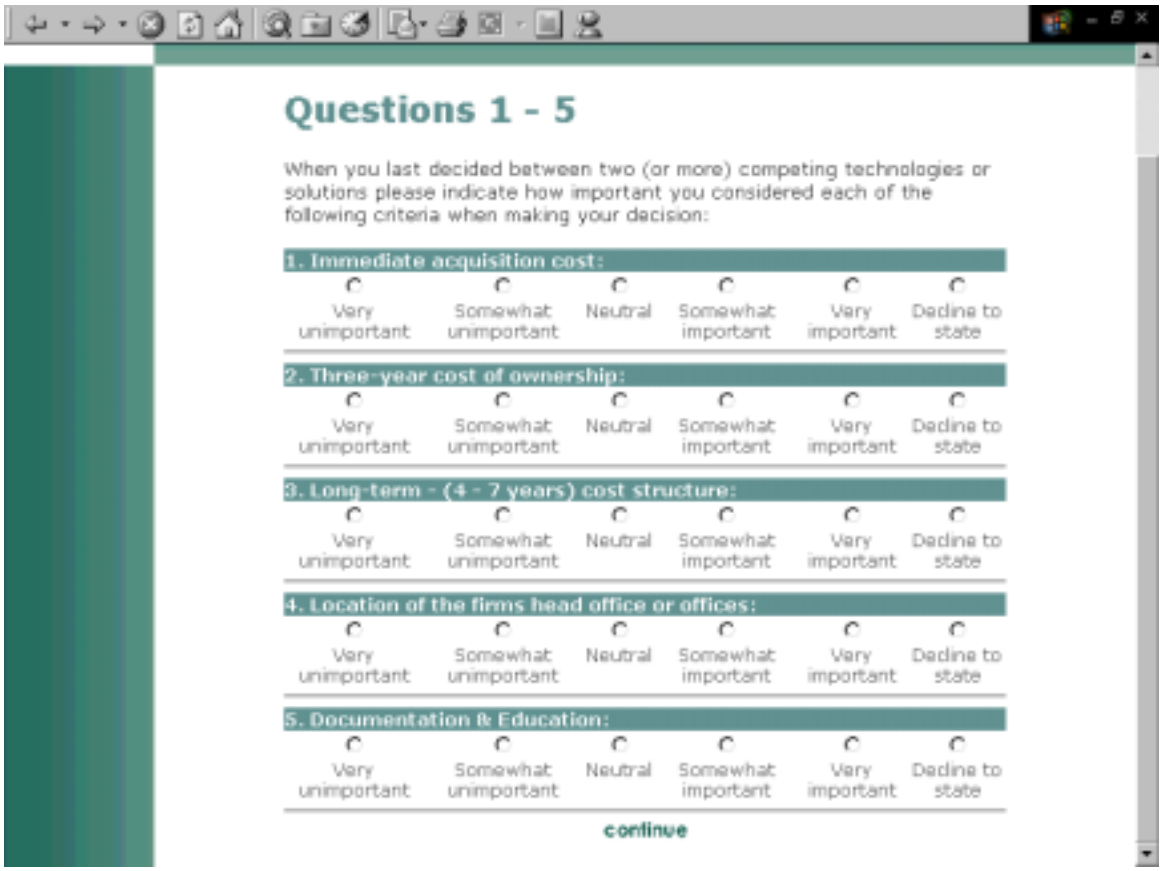
APPENDIX A : EVALUATION CRITERIA

These factors were pretested with field interviews with two IS executives from different firms. Responses were indicated on a five-point Likert-type scale anchored with very important (1) and very unimportant (5).

1. Immediate acquisition cost
2. Three-year cost of ownership
3. Long-term (4 to 7 years) cost structure
4. Location of the firms head office or offices
5. Documentation and education
6. Technical support
7. Market share
8. Financial strength of the firm
9. Number and reputation of the firm partners
10. Architecture and degree to which product is open or extensible
11. Existing clients—names of existing clients
12. Existing clients—the industry of existing clients
13. Capabilities—features available in the existing product
14. Capabilities—features that the vendor advises are under development and may be available in the next release (under development)
15. Ease of use—how easy it is to use or to install or configure the product
16. Other important criteria—please specify

APPENDIX B. WEBSITE IMAGES





Questions 1 - 5

When you last decided between two (or more) competing technologies or solutions please indicate how important you considered each of the following criteria when making your decision:

1. Immediate acquisition cost:

Very unimportant	Somewhat unimportant	Neutral	Somewhat important	Very important	Decline to state

2. Three-year cost of ownership:

Very unimportant	Somewhat unimportant	Neutral	Somewhat important	Very important	Decline to state

3. Long-term - (4 - 7 years) cost structure:

Very unimportant	Somewhat unimportant	Neutral	Somewhat important	Very important	Decline to state

4. Location of the firms head office or offices:

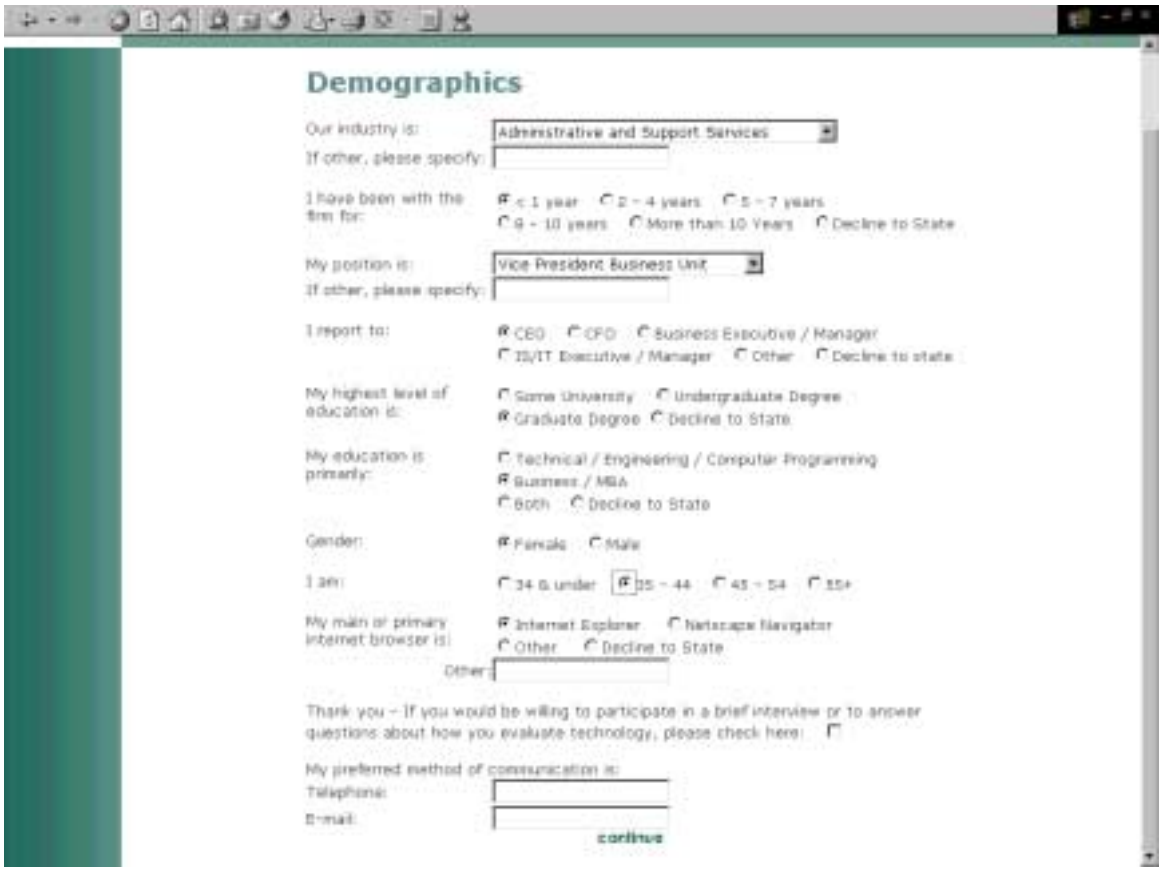
Very unimportant	Somewhat unimportant	Neutral	Somewhat important	Very important	Decline to state

5. Documentation & Education:

Very unimportant	Somewhat unimportant	Neutral	Somewhat important	Very important	Decline to state

continue


Please make your decision as if you were in your current capacity at your existing firm or organization.
Your firm or organization will be implementing a strategic business-based solution that requires a 'plug-in' to the Internet browser that your company uses. Your organization has performed an extensive and thorough evaluation of two different products described below. One has to be selected in order to maintain the project schedule. This project has the full support of your top executive team and is a key element of your firm's competitive position and strategy.
The products were evaluated on the following criteria:
Age of firm
Price
Location
Documentation
Support
Contract Terms
Marketshare
Fiscal Strength of the Firm
Partners
Architecture
Existing Clients
Capabilities
Ease of use
Marketshare
One firm has a slightly higher number of clients than the other although the other has slightly more licenses installed at each client. (using vendor reported figures for both).
Both of the products that they have evaluated have slightly different features with each one having most of the specific capabilities that you need. Neither meets all of your requirements, although both have separately indicated that the features that you need will be delivered in the next release.
Each of the products was evaluated against each of these criteria and the scores in each category multiplied by the weighting. These scores were then summed and the totals were within 5 points of each other.
XYZ received 156 points in the evaluation, and SPQ received 161 points (of a maximum 225 points). At a trade show you were recently informed that a competitor has selected XYZ
Please choose the plug-in that you would recommend your organization purchase
PRODUCT SPQ
PRODUCT XYZ



APPENDIX C. TREATMENT STATEMENTS

The treatments were created dynamically with active server pages. The following text was included on the selection page.

> Your firm or organization will be implementing a strategic business-based solution that requires a **"plug-in"** [*Plug is was a "hover over" that provided a lay explanation of the product*] to the Internet browser that your company uses. Your organization has performed an extensive and thorough evaluation of two different products described below. One has to be selected in order to maintain the project schedule. This project has the full support of your top executive team and is a key element of your firm's competitive position and strategy.
>
> Both of the products that they have evaluated have slightly different features with each one having most of the specific capabilities that you need. Neither meets all of your requirements, although both have separately indicated that the features that you need will be delivered in the next release.

Each of the products was evaluated against each of these criteria and the scores in each category multiplied by the weighting. These scores were then summed and the totals were within five points of each other. [*Treatment text was inserted here*]

The products were evaluated on the following criteria: [the criteria from Appendix A were listed as a series of *"hover- over" links that provided an explanation of the item.*] The total scores were displayed

Please choose the plug-in that you would recommend your organization purchase.

[Radio buttons for the selections were provided]

The statements were dynamically embedded and took the following form:

0 No treatment [Control Group].

1 [Low] At a trade show, you were recently informed that a competitor has selected [the lower scored technology].

2 [Moderate] At a trade show, you were recently informed that a high performing competitor has selected [the lower scored technology].

3 [Reverse] At a trade show, you were recently informed that a competitor selected the alternative and rejected [the higher performing technology]. [Because there are only two selections, this statement is essentially identical to the low treatment but was framed as a negative endorsement.]

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