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E-market Framework: The Assessment and Comparison of Auction, Negotiation and Decision Support

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Abstract

E-market systems are information systems (IS) that assist decision making through different features and regulate the execution of transactions via the exchange mechanism. A framework integrating behavioural economic and IS perspectives is presented for evaluating e-market systems. From this framework, a research model is devised and tested in a laboratory experiment. The results indicate that decision support affects economic outcome and system perceptions, but the exchange mechanism influences behavioral outcomes.

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1. Introduction

E-commerce and new forms of technology-enabled exchange models demand the integration of IS and economics fields (Bhargava and Sundaresan, 2004; Zhu, 2004; Zwass, 1996). This de-facto merging of the structures of exchanges among participating economic entities with the types of evolving decision support solutions facilitating exchanges necessitates the development of novel research models to study the resulting forms of e-market systems.

E-markets bring online demand and supply for goods and services into balance. They are the meeting places for buyers and sellers who use exchange mechanisms to conduct transactions. Exchange mechanisms include *catalogues*, with posted requests or offers, *negotiations*, with the participants bargaining over the conditions of an exchange, and *auctions*, with one side automating the process in which participants from the other side compete against each other. The design of mechanisms is the concern of economists. Since the 1990's, they seek to create specific rules that control the exchanges and trade execution to increase market efficiency (Roth, 2002). The field of market design is interested in how the outcomes of particular mechanisms can be computed as equilibrium, and the mechanisms could be designed to induce socially optimal outcomes (Maskin and Sjöström, 2002).

Clearly, an exchange mechanism can be used only if it is implemented in some and kind of IS. Behavioural economists make a deliberate effort to devoid the system of any features, which may contribute to its ease or difficulty of use or its appeal, as they are concerned with the relationships between different incentive structures and mechanism outcome, along with the selection of a revenue-maximizing mechanism and separate market participants' deviations from perfectly rational behaviour.

From a different perspective, e-markets are information technologies and as such, they are of interest to IS researchers. This school aims to study the behaviours of users, with a particular interest in explaining system-based perceptions (e.g., perceived usefulness) that contribute to adoption factors (e.g., DeLone and McLean, 2003; Goodhue, 1995; Iivari, 2005). Beginning with the technology acceptance model (TAM) proposed by Davis (1989), to the unified theory of acceptance and use of technology (Venkatesh et al., 2003), to TAM/user satisfaction integrated model (Wixom and Todd, 2005), users' attitude and behavioural intention has been the predominant concern of IS researchers.

Many studies of technology use, adoption and performance consider the overall perception of the experience with hardware, software and rules of their use in performing a particular task (DeSanctis and Poole, 1994; Goodhue and Thompson, 1995; Zigurs and Buckland, 1998). If several technologies are bundled together in order to undertake the task, then such an approach may not give useful results for the developers of a particular technology and/or the technology adopting organization. Similarly, practical value of the assessment of software performance that produces similar results but uses different embedded mechanisms is questionable if these mechanisms are not explicitly distinguished.

Over the last 30 years, IS and specifically information and communication technologies (ICT) have undergone dramatic changes. While the old systems were single-purposed, the new

systems allow to dynamically binding different low-level services into a service requested by the users (Turner et al., 2003). The old systems were difficult to modify; the new ones have components with partial and provisional connections, which can be easily changed in order to adapt the system to the user's preferences and the task at-hand (Orlikowski and Lacono, 2001) For the user, old systems were difficult to manipulate, but the new ones share common graphical interface features and require little training. These and other changes led to ICT being increasingly ubiquitous and entering all dimensions of work and leisure. Often it is no more a question of whether a system is being adopted, but rather what selection of the system's components and services yields better results than if another composition was made. We therefore argue that we need to concentrate on seeking comprehensive answers to: What e-market systems features, components and services are particularly useful for a given user, task, and context? More specifically, we try to answer: *how e-market mechanism (auction and negotiation) and system feature (decision support) affect the process, system perceptions, behavioral and economic outcomes?*

The purpose of this work is to present a framework that is used to build a concrete research model for studying e-market systems from the economic and IS perspectives. We aim to: (1) assess the overall impact of e-market systems by incorporating objective measures and subjective perceptions; (2) compare English auction with multi-bilateral negotiation and value of decision support; (3) provide a concrete model, based on our framework, to establish causality among independent, process and outcome variables; and (4) develop prescriptive advice for e-market systems depending on the mechanism and system feature(s). The paper is structured as follows. First, we review the economic and IS perspectives on e-market design to propose a conceptual framework. We suggest a concrete research model, which is tested through the comparisons of mechanism (English auction and multi-bilateral negotiation) and system feature (decision support) in a laboratory experiment. We then present the results of the experiment followed by a conclusion section explaining our outlook on future work.

2. Background

E-markets are economic entities as well as information technologies that implement theoretical economic mechanisms, but they are also composed of software and hardware that specify the features of the system. Thus, the theories that would usefully allow researchers to assess, compare, and prescribe e-market systems must include both economic and IS perspectives.

From the economic perspective, e-market design deals with axiomatic models to obtain propositions and theorems about the impact exchanges have on resource allocation. Unlike other areas of economics, market design focus on human decision-making behaviours under different exchange mechanisms and incentive structures (Roth, 1995; Smith, 2003). Through mostly laboratory and some field experiments, economists have debated heavy on the benefits of one mechanism over another. For example, Bulow and Klemperer (1996) have shown in one of the first formal comparative studies that simple English auction with $N + 1$ participating bidders always yielded higher revenue than a negotiation with N participants. In essence, Bulow and Klemperer did not analyze a specific negotiation protocol (i.e., concrete implementation of a mechanism) instead they referred to an "optimal" mechanism. Such mechanism denotes an abstract selling scheme, which is designed so as to maximize revenue

of the seller. However, Kirkegaard (2004) showed that different mechanism, such as a seller-offer bargaining game is more advantageous for the seller than an English auction when demand is discrete, i.e., it has finite space, and the buyers are patient. In those cases, sellers prefer a bargaining protocol over an English auction.

In addition, Thomas and Wilson (2002; 2005) conducted two experimental studies, in which reverse auctions were compared with multi-bilateral negotiations. In their most recent laboratory experiments, they noted that general superiority of auctions predicted by Bulow and Klemperer's (1996) was not supported by the empirical data. In multi-bilateral negotiations, a buyer solicits price offers from multiple sellers and then the buyer requests more favourable offers form the sellers who need to compete against each other. In their first experiment Thomas and Wilson (2002) compared multi-bilateral negotiations with first-price sealed-bid auction. In the second experiment they replaced the first-price with the second-price (Vickrey) sealed-bid auction (2005). Thomas and Wilson (2002) observed that for the inexperienced buyers and sellers multi-bilateral negotiations with two sellers led to significantly higher prices than first-price sealed bid auctions. In the experiment with four sellers both mechanisms were found outcome-equivalent. In their second study, Thomas and Wilson (2005) observed that prices in second price sealed bid auctions exceed the prices generated in multi-bilateral negotiations, suggesting that this auction mechanisms is inefficient in the given experimental setting.

The reconciliation of these different results can be found in Smith's (2003) depiction of microeconomic systems. This microeconomic system consists first of an economic *environment* describing all contextual factors (e.g., legal regulations, types of products and services, customs and laws), which influence demand and supply, and economic agents (i.e., *individuals*) operating in it. From agents and context, *individual choice behaviour* (decision process) emerges as a result of their interaction with the *exchange mechanism*. The mechanism is the set of rules and formulae which specify the way offers (e.g., bids and proposal) can be formulated and how they are translated into *outcomes* (i.e., allocation and prices). In other words, it is fed inputs (offers) and yields as its output an allocation of resources among the participating users. The mechanism can be seen as a dialogue between its users leading to an allocation of resources.

Individual choice behaviour does not depend solely on the individual and the environment she or he operates in. The behaviour is a middle layer between the motivations of individual buyers and sellers embedded in their local environment and the feasible actions confined by the market mechanism and the resulting outcomes. The participating users need to formulate their needs in terms, which are acceptable by the mechanism. Therefore, market institutions restrict the users' response behaviour, without uniquely prescribing it (Hurwicz 1973). The outcomes of the use of the mechanism by individuals are the allocation of the resources among the individuals and the corresponding prices which they pay. Finally, *performance* is determined by the outcomes, the environment and the mechanism users. The performance is of the mechanism rather than its users; it is defined by the comparison of the outcomes achieved when two or more mechanisms are employed.

The mechanism design problem is, in fact, the identification of a set of rules for which that the equilibrium outcome satisfies the desired performance expressed by an evaluation function. The evaluation function values the outcome attained by the mechanism in a specific

environment. This formulation is rather general, as it regards not only the preferences of the individual, but also all other possible arguments of the environment. Economic market design seeks to describe mechanisms, which maximize the evaluation function. It is not concerned with the user's evaluation of outcomes, benefits of system features for a given mechanism, perception of the system and possibilities for real-world implementation. The IS discipline, with its concern for peoples' perceptions, beliefs, attitudes and intentions, can help introduce design issues to behavioural economics in order to model real-life systems.

Glass et al. (2004) review of over 1,500 papers from IS, computer science and software engineering shows that the IS papers are predominantly concerned with evaluative and descriptive research (76%) with validation coming from field studies (27%), laboratory experiments (16%) and case studies (13%). Discussion on the system evaluation measure has been, as DeLone and McLean (1992) put it "the quest for the dependent variable". The results of this discussion are not one but several main models, four of which are briefly mentioned below.

TAM is one of the models most often used to explain the willingness of potential users to actually use an information system (Davis, 1989). In this, as well as in other is models technology is viewed as hardware, software, services and their combinations. According to TAM, the actual use of a system is determined by the behavioural intention to use a system. This intention depends on the attitude towards using the system, which is described by two behavioral beliefs: the perceived usefulness and the perceived ease of use of the system. But depending on the amount of exposure to the system, these behavioral beliefs may not solidify from a short period of usage and remain simply behavioral perceptions towards usage (Davis and Venkatesh 2004).

Task-technology fit (TTF): proposed by Goodhue and Thompson (1995) because technology may be accepted and used, and yet fail to bring forth expected changes. The dependent variable is the individual performance and the purpose of the model is to measure the impact of the technology on such. The ttf model, like many other is research models, considers technology as a complete computer system but the technology is black-boxed and no specific features, tools and mechanisms are included. Recent modifications include the "exploration of the black box" (Gebauer and Ginsburg, 2006) in terms of system characteristics rather than its structure. System characteristics include data quality, ability to retrieve and consolidate required data and reliability. They are important but their assessment provides little insight regarding system adaptation and modification.

The end user computing satisfaction (EUCS) model (Doll and Torkzadeh, 1988) and the information systems success (ISS) model (DeLone and McLean, 1992, DeLone and McLean, 2003) explicitly consider object-based perceptions relating to information and system. The purpose of EUCS is to measure satisfaction of users through the measurement of five variables describing information content, accuracy and format, and the system ease of use and timelines in producing data. The model has been widely used and considered as one that is principally connected to the IS field with the premise that this field differs from social and cognitive psychology (Doll and Torkzadeh, 1991, Pikkarainen et al., 2006).

The ISS model was designed to explain the key factors that are accountable for the success of information system projects. The key feature of the model is the separation of the information quality provided by the system from the operational measures of system quality. The former includes such measures as information accuracy, precision, timeliness, and relevance, while the latter refers to such indicators as reliability, response time, and ease of use.

From the IS perspective, the major focus of IS research has been on the attitudes and behaviours induced by the use of instantiated systems in organizations. This perspective brings in the psychological, organizational and social factors into the study of the impacts of information systems. The variables that describe subjective perceptions and aim at the facilitation of adoption of information systems and their impact on the individuals and organizations have been identified. These findings help explain how people perceive systems and which variables help successful adoption of systems by the users.

Behavioural models discussed in the preceding section and their various refinements are largely concerned with technology use, adoption, efficacy and satisfaction of its users. They are less concerned with the issues pertaining to the identification of the concrete is artefacts, features and contributions to the achieved results. They are also less concerned with the identification of types of users, decision problems and organizations that are particularly (un)suitable for a given technological solution.

In this respect, it is worthwhile mentioning recent important concerns raised by the prominent researchers in the field. The first one is concerned with the diversity of themes in IS research and venturing by the researchers into the areas remotely related to the field (Iivari 2003). These tendencies, according to the authors are undermining the very identity of the IS field. The incorporation of system features in theoretical models could help tackle both of these issues. Firstly, the IS artefact would become an organic part of these models, thus battling the "identity crisis". Secondly, this would enable illuminating better design decisions during system development, as the theoretical findings will provide direction and support as to which salient features and functionalities to incorporate for a given class of contexts.

Typically, a system has several components that are used and configured in a way that determines the system's services. Therefore, to assess the usefulness and performance of systems that can be configured and reconfigured in real time, we need to be able to assess its components or artefacts of a technology separately rather than jointly as a black-box. To obtain a comprehensive assessment we also need to consider all four views of technology (tool, perception, model and project). In the case of e-market systems this leads us to draw from behavioural economics and IS research so that a framework is proposed to integrate independent variables from economics (environment, individual) and from IS (task, system features, individuals) with intervening variables relating to process (decision process and evaluation of process) to dependent variables (economic and behavioral outcome, and system perception).

3. Conceptual Framework

In the integrated framework, the characteristics of: *task*, *individual*, *mechanism*, *environment*, and *system features*—jointly called **times**—are included as independent constructs. Below we

will introduce basic concepts and dependencies first by pointing out the differences with economic models and with the IS research models.

The *individual* construct refers to those aspects of individuals that tend to be relevant to market processes and outcomes, including: individual characteristics, number of users, as well as psychological issues such as attitude, beliefs etc. Here, the purpose is to explain the choices made by the individuals in light of their characteristics, and their interactions with the task, system, mechanism, and environment.

The independent constructs of the times model impact, through the user-system interactions, the individual behavioural perceptions and outcomes and also the economic outcomes. Both types of outcomes describe performance of individuals participating in a single transaction (e.g., dyads in bilateral negotiations) and the *mechanism* performance (e.g., English auction and Vickrey auction).

Complex negotiation *tasks* that require substantial cognitive efforts tend to lead to suboptimal solutions (Hyder et al., 2000). People's cognitive limitations, their lack of interest in engaging in highly complex transactions, and their involvement with many competitive activities often lead to their selection of a quick and simple tool which does the work even if the results are not optimal. Some may know that the use of a simple tool allows them doing more elsewhere; others may be unable of learning the tool's intricacies. This latter issue has been studied within the IS domain. Having in mind the importance of the task, it appears reasonable to separate the task from the environment, where the task construct refers to the properties of the goals that need to be accomplished through the use of an exchange mechanism. Rangaswamy and Starke (2000) provide the characteristics of bargaining orientation, degree of conflict, time pressure, and complexity for describing tasks.

The *environment* construct captures the environmental factors that may have impact on the negotiation outcomes, including type of market, type of product, level of competitiveness among buyers and sellers, and other important contextual considerations. The mechanism is an abstract artefact describing the protocol and mode of exchange regardless of its implementation. The description of the mechanism can be based upon the Montreal Taxonomy, which provides a comprehensive schema for classification of such mechanisms (Ströbel and Weinhardt, 2003). The characteristics include: flexibility, rounds, concurrency, number and nature of attributes of offers, offer matching, and offer evaluation. Additionally, the availability of analytical support (decision support capabilities) and mediation can be added for a useful description (Rangaswamy and Starke, 2000). Taking only the mechanism into consideration is, however, not sufficient, as it abstracts away from the implementation and thus limits the consideration of subjective factors explaining its acceptance.

Different from economics, the **times** framework regards the way and form a mechanism is presented to its users, its embodiment into a system and the interaction process between the system and the user to be crucial for studying both systems and their mechanism. We know that the way problems are presented and the way people are prompted to make choices and solve problems, affects their behaviours. A mechanism has to be implemented in some medium; it has to communicate with the user using media. These are design issues and they are no less important for the mechanism, the outcomes and the performance than the mechanism itself. Thus, we include the construct *system* features in our framework. It reflects

those characteristics of the instantiated systems that are implementation-specific, including user interface, various features, and functionalities that process and manage information required by the market participants (Lomuscio et al. 2003).

The transactional *process* is identified in economic models as the choices made by the individuals, and the information provided by the mechanism and other market participants. The decision process is measured through: the strategies and tactics employed by the users to achieve their means; the number of interactions (e.g., offers, bids, etc) that users engage in for a given market allocation; the concessions or behavioral patterns necessary to reach an agreement; and the time require to complete the transaction. IS models – with the exception of the DeLone-McLean ISS model– tend not to model the interaction process. Most models are variance models and according to Seddon et al. (1999) explaining variation in a dependent variable by studying its association with one or more independent variables. The decision process is not only governed by objective variables, but also subjective variables that relay the evaluation of the process. TTF stipulates that systems, which enhance objective decision outcomes and reduce effort, create a high task-technology fit, a necessary condition towards improving outcomes. Lilien et al. (2004) suggest that (cognitive) effort, complexity and learning serve as subjective measures to determine the impact of decision support on the process.

The assessment of performance used in the **times** model is more complicated than the economic notion of performance. The dependent variables are both objective and subjective or "perceived". The former type seems to be emphasized in economics, while the latter has been the focus of extensive behavioural investigations in the area of information systems. The importance of subjective assessments lies in the fact that the latter tend to contribute towards the adoption of the systems by individuals. We have incorporated *economic outcomes* as an objective dependent construct in our model and two types of behavioural variables: *system perceptions* and *behavioural outcomes*.

Objective (economic) outcomes are separated from subjective evaluations because the former describe results important for judging the benefits of e-market systems compared to theoretical values or social welfare. Economic outcomes for individuals include revenue, efficiency (e.g., distance to efficient frontier) and equity (e.g., social welfare distribution).

System Perceptions describe user assessments of the system, which can be object-based (i.e., information and system quality) depending on ISS or behavioral (i.e., usefulness and ease of use) depending on TAM. The incorporation of important object-based and behaviour perceptions had brought together the important theoretical constructs to provide a more comprehensive picture of system adoption (Wixom and Todd, 2005).

Behavioural outcomes pertain to the subjective assessments of the final results, e.g., satisfaction with the outcome, satisfaction with the process and relationship established with other participants. E-market systems may be used to engage in purely economic transactions; they may also be used for socio-economic transactions which involve such issues as trust, relationships and affect (Bakos, 1998). The concept of satisfaction is a behavioural outcome associated with the achievement of both goals established prior the transaction process and the factors that the users did not consider beforehand. Satisfaction is an integrative evaluation of the person's attitudes as they form during a process (Yi, 1990); it is a high level assessment

that integrates other cognitive components. Thus, we have incorporated satisfaction as an important factor towards evaluating the benefit of the system. Since we are interested in both important objective (economics) as well as subjective (behavioural research in IS) factors our framework postulates that the satisfaction and other behavioural outcomes may be influenced by the decision process and evaluation of the process by individuals. The overall impact of times variables on important dependent constructs is shown in Figure 1.

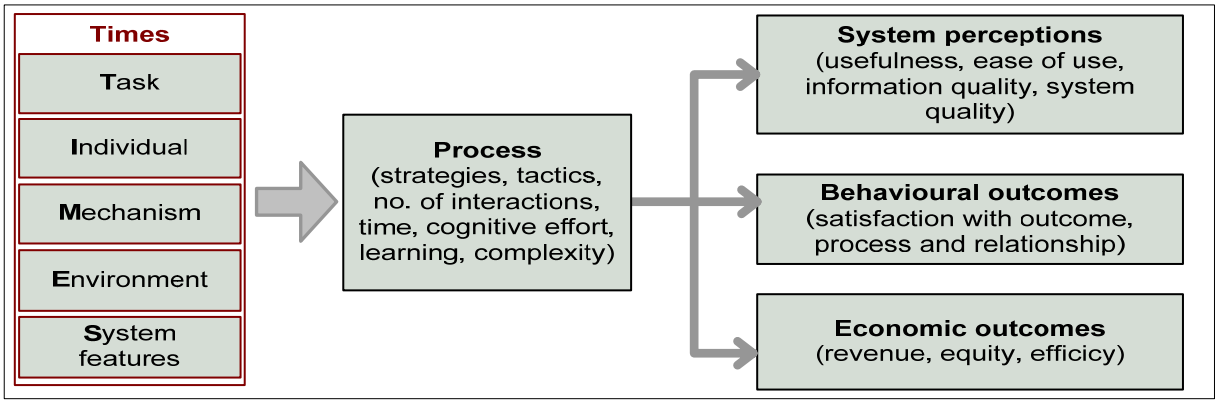

Figure 1. Conceptual framework

4. Methodology

The verification of the **times** framework and its constructs requires several experiments and field studies as it includes behavioural, economic and technical perspectives, all of which allows for the construction of different models. By providing a common foundation for comparative economic, behavioural and IS studies, **times** has the potential to provide a holistic picture of e-market systems. A thorough and exhaustive assessment is beyond the scope of this work; we hope that the two studies reported in this section will be followed by a larger number of experimental and field studies.

For the purpose of comparison of e-market systems, we need a detailed specification of the model constructs and the formulation of the associated research instruments. The comparison has been undertaken as part of the project called "Negotiations or auctions" (InterNeg, 2006). The project focus is the comparison of two market mechanism and two e-market systems. The overview of the project and its relationship to the times framework is illustrated in Figure 2.

In the first study the same software platform was used with a very similar interface but with different market mechanisms, i.e., auction and negotiation. The second study compared the value of decision support in an English auction. In our attempt towards model building, we investigate the effects of mechanism and system feature based on general hypotheses of process and outcome variables, rather than postulating formal hypotheses.

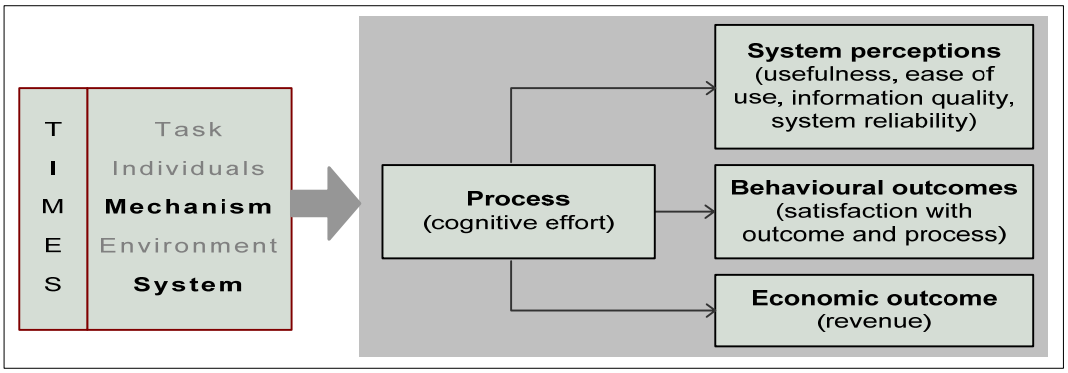

Figure 2. Research model

While widespread popularity of on-line auctions is well known, however their claimed superiority is not obvious. This is one purpose of the project for which **times** was used to construct a research model. Another purpose of the project is to study the system features, and test the relationships between the process (cognitive effort) and the economic outcome (revenue), behavioral outcome (satisfaction with outcome and process) and system perceptions (ease of use, usefulness, information and system quality). In order to show a more concerted research model, variables measuring decision process were traded for cognitive effort as IS literature has stressed the importance of providing users with a system that reduces cognitive effort. Furthermore, the variable satisfaction with relationship in behavioural outcomes could not be measured in an auction system when bidders do not communicate with the owner, and the variables related to efficiency and equity in economic outcomes are not relevant to the simple case design in this project.

We consider the following two exchange mechanisms: (1) multi-attribute English auction with a buyer being the auction owner; and (2) multi-bilateral purchasing negotiation involving one buyer and several suppliers. The auction bidders can submit multiple bids during the process. Between the bids they can have information feedback and they have the chance to adjust their bids. This characteristic resembles negotiation to some extent, and makes the comparison easier.

The difference between auction and negotiation has been the subject of numerous studies. Thomas and Wilson (2002, 2005) found that negotiations and auctions were similar in economic efficiency for a market of four bidders or greater competing on a single attribute. But, when the number of bidders was reduced, negotiation produced higher revenues for the bidders. We hypothesize that:

H1a. Negotiation will generate higher revenue for the bidders than auction.

The behavior outcomes consist of satisfaction with outcome, which is the difference between the results of the exchange in comparison to the expectations that have anchored the process, and satisfaction with process points to the emotions expressed and the degree of conflict felt by the participants (Suh, 1999). Ivanova-Stenzel and Kroger (2005) found that participants were more satisfied with the results derived from an auction because the process is more transparent. We expect that:

H1b(i and ii). Auction will generate greater satisfaction with outcome and process for the bidders than negotiation.

Even though the mechanism is embedded into the e-market system, the difference in the market institution would not interfere with the user's perceptions of the system. We posit that:

H1c(i, ii, iii and iv). Auction will have no differential effect on IS perceptions (i.e., usefulness, ease of use, information and system quality) relative to negotiation.

As auctions require little to no interaction among market participants and the owner, we hypothesis that:

H1d. Auction will reduce cognitive effort for the bidders.

The two mechanisms are embedded in systems features generated by a software platform, Invite (Strecker et al., 2006). Invite allows setting up systems supporting different auction and negotiation processes and varying the range and type features and tools available to the system users. One of important capabilities of the platform is the ability to easily modify the interface of the generated systems. Figure 3 shows two screenshots, the left one comes from the auction system and the right-hand side comes from the negotiation system. In order to reduce the potential impact of the system interface "look and feel" on process and its results the differences between these two systems are minimal (the colouring is different only for illustrative purposes). However, both systems have complete functionalities and provide support for offer (bid) analysis, selection and comparison.

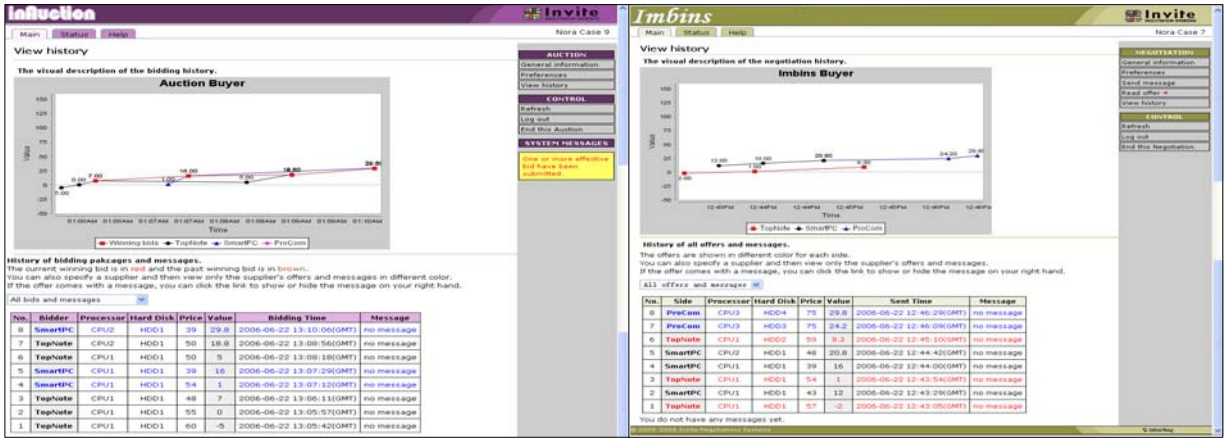

Figure 2. Screen shots of two e-market systems: English auction (InAuction) and multi-bilateral negotiation (Imbins)

Meet2trade is a generic, flexible trading platform facilitating the creation and automation of auction-based markets. The platform is flexible enough to host markets from a large variety of domains and to support various market mechanisms (Kolitz and Weinhardt 2006). It follows a client-server architecture with a central server that structurally conforms more towards actual exchange market settings than Invite. The server provides the running platform for all

available markets as well as the hosting of all data (e.g. user data, account data, product information, protocol data) and the data preparation. The clients connected to this central server display this data and provide an interface for submission of bids and for displaying relevant information. Meet2trade designs auctions for experience users requiring a one page display of pertinent information and, as opposed to Invite, providing little decision support or sequential guidance throughout the process. Figure 4 shows a multi-attribute, English, auction on meet2trade.

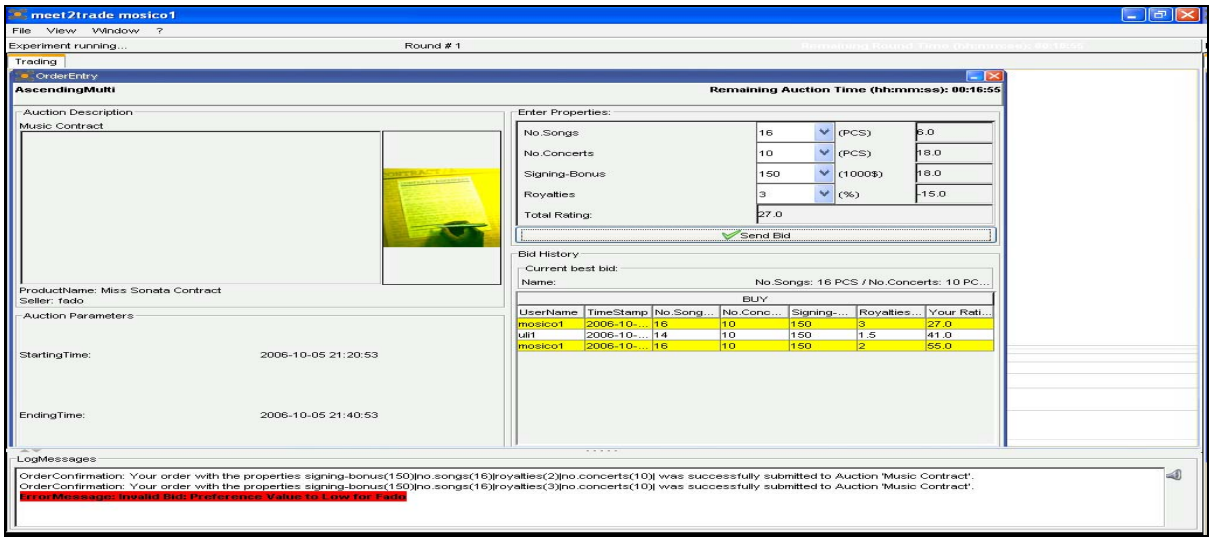

Figure 2. Screen shots of meet2trade (multi-attribute English auction)

Given these different instantiation of Invite and meet2trade, the English auction created in Invite provides greater decision support than that of meet2trade. This difference can be valuable to novice market participants who must engage in multi-attribute discussions. The following general propositions are made taking into account the past research in e-market and related exchange systems described in the previous sections.

From research in IS, objective outcomes (such as revenue) can be enhanced through decision support for inexperience users Lilien et al. (2004). We hypothesize that:

H2a. InAuction (English auction with decision support) will generate greater revenue for bidders than meet2trade (English auction).

While the systems have different user interface, they process bidding information in the same manner, which reduces variation on the impact of sociological aspects on outcome (Delaney et al., 1997). This gap between reality and perception cause us to postulate that:

H2b(i and ii). InAuction (English auction with decision support) will have no differential effect on the behavioral outcomes satisfaction with outcome and process relative to meet2trade (English auction).

Meet2trade is design to allow for rapid, real-time exchange of bid similar to stock markets. It functions on one screen such that users readily see all bidding information. In addition, meet2trade uses Java applet technology that does not require refreshing the browser. Thus, we expect that:

H2c(i and ii). Meet2trade (English auction) will be perceived as easier to use and as providing greater system quality than InAuction (English auction with decision support).

However, the characteristics of system features play an important on its perception according to cognitive theory (Agarwal and Prasad, 1997). Given that Invite provides a history graph and step-by-step guidance through the exchange, we posit that:

H2c(iii and iv). InAuction (English auction with decision support) will be perceived as more useful and providing better information quality than meet2trade (English auction).

In addition, we believe that:

H2c(iii). InAuction (English auction with decision support) will require less cognitive effort than meet2trade (English auction).

Both studies employed a contract case involving: (a) an agent representing an artist, and (b) representatives of three entertainment firms interested in signing up the artist. The case entails four discrete issues: (1) the number of song the artist must introduce each year, (2) the royalties given to the artist for each CD sold, (3) a contract signing bonus, and (4) the number of promotional concerts that the artist must perform each year, all of which are comprised of various options. The importance for each of these issues was explicitly defined for the subjects in the negotiation.

Participants consist of university students from a major Canadian city. Students were used as our purpose is to introduce novice users to potentially e-market systems. They represent future traders who would contribute to the growth of e-commerce. In this study, they play the role of agents who represent one side of the case, and they are randomly assigned to different treatments depending on the study. The experiments were divided into three phases: *pre-exchange*, whereby participants answer questions about the case, their reservation values and expectation, as well as their conflict approach; *exchange*, whereby three subjects in every market interact with the system in hopes of winning a successful contact that is favourable for the principal; and *post-exchange*, whereby participants answer questions on their experience related to the subjective variables.

The variables are categorized as: (1) treatment variables, (2) subjective variables, and (3) objective measure of economic outcome.

The independent variables were manipulated according to the e-market system: Imbins (Multi-bilateral negotiation), InAuction (multi-attribute English auction with decision support) and meet2trade (multi-attribute English auction) following their difference in mechanism and system features.

The subjective dependent variables were measured using slightly altered items from previous research to meet the needs of this project (satisfaction with outcome and process were adapted from (Suh, 1999); cognitive effort was developed based on (Lilien et al., 2004); usefulness and ease of use were modified from (Davis et al., 1989); and information and system quality were adapted from (Wixom and Todd, 2005). Factor analysis served to assess the quality of the seven constructs (information quality, system quality, usefulness, ease of use, satisfaction with outcome and satisfaction with process). In Table A of the appendix show the factor rotation whereby convergent and discriminant validity are supported. It also relates the reliability of the items assessed by Cronbach alphas between 0.708 and 0.896.

The objective market variable is the revenue obtained by participants after the exchange. Since only one bidder can win the auction or negotiation in each market, this variable is determined solely by the winners.

5. Results

In experiment 312 students participated; most were aged between 20 and 30 years old; and the male-female ratio was the same for both mechanisms. There were 20 multi-bilateral negotiations (three parties negotiated with a single counterpart) and 27 auctions with three bidders. The effective samples for this study (i.e. those instances with complete questionnaires) enabled us to conduct analysis on both objective and cognitive measures. The data analysis of subjective measures is only for the buyer side (i.e. the music companies) because there was no auctioneer in auction sessions, such that the sample consist of only 272 records.

The responses collected from the participants were tested using a series of analysis of variance (ANOVA). The results are reported in Table 1 with significant effects highlighted. The bidders' revenue was expected to be affected by the mechanism (H1a) and the system (H2a). However, the results show only support for H2a, meaning that negotiation is no better than auction, but decision support generates higher revenues than no support for the multi-attribute auction.

Users related greater satisfaction with outcome and process for auction compared to negotiation as predicted by H1b(i) and H1b(ii). There was no difference between decision support and no support, which corroborate H2b(i) and H2b(ii).

H1c(i, ii, iii and iv) predicted that difference in mechanism would not result in difference in system perceptions, and it is supported. In terms of system perceptions when different systems are used, meet2trade (no decision support) was found to be easier to use and provided greater system quality than InAuction (decision support), supporting H2c(i) and H2c(ii). InAuction did not result in greater usefulness or information quality as expected in H2c(iii) and H2c(iv).

The cognitive effort required in the exchange process follows H1d and H2d, which means that auction requires less effort than negotiation and systems have no effect.

Further analysis was performed to determine the influence of the cognitive effort on the outcome variables. We ran exploratory regression analyses with cognitive effort as the antecedent on market and behavioral outcome, as well as IS perceptions. The results are

summarized in Table 2. In general, cognitive effort does not affect the participant's revenue, satisfaction with outcome or system reliability. But all e-market systems led users to express that cognitive effort influences their perception of information quality and reliability of the system. When using a negotiation mechanism, users describe that less effort influences greater satisfaction with process. In instances of Invite, less effort allows for higher perception of usefulness.

Table 1. Summary of experimental results of mechanism and system comparisons

	Imbins	**InAuction**	**meet2trade**		
	Negotiation	Auction (decision support)	Auction (no decision support)	Mechanism ANOVA	System ANOVA
	mean (SD)	mean (SD)	mean (SD)	F (p-value)	F (p-value)
revenue	4.95 (16.48)	7.27 (11.04)	0.57 (8.51)	0.44 (0.51)	6.46 (0.013)
satisfaction with outcome	-0.32 (1.86)	0.46 (1.60)	0.28 (1.33)	7.44 (0.007)	0.66 (0.42)
satisfaction with process	1.35 (1.33)	1.72 (0.84)	1.56 (0.84)	4.30(0.04)	1.48 (0.23)
usefulness	1.21 (1.34)	1.31 (1.06)	1.45 (1.11)	0.57 (0.45)	0.77 (0.38)
information quality	1.50 (1.16)	1.58 (0.91)	1.57 (0.99)	0.27(0.61)	0.013 (0.91)
ease of use	1.93 (1.14)	1.81 (0.98)	2.14 (0.72)	0.37 (0.54)	7.08 (0.008)
system quality	0.93 (1.40)	1.07 (1.35)	1.82 (0.91)	0.49 (0.48)	19.11 (0.00)
cognitive effort	0.42 (1.48)	0.92 (1.24)	0.61 (1.20)	4.84 (0.029)	2.62 (0.11)

Table 2. Regression of process (cognitive effort) on outcome variables

	Imbins			**InAuction**			**meet2trade**		
	Negotiation			Auction (decision support)			Auction (no decision support)		
	$\hat{\beta}$	F (p-value)	R^2	$\hat{\beta}$	F (p-value)	R^2	$\hat{\beta}$	F (p-value)	R^2
revenue		ns			ns			ns	
satisfaction with outcome		ns			ns			ns	
satisfaction with process	0.53	22.91 (0.000)	0.28		ns			ns	
usefulness	0.50	19.31 (0.000)	0.25	0.31	8.71 (0.004)	0.10		ns	
information quality	0.45	14.71 (0.000)	0.20	0.31	8.63 (0.004)	0.10	0.33	9.78 (0.002)	0.33
ease of use	0.41	12.00 (0.001)	0.17	0.43	18.30 (0.00)	0.18	0.43	17.97 (0.00)	0.19
system reliability		ns			ns			ns	

The mechanism and system comparisons revealed that revenue acquired by bidders is affected by the difference in providing decision support or not rather than that in mechanism design. However, users report contrary results, in that they are more satisfied with the outcome and process of an auction versus a negotiation. System perception is rightfully unaffected by the mechanism, but a more professional-oriented system with less decision support (meet2trade) increases perceived ease of use and system quality. Even though decision support allows bidders to generate more revenue in auction, they did not report a greater perception of usefulness or information quality than those without support.

The process, in terms of reported cognitive effort, influences perceived information quality and ease of use for all e-market systems, because these two construct describe the participants' interaction with the system. Contrary to auction where market information is readily available to the bidders, bidders are required to elicit information about the market from the owner. This requires more cognitive effort, which impacts satisfaction with process for negotiation.

6. Conclusion

E-commerce has led to the emergence of the new forms of electronic exchange mechanisms driven by the convergence of economic and technological factors. The complexities of these formations preclude one-sided attempts to meaningfully study them from either side. Instead, a comprehensive approach to investigate the components and workings and guide the design of e-markets demand an adoption of the integrated techno-economical frameworks of reference. The purpose of this paper has been to propose a framework for studying the impacts of exchange mechanisms on key variables of interests, both objective, as well as subjective ones. To this end we had reviewed and incorporated relevant concepts from both fields of economics and IS.

The proposed **times** framework allows the study of different types of exchange *mechanisms* in their various implementations (*system features*) within different *task*, *environment*, and *individual* contexts. These mechanisms could range from the simplest catalogue-based models to advanced auction and negotiation schemas. Thus, the framework can accommodate continuity in the key design principles of the mechanisms, as opposed to considering them as distinct classes. **Times** enables the comparison of various exchange structures in terms of the same set of key dependent factors.

The research project reported utilizes **times** to compare multi-attribute English auction to multi-bilateral negotiations and decision support with no decision support in such an auction, and thus we manipulated the independent variables mechanism and system features of our framework. This project provides empirical data for testing the theoretical model, and provides key insights into the implications of design of market mechanisms and of system features. In particular, the process and performance characteristics, as well as subjective perceptions and evaluations induced by these e-market systems are revealed. Comparisons of other mechanisms within **times** will be the core part of future empirical efforts.

While the study of exchange mechanisms has been the primary motivation for developing **times**, we believe it is not limited to studying e-market systems, but it can be used to study other ICT that incorporates economic measures. In this respect, the inclusion of the abstract

representation of the underlying "mechanism" in addition to the concrete implementation-specific features would enable studying broad classes of systems. **Times** could be potentially extended to become a powerful tool for the design research community, as the latter is focusing on developing innovative classes of systems.

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Appendix

Table A. Factor analysis of subjective variables[1]

		SQ	U	IQ	SO	EU	CE	SP	Reliability (Cronbach alpha)
Information quality	IQ1	.162	.337	.791	.134	.009	.128	.057	0.879
	IQ2	.204	.263	.836	.135	.079	.100	.136	
	IQ3	.267	.039	.649	.029	.377	.104	.175	
	IQ4	.230	.194	.762	.113	.275	.113	.117	
System quality	SR1	.742	.134	.208	.094	.267	-.006	.186	0.874
	SR2	.794	.187	.207	.027	.211	-.032	.128	
	SR3	.801	.176	.161	.109	.059	.104	.036	
	SR4	.812	.220	.143	.081	.084	.097	-.023	
Usefulness	U1	.236	.764	.252	.101	.124	.178	.185	0.895
	U2	.178	.834	.210	.203	.156	.125	.109	
	U3	.302	.750	.137	.176	.233	.114	.098	
	U4	.172	.733	.269	.114	.189	.083	.238	
Ease of use	EU1	.225	.270	.157	.067	.776	.163	.150	0.858
	EU2	.321	.276	.088	.046	.722	.135	.159	
	EU3	.084	.086	.215	.071	.839	.131	.049	
Satisfaction with outcome	SO1	.123	.102	.088	.889	.043	.111	.136	0.896
	SO2	.066	.176	.113	.859	.050	.122	.120	
	SO3	.064	.123	.092	.872	.067	.072	.074	
Cognitive effort	CE1	-.056	.100	.095	.137	.150	.855	.058	0.708
	CE2	.066	.084	.241	.163	.015	.797	.165	
	CE3	.192	.217	-.007	.019	.266	.729	.225	
Satisfaction with process	SP1	.013	.109	.106	-.028	.310	.078	.698	0.809
	SP2	.111	.237	.147	.321	-.057	.165	.710	
	SP3	.142	.149	.118	.175	.076	.197	.753	

[1] Factor analysis was rotated by Varimax method with Kaiser normalization.
All seven factors have eigenvalues above 1.