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Abstract

This paper reports on an investigation into the feasibility of an electronic marketplace for the florist chain where cut flowers and potted plants are traded. Despite its potential advantages over conventional auction markets, introducing the electronic market into the florist chain has been challenged by difficulties of product representation. We delineate an electronic auction system that incorporates computer-based trading with multimedia representations for cut flower trades. The electronic auction system decouples product flows from market processes. Since the decoupling brings economic efficiencies as well as risks to traders, the adoption of the electronic auction is highly dependent on decisions of potential market participants. The transition to the electronic market becomes feasible only when benefits gained by the decoupling exceed risks involved. A business simulation game is proposed to test economic behavior and theories behind the transition to this new electronic alternative. Simulated Electronic Auction (SEA) of Flowers, designed for the simulation game, is presented.

1. Introduction

The innovations in information technologies of the last two decades have radically reduced the time and cost of processing and communicating information. The use of this electronic communication allows companies to take advantage of two types of inter-organizational information systems: *electronic integration* or *electronic markets* (Malone *et* al. 1987). When a supplier and a procurer use information technology to create joint processes in value-added chains, they are taking advantages of the electronic integration effect. Electronic Data Interchange aims primarily to exploit the electronic integration effect. One benefit of this effect is curtailed time and cost of communications. Another benefit is that the supplier can ship the products *just in time* for use in procurer's manufacturing process.

The electronic market effect occurs in the case of computer-based markets where information technologies serve as intermediaries between buyers and suppliers. Electronic markets substantially reduce the need for buyers and suppliers to contact a large number of alternative trading partners individually (Bakos 1991). Acting as either broker or auctioneer between buyers and sellers, electronic market systems facilitate parts or the whole transaction process: from search to contract formation and to trade settlement. Electronic markets are of increasing interest because of their advantages over conventional markets. Screen based trading systems can become 24-hour global markets and provide regulatory advantages such as electronic audit and surveillance. In addition, the use of information technologies reduce transaction costs incurred in the market process.

The largest number of flower transactions in the world takes place in the Netherlands. Dutch auctions play an important role to tune supplies with demands of cut flowers and potted plants around the world: growers bring their products into Dutch auctions, where buyers get together to purchase flowers. In spite of potential advantages of electronic alternative over current auctions, introducing electronic markets into the florist chain was challenged by difficulties of product representation (van Heck and Groen 1994). Unlike other commodities, such as cotton or securities, flowers can hardly be represented using text only. Electronic market systems for the florist chain need to incorporate multimedia representation (picture) for the product representation. Thanks to recent innovations in multimedia technology and wider bandwidth communications such as ISDN and ATM, the merge of computer-based trading systems with multimedia communications has become economically feasible.

Without intervention of government authorities, the transition from conventional auctions to electronic markets is feasible only when all intended market participants are convinced of its benefits. Electronic markets in the Dutch florist chain aims to decouple product flows from market processes. This decoupling brings both benefits and risks to market participants. In particular, buyers may face uncertain product qualities because pictures substitute for real flowers in electronic marketplaces. Unless the advantages of the electronic market exceed its risks, the transition is not feasible even though other market participants, such as growers and auctions, are eager for the new electronic alternative.

The principle research question is: *Can the benefits of electronic markets be sufficient to overcome its risks?* Data from real auction markets do not allow the direct testing of trader's choice between different market institutions. Analytic models of trader choice also cannot lead to a unique prediction of traders' behavior. Recently, laboratory experiments have become recognized as a useful and valid way to test economic behavior under different market microstructures, mainly in financial markets (Smith 1982, Clemons and Weber 1991). The trade-off between uncertain

product quality and increased market efficiency is subject to bounded rationality of market participants. The dynamics of traders' behavior can be captured only by a business simulation game. Additionally, the experimental results of the simulation game can provide insights on the implementation of electronic markets later on.

We delineate Simulated Electronic Auction (SEA) of Flowers, an inter-organizational system that simulates electronic markets for the florist chain. The objective of the simulation game is two fold: (1) to demonstrate the feasibility of electronic markets to market participants, and (2) to gain insights into the best design for the full-fledged implementation. This paper describes the initial design of SEA of Flowers, together with incentives to introduce it to flower markets. Real experiments with detailed hypotheses will be carried out in the near future.

Section 2 describes the Dutch florist chain, together with its current clock auction systems. In section 3, we discuss electronic auctions under a market taxonomy and explain the institutional rules which govern trading. This is followed by a discussion of driving forces behind the transition to the electronic auction: potential benefits and risks involved in the electronic auction. Section 5 describes SEA of Flowers, including its design philosophy, the underlining economic model, the use of business scenarios and the automated roles used. Finally, we discuss the significance of this prototype design and future research directions.

2. Flower Markets

2.1 International Florist Chain

Flower industry, or florist chain, is one of the major economic sectors in the Netherlands. The flower industry consists of cultivation and trade of cut flowers and potted plants. Holland has an almost 80% share of the world market. In 1993, the total trade volume exceeded US$ 3 billion and the market is growing at an annual growth rate of 10%. There are several organizations involved in the international florist chain: growers, buyers, auctions, banks and transport companies.

The auction is a co-operative of growers and is obliged to sell all products of its member organizations (growers) through their auction processes. For the sale of their products, the growers pay auctions between 5 and 6 percent commission. Seven international flower auctions are currently under operations in the Netherlands. Bloemenveiling Aalsmeer (VBA), the largest auction located near Amsterdam, is a co-operative of about 5,000 growers and controls 43% of the market. On a typical day VBA processes trading of around 14 million cut flowers and 1.5 million potted plants. Buyers can be large organizations, such as exporters and wholesalers, as well as small ones, such as florists or street vendors. Banks and transport companies have offices in auctions to expedite payment and delivery.

2.2 Dutch Clock Auction

Since cut flowers are highly perishable goods, fast transaction and delivery are vital factors in the florist chain. Auction markets perform two functions for this purpose: market and distribution. Flowers and potted plants, brought to the auction by growers, are sold at the price determined by the Dutch auction process (market), and then handed over to buyers (distribution).

Flowers are cut and brought to the market during the evening or night preceding the auction. Growers either bring the cut flowers themselves or have them delivered by transport companies. Once flowers arrive at the market, they are kept in large refrigerated areas until the time of auction. All the flowers are inspected by the auction's own inspectors (Flower Master) who check the quality of each lot. Their remarks are recorded in computers so that they can be displayed during the auction.

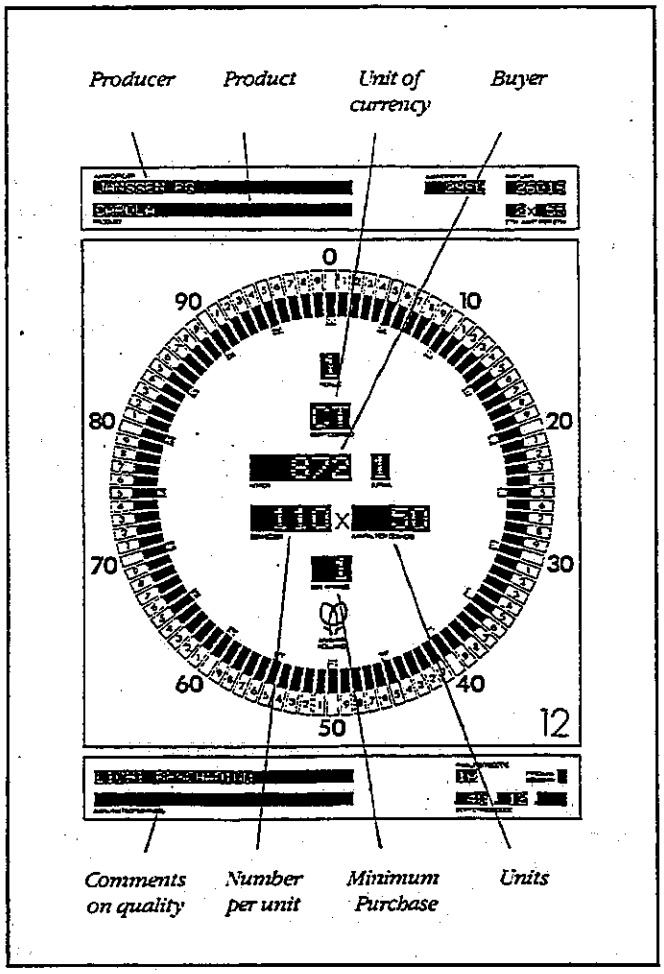

Figure 1 Clocks for Dutch Auction

The auction takes place in auction rooms which are equipped with clocks and buyers' bid desks. Auction normally starts early in the morning and goes on until all the products are sold. When a buyer registers, he is given a buyer's card coded with his own number. When the buyer's card is put into the buyers' bid desk in the auction room, it unlocks the push button needed for bidding. The products are sold by Dutch auction rules: an auctioneer begins by asking a high price and gradually lowers the price until some bidder takes the offer. Clocks are used for this purpose. The clock runs from the highest to the lowest prices and a buyer stops the clock by pushing a button when the running light along the clock reaches the price he

wants to pay. The person who first stops the clock becomes the buyer, and his number appears on the clock board. During the auction process, the clock board also displays product information such as producer, product name, supply lots, comments on quality (provided by the Flower Master), and so on (See Figure 1).

It should be noted that flowers go through the auction hall during the auction so that buyers can make purchasing decisions based on what they see. After being sold, the lots are driven out and are loaded into vans or trucks arranged by buyers. Buyers pay cash at the cashier's office or have the bill sent through their banks. In this way, products auctioned in the morning can be sold the same evening or the next morning at florists and retailers in Europe, USA, Canada and practically any other part of the world.

3. Electronic Auction (EA)

3.1 Market Structures and EA

Market structures can be classified into four types depending on how traders search for their counterparts: (1) direct search markets where traders must seek out compatible trading partners independently; (2) brokered markets where traders employ agents (brokers) to conduct the search; (3) dealer markets where traders exchange goods with dealers who hold their own inventories and are always willing to buy and sell; and (4) auction markets where traders transact directly against the orders of other traders by communicating through a single central intermediary (Garbade 1982). Information technologies can be employed to create electronic markets in either brokered markets, or dealer markets or auction markets.

Computer Reservation Systems (CRS), such as SABRE or Apollo in the airline industry, can be classified as electronic brokerage. By subscribing to SABRE, travel agencies can have access to flight schedules and fares of airline companies around the world. Another example of the electronic brokerage is FAST, a computer network broker for electronic parts and components (Neches 1993). A consumer can send a request for quote (RFQ) to FAST via Internet or commercial networks. FAST distributes the RFQ and receives quotes from vendors in an attempt to link the customer's request with the best quote. Electronic shopping systems such as CompuServe or Prodigy can also be characterized as an electronic brokerage, as they help consumers to search for products which best fit their preferences.

Well-known examples of electronic market systems in dealer markets are SEAQ in the International Stock Exchange in London, and NASDAQ in the United States (Cohen *et* al. 1986). In the SEAQ, dealers display their quotes over computer terminals so that customers can find the best dealer bid or the best dealer ask. Similarly, dealers can expose orders to the market by displaying quotes on the NASDAQ system in the OTC market in the United States. NASDAQ and SEAQ do not execute trading: they simply help investors execute at the best price by displaying dealer bid-offer quotes in electronic boards.

Computer-based trading systems in auction markets (electronic auction) automate order matching between buyers and sellers. The electronic auction was pioneered by Toronto Stock Exchange's CATS (Computer Assisted Trading System), where orders to sell or to buy are electronically submitted and automatically matched by a certain matching rules based on price and quantity (Freund 1991). Other examples in financial markets include Instinet, INTEX, SOFFIX, and Globex (Cohen and Schwartz 1989). Electronic auction markets are also introduced in some commodity spot markets. For example, TELCOT is an electronic auction system for cotton trading (Lindsey *et* al. 1990). TELCOT automates all aspects of cotton trading, from the matching of buyers and sellers to the transfer of funds and titles. Electronic markets for the florist chain belongs to this category since orders to buy and to sell are matched by computer-based market systems.

3.2 Trade Governing Rules in EA

In electronic auction systems, bids and offers for products are submitted by traders via computer terminals to a computer-based market system. Buyers and sellers can place their orders using standard messages and protocols over commercial networks. When order messages are received by the computerized market system, they are automatically entered into the database. The trade match algorithms then transform the streams of bids and offers into transactions based on trade governing rules.

Since orders are matched automatically, trade governing rules used for the order matching are crucial to all market participants: buyers, sellers and market makers (trading system developers). Continuous trading and periodic call trading have been widely used as trade governing rules in financial auction markets (Whitcomb 1985). In the continuous trading, transactions occur whenever a buy and a sell order cross. In the periodic call trading, by contrast, orders are accumulated over a period of time, rather than being transacted immediately, and are transacted later in a batch. That is, the periodic call trading aggregates buy and sell orders and seeks a market price that equates supply and demand.

Neither continuous trading nor periodic call trading is appropriate for a trade governing rule in SEA of Flowers because of differences between flower markets and financial markets. Since SEA of Flowers aims to replace current flower markets, its trade governing rules should be as close to the Dutch clock auction as possible. In addition, the electronic auction need to provide buyers with product information, such as price, quality and growers, so that buyers can decide their bid prices before the auction is held. This contrasts with financial markets, where buyers can make purchasing decisions without seeing products.

SEA of Flowers provides an opportunity to test diverse trade governing rules that can be adopted by trading systems developers. Since different rules result in different market prices and performances, the decision on the trade governing rule is critical when electronic markets emerge. The SEA of Flowers prototype employs a trade governing rule that is implementable as well as close to current price discovery mechanisms in flower auctions. Other forms of trade governing rules can be implemented to explore alternate institutional rules.

4. Decoupling of Products Flows and Markets

Current flower auction markets refer to a physical location where suppliers and buyers get together to sell or to buy flowers or potted plants. As a result of market formation, various bid and ask prices are quoted and goods are handed over from suppliers to buyers at market prices. Product flows are coupled with the market process that determines the actual transaction prices. Electronic auction systems, on the other hand, decouple product flows from price determination mechanism in markets. Bids and offers for products are submitted electronically and computer-based trading systems determine the market price based on bids and offers. Products stay at sellers' places during the market process and flow after being sold out via on-line transactions.

The decoupling of product flows from the market process may result in risks as well as benefits. Before discussing the design of the electronic auction system for the florist chain, we elaborate its potential benefits and pitfalls. In the florist chain, the decoupling can be advantageous from three perspectives: (1) interactivity between traders and market, (2) network externality, and (3) efficient transactions.

4.1 Increase of Interactivity of Traders with Markets

Growers: In general, sellers establish reservation (ask) prices because they do not have perfect information about the consequences of their actions in markets. The reservation price plays a role as sequentially rational rules under incomplete market information (Stigler 1961). In current Dutch clock auctions, sellers are not allowed to specify their reservation prices. Once being cut, flowers should be sold out whatever the market price is, since cut flowers are perishable goods. The auction market sets up the minimum price for each product offered to the market. But the minimum price is a system price to protect market prices, rather than supporting reservation prices of sellers. For a grower, a reservation price reflects individual costs and profit margins. If product flows are decoupled from the market process, a grower can specify his reservation price, i.e., the lowest price at which he is willing to sell. If there is no buyer who is willing to pay higher than the grower's reservation price, a grower may withdraw his products from the market and offer them to the market again later on, since flowers are not harvested until sold. However, there are only a few days of flexibility for fresh cut flowers.

Buyers: Decoupling allows buyers (wholesalers and exporters) to respond flexibly to local retailers' demands. In the current auction system, buyers can get the information of available products only on the day of auction. Decoupling can expand this time horizon to several days. This expansion is significant to buyers who are in principle sellers in retailer markets. Prices of flowers change significantly day by day depending on supply and demand. For instance, it is not uncommon that a price of rose sometimes varies up to 20% or 30% in sequential trading days. If the electronic auction provides a database of products in the market, together with their auction schedules, big buyers can communicate with retailers based on the database. They can use the response from retailers to make purchasing decisions, such as what to buy, how many lots to buy, and how much to pay. Since buyers have better information in advance on the supply from growers as well as the demand from retailers, they can come up with better bidding strategies, increasing the possibility of higher profits. This interaction with auction and retailers should allow buyers to smooth out the supply and demand fluctuations.

4.2 Network Externality

The benefits realized by individual participants in an electronic marketplace increases as more organizations join the market. This property, known as network externality, can affect the dynamics of the introduction and adoption of electronic market systems (Katz and Shapiro 1985). Electronic market systems with large installed bases create more value for their participants, who are provided with a wider selection of potential buyers and sellers. There are seven international flower auctions in Holland currently under operation. Each auction market has several auction rooms: an individual auction room can accommodate from 200 to 400 buyers. For example, VBA has five auction rooms, each with two to four clocks.

In current clock auction systems, a product offered can be exposed to buyers sitting in a single auction room. Bids of buyers are also restricted to products auctioned in a single auction room. The electronic auction can remove physical barriers to integrating several auction rooms into a virtual single market. In the long run, the electronic auction also paves the way for integrating seven auctions into the larger international market. This integration will enable buyers and sellers to find better trading partners in terms of price and quality.

4.3 Efficient Transactions

Economic efficiency can be gained when information flows for the market process are decoupled from the product flows. Because traders place bids and offers through computer terminals, they do not have to incur travel costs to come to the markets. The decoupling also brings an economic efficiency to trade settlement: delivery. In the florist chain, growers specialize in one or two types of flowers, thus cultivating a few products in a large scale. Buyers purchase a wide range of flowers from several growers and bundle them into packages for retailers. A wholesaler purchasing a large number of lots from a nearby grower may have goods delivered directly to his location, if it is cheaper than current indirect deliveries. If the direct delivery is not justified economically, traders will continue to use the current distribution at auction markets.

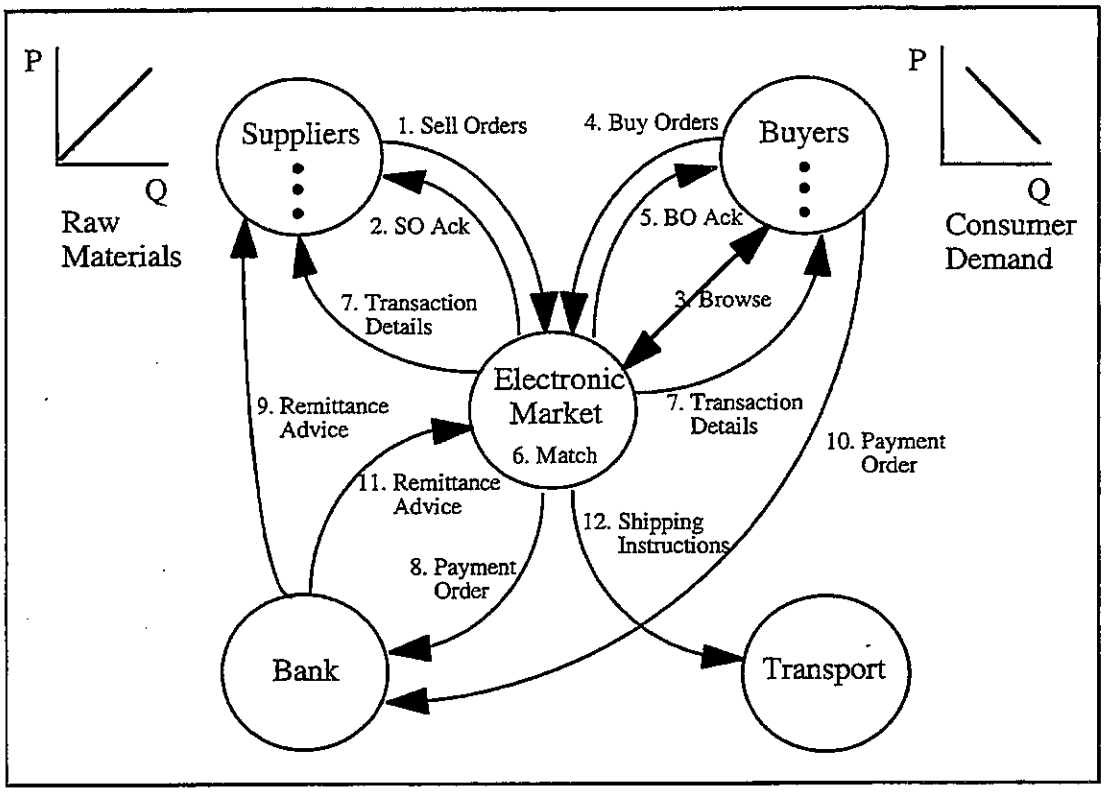

Figure 2: SEA Games Scenario

Auction market organizations have strong motivation toward decoupling product from information flows. They can accommodate ever increasing trading volumes without expansion of physical infrastructure. With annual growth of 10% in the trading volume, all seven auction markets have been increasing their storage spaces and auction room capacities. Even VBA with a refrigerated space of 30,000 m^2 is currently concerned with its lack of capacity to handle daily transactions. Direct delivery from growers to buyers, if any, will ease this capacity problem. Even in the case of indirect delivery, the decoupling enables auction organizations to utilize the infrastructure more efficiently. Since flowers and potted plants can be delivered to the market by flexible schedules, the use of storage space can be curtailed or even eliminated. This contrasts with the current distribution method, in which all products offered to the market have to be delivered and stored altogether by the night before the auction.

4.4 Product Representation using Multimedia

In the current clock auction system, markets provide a centralized product quality control point, since all products are delivered and inspected by a professional Flower Master. The Flower Master checks the quality of each supply lot and grades them accordingly. Buyers have an opportunity to inspect the quality themselves before the auction and also during the auction when the products pass through the auction hall. Buyers decide their bid prices on the basis of the remarks made by the Flower Master and on the basis of what they see. In the electronic auction, by contrast, buyers purchase flowers without seeing them. Pictures in the product database (product catalog) replace the original products. Therefore buyers may face uncertain product quality.

There are several aspects which should be addressed to overcome this limitation. First, the technology of multimedia should provide high quality pictures good enough to substitute for original flowers. Second, this multimedia representation and communications should incur reasonable costs so that all market participants can afford it. Finally, markets need to have a different product control mechanism to ensure that the picture accurately represents the product quality.

Our conclusion from the above analysis is that the formation of electronic auctions results when the risk of uncertain product quality is less than the benefits gained through the decoupling. Once the benefits outweigh the uncertain quality, transition to the electronic auction becomes feasible. Analytic methods cannot determine this trade-off point since traders' judgments involve a certain degree of subjectivity. Alternatively, fully implemented systems are expensive ways to find negative results. We propose that a business simulation game be used to test economic behavior and theories behind the transition to electronic auctions. SEA of Flowers is designed for this experimental purpose. Finally, the results of market simulations can provide insights on the implementation of real electronic markets.

Document	Document Name in SEA	Document	Document Name in SEA
Buy Order	GA-BO	Market Transaction	GA-TNS
Buy Order Ack	GA-BOACK	Failed Market Order	GA-FMO
Buy Order Cancel	GA-BOCAN	Payment Order	GA-PAY
Sell Order	GA-SO	Remittance Advice	GA-REM
Sell Order Ack	GA-SOACK	Financial Return Notice	GA-FRN
Sell Order Cancel	GA-SOCAN	Account Summary	GA-ACC

Table 1: Business Documents

5. SEA Design Prototype

5.1 SEA Background

The Simulated Electronic Auction (SEA) project was formed by three independent lines of investigation. Wagenaar (1991) developed the EDIGame to provide a simulation tool for understanding logistical functions within a port scenario. Wrigley (1992, 1995) developed the IOSGame to provide a general gaming environment for building and experimenting with electronic commerce scenarios. Although the IOSGame uses EDI to support bilateral trading partner relationships, neither the EDIGame nor the IOSGame provided automated search or price discovery among players. Lee and Lee (1994) provided trade matching mechanisms for price discovery based on single or multiple product attributes, mainly for commodities. This experience, and some of the software from these three projects, formed the inputs to the SEA. During the early part of 1994 we built the prototype and added multimedia product representation capabilities.

SEA is designed as a technology platform by which electronic markets of *any* product can be built. The features of the electronic auction in SEA hold for other products as well as flowers. As a first application, we chose the Dutch florist chain because cut flowers are challenging products for multimedia representation. Our assumption is that, if shortcomings of multimedia representations are outweighed by economic gains in flower markets, this finding will hold for other goods whose product representation is less challenging.

5.2 Market Scenario

The central feature of the SEA is that it is played within the context of a business scenario. A business scenario is defined as a number of interdependent firms who coordinate their activities to produce and deliver economic goods within a well-defined market. It includes not only different firm types but also many firms of each type. Firms of the same type compete for market share or profits while firms of different types engage in trade either through bilateral contracts or through a computer mediated market mechanism. Figure 2 provides the example market scenario along with the sequenced exchange of documents. A business scenario specifies: (1) the role definitions of each enterprise in the economic sector and (2) their business protocols. A business protocol is the defined sequence of messages and their contents, exchanged among two or more trading partners such that commerce occurs smoothly. A business protocol must necessarily specify the message type for each business purpose, the anticipated response to each message, and clear rules as to the appropriate action in case of error or message time-out. All trading partners should know the proper sequence of messages for offering to buy or sell from the market, and for completing the trade cycle in terms of goods' delivery and payment.

5.3 Business Documents

Companies use the documents listed in Table 1, and shown in Figure 2, to interact with the SEA market and other trading partners. Each document has its corresponding implementation in X.12 (North American EDI Standard) and EDIFACT (International EDI standard).

5.4 Economic Model

The underlying economic model of the game environment involves two counter rotational flows among firms: product and money, and bi-directional information flows. The GameMaster controls money flowing into the economy and product flowing out of the economy by adjusting consumer demand in retailer markets. The GameMaster also controls product flowing into the economy and money flowing out of the economy by adjusting input supply quantities, prices and elasticity. Each firm receives initial capitalization including goods, cash, technology, land and buildings. Between resource inflow and resource outflow a variable number of processing, or value-added activities can be designed into the scenario. Firms engage in trade and coordinate their activities through the exchange of business documents.

The GameMaster balances the model at the beginning of the game so that each firm has an equal opportunity to make profit. Each firm receives software game tokens by the GameMaster at the start of the game. These digital tokens represent physical assets that include: land, buildings, production technology, and a transport technology, as well as the goods that firms buy and sell. The game software controls token manipulation to ensure that players do not violate physical laws. For example, players cannot modify a 1000 tulips token into 5000 roses, nor arbitrarily duplicate the token without detection. Additionally, each technology token has capacity constraints per unit time to ensure that the technology behaves consistently with the simulated industry sector.

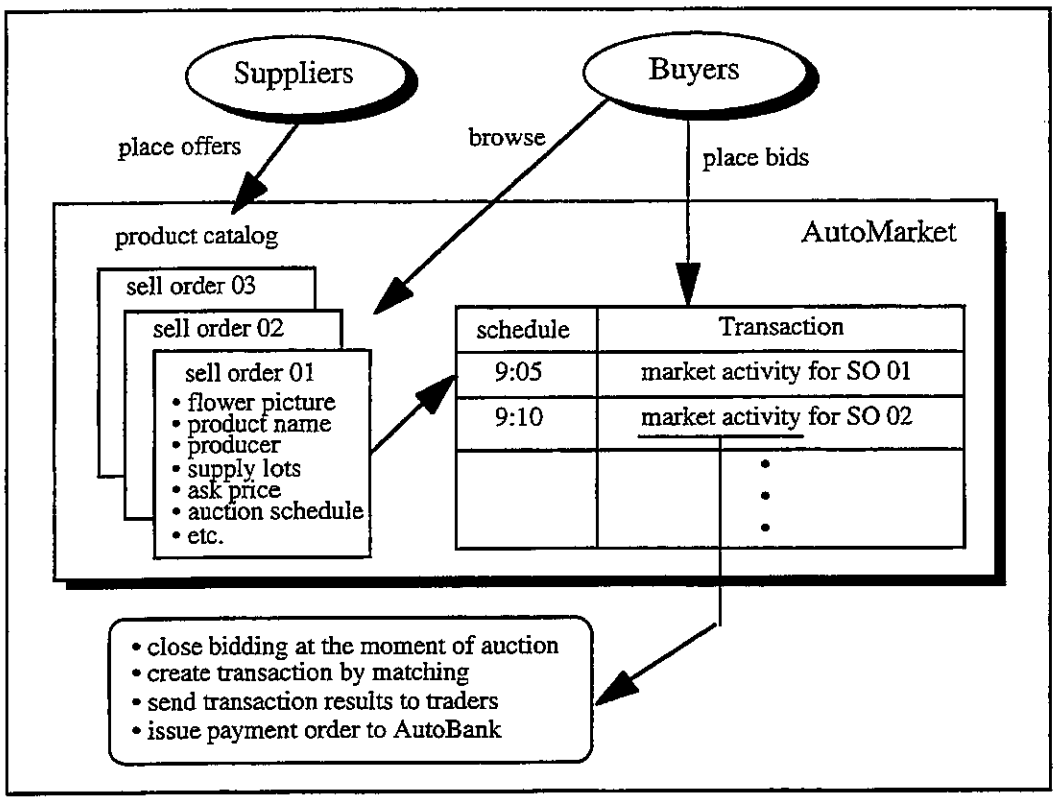

Figure 3: Simulated Electronic Auction

5.5 Player Roles

In the simplest market two roles, sellers and buyers, form the competitive market. Sellers' reservation prices are constrained by production cost and profit margin, while buyers are constrained by a backward sloping demand function of each product in retailer markets.

5.6 Automated Roles

SEA uses three automated roles that operate independent processes on the Internet. These roles run continually allowing 24 hour real time support, although some roles have certain tasks that run on a defined schedule.

AutoMarket: The purpose of the AutoMarket is to act as an intervening market mechanism between players, providing product search, price discovery and contract completion. The automated market accepts sell orders from suppliers and generates sell order acknowledgments with a unique sell order number. These sell orders are made available to buyers through a multimedia browser (see Figure 3). Buyers may select the sort sequence with which to view the current sell orders. For example, buyers may view the market by product type or by supplier ID. The market also accepts buy orders and provides buy order acknowledgments with unique buy order number. The order matching algorithm can be initiated in a variety of ways. Once matches are made, players receive either market transaction details or failed market orders. Successful market transactions also generate payment orders to the Autobank, which forwards remittance advice documents to suppliers.

AutoBank: The AutoBank maintains account balances and transaction history for all players in the game. Each time one firm wishes to pay another firm, they send a Payment Order to the AutoBank. The AutoBank validates the transaction, debits the payer's account and credits the payee's account, then sends a Remittance Advice to the payee. Payments received in error generate a Financial Return Notice that the AutoBank returns to the payer. Additionally, the AutoBank sends periodic Account Summary statements to all firms. Except for occasional intervention by the GameMaster to handle error conditions, the AutoBank runs in background mode.

EDIMail: The EDIMail program acts as a communication gateway to the Internet by continually polling each user directory for pickup and delivery of new documents. The primary purpose of the EDIMail program is to encapsulate EDI messages inside Email envelops according to the MIME (Multimedia Internet Mail Extensions) standard.

5.7 Trading Rules

Once products are offered by growers, the AutoMarket assigns auction schedules to lots and constructs a product catalog, which can be accessed by buyers. The product catalog contains product information necessary for buyers to make purchasing decisions, including supply lots, growers, ask prices, auction schedules and pictures of flowers (see Figure 3). Buyers bid on a blind basis for a product entered in the product catalog. All buy orders are valid as long as they are received before the scheduled auction time. At the moment of auction, the AutoMarket closes the bidding for the product and awards the product to the highest bidder,

provided the price was equal or above an ask price (reservation price) set by the producer. Equal bids are sorted on the FIFO (First In First Out) basis.

6. Discussion

With SEA of Flowers, we attempt to demonstrate that the transition from established flower auction markets to a potentially superior electronic auction is feasible. Since the adoption of an electronic marketplace is highly dependent upon the decisions of a group of potential market participants, a business simulation game is proposed as a way to test its feasibility. This paper delineates the first prototype design of SEA. A set of business simulation games will take place with experimental subjects to estimate *a priori* the potential value of the electronic alternative. Detailed and testifiable propositions will be developed based on our analyses.

SEA prototype provides a vehicle for investigating a number of research issues. The issues fall into three general categories: product attributes, trading mechanisms and market structures. The first area for investigation is to examine the conditions under which different types of products may be brought and sold using multimedia. Here the critical issue revolves around product representation quality as compared to standard attributes, which may be conveyed using textual data. The second area involves examination of different market mechanisms including price discovery and multi-attribute matching rules. The performance comparison of different trading rules provides market makers with crucial information. The third area involves experimenting with different market structures. For example, to examine the effects of expanding a market's size, SEA may be used to compare markets characterized by several small independent groups, with a market where all groups are pooled into a single larger market. Additionally, since electronic markets are forming every day, some more successful than others, one critical question is to determine the minimum size, in terms of market participants, necessary to form a stable market. Finally, SEA will allow us to look at transition feasibility from one market regime to another. For example, from a direct search market to an auction market.

SEA also has a significant educational value. Experiences with both the EDIGame and the IOSGame are that players can gain an enormous amount of hands-on experience simply by being placed in a competitive gaming environment. These benefits can be brought into the SEA environment. Electronic commerce concepts, revolving around the communications and document standards, also form part of the learning experience. In addition, SEA adds exposure to market mechanisms and multimedia product representation: both the advantages and shortcomings. For students and practitioners of information systems, response time and bandwidth requirements for different market situations become readily observable.

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