Information Technology, Competition and Market Transformations: Re-engineering the Dutch Flower Auctions

Ajit Kambil* & Eric van Heck**

*Information Systems Department
NYU Stern School of Business
Room 9-82, 44 West 4th Street
New York, NY 10012
212-998-0843
212-995-4228 (fax)
akambil@stern.nyu.edu

**Department of Management Studies
Wageningen Agricultural University
Hollandseweg 1
6706 KN Wageningen
The Netherlands
(+31) 8370-83315
Eric.vanHeck@ALG.BK.WAU.NL

Working Paper Series
Stern #IS-95-1

Information Technology, Competition and Market Transformations: Re-engineering the Dutch Flower Auctions

Abstract

The Dutch flower auctions have play a critical role in the world cut-flower industry by providing efficient centers for price determination and transactions of flowers between buyers and sellers. These auctions owned by by Dutch cut-flower grower cooperatives have traditionally used the "Dutch auction" as the mechanism for price determination. This paper considers how changing patterns of international competition, buyer preferences and information technology are likely to effect the organization of the Dutch flower auction. We provide a framework for analyzing the merits of different transaction models and use this framework to evaluate the strengths and weaknesses of existing and proposed electronic auction models for trading flowers. We propose information technology will enable new forms of trading that will partly replace and supplement the traditional Dutch auction as a method of organizing price determination and transactions. We identify how electronic trading will differ from prior mechanisms, and consider key challenges to the implementation of new auction models. Specifically we illustrate how the current auctions have been structured to serve the interests of growers, while electronic markets will primarily benefit buyers. Thus we highlight the importance of altering incentive and ownership structures in the Dutch flower industry to effectively transition to new electronic markets. This case illustrates the various complex issues that arise in the design and implementation of electronic markets, in settings characterized by changing technologies, pre-existing organizational processes and power structures.

1.0 Introduction:

Information technology enables new ways of competition and coordination changing the ways in which individuals and organizations exchange goods and services. In this paper we critically examine how technology, competition and changes in the international flower trade are re-shaping the structure of exchange among buyers and suppliers to the Dutch flower auctions. The Dutch flower auctions are the world's leading centers for price determination and trading of cut-flowers and potted plants. Holland is also the world's largest exporter and distributor of flowers dominating world export markets with a 65% market share (Haak, et al., 1992).

Despite comparative disadvantages in natural factors of production such as weather, labor and land costs, Holland remains the world leader in the flower industry. The Dutch flower industry maintains worldwide leadership by effectively coordinating and managing a combination of systems. These include: innovations in seeds and efficient production techniques, excellent price determination and logistic systems, and feedback systems from customers to determine new product varieties. However, the Dutch flower industry faces new challenges from increased foreign competition, changes in buyer preferences and the application of new technologies to the production and distribution of cut-flowers.

In this paper, we examine how the Dutch flower auctions use information technologies to adapt to the above challenges and consider alternative models of trading made feasible by these technologies. We begin our analysis in section two with a description of the Dutch flower industry and auctions. Next in section three we use transaction costs and political economy perspectives to propose a framework for comparing the strengths and weaknesses of alternative trading models. In section four we use this framework to evaluate the strengths and weaknesses of the traditional Dutch flower auction. In section five we examine how the Dutch flower auctions currently use information technologies, and evaluate various technology initiatives undertaken by these auctions to re-organize trading. In section six we identify feasible models for re-organizing the flower auctions and use our framework to compare and contrast electronic auctions and the traditional

Dutch auction. We also examine how the history and the ownership of the auctions and flower auctions are likely to shape the adoption of new electronic markets. We conclude our analysis in sections seven and eight by developing a series of propositions on the process of adapting to electronic trading and the likely organizational impacts of electronic trading on the Dutch flower auctions.

The traditional literature on information technology and exchange focuses on the effects of technology on the choice of markets, hierarchies, and partnerships for coordinating exchange (Bakos, 1991, Johnston and Lawrence, 1988, Malone, et al., 1987, Powell, 1990). In contrast, this paper focuses on the role of technology and global competition in reshaping one specific market. While more recent studies evaluate the role of IT on the microstructures of financial markets (Clemons and Weber, 1990, Clemons and Weber, 1991, Cohen and Schwartz, 1989, Economides and Schwartz, 1993, Riess, 1989, Smith and Williams, 1992, Weber, 1991), this paper examines the effects of technology on the structure and processes of a market for perishable physical products, characterized by one way trading between suppliers and buyers. This rich case and analysis illustrates the complexity of designing new electronic trading mechanisms in settings characterized by changing technologies, pre-existing organizational routines and power structures. The case will also highlight how prior history and ownership of trading structures will likely influence the transition to new markets. We also provide a framework to compare and contrast the strengths and weaknesses of alternative trading mechanisms, and propose likely trajectories for the adoption and evolution of electronic markets. We developed this research study by interviewing key officers of the Dutch flower auctions, and the analyzing of industry reports and archival data on the auctions collected over the last two years.

2.0 Background

2.1 The Dutch Flower Industry

Cut-flower production and distribution is one of the most successful sectors of the Dutch economy (Haak, et al., 1992). Since the mid-1970's the cut-flower industry has shown explosive growth. In 1993 Dutch growers produced over 7.8 billion blooms and the flower auctions collectively traded more than 4.9

billion guilders (about $2.5 billion) in cut-flowers, contributing over 4 billion guilders annually to the Dutch trade balance.

The Dutch flower industry consists of about eleven thousand growers and nearly five thousand buyers. Growers are typically family businesses that grow flowers in specialized greenhouses heated and lit by the country's abundant supplies of natural gas to create a suitable climate for growing flowers. Increasingly growers face competition from Kenya, Spain, Israel, India and Colombia. Lower labor costs, fewer environmental regulations, the diffusion of agricultural technologies, lower trade tariffs and cheaper air transport have enabled these low cost foreign competitors to effectively compete against Dutch growers for lucrative European markets. At home the Dutch growers also face new cost pressures from increasing land costs, more environmental regulations, and political pressures to reduce subsidies for gas prices. The above changes increase the direct as well as opportunity costs faced by growers who maintain greenhouses. In response to these changes, growers are shifting their product mix to high value added flowers that serve year round "impulse" buyers in contrast to just serving the "occasions" (e.g., Christmas, Valentines Day, etc.) market. Future growth of the Dutch industry will require occasions' markets such as the United States and the United Kingdom to become impulse markets such as Germany and France.

Buyers from various wholesalers and retailers participate daily in the Dutch flower auctions to purchase flowers which are then repackaged and resold to end consumers or retail stores. As supermarkets and large retail store chains become outlets for flowers, individual buyers purchase larger volumes and are becoming more sophisticated in coordinating purchases across different auctions. There are also economies of scale in the purchase and distribution of flowers leading to greater buyer concentration.

2.2 The Dutch Flower Auctions and the Trading Process

The Dutch flower auctions are key institutions in the world flower industry. They provide a setting for price determination and are the point where the growers' supply of flowers meets the buyers' demand. The auctions use the "Dutch" auction method for price determination. The method uses a clock,

where the clock hand starts at a high price and drops till a buyer stops the clock to bid for and take the lot. The Dutch auction is very efficient as an auction mechanism. It frees growers from the price determination process and the task of bidding and allows them to focus on production. Indeed a Dutch cauliflower grower invented this mechanism for trading agricultural products in the 1870s to reduce the time spent by growers at markets. The auction also provides a central location for the meeting of buyers with suppliers allowing for efficiencies in the logistics of product redistribution.

There are nine flower auctions in the Netherlands. The two largest flower are in Aalsmeer (VBA) and Naaldwijk (BVH). The remaining auctions sell specialty flowers or are more local distribution mechanisms. The world's biggest flower auction is in Aalsmeer nearby near to Schiphol airport, on of Europe's largest air cargo transportation centers. The Aalsmeer auction is one of the largest commercial buildings in the world spread across the equivalent of 100 soccer fields providing space for 2,000 buyers. Flower auctions occur in different auction rooms under nine different clocks each of which can handle 1,000 transactions an hour (approximately one transaction in four seconds). On average fifteen million flowers trade daily in 50,000 transactions, generating an annual turnover of 2.4 billion guilders. The Aalsmeer auction is owned by a cooperative of about 5,000 growers.

The auctions constitute a critical part of the trading process that begins when growers harvest the flowers (Woodward, 1993). Typically growers may harvest roses for export to the United States at 11 o'clock on Monday morning. By 3:30 p.m. machines will have sorted the roses by as many as 200 varieties, and by the length of the stems. These roses are gathered, labeled for quality, and packed in uniform plastic tubs for transport. By 10 o'clock in the evening the flowers arrive at the auction house where they are stored in cold storage overnight. Next morning at 4:30 a.m. they are transported to the collection hall, inspected, assigned lot numbers and assembled onto “stapelwagens” or uniform carts for transport into the auction hall. The stapelwagens are then towed into the auction halls where their contents are auctioned, beginning at 6:30 in the morning in auction rooms with up to 500 buyers. The computerized auction clocks in the room provide the buyers with information on the producer, product, unit of currency, comments on

quality and minimum purchase necessary. Using the Dutch auction the first buyer who stops the descending clock by pressing a button, accepts the lot for the highest price. These transactions are completed every four seconds on each clock and such bidding continues until all lots have been sold.

Once the auction is complete, each lot of flowers is tagged with a computer print out of the sale and distributed to the buyer's area in the auction house where they are repackaged and boxed for air or land transport. Flowers exported to New York are transported on a special eight hour KLM flight, which departs Schiphol airport at 7:10 p.m. and arrives in New York at 9:10 p.m. local time. The cargo is then unloaded, inspected, cleared by customs and shipped to nearby warehouses or to other to wholesalers. The next morning lots are sold to a network of 170 wholesalers around U.S. The wholesalers in New York City receive their purchases from the importers as early as 3:30 a.m. on Wednesday and the produce is sold from retail outlets by 11:00 a.m. on Wednesday. Thus roses from an Aalsmeer greenhouse are sold in New York within forty-eight hours after they are cut. Similarly redistribution to other European countries by land occurs within forty-eight hours. Time is critical as the product declines in value to zero within 10-12 days after harvest.

The various flower auctions owned by Dutch grower cooperatives are critical institutions in the Dutch and world flower industry. International growers and buyers readily acknowledge that the Dutch flower auctions provide the best settings for determining prices in the international flower trade. These auctions also provide a point of entry into the downstream logistics and distribution process for foreign growers. Today over 15% of flowers traded at the largest Dutch Flower auctions are imported from and re-exported to foreign countries (sometimes back to the country of origin). Indeed, the flow of foreign cut-flowers to the Dutch Flower auctions is increasing, and it increased by 78% between 1985 and 1990. In 1993, the import of foreign rose stems to the two largest auctions reduced average prices by 40% during the winter season. This growth in the volume of foreign imports traded at the Dutch Auction houses, illustrates the critical role of these auctions in the international flower trade. The dramatic drop in 1993 winter rose prices also illustrates the emerging effects of foreign competition on the Dutch grower (Griffin, 1994).

Despite their vital role, the Dutch flower trade and the auctions face new challenges. First buyers for supermarkets and large retail store chains are becoming increasingly sophisticated, purchasing larger volumes and coordinating purchases across different markets and auctions. Indeed, some large retailers like Marks and Spencer are *bypassing* the Dutch auctions and their commissions to source directly from growers in Spain and other countries. Second, the sheer scale of transactions requires large amounts of space and generates substantial traffic to and from the auction houses. With current growth rates, traffic will be unmanageable within the decade and the auctions are close to their limits in terms of complexity and available space for expansion. Third, the auctions confront a critical challenge of coping with the influx of foreign growers, and devising appropriate access rules and pricing schemes for these growers while serving the interests of Dutch grower cooperatives that own the auctions.

One means of addressing these challenges is to re-engineer the auction house by using information technology to enable the uncoupling of the logistics, quality control and price determination processes. In this situation information technology will be used to coordinate and support the pricing and sale processes by using a data representation of the physical flower. The technology will also be applied to monitor the quality at the growers firm, and to coordinate shipping of the physical flowers directly from grower to the buyer. Information technology will then be used to register, analyze, trade and distribute flowers around the world. This would reduce space requirements and traffic problems at the auctions. It will allow growers to customize the delivery of flowers in the packaging required by different buyers and reduce damage to the product from frequent handling of the flowers.

The remainder of this paper critically evaluates the Dutch auction and alternative ways of re-organizing the auction processes as enabled by information technologies.

3.0 Markets, Auctions and Information Technology: Toward a Framework for Comparative Analysis

Markets provide buyers and sellers with a venue for exchange or the transfer of property rights from one party to another. Typically buyers and sellers confront many different uncertainties and risks in trading goods and services. These uncertainties arise from the traders' bounded rationality and inability to forecast the future, combined with the potential for opportunistic behaviors (Williamson, 1975, 1985). Markets as institutions provide specific routines, procedures and guarantees that enable the buyers and sellers to undertake the exchange by providing them with the relevant information and safeguards to reduce uncertainty and risk. Thus markets as well as other governance mechanisms provide specific information processing capabilities to exchange parties and serve to generate trust in the exchange process (Kambil, 1992).

Early research concerning the effects of information technology (IT) on exchange organizations and processes typically applied transaction costs and agency theory to predict shifts from hierarchies toward market or other intermediate forms of organizations (Bakos, 1991, Johnston and Lawrence, 1988, Malone, Yates and Benjamin, 1987, Powell, 1990). A central argument of these articles was that information technology would improve communications, search, monitoring and information sorting capabilities, thereby reducing transaction costs and enabling purchasers to take advantage of production economies available in markets. A critical drawback of this analysis was the definition of markets in abstract economic terms (i.e. markets coordinate economic activity through a price mechanism) without consideration differences in market organization. For example, different market types include *direct search markets* where partners directly seek each other out, *brokered markets* where exchange parties employ agents to seek compatible partners, *dealer markets* where dealers as intermediaries hold, buy and sell product inventories, and *auction markets* where traders transact directly through a centralized intermediary. Each of these mechanisms organizes the trading process and related information processing activities in different ways. Thus we can expect the impact and role of IT can vary across types.

Recently, information systems researchers have examined the impact of information technology on market institutions. Konsynski et al., (1992, 1989,

1990, 1989) provided a number of descriptive case studies of electronic markets providing a rich case base for research. Clemons and Weber (1990, 1991) examined the effects of computerization on the London Stock Exchange and Lee (1993) provided a technology to support order matching of complex products. These studies take into account the importance of different market types and institutional histories. However, what is lacking is a way to classify exchange processes to facilitate systematic comparison across alternative market institutions. By using transaction costs and political economy perspectives we build on this important prior work to define different exchange processes. Next, we use the classification to examine and compare processes at the traditional Dutch Flower auctions and alternative organizations for trading flowers enabled by information technology. The framework for analysis developed in this section can apply to the analysis of other market structures.

3.1 Toward a Framework for Comparative Analysis

Researchers and investors characterize the ability of markets to provide stable infrastructures for exchange by a number of different dimensions. For example Clemons and Weber (1990) characterize financial markets in terms of liquidity, volatility and transparency. Liquidity is the ability of the market to absorb large orders without significant price changes, indicating the depth and extent of market participation by buyers and sellers. Volatility refers to the variance in day to day volumes and prices, and transparency refers to keeping the widest group of buyers informed on current prices and allowing them access to trading. Highly liquid markets with low volatility and high transparency provide stable forums for exchange.

While liquidity is a key indicator of market quality for financial markets it is an inappropriate measure in the case of the Dutch flower auctions. First, the size of any one order is limited by the lots available on any stapelwagen. Thus it is hard to evaluate the impact on price of large orders. Second, the flowers are sold from the auction to buyer without further resale among the buyers. These two features of the Dutch auction make it difficult to measure liquidity.

The above measures highlight gross level outcomes of an exchange process. However to design exchanges we must also be able to compare the relative

effectiveness and transaction cost efficiency of different market mechanisms at the level of different exchange processes. Kambil (1992) identifies ten distinct processes that can operate in an exchange relation providing a basis for a finer grained analysis of market structure and costs. These processes are described in Table 1.

The ten exchange related processes provide parties to an exchange relation with the information processing, coordination and influence mechanisms required to mitigate uncertainty and exchange related risks. Implementation and operation of these processes and systems create transaction costs for the exchange parties. Transaction costs and the complexity of exchange processes increase as products and production become more complex, and as the market environment becomes more uncertain. Transaction costs also increase as exchange parties establish more complex mechanisms to defuse opportunism risks when buyer and seller relations are subject to substantial opportunism risks. Economic theory postulates that firms will choose to organize exchange relations so that they achieve the lowest possible transaction and production costs. Thus we can compare alternate market structures by considering the costs of each distinct exchange process in different market mechanisms. In addition, the relative effectiveness of each auction structure at providing the relevant information to buyers and seller through these ten processes must be considered.

Exchange related processes	Process Description	Exchange related systems
1 Search	Information processing activities undertaken by exchange partners to identify trading opportunities	Trade search system
2. Communication	The process of exchanging information to support and exchange relation	Market access and communications system
3. Product Specification	Information processing undertaken to specify the product features or characteristics	Product specification language and quality standards
4 Valuation	Negotiation and related information processing to determine the price of the good or service to be exchanged	Price formation and evaluation systems
5 Logistics	Negotiation and specification of delivery, and actual transfer of property and property rights	Logistics and routing systems
6 Settlement	Negotiation, specification and delivery of payment for property transfers	Settlement systems
7. Influence	Enforcement of credible commitments, incentives and sanctions to attenuate opportunism risks in exchange relations	Commitments, Incentives and sanction system
8. Legitimization	External legitimization or validation of exchange relation	Contracting and Legitimization system
9. Monitoring	Information processing to determine if exchange partners adhere to contract	Monitoring system
10. Dispute Resolution	Resolution of uncertainties and disputes that arise in the exchange relation	System of decision rights and court ordering or arbitration processes

Table 1: A Classification of Exchange Processes

When products are perishable, the time to trade the product is also critical in accounting for the costs of a trading structure. As flowers have a lifetime of about ten days after harvest, it is important to account for inventory holding costs and the opportunity costs to growers, and buyers of time taken to trade the product.

In addition to considering transaction costs, a comparative analysis of market structures must take into account the relative power of different market actors in shaping market rules. The political economy of the auction environment will determine the distribution of surplus in trading and the relative advantages that accrue to sellers, buyers and auctions as intermediaries. Thus the ownership of the auctions, and incentives for participation must be examined to assess the feasibility of alternative market structures enabled by information technology.

Below we apply the above perspectives to the analysis of the Dutch flower markets.

4.0 Evaluation of the Traditional Dutch Flower Auction

The Dutch flower auction provides a highly efficient infrastructure to support exchange. All auctions are organized and run by growers' cooperatives. We summarize the strengths and weaknesses of this institutional structure from efficiency and effectiveness perspectives in Table 2. We examine selected features in greater detail later in this section.

Exchange processes	Strengths of the Dutch Auction	Weaknesses of the Dutch Auction
1 Search	Highly efficient as the centralized auction as intermediary reduces search costs	The sequential nature of the auction makes it difficult for the buyer to search for a specific product variety
2. Communication	Very efficient for the buyer as the auction uses the flower itself and simple rules to communicate bids and prices. The ability to observe other traders provides powerful visual cues.	Requires synchronous communications for trading. Requires colocation of parties to the limited trading floor. Growers do not know final demand patterns for products.
3. Product Specification	Efficient visual inspection of the product	Buyers and growers perceive quality grades as too broad, artificially inflating valuation of products at the lower end of quality rating.
4. Valuation	Very efficient for small product lots. All transactions occur in a fixed time slot. 1000 transactions per hour	Auction price for specific products decrease during the day. Hence assignment of auction sequence for different growers is done by lottery. Clock speeds and small lots (Staff-Reporter, 1994f) stretch the cognitive capabilities of buyers favoring higher prices for growers.
5. Logistics	The physical transfer of goods from seller to buyer is efficient utilizing the hub and spoke system.	Packaging costs are incurred multiple times - for transport to the auction, and repackaging for transport out of the auction
6. Settlement	Very efficient with one day settlement periods	
7. Influence	Centralization of trading limits likelihood of buyer/seller opportunism	As auctions are grower cooperatives, auction rules favor grower
8. Legitimization	Efficient	
9. Monitoring	Efficient tracking of orders	
10. Dispute Resolution	Arbitration mechanism of the auction reduces dispute resolution costs.	

Table 2: Evaluation of the Dutch Auction

The auctions provide both buyers and sellers with efficient search, communication, and product specification capabilities for highly varied

products. Auctions are also very efficient in determining price enabling approximately a thousand transactions per hour. The Dutch auction eliminates problems of haggling and reduces bargaining costs that are otherwise associated with the trade of nonstandard and unusual value products (Milgrom and Roberts, 1990). By operating at a high clock speed, encouraging competition among buyers, and setting a fixed time by which to complete a transaction (or the clock goes to zero) the auction enables efficient trading. The hub and spoke operation, and logistics within the auction hall allows the auction to quickly transfer a large volume of flowers from suppliers to buyers. The auction, by inter-mediating all buyer-grower exchanges also provides efficient settlement, and dispute resolution mechanisms that mitigate against opportunism risks encountered by buyers and sellers. These features reduce transaction costs to growers and buyers. In total the auctions represent nearly 3% of the costs to customers, and on average they realize a gross profit margin of 5.5% of goods transacted[1] (Haak, et al., 1992).

When we examined the ownership and structure of the auction from a political economy perspective, we identified a number of rules that favor growers over buyers. First, the clocks move at a high speed. Higher speeds reduce the decision time available to buyers. This causes to higher bid prices. The auctions have experimented with different clock speeds and it is widely known that faster clock speeds result in higher prices. However, the auctions are reluctant to fully disclose the results of their experiments and selection of auction clock speeds. Second, the service costs to buyers for processing trades favors trading in smaller lots instead of purchases of large lots. This ensures no one party can purchase the entire lot without competition. It also increases the cognitive complexity and competition confronted by buyers. Buyers must now purchase products and adjust purchasing decisions to availability across multiple clock auctions. Imperfect information, and low transparency about available inventories favors growers.

Other disadvantages of the auctions are that buyers must be physically present at the correct location and correct time to bid on a specific product. In addition

[1]As part of this research program we are currently collecting more detailed data on transaction costs.

it is hard to simultaneously search other markets to estimate prices. Today large buying organizations provide cellular phones to their buyers to coordinate purchases across auctions. Increasingly the auctions are also responsive to the buyers' use of information technology to coordinate across markets. Auctions are coordinating to ensure similar products are sold at the same times under specific clocks at different auction houses. This will allow the large buyers to find the best price across auctions.

Finally the expansion of the international trade (Griffin, 1994) for flowers causes capacity problems and creates negative economic externalities. First the current facilities have limited space for expansion. Capacity expansion would therefore require very high cost investments. Second, traffic flows generated by the auctions cause delays and traffic jams in the transportation network feeding the auctions. This creates problems for communities close to the auction.

5.0 Using Information Technology in Auctions

5.1 Traditional Uses of IT

The auctions primarily use information technology to manage the order processing, inventory and logistics within the auction hall (Van Heck and Groen, 1994). When the flowers arrive at the auction hall, quality inspectors grade them for quality. The quality, inventory, grower and flower type information are then entered into control computers. This information is cross-indexed with bar-code numbers attached to the flower carts and specific lots, to enable tracking through the auction hall. The auction clock presents part of this information to the buyers. When buyers bid on a lot, the price and quantity information are directly captured from the buyer's keypad into the auction computers. The computers consolidate all purchase information for settlement of accounts and generate summary reports and transaction reports for buyers and sellers.

Auctions also use information technology to schedule and coordinate the complex logistics of the auction hall. Computers control the routing and distribution of carts by using bar codes and automated guided vehicles. These technologies enable the auction to process transactions more quickly.

Most of the above applications focus on activities within the auction hall -- which we characterize as internal automation. They serve to make the existing processes within the auction hall more efficient and expedite existing processes at the auction. Cheaper electronic data interchange and multimedia technologies now make it feasible to radically restructure the auctions. These changes have resulted in experiments with Sample-Based Auctions and Video Auctioning.

5.2 Electronic Data Interchange and Sample-Based Auction

Beginning in 1992, growers and auctions adopted electronic data interchange to link to auctions. Using EDI growers and auctions communicate product, order and transaction information to each other electronically. EDI reduces double entry of data into systems, paperwork and errors. Growers who use EDI can product submit data till 3:00 p.m., instead of 12:00 p.m. for paper transfer. The adoption of EDI has provided the auctions a platform to re-engineer the trading process. The auctions can now uncouple logistics and price determination in ways that reduce logistics costs, and physical capacity requirements.

In 1994, the Aalsmeer auction began a sample based auction for trading potted plants (Griffioen, 1994, Griffioen, 1994a, Van Heck and Groen, 1994). In this auction, growers send a sample of the product to the auction house along with information on the quantity of the product available. During the auction the sample product represents the entire quantity available to buyers. Buyers both bid for product and specify requirements for product packaging and delivery. Growers then package the product as specified and deliver it the next day to the buyer location in the auction complex or to other buyer warehouses. Growers, buyers and auctions used electronic data interchange to coordinate all the information exchange in this process. This process reduces the number of times a product is handled, increasing quality and reducing packaging costs.

The different actors: auctions, growers and buyers expected a number of different benefits. First by uncoupling logistics and price determination, the

auctions and growers expected the number of transactions per hour to increase. In reality the number of transactions per hour decreased as buyers had to specify terms of delivery. While the auctions expected 45% of the supply of potted plants to be transacted in the sample-based auction, only 10% of the product was transacted this way. Thus, sample based auctions also did not effectively reduce storage requirements at the auction.

The initial sample-based auction failed to meet expectations for many reasons. First, the incentives to buyers and growers (in particular) did not change to encourage their participation in this market. Specifically, the growers received no extra compensation for modifying packaging and delivery practices to suit the customer. Second, the growers perceived they got lower prices in a slower auction. This led to increased gaming of the system by growers. Growers would break the same product into different sample lots so that it would be priced multiple times during the auction hoping it would lead to higher prices. Third, the auction rules did not change to provide incentives to buyers by supporting transactions on large lots. Instead the auction maintained rules to favor transactions in small lots. Thus an insufficient number of buyers and sellers adopted this new form of trading to make the sample based auction market viable and effective as a means of trading.

In response to the original failure, the auction undertook various rule changes beginning in March 1994. First, the auction established a price floor of 70% of average price of a flower type in the most recent five days to reduce volatility and downside risks. Second, the representative lot was auctioned first. This sample lot typically received a higher price than following lots of the same type and quality. Buyers believed the sample to always be of best quality within any quality rating. Third the lot size was increased to three stapelwagens from one. The growers were also forced to increase the amount offered for any one transaction so that they did not game the system. More recent changes allow buyers to buy either one or three stapelwagens and the grower for any type of flower is only allowed one auction per category of product for price determination. These rule changes have stabilized the market.

5.3 Video Auctioning

A second way of uncoupling logistics and delivery is through video auctioning, tested out at the BVH (Spooner and Copeland, 1992)[2]. In this experiment initiated by the information technology staff, the BVH implemented the test video auction (the Videfleur experiment) with minimal changes to the original auction clock process. Experimenters converted one of three auction clocks in a room, to have video screens for product display around the clock. The auction also moved the real product under the auction clock providing a second visual display of the product. This was done to maintain existing logistics processes in the auction without disruption. An auction room solely dedicated to this experiment was not available given the demand for limited auction facilities.

When the product arrived at the auction, a picture was taken, digitized and stored in auction computers. These computers transferred the picture for display to a screen in the auction hall, where buyers could bid for the product based on the image of the product. Buyers were also able to bid for and look at the flowers on computer screens in their private auction offices. The computer in the office provided a screen based representation of the clock. Auctioneers expected this remote video auctioning would provide buyers with better information, as they could access their own office computers for purchasing, order, sales and local inventory information. In addition, auction officials had noticed that buyers often tended to select goods from specific sets of growers rather than inspect the product in great detail and expand the selection of producers. This suggests that reputations play a substantial role in shaping buyer purchases. As Leifer (1985) notes, market institutions are both decision arenas as well as stable or uncertainty reducing structures. Thus reputations in the Dutch flower auctions allow producers and buyers to reduce uncertainty about product quality.

Buyer reaction to screen based trading was negative. First, buyers perceived the quality of the auction hall video display was poor. Second, the clock based

[2]Spooner and Copeland (1992) provide a teaching case of IT initiatives at Flower Auction Westland in which they discuss the motivation and technology used to implement the Videfleur experiment.

trading system provided no new efficiencies for the buyer. In addition there was a major informational disadvantage for traders outside the auction hall. In floor based trading the buyers could observe each other, and the reactions of large buyers (from supermarket chains, etc.,) to specific bids. This important non-price information was incorporated into the decision making of the buyers. Video based auctioning was a limiting medium, not rich enough to capture this information. Thus buyers had limited advantage in trading from their offices, when there was also a floor based auction which provided the traders with more information. Indeed buyers who tried to trade from offices complained that could not feel the "tension" in the market place. Third, at the back of each auction hall is a coffee shop were buyers interact informally and share information about the market. Again this information was not easily available to traders in the office.

Video auctioning can uncouple the price determination and logistics mechanisms by providing an infrastructure enabling buyers to trade from outside the auction hall. It can also reduce the complexity and constraints imposed by logistics and capacity within the auction premises. However, the limited experiment illustrates that any electronic trading mechanism must either be separated from or completely integrated to a floor based trading system so that all trading parties have similar information.

5.4 Image Representations and Negotiated Trading

Beginning in 1980s the auctions have diversified to create a *brokered market* for flowers. In the “bemiddelingsbureau”(BB) or *Mediation Office* an auction employee acts as an agent for the growers and negotiates between growers and buyers in a forward market. Prices, product specifications, amount of lots, and delivery specifications are specified in a contract which is legitimized and monitored by the mediation office. About 5% of the flowers are traded this way. The mediation office is useful for the sale of large lots to large buyers like supermarkets for the occasions market.

The mediation office as an honest broker reduces the costs of search, communications and bargaining for buyers and sellers. It also provides a mechanism to legitimate the transaction and resolve disputes in the event the contract is not met. Image databases of product types and inventory are

especially useful for transactions in the mediation office. Wholesale buyers find that the pictures of the product are also very useful marketing tools to downstream retailers. Electronic data interchange is used for communications of orders and the coordination of settlements, and delivery resulting in fewer errors and greater transaction efficiency.

6.0 Information Technology and Feasible Models for Re-organizing the Dutch Flower Auctions.

Prior IT based re-engineering efforts provide the auctions with the knowledge and capabilities to develop electronic trading. Despite the limited success of early experiments, the auctions have the capacity to execute IT based strategies that implement screen based trading and uncouple the logistics and price determination processes. Below we consider plausible ways of using information technology to re-organize the Dutch Flower Auctions in ways that better meet customer requirements and support the Dutch Flower industry's global leadership.

6.1 Increasing Transparency and Supporting Existing Decision Processes

Within the current trading mechanisms of the Dutch auction and the mediation office, information technology can play a powerful role in increasing transparency and supporting the decision making of buyers. Buyers could use wireless hand held computers to have up to date information on their order books, inventory, reservation prices and prices in other markets. Such a system would allow the buyer to monitor multiple clocks at the current auction as well as other auctions from the auction floor. However there are few incentives for the auction to implement such a system. In part cellular telephones already enable buyers to coordinate across markets.

Decision support systems would allow brokers in the mediation office to search for growers, and identify trading partners for forward contracts. It is also feasible to design systems for electronic order matching. These changes will make the trading processes more efficient and reduce the transaction costs of the negotiated trading process. The auction has strong incentives to implement these tools and shift more trading toward forward contracts. This reduces capacity requirements at the auction. The technologies to support

search, indexing and retrieval of information on product varieties can also be used in screen based trading.

6.2 Uncoupling Logistics from Price determination

The key to substantially increasing the capacity of the auctions is the ability to uncouple the logistics from price determination processes through screen based trading of flowers. Screen based trading allows growers and buyers to directly transfer products according to buyer specifications without transportation to the auction hall. Screen based trading also has potential for international trading of flowers as it would reduce the costs incurred by international suppliers and buyers for transporting and handling goods sent to the Dutch Auctions.

However, the uncoupling of logistics and price determination will not substantially increase the throughput of the auctions if there is no change in the price formation and discovery processes. Clocks are already optimized to a high speed making it impossible to further increase throughput by speeding up the clock. Otherwise more clocks would have to be added in the electronic trading system increasing the number of buying agents required and the transaction costs to buyers.

Many different auction models exist to re-organize the electronic trading and price determination processes (see Davis and Holt (1993), and McCabe (1990, 1992) for illustrative models). However, the time specificity (Malone, et al., 1987) of trading flower, and the transactions costs of different trading, logistics and coordination regimes limit the useful alternatives. Appendix 1 provides summary definitions of different simultaneous and sequential decision auction models. We also identify feasible models for electronic flower trading in Appendix 1.

Two likely auction models are the clearinghouse and the posted offer auction. Of these the clearinghouse auction is more likely as it creates competition among sellers and among buyers. This can lead to higher prices than a posted offer auction which creates competition among sellers and may limit prices to the posted offer. Given that sellers own the auction, they are also unlikely to endorse a posted offer system which creates competition among themselves

but not amongst the buyers for product. The clearinghouse can be implemented as a sealed bid system combined with an electronic order matching system. In this re-engineered auction system the growers will electronically communicate available inventories and availability of flowers that they can deliver the next day. Growers using an image database can provide an image of the type of product for sale, and additional information on quality, inventory and the asking price (the asking price will not be revealed to buyers). In this electronic auction the buyers, using a search system, can identify the products they want and can make sealed bids for the product to the auction clearinghouse. After an hour the system can clear -- matching sealed bids and orders against the prices provided by the growers.

Products not sold through this mechanism will be made available the next day through the traditional Dutch Auction but would incur greater handling and re-packaging costs. In addition to transforming price determination, the new system would have to provide information processing and support for the logistics required to deliver products.

Table 3 summarizes the comparative strengths and weaknesses of the clearinghouse electronic trading system in comparison to the traditional Dutch auction. There are numerous advantages to this system.

First, the market can clear more quickly and efficiently while retaining competition among buyers. For example buyers can bid on large lot sizes and do not have to be constrained by the limitations of stapelwagen capacities as in traditional floor based trading. This increases the speed and efficiency of trading.

Second, it provides baseline prices for trading in the traditional auction the next day. Growers can benefit from this as it increases their participation in the price setting process and they can reserve their stocks by not harvesting for a few extra days.

Third, the system increases the competitiveness of Dutch growers as foreign growers are unlikely to be an able to match the overnight delivery schedule. For example the Dutch transportation infrastructure is specialized to this

industry. Foreign growers do not have similar infrastructures. This can give the Dutch growers a critical advantage as foreign competition increases.

Growers and buyers also benefit from the products' better customization of packaging and reduced handling. Growers are able to differentiate production and delivery vis a vis foreign competitors and buyers are able to reduce overall packaging and handling costs.

Buyers will also benefit from the ability to reduce uncertainty about purchases as they will have acquired a portion of their following days inventory ahead of time.

In addition the system increases the transparency of the market to all users.

Exchange related processes	Strengths of the Electronic Auction vs. Dutch Auction	Weaknesses of the Electronic Auction vs. Dutch Auction
1 Search	The search is more efficient compared to the sequential display of products in a Dutch Auction.	
2. Communication	Very efficient for the buyer and growers.	
3. Product Specification	Efficient visual representation of the product using images	Buyers see an image vs. the real product. Resolutions cannot communicate other details. Assessment of quality becomes more difficult.
4 Valuation	Efficient for valuing sales. Growers are involved in price setting and order of transaction does not matter for the clearing price.	
5 Logistics	Reduces packaging and handling costs	Requires logistics support and coordination system to support direct delivery to buyers.
6 Settlement	Very efficient with one day settlement periods	
7. Influence	Very efficient in a centralized system	Distributed and more costly
8. Legitimization	Efficient	
9. Monitoring		Quality assessment outside of the auction hall between the buyer and grower becomes more difficult
10. Dispute Resolution	Arbitration mechanism of the auction reduces dispute resolution costs.	Arbitration mechanisms and incentives to assure quality need to implemented

Table 3: Comparing Electronic Clearinghouse and Dutch Auctions

There are a number of costs and challenges to implementing an electronic clearinghouse system using sealed bids. First, new quality assurance (monitoring) and influence mechanisms are required. As growers specify quality, they could cheat in their specification. Indeed the lack of trust of growers is exemplified by the higher prices buyers pay for the sample lot in a sample based auction. The product can also be damaged in transit. To mitigate against these risks new influence and monitoring mechanisms are needed to

assure quality when logistics is separated from the centralized auction hall. One mechanism is to have quality inspectors randomly spot check arrivals of flowers at the buyer site, and for the shipper to monitor quality prior to shipping. This would require more inspectors than currently employed. In addition, for repeated quality problems, the auction can impose fines or exclude shippers or growers from participation in the trading network. However, a decentralized system creates new costs to the auction.

Second, it would require an upgrade of the grower's and buyer's hardware and communications facilities. While most growers already use computers, communications facilities would have to be upgraded to ISDN services. However, the costs of these services are falling rapidly, and the Netherlands PTT will offer nationwide full Internet and ISDN services by 1996.

Third to make electronic trading work, the auction or electronic clearinghouse must also provide information on logistics to the grower. The auction can reduce the coordination costs of buyers and sellers by supporting logistics.

Fourth, it is feasible buyers and growers can now inefficiently game the system. For example, by withholding the harvest of stock for a few days it is feasible that growers can create more volatility in the supply of flowers into the markets. Similarly, by tracking inventories buyers may also undertake a strategy that waits for the largest amount of supply to be released into the market thereby driving prices down. The likelihood of greater volatility and gaming are best modeled through behavioral market simulations outside the scope of this paper (See Davis and Holt (1993) who identify different experimental and simulation techniques for studying auctions).

6.3 The Political Economy of Market Transitions: The Problem of Incentives

Historically the Dutch Auctions have developed as an agent of the growers to facilitate the trading of flowers. Grower cooperatives were owners of the auctions and thus growers are residual risk bearers on the cash flows to the auctions. This ownership structure poses a number of incentive problems in the transition to electronic trading. From a political economy perspective it is

unclear that the Dutch growers have sufficient incentives for a transition given unclear benefits to themselves.

While there are a number of possible efficiency and competitive benefits to buyers, the benefits of electronic trading to growers seem tenuous. The one-day forward market with direct delivery can differentiate Dutch growers vis a vis foreign producers who are unable to meet the same delivery requirements. However, separating price determination and logistics poses new burdens on the grower from packaging requirements, coordination work and price estimation. Growers will also bear the cost of automation in earnings reinvested by the auction hall to implement new technologies.

In contrast, buyers and downstream logistics functions are the main beneficiaries of the new system. Reduced handling of the product, and just in time harvest increase the quality and likelihood that the flowers stay fresh for a longer time for buyers. It also maintains Holland's leadership as the center for price determination and management of downstream logistics. The auctions will increase in volume, and the Dutch will benefit from the flow of goods through Holland, or from transaction fees in coordinating the flow of goods.

The increased auction capacity to transact flowers can also further offset benefits to growers by enabling more foreign growers enter the traditional Dutch flower auctions and the distribution chain. This can increase international competition with existing Dutch growers. The role of foreign growers and their leverage of the existing infrastructure is a major issue of contention in the Dutch flower industry. This issue became more prominent after the dramatic fall in rose prices in the 1993 selling season due to foreign competition. Buyers and downstream logistics providers favor more foreign participation including stakes in the auction house. However, current growers do not favor this and in October 1994 after a referendum both major auctions decided to ban foreign grower participation in auctions for specific products during the summer (Staff-Reporter, 1994a, 1994b, 1994e). The auctions were also required to tighten quality control and inspections of foreign products.

These efforts to reduce foreign access to the traditional Dutch auctions have led buyer organizations and foreign growers to announce proposals to create competing auctions (Staff-Reporter, 1994c, Staff-Reporter, 1994d, Vliet, 1994). In October 1994, a buyer organization announced the intent develop an import only auction and in November the East African flower growers' association announced its intent to site a flower auction close to Aalsmeer and Schipol airport. The East Africans have proposed electronic trading in a one day forward market for flowers. These new auctions would enable foreign growers to bypass auctions owned by the Dutch growers and provide a direct entry point into the Dutch distribution system. The foreign growers would benefit from the Dutch distribution infrastructure without having to develop such an infrastructure in their home countries. If these auctions are successfully implemented they could expand to include Dutch growers, fragmenting the current consensus and creating greater competition among auction houses.

Given the asymmetric distribution of benefits and incentive misalignments its unlikely the grower cooperatives will support the transition without substantial payoffs. Higher transaction charges to buyers and transportation firms, or for foreign growers to list products in the Dutch auctions is one possible source of revenue. However the sustainability of this strategy is now questionable given the proposals to develop alternate auctions. Another source of revenue would be to sell shares in the current auctions to buyers and foreign growers. This would compensate existing growers and finance electronic trading. As buyers and foreign growers are likely to benefit the most from innovations in future electronic trading mechanisms they should also bear the risk of implementing them.

As world competition increases in the production of flowers, the Dutch growers confront the shift in value added from production toward coordination of price determination, and the logistics of distribution. As production in Holland becomes less attractive and downstream processes become more important, growers must select from a variety of alternatives. These are: to maintain the status quo strategy; to invest in electronic trading and expand capacity for competitive advantage, and/or to open auctions to foreign or buyer ownership. Maintaining the status quo is likely to result in

an erosion of the Dutch growers' market share. Investing in electronic trading would enable them to provide more customized service to buyers. Opening ownership to buyers and foreign growers provides revenue to the growers and shifts the risk of investments to those who most benefit from them: buyers and foreign growers.

In summary, to increase capacity and expand trading through the Dutch Flower Auctions the auctions must radically re-engineer the trading processes and uncouple logistics from price determination. This is an expensive proposition and requires major redesign of processes. As most benefits accrue to customers, the current ownership structure provide few incentives for growers to make the investments required for the transition. Indeed the ownership structure has limited prior experiments with electronic auction structures (such as the sample based and video auctions) to the Dutch Auction model that traditionally favors growers.

Finally, to accrue benefits from the electronic clearinghouse the growers must have incentives to participate in the clearinghouse in preference to the Dutch auction where logistics and price determination are coupled. Thus transaction fees to growers for listing their products on the Dutch Auction must be set at a higher price than listing on the electronic auction.

We believe these incentive problems are best overcome by allowing foreign growers and buyers to purchase equity in the current auctions. This can be used to compensate existing growers and align incentives to develop an electronic market. Dutch growers will be better off influencing the auction structure with foreign growers and buyers, in contrast to being bypassed completely by competing auctions. Thus the move to limit foreign participation in the current auctions is short sighted as this will lead to a competing auction where current growers have no influence.

7.0 Lessons Learned

A number of propositions can be made from the case which may shed light on likely changes in other settings that adopt electronic trading.

The application of information technologies to trading will lead to increased separation of informational and physical trading processes

First, advances in information technology substantially reduces coordination costs. This combined with new communications capabilities enable the separation in space and time of informational and physical processes required for trading. Informational processes are those such as price determination, and product description, etc. These processes will be de-coupled from one another in time and space and may even be carried out by different parties. For example, the logistics and price determination processes can be uncoupled in the Dutch Auction. Indeed by extension each of the ten exchange processes defined in this paper could be decoupled from one another and provided by different actors without the necessity for co-location.

New distributed monitoring and influence processes are likely emerge to support electronic trading.

Uncoupling of processes in electronic trading will typically require new distributed monitoring and influence mechanisms. These mechanisms will monitor and enforce commitments and ensure that trading parties are not opportunistic. These functions are vitally important for creating trust in the trading process. As illustrated by discounting and trading patterns in the sample auctions there is little trust between buyers and sellers (despite the fact that buyers use reputations to support purchase decisions). In the Dutch Auctions we observed that quality assurance and monitoring functions will have to be distributed from the central auction to buyer or seller sites. In addition to redistributing these functions, if a grower does not meet commitments, new sanctions and dispute resolution mechanisms are required to compensate parties subject to opportunism.

Information Technology will permit more varied forms of trading customized to different user requirements

Malone et. al., (1987) noted that information technology would lead to personalized markets where software agents would support trading customized to individuals and firm preferences. As the costs of coordination, monitoring, evaluation and transportation go down due to information technology, buyers and sellers will implement more specialized trading mechanisms that are better customized to their needs. These new forms will

achieve a better fit between the transaction characteristics and the organization of exchange processes. For example in this case we have seen the implementation of the mediation bureau to broker trading of large futures contracts between large buyers and different growers. In the future electronic trading will make feasible more efficient and timely transactions that overcome the capacity limits and time required for floor based trading. These new trading mechanisms will better suit their unique requirements of large vs. small buyers, occasions vs. impulse markets and domestic vs. international growers. We expect traditional and novel forms of organizing the exchange of flowers are likely to co-exist with most new innovations initially targeted to large customers. Indeed, one interpretation of the Coase Theorem is that as transactions costs go down, trading parties will be indifferent to the organization of exchange.

The economically feasible ways of organizing transactions remain limited and new transaction cost efficient ways of organizing exchange will also change the distribution of surplus to different parties. For example in this case the clearinghouse was the most likely alternative suitable for electronic trading. The mediation bureau was another feasible form. Other auction models such as the English auction or the Dutch auction are less efficient under emerging market and information technology conditions.

Electronic trading is likely to reduce the total producer or broker surplus and increase consumer surplus

Electronic trading reduces the total surplus available to producers or brokers. Most benefits from trading accrue to the consumer or buyer of flowers. Electronic trading and coordination removes informational inefficiencies in the trading process, reducing the opportunities for sellers or brokers to take advantage of profit from these inefficiencies. Individual brokers or auctions may profit from more efficient trading, but all brokers will not. Electronic trading also increases quality, delivery and other expectations of growers.

Bias in electronic trading will depend on the ownership of the electronic market and the availability of cost effective trading alternatives.

Malone et. al., (1987) propose that electronic markets will become less biased. However, this proposition depends on the ownership structure, the power of

participants in the auction, and the availability of alternative trading mechanisms. The case illustrates that the growers who are well organized and own the auction have been able to structure the trading process in their favor. As buyers become more powerful, the arrangement is being re-negotiated. For example by not participating in the sample auction, the buyers were able to influence the restructuring of the sample based auctions. If buyers and foreign growers implement alternate markets in the future, they will reshape the access, price determination and trading rules in the flower markets. Thus we expect these new owners to implement new trading patterns that are less biased in favor of Dutch growers.

Owners of existing markets may not benefit from electronic trading. This incentive incompatibility will impede the transition to electronic markets unless there are changes in ownership in the existing market structure.
The paper illustrated the problem of incentives that must be overcome to transition to electronic markets. Increasingly the consumer surplus is shifted away from the grower toward the buyer. Thus growers as current owners of the auctions have few incentives to adopt more efficient auction mechanisms. One model is to transform the property rights of the different parties in order to change incentives, or establish side payments among parties in order to accomplish a transition. Transferring property rights or compensating owners for the transition will be crucial to development of electronic flower markets. Financing capacity expansion and transitions to electronic markets through buyer or foreign grower equity in the auction transfers technological risk to these parties. Electronic trading should also permit a competitive advantage for current owners vis a vis foreign growers. Financing and creating incentive compatible structures for transition to electronic markets are critical requirements for such major transformations. However, as illustrated in the case these organizational transformations are difficult and unlikely without a clear and tangible external threat such as the entry of a competing group in the auction markets.

Information asymmetries arising from media limitations discourage the transition to electronic markets
The video auctioning did not succeed in substantial part because it did not account for the non-price information and informal social interaction on the

trading floor of importance to buyers. Information technology was a lean medium that did not capture this information efficiently for buyers providing floor based traders with an informational advantage. Thus any new electronic trading process must be introduced in a way that different buyers do not have an informational advantage which arises from the limitations of electronic media. This requires that the transition or cut over to a new auction system be implemented simultaneously for all users, and the auction system provide the same information to all users. The clearinghouse electronic trading system gives all parties similar information and can be implemented in this way.

Given alternate trading mechanisms, adequate positive incentives must be provided for buyers and sellers to adopt the use of new electronic markets.
The prior experiments toward electronic trading such as sample based auctions further illustrate the need to carefully roll out electronic markets and design adequate incentives for participation. The prior experiments failed because growers incurred higher costs in this new market mechanism without ensuing benefits. When multiple mechanisms co-exist such as an electronic clearinghouse and traditional Dutch auction, the transaction rules and costs of each auction must be set appropriately to favor different types of trades in each auction. Otherwise growers and buyers are likely to continue using the traditional Dutch auctions for most transactions despite its limitations.

8.0 Conclusions

This paper presented a framework for comparing different forms of trading and illustrated the complex issues confronted in selecting and changing to new auction systems. Any new trading system must have comparative advantages in executing different exchange related processes (expanding the transaction cost perspective) as well as be incentive compatible with the existing structures to assure adoption. Otherwise the political economy in which a new technology is introduced will require incentive structures to be modified to allow for the adoption of new technologies.

The Dutch auctions have existed for over a century as the premier mechanism for the trading of flowers in Europe. They have been critical to

Holland's leadership in the world flower markets. However, the role of the traditional Dutch auction will diminish due to changes enabled by technology, and international competition. To retain their current price determination role, increase their capacity and respond to world competition it is critical that new auction mechanisms be adopted which separate the logistics and price determination processes. The case study and propositions developed in this paper illustrate the complexity of implementing these new markets. The prior experiments position the Dutch flower auctions to implement new technologies. However, the structure, rules and operation of new electronic auctions are likely to be negotiated and determined by the actions of buyers, auction officials and growers as illustrated by the case of the sample auctions. This will also require consideration of ownership changes in the Dutch flower auctions to provide the necessary incentives and capital to finance market transitions.

Appendix 1: Alternative Auction Models

The definitions below are adapted from Davis and Holt (1993)

Feasible Auction Models for the Dutch Flower Markets

Clearinghouse Auction

In the clearinghouse auction buyers submit bids and sellers submit offers. Once submitted, bids are arrayed in descending order, from highest to lowest, while offers are arrayed in ascending order, from lowest to highest. A price is then determined by a crossing of the bid and offer arrays. This two sided institution eliminates the performance asymmetries associated with allowing only one side of the market to submit price quotes. It is perceived as a fair auction.

Posted Offer Auction
In the posted-offer auction, sellers independently select a price and a maximum quantity limit. After prices and quantity limits have been selected, the prices are displayed on the blackboard or on all traders' computer screens. Then buyers are chosen randomly from a waiting mode. The fist buyer selected makes purchases from sellers at their posted prices. When a buyer has purchased all desired units, another is selected randomly and is given the same opportunity. The trading period ends when all buyer have an opportunity to shop or when all sellers are out of stock. Then earnings are calculated, and a new period typically follows. This model is less likely in the Dutch Flower Auctions (DFA) as buyers do not compete with each other.

Unlikely Auction Models for the Dutch Flower Markets

The auctions below are unlikely models for organizing the auction and are only included here for illustrative purposes.

Posted Bid Auction
Reversing the roles of sellers and buyers in a posted offer (i.e., allowing buyers to post bids and subsequently selecting sellers in random order to make sales decisions) implements the posted-bid auction. This would cost too much in time for a seller.

Discriminative Auction
The case where buyers submit posted bids to a single seller, who offers some fixed number of units, N, to the highest bidders, generates a discriminative auction. For example, if two units are offered for sale and four bidders submits bids of 15, 17, 10, and 9, then the first two bidders obtain the units at prices of 15 and 17 respectively. This auction is called discriminative since

winners must pay their own bid prices, and in this sense the seller engages in "price discrimination".

First-Price Sealed-Bid Auction
When there is only one unit or "prize", the high bidder in the discriminative auction wins the auction and purchases it at his/her bid price, which is the highest, or "first" price. Therefore a discriminative auction with a single unit is sometimes called a first-price sealed-bid auction.

Competitive Sealed-Bid Auction
In contrast to the discriminative case, it is possible to design a mechanism for selling multiple units in which all of the N highest (winning) bidders pay a uniform price. When the uniform price is specified to be the highest rejected bid, the institution is known as a competitive auction. In the previous example, with two units and bids of 15, 17, 10, and 9, the first two bidders obtain the units, but they pay the same (third) price, 10. Since all winning bidders pay the same market-clearing price, this institution can create an impression of fairness.

Second-Price Sealed-Bid Auction
A second-price auction is a special case of a competitive sealed-bid auction with only one prize; the highest rejected bid is the second highest price, which is what the winning bidder must pay.

The various auctions excluding the posted bid are variations of the clearinghouse which is most fair to both seller and buyer.

Other Unlikely Models for Organizing Electronic Trading
The models below require synchronous participation by the buyer and seller. While IT enables distributed sychronous participation - these are unlikely auction models due to the opportunity costs of time to sellers (i.e the growers of flowers who do not have much time for the trading activity in addition to farming). Using brokers as selling agents would also be too expensive for day to day trading as it increase search costs to buyers and agency costs to sellers. The most effective broker model is that of a single agent for all trades as in the Dutch Auction.

Decentralized Negotiation
In a decentralized negotiation institution each seller (buyer) is allowed to roam freely around the room and negotiate contracts. Each seller (buyer) had one unit that could be sold (purchased) with a cost (reservation value) listed on a card. After a contract was completed, the buyer and seller would report the price to a central point, and the price was usually written on the blackboard at the time it was reported. The most striking result of the decentralized negotiation is the tendency for quantity exchanged to be too

high. While centralized bid and offer information would tend to eliminate trades involving extra-marginal units, the absence of information on the bid-ask spread in decentralized markets would facilitate the consummation of these inefficient contracts. In the flower markets this would be too costly in time for both sellers and buyers.

Double Auction
Under double auction rules, any buyer who makes a bid must raise his/her hand and be recognized. The bid is then publicly announced to the market. Sellers' offers are also publicly announced. All bids and offers are written on the blackboard as they are made. Only the most attractive bid or offer has "standing" or can be accepted. Any buyer is free at any time to accept a standing offer, and any seller can accept a standing bid. It is common practice to add an "improvement rule", that is, that a new bid be greater than the standing bid and that a new offer be lower than the standing offer. This is a double auction in a sense that bids rise and offers fall at the same time.

Offer Auction
An offer auction is an institution in which sellers can make offers sequentially, and buyers are able to accept any offer, but not to make bids.

Bid Auction
A bid auction refers to the opposite case in which buyers can make bids sequentially, but sellers can only indicate that that a bid is accepted.

English Auction
A bid auction with a single seller is essentially an English auction (but with no auctioneer) in which the seller waits while bids rise until only one active bidder remains.

Dutch Auction
In a Dutch auction a single selling agent lowers the price sequentially until a buyer agrees to pay the seller's price. Often the prices are indicated by a clock, which falls over a price scale until a buyer presses a button to stop the clock. The first buyer to do this obtains a unit at the price in effect at the time that the clock was stopped. The Dutch auction derives its name from its extensive use in wholesale flower markets in Holland.

References

Bakos, J. Y., "Information Links and Electronic Marketplaces: The Role of Interorganizational Information Systems in Vertical Markets", *Journal of Management Information Systems*, 8, 2 (1991), 31-52

Clemons, E. K. and B. Weber, "London's Big Bang: A Case Study of Information Technology, Competitive Impact, and Organizational Change", *Journal of Management Information Systems*, 6, Spring (1990), 41-60

Clemons, E. K. and B. W. Weber, " Evaluating the prospects for alternative securities markets," in *Proceedings of Twelfth International Conference on Information Systems,* New York, 1991.

Cohen, K. J. and R. A. Schwartz, " An Electronic Call Market: Its Design and Desirability," In H. C. L. a. R. A. Schwartz,(Eds.), *The Challenge of Information Techno-logy for the Securities Markets: Liquidity, Volatility & Global Trading*. Dow Jones-Irwin,, Homewood, 1989, pp. pp 15-58

Davis, D. and C. Holt, *Experimental Economics,* Princeton University Press, Princeton, 1993.

Economides, N. and R. A. Schwartz, "Electronic Call Market Trading", working paper, EC-93-19, Department of Economics, Leonard N. Stern School of Business, New York University,, (1993)

Griffin, M., "Imports cut into Dutch flower power," *Financial Times*, August 5,1994,

Griffioen, A., "Goede start informatieveilen in Aalsmeer," *Vakblad voor de Bloemisterij,* nr. 2 (1994), 9.

Griffioen, A., "Informatieveilen moet de stagnatie overwinnen," *Vakblad voor de Bloemisterij,* nr. 7, (1994a), page 56-57.

Haak, M., H. Tap and A. M. A. Heybroek, "A View of International Competitveness in the Floristry Industry", Rabobank Nederland i.c.w. LEI-DLO,, Eindhoven, (1992)

Johnston, R. and P. R. Lawrence, "Beyond Vertical Integration- the Rise of the Value-Adding Partnership", *Harvard Business Review*, (1988), 94-384

Kambil, A., "Electronic Integration: Designing Information Technology Mediated Exchange Relations and Networks," Doctoral Dissertation, Sloan School of Management, Massachusetts Institute of Technology, 1992

Konsynski, B., "Thinking of Linking: Managerial Perspectives on Electronic Linkages across Organizations,," in *Proceedings of Scientific Research on EDI*, Noordwijkerhout, Netherlands, 1992.

Konsynski, B. and A. Warbelow, "American Gem Market System", Case Study, 9-190-001, Harvard Business School, 7/19/1989, (1989)

Konsynski, B. and A. Warbelow, "Cooperating to Compete: Modelling Interorganizational Interchange", Harvard Business School, (1990)

Konsynski, B., A. Warbelow and J. Kokuryo, "AucNet", Case Study, 9-190-001, Harvard Business School, 7/19/1989, (1989)

Lee, H. G., "Intelligent Electronic Markets for Commodity Auction: An Integrated Approach of Economic Theory and Social Choice Theory," Ph.D Dissertation, University of Texas, Austin., 1993

Leifer, E. M., "Markets as Mechanisms: Using a Role Structure", *Social Forces*, 64, 2 (1985), 442-472

Malone, T. W., J. Yates and R. I. Benjamin, "Electronic Markets and Electronic Hierarchies", *Communications of the ACM*, 30, June (1987), 484-497

McCabe, K. A., S. Rassenti and V. Smith, "Auction Institutional Design: Theory and Behavior of Simultaneous Multiple-Unit Generalizations of the Dutch and English Auctions", *The American Economic Review*, December (1990), 1276-1283

McCabe, K. A., S. Rassenti and V. Smith, "Auction Institutional Design: Theory and Behavior of Simultaneous Multiple-Unit Generalizations of the Dutch and English Auctions", *The Economic Journal*, 102, January (1992), 9-23

Milgrom, P. and D. J. Roberts, "Bargaining Costs, Influence Costs, and the Organization of Economic Activity," In J. Alte and K. Shepsle,(Eds.), *Perspectives on Positive Political Economy*. Cambridge University Press, Cambridge,England, 1990, pp.

Powell, W. W., "Neither market nor hierarchy: network forms of organization", *Organizational Behavior*, 12, (1990), 295-336

Riess, R. N., "NASDAQ: Experience with Pioneering an Electronic Market," In H. C. Lucas and R. A. Schwartz,(Eds.), *The Challenge of Information Techno-logy for the Securities Markets: Liquidity, Volatility & Global Trading*. Dow Jones-Irwin, Homewood, 1989, pp. 214-223

Smith, V. L. and A. W. Williams, "Experimental Market Economics", *Scientific American*, 267, 6 (1992), 72-77

Spooner, I. and D. Copeland, "Flower Auction Westland: The Cosmos Project", Case Study, University of Western Ontario, 3/3/92, (1992)

Staff-Reporter, "Bloemenveiling Aalsmeer draait importbeleid terug onder druk leden," *Vakblad voor de Bloemisterij*, 1994a, 14.

Staff-Reporter, "Bloemenveiling Holland wijzigt importbeleid fundamenteel," *Vakblad voor de Bloemisterij,* nr. 40 (1994b), 8.

Staff-Reporter, "Bloemveilingen niet verrast door oprichting importveiling," *Vakblad voor de Bloemisterij,* nr. 49 (1994c), 8.

Staff-Reporter, "Importveiling is op één na beste oplos-sing," *Vakblad voor de Bloemisterij,* nr. 50 (1994d), 14.

Staff-Reporter, "Stoom lijkt van de ketel in geschil over import," *Vakblad voor de Bloemisterij,* nr. 43 (1994e), 10.

Staff-Reporter, "Veilen per beeldscherm hapert," *Automatiserings Gids*, 28 januari,1994f, page 3.

Van Heck, E. and T. P. Groen, "Towards an Electronic Flower Auction?," in *Proceedings of First International Conference on Agri-Chainmanagement,* Wageningen Agricultural University, Wageningen, 1994.

Vliet, C. v., "EAF wil met importveiling centrum bloe-menhandel in Nederland houden," *Vakblad voor de Bloemisterij*, 1994, 40-41.

Weber, B. W., "Information Technology and Securities Markets," Ph.D Dissertation, University of Pennsylvania, 1991

Williamson, O. E., *Markets and Hierarchies: Analysis and Antitrust Implications,* The Free Press, New York, 1975.

Williamson, O. E., *The Economic Institutions of Capitalism: Firms, Markets and Relational Contracting,* Free Press, New York, 1985.

Woodward, R. B., "Business is Blooming: From Amsterdam to Amsterdam Avenue (give or take a mile), the saga of a Mother's Day bouquet," *New York Times Magazine,* (May 9), (1993), pp 33-37.