Innovative electronic auctions in supply and demand chains: Empirical research in the flower industry

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Abstract

Exploiting the Internet for commercial ends has become a key theme for most organizations. There are significant advantages for both buyers and sellers in using this medium. Savings are made as a result of reducing transaction costs, increasing the circle of potential customers, and improving the search-and-find capabilities for all parties concerned. At the moment there are several hundred Web-based auctions. And yet the place to see state-of-the-art auctions is not on the Web but rather in one of the dozen or so auction halls in Holland. This article analyses different electronic auction initiatives in the Dutch flower industry. These auctions use the "Dutch auction" as price discovery process. In a Dutch auction the auctioneer offers products at successively lower prices until his offer is accepted. Most auctions on the Web today use the English method. An English auction process involves a succession of increasing bids by potential buyers until the highest (and final) bid is accepted by the auctioneer. But the Dutch method offers advantages, as the flower auctions reveal. The Dutch method is much faster and tends to generate higher prices. This is illustrated by presenting the results of experimental economic research with different Web-based auctions. One of the analysed electronic auction initiatives, Tele Flower Auction, shows that electronic auctions have an impact on the chain configuration and its performance. Conclusions are formulated and further research is discussed.

Key words: chain management, Dutch auction, electronic markets, experimental economics, flower industry

1. Introduction

The rapid developments in information and communication technology (ICT) and its applications in business have resulted in electronic markets being increasingly popular. Significant benefits are obtained by reducing transaction costs, increasing the circle of potential customers, and improving the search-and-find capabilities for all parties concerned (Van Heck and Vervest, 1998). An electronic market is defined as an inter-organisational information system through which multiple buyers and sellers interact to accomplish one or more of the following market-making activities: (1) identifying potential trading partners, (2) selecting a specific partner, and (3) executing the transaction (Choudhury *et al.*, 1998). Examples include airline reservation systems such as SABRE and APOLLO (Copeland and McKenney, 1988); AUCNET for the sale of used cars (HBS, 1988); TELCOT in the cotton industry (Lindsey, 1990); Inventory Locator Service (ILS) in the aircraft parts industry (Choudhury *et al.*, 1998), and numerous auction examples on the Web (for example eBay.com, FastParts.com, Onsale.com, FreeMarkets.com).

The primary benefit offered by an electronic market is efficient market search, or electronic brokerage (Malone *et al.*, 1987). The impact of lower search costs might result in dis-intermediation in the marketing channel and commoditization of the market, resulting in increased price competition (Bakos, 1991; Bakos, 1997; Malone *et al.*, 1987). However, little empirical evidence exists to support these claims. Choudhury *et al.* (1998) analysed an electronic market in the aircraft parts industry and showed that current models do not adequately capture the complexity of electronic markets. For instance, while ILS sometimes helped buyers to find a better price, in other cases it helped suppliers extract an extra premium by providing more accurate information on parts availability. ILS also had little impact on the extent to which brokers are used, although the specific nature of the value added by brokers appears to be changing. Finally, inventory levels in the industry have been unaffected by the use of ILS. However, as Choudhury *et al.* also describe, the ILS electronic market is limited in scope. It includes the capability of helping a firm to identify a set of potential trading partners for a transaction. In ILS it was not possible to select and execute a transaction. So caution must be exercised in generalizing the findings to systems that also support selection and execution. Therefore the impact of ILS on prices could not be measured directly.

Given the preliminary state of current knowledge and evidence on the impact of electronic markets it is believed, also by Choudhary *et al.* (1998), that the appropriate strategy

for gathering empirical evidence is not a broad-based survey but rather in-depth studies of multiple electronic markets. The underlying premise in advocating this approach is that the use and impact of electronic markets may be influenced by product, transaction, system, and industry attributes that have not been identified in the literature to date. As Choudhury *et al.* (1998) point out "a cumulative body of case evidence that helps to identify these variables needs to be built". This paper goes a step further toward that objective with a study of electronic markets which support identification, selection and execution: electronic auctions in the Dutch flower industry. Electronic markets in the Dutch flower industry are particularly interesting due to the perishable nature of the product with high time-specificity and complex product descriptions.

The paper begins by presenting a stakeholder/process framework. This framework is useful in analysing electronic markets and auctions. In section 3 different case studies on electronic markets and auctions in the Dutch flower industry are presented. It is concluded that the traditional Dutch flower auctions - and their electronic versions, like Tele Flower Auction (TFA) and Buying at Distance auction (BADA), are successful in supply-oriented chains. These auctions use the "Dutch auction" as price discovery process. In a Dutch auction the auctioneer offers products at successively lower prices until his offer is accepted. Most auctions on the Web today use the English method. An English auction process involves a succession of increasing bids by potential buyers until the highest (and final) bid is accepted by the auctioneer. But the Dutch method offers advantages, as the flower auctions reveal. The Dutch method is much faster and tends to generate higher prices. This is illustrated by presenting the results of experimental economic research with different Web-based auctions. Section 4 describes the electronic Web-based market system (including bilateral bargaining and different auction mechanisms) which will be used in these experimental settings. Results of one of the experiments are presented. The paper concludes in section 5 with implications and suggestions for further research.

2. Analysing exchange organizations

Kambil and Van Heck (1998) specified a generalizable model of exchange processes and developed a process-stakeholder analysis framework to evaluate alternative market designs. In this framework, see figure 1, five basic trade processes (search, valuation, logistics, payments and settlements, authentication) and five trade context processes (communications and computing, product representation, legitimation, influence, and dispute resolution) are distinguished. This framework is applied to analyse a number of ICT initiatives in the Dutch flower markets. The ICT initiatives analysed are the Vidifleur and the Sample Based Auction, see also Van Heck and Groen (1994); the Tele Flower Auction, see Van Heck *et al.* (1997) and Van Heck and Ribbers (1998); and the Buying at Distance System.

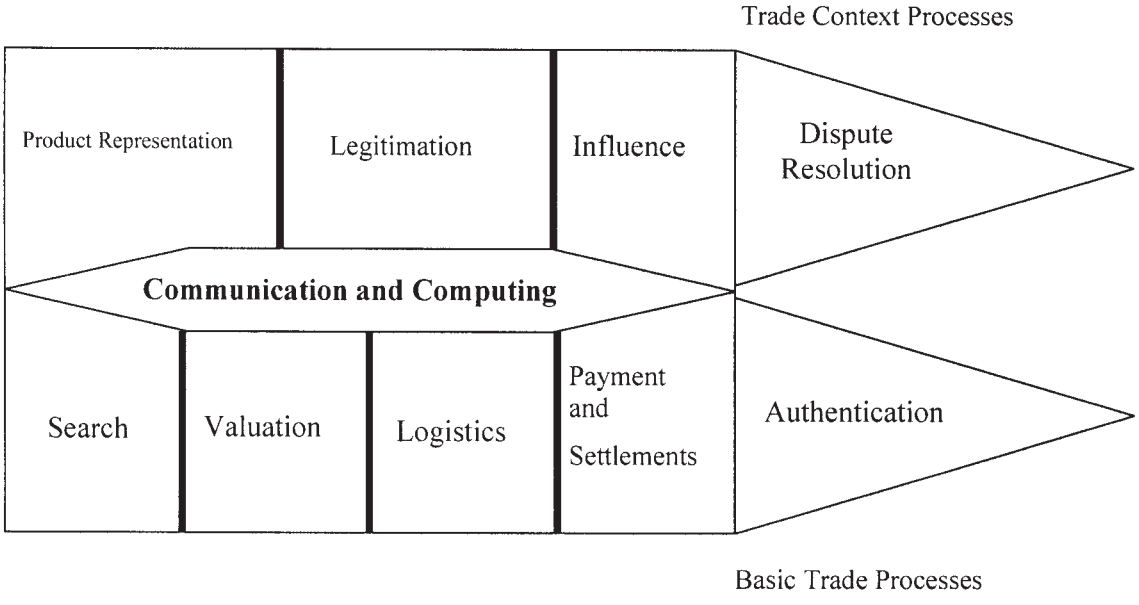

Figure 1. Generalized model of exchange processes (Kambil and van Heck, 1998).

3. Case studies in the Dutch flower industry

In this section we will discuss the characteristics of the Dutch flower industry, the Dutch auction method, and the four electronic auction initiatives in this industry.

The Dutch Flower Industry

The Netherlands is the world's leading producer and distributor of cut flowers. The Dutch dominate the world export market for cut flowers with approximately a 59 per cent share and for potted plants with a 48 per cent share. The world's two biggest flower auctions are in Aalsmeer (VBA) and Naaldwijk/Bleiswijk (BVH); where every day on average 30 million flowers - originating not only from the Netherlands but also from countries such as Israel, Kenya and Zimbabwe - are traded in 100,000 transactions. The Dutch flower auctions play a vital role in Holland's leadership of this industry, by providing efficient centres for price discovery and transactions of flowers between buyers and sellers. These auctions traditionally use the "Dutch auction" as the mechanism for price discovery. They are established as cooperatives by the Dutch growers.

The Dutch flower auction concept

In this section we shall describe the auction rules of the Dutch flower auction concept. Dutch flower auctions use a clock for price discovery, as follows. The computerized auction clock in the room provides the buyers with information on producer, product, unit of currency, quality, and minimum purchase quantity. The flowers are transported through the auction room, and are shown to the buyers. The clock hand starts at a high price determined by the auctioneer, and drops until a buyer stops the clock by pushing a button. The auctioneer asks the buyer by intercom, how many units of the lot he or she will buy. The buyer provides the number of units. The clock is then reset, and the process begins for the left-over flowers, sometimes introducing a new minimum purchase quantity, until all units of the lot are sold. In the traditional way, buyers must be present in the auction room. The Dutch flower auction is an extremely efficient auction mechanism: it can handle a transaction every four seconds.

Four electronic auction initiatives

Table 1 describes the main characteristics of the electronic auction initiatives and their processes.

The vidifleur auction
Vidifleur intended to use video auctioning to decouple price determination and logistics, and to allow buyers to trade from outside the auction hall. When the product arrived at the auction, a picture was taken, digitised and stored in auction computers. The computer 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 potted plants on computer screens in their private auction offices. The computers in the private offices provided a screen-based representation of the clock, which was synchronized with the clock in the auction hall.
Buyer reaction to screen-based trading was negative and led to the termination of the experiment in late 1991. Buyers cited three main reasons for not adopting the new system. First, the clock-based trading system provided no new efficiencies for the buyer. Second, the quality of the auction hall video display was perceived as poor, and trading from outside the auction hall created an informational disadvantage. In floor-based trading the buyers could observe each other, and the reactions of other major buyers to specific bids. Third, at the back of each auction hall is a coffee shop where buyers interact informally and share information about the market. Again, access to the social interaction and information was more difficult through screen-based trading.

The sample-based auction
Flower Auction Aalsmeer began a sample-based auction for trading potted plants in 1994. In this concept, growers sent a sample of the product to the auction house along with information on available inventory. During the auction the sample represented the entire inventory available to buyers who could bid for the product and specify product packaging and delivery requirements. Growers then packaged the product, as specified, and delivered it the next day to the buyer location in the auction complex or to other buyer warehouses. Buyers had to be physically present in an auction room. Growers, buyers, and the auction used electronic data interchange (EDI) to share all information required in this process. This trading model reduced the number of times a product was handled, reducing overall packaging costs and damage.
The different actors, the growers, the buyers, and the auction, expected a number of different benefits. First, by uncoupling logistics and price determination, the auction 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. Second, while the auction 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, SBA also did not effectively reduce storage requirements at the auction. After numerous attempts to increase the volume of sample-based

Table 1. Characteristics of four electronic auctions in the Dutch flower industry.

Variables	Indicators	Vidifleur Auction (VA)	Sample-Based Auction (SBA)	Tele Flower Auction (TFA)	Buying at Distance Auction (BADA)
General Parameters	Intermediary	Flower Auction Holland (BVH)	Flower Auction Aalsmeer (VBA)	East African Flowers (EAF)	Flower Auction Holland (BVH)
	Sellers	Dutch growers as members of cooperative	Dutch growers as members of cooperative	Non-Dutch growers	Dutch growers as members of cooperative
	Buyers	Wholesalers	Wholesalers	Wholesalers	Wholesalers
	Products	Potted plants	Potted plants	Flowers	Flowers
	Start (End) Year	1991 (1991)	1994 (1994)	1995	1996
Basic Trade Processes	Search	Buyers can have a look in the storage rooms	Buyers can have a look in the storage rooms	Buyers can search supply data base	Buyers can search supply data base
	Valuation	Dutch auction clock	Dutch auction clock	Dutch auction clock	Dutch auction clock
	Logistics	Via auction room to buyer's place	Directly from grower's to buyer's place	Directly from storage room to buyer's place	Via auction room to buyer's place
	Payments and settlements	Within 24 hours; guaranteed by intermediary	Within 24 hours; guaranteed by intermediary	Within 24 hours; guaranteed by intermediary	Within 24 hours; guaranteed by intermediary
	Authentication	Quality grading on lot	Quality grading on sample	Quality grading on lot	Quality grading on lot
Trade Context Processes	Communication and computing	Computerized clock in room and on PC screen, video image on screen in room	Computerized clock, EDI with growers and buyers	Computerized clock on PC screen, 1 digital image on PC screen, EDI with growers and buyers	Computerized clock in room and on PC screen, no digital image on PC screen, some buyers use video system, EDI with growers and buyers
	Product representation	Real lot on site; video image on screen	Sample of lot	1 digital image on PC screen	Real lot on site
	Legitimation	By intermediary	By intermediary	By intermediary	By intermediary
	Influence	Growers are owner of intermediary	Growers are owner of intermediary	Intermediary is importer of foreign flowers	Growers are owner of intermediary
	Dispute resolution	By intermediary	By intermediary	By intermediary	By intermediary
Overall result		Failure	Failure	Success	Success

auctions they were discontinued in late 1994. The system had a negative effect on the functioning of growers, the auction house, and buyers. The sample-based auction system ended as a complete failure.

The tele flower auction

An important effect of the import restrictions imposed by the Dutch flower auctions was the creation of TFA by East African Flowers (EAF) (Van Heck *et al.,* 1997). EAF is one

of the biggest importers of cut flowers; they specialize in supply from East Africa (Kenya, Tanzania, and Uganda). For EAF, the effect of the import restrictions was that 30% of their imports could no longer be traded via the Dutch auction clocks during the traditional import season; in the summer season 100% of their imports could not be traded at all. EAF announced the creation of TFA in December 1994. On March 24, 1995, TFA was launched with 2 growers and 70 buyers. After some months, EAF decided that growers from other countries (for example, Spain, Colombia, France, India, and Israel) were allowed to use TFA. After one year, approximately 35 growers and 150 buyers were connected to TFA.

In the TFA, buyers can bid via their personal computer (PC) screens. Each PC is connected to a fully computerized auction clock. Logistics and price discovery are uncoupled. Flowers are no longer visible for buyers, and buyers are no longer physical in an auction room. The PC provides the buyer with information on the next flower lots. On a PC, the buyer can earmark interesting lots, so at the time those lots will be auctioned, the PC will warn the buyer. The PC provides information on the producer, product, unit of currency, quality, and minimum purchase quantity. For each lot one image is presented on the PC screen. The underlying auction concept remains the same: the Dutch flower auction. On the PC screen the buyer sees the Dutch auction clock. The clock hand starts at a high price, and drops until a buyer stops the clock by pushing the space bar on the keyboard of the PC. The auctioneer asks the buyer, via an open telephone connection, how many flowers of the lot he or she will buy. The buyer provides the amount. The clock is then reset, and the process begins for the next units, until the remainder of the lot is sold.

Growers send the flowers to EAF, and EAF stores these flowers in Amstelveen. Logistics and price discovery are uncoupled within the auction hall. The distribution of the flowers from the Amstelveen area to the buyer's addresses (nearby the traditional auctions of Aalsmeer, Naaldwijk, and Rijnsburg) is done by transporters of EAF. Transport costs are paid by EAF.

Compared with SBA, buyers can trade at a distance. TFA provides better and more frequently updated supply information. The speed of the TFA system is amazing. Not only the auctioning process, but also the after-sales process is very fast; sometimes within half an hour products are delivered at the buyer's address. It soon became clear that one of the main propositions of TFA was that the quality of the flowers determines the buyers' trust in the TFA concept. TFA's motto is: "Buyers have to trust the quality blindfolded", because buyers cannot physically see the product anymore. Still, buyers who are nearby TFA can inspect the imported flowers; 30% of the buyers do so regularly. Reliable product information and stable quality control are essential. Quality control is done by TFA's quality inspectors at the grower's place, at the distribution point in Nairobi (Africa), and at TFA in Amstelveen. Buyers also trust the IT innovations. One of the reasons seems to be that the Dutch auction clock is still the price discovery mechanism; buyers are used to that mechanism. Buyers were enthusiastic about the quality and the delivery time of the auctioned products, and about the service level of TFA. The prices were on average not higher or lower than in the traditional Dutch flower auctions. TFA expected a turnover of 50 million dollars for the growing season 1995/1996. Compared with the seven Dutch flower auction, TFA ranks fourth.

The buying at distance auction

Flower Auction Holland started in June 1996 with the concept of "buying at distance", elaborating on their previous experiences with the Vidifleur project. The concept is that buyers can connect their PC with a modem to several auction clocks in the auction rooms. On their PC screen they can click on an icon and open up a window for every clock available. The "buying at distance" project started with 6 clocks and 16 buyers. In 1997 already 60 buyers were on the waiting list. In 2000 approximately 90 buyers were connected to the system. The other flower auctions in the Netherlands also implemented their buying at distance auctions. The connected buyers perceived buying at distance as successful due to the lower search costs - one can search in the supply database for certain products or growers - and due to the better overview of the marketplace - one can easily switch among different auction clocks. Also, lower travel costs were reported. A reported side-effect of this system was that one of the members of the purchasing crew had to come back into the office - for the online purchasing - and therefore communication with the sales department improved. The auction house mentioned that the amount of buyers (physically or electronically connected) in one marketplace will be stable or increase, and that might increase the auction prices.

Lessons learned

The following lessons were learned from the experiences with electronic auctions in the Dutch flower industry.

Lesson 1: The application of information technologies to trading can enable increased efficiencies and separation of informational and physical trading processes. This in turn will permit more varied forms of trading customized to different user requirements (Kambil and van Heck, 1998).

The four cases illustrate the use of IT to separate the informational and physical trading processes. In all cases the valuation and logistical processes are increasingly de-coupled in time and space. TFA de-couples logistics and price discovery in the auction hall. Therefore, the internal logistics of the auction hall are much simpler, compared with the traditional auction system. This explains why TFA has a much better logistical performance and service level, in the opinion of the buyers. EAF paid much attention to its after-sales program (providing transport to the buyers). The TFA case shows the impact of the electronic auction on the supply chain configuration and its performance. In this case the use of electronic auctioning leads to simpler logistics and distribution and a better logistical performance of the total supply chain. For consumers it could mean fresher flowers for the same price.

Lesson 2: Conformance of the actual and the perceived quality of the product, logistical performance, and IT performance result in high trust; high trust contributes to a successful electronic auction system (Van Heck *et al.*, 1997).

In the SBA the buyers chose to discount the prices bid for non-sample lots by nearly ten percent because they could no longer authenticate quality by visual inspection. Logistical performance was questioned by growers, and buyers. No problems were reported about the IT performance as such. In the TFA case, sellers and buyers find that TFA keeps their promises concerning quality of products, delivery time of products, and reliability of IT performance. Buyers trust the TFA products. Usually, they get better products than expected from the data and images provided on the PC screen, due to a centralized quality control program. Buyers also trust TFA, because the underlying auction concept is the same: the Dutch flower auction. Buyers trust the IT innovation: if a buyer is the first to push the space bar on the PC keyboard, he or she is certain that the computer network transfers this signal quickly and reliably, regardless of the distance between the buyer's computer and the auction computer.

Lesson 3: Market organizations are the meeting point for multiple stakeholders: buyers, sellers, and intermediaries with conflicting incentives. Given existing or competing market alternatives, no new IT-based initiative is likely to succeed if any key stakeholder is worse off after the IT-enabled innovation (Kambil and van Heck, 1998).

In the two cases of failure, the application of the process-stakeholder framework clearly identified that either the grower or the buyer was worse off from the innovation. For example, the SBA failed to meet expectations for many reasons. First, the incentives and benefits to buyers and growers (in particular) did not change substantially to encourage their participation in this market. Specifically, growers received no extra compensation for modifying packaging and delivery practices to suit the customer. Second, the growers perceived that they got lower prices in a slower auction. To overcome this disadvantage 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 initially did not 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 initially adopted this new form of trading. In the Vidifleur auction, the buyers did not perceive a new benefit from the system. The video quality was poor, authentication of quality less convenient, and trading online did not provide all the information available in the auction hall.

Lesson 4: New entrants, facing established dominant players, can quickly build competitive advantage with an innovative auction system concept (Van Heck *et al.*, 1997).

The TFA case demonstrates the way a new entrant may use IT in an innovative way, in order to enter a market and compete with dominant players in that market. The efforts to reduce foreign access to the traditional Dutch auctions, led buyer organizations and foreign growers to announce the creation of competing auctions. Indeed, EAF's development and introduction of TFA is one of the initiatives created in response to these import restrictions by the traditional Dutch flower auctions. It was the first time in Dutch history that an importer organization performed this function. Traditionally, the Dutch flower auctions are established as cooperatives by the Dutch growers. Another interesting point was the high speed of entrance. The import restrictions came into effect in October 1994. At that time EAF developed the first ideas about TFA. TFA started in March 1995. So EAF developed and implemented TFA in a few months. This case shows that new entrants can quickly build a competitive advantage. It illustrates the conclusion derived by Clemons *et al.* (1996) concerning the strengths of new entrants in a competitive market. Besides the strengths of TFA, the weaknesses of the traditional Dutch auctions partly explain the success of TFA. The cooperative structure of the Dutch auctions (every single grower has one vote), the complexity of the after-sale logistics (due to the coupling of the logistics with the price discovery process),

and their inability to implement IT innovations quickly further decreased the market share of TFA's competitors.
In the near future we expect that the Dutch auction method will become popular on the Web (Van Heck, 2000). The Dutch auction method offers advantages. For one thing, the Dutch method is much faster. When a large quantity of easily evaluated goods must be sold quickly, it is ideal. Second, the Dutch method tends to generate higher prices. To avoid losing a particular lot, buyers will often stop the clock at a higher price than they would have offered in competitive bidding. To investigate this proposition we built a Web-based market system, which can be used to conduct experimental research on different aspects of innovative electronic markets and auctions.

4. Innovative electronic auctions and experimental research

In this paper we will discuss one of the experiments. In this experiment we compared bilateral bargaining, with English and Dutch auctions. We are particularly interested in the existence of the winner's and loser's curse. The winner's curse refers to the phenomenon that the winning bidder will be the bidder with the most optimistic estimate of the good's value, so he or she may end up paying too much for the good. This contrasts with a situation in which a failure to anticipate the informational content of a bid's acceptance will cause one to bid *below* the optimal bid, resulting in a loser's curse (Holt and Sherman, 1994). In a laboratory experiment, it is possible to select parameter values so that the winner's curse bias dominates the loser's curse bias, and vice versa. It is also possible to choose parameters so that these two effects exactly balance each other, for a "no curse" treatment. So, we considered three bargaining situations (bilateral, English auction, Dutch auction) under three different treatment conditions (winner's curse, no curse, loser's curse).

Web-based system and experimental design

In the laboratory experiment we used a Web-based market system. The Web-based market system consists of four different subsystems:
- Bilateral brokerage method;
- English auction method;
- Dutch auction method;
- Auction control functions.

The auction control functions enable the auctioneer to select an auction from the database and execute it. For the platform of the Web-based market system we use a TCP/IP network (Internet or Intranet) with 1 *server* running Windows NT 4.0 Server with Internet Information Server (ISS) version 4 and 20 *clients* running Windows NT 4.0 Workstation with Microsoft Internet Explorer. CommercePack version 1.5 from InfoCommerce was selected as server application software.
The laboratory experiments took place in the ENECO RSM trading room. This room facilitates electronic trading systems and is equipped with 20 PC's. The experiment was done with 13 subjects on May 12, 1999. Subjects were recruited from graduate business administration and information management classes at Rotterdam School of Management (RSM). Upon arrival in the laboratory, subjects were seated at personal computers, they read the instructions and the instructions were also read aloud. Each subject made bidding decisions for 10 trials in the bilateral bidding method and 5 trials in the English and Dutch auction bidding methods. For the detailed instructions see Appendix 1. Cumulative earnings were set to the initial level of NLG 10.00. Subjects were paid at the end of the experiment.

Results

In the experiment the following results were obtained related to the winner's curse, no curse, and loser's curse. Table 2 presents the bid results related to the winner's curse, no curse, and loser's curse for bilateral bargaining, English auction, and Dutch auction. The results indicate that the bid levels of the English auction are significantly higher compared with bilateral bargaining; and that the bid levels of the Dutch auction are significantly higher compared with the English auction. Under conditions of the loser's curse the bid levels of English and Dutch auctions came close to the rational bid level. Under the conditions of winner's curse the results of English and Dutch auctions were significantly above the rational bid level. It is also concluded that for the bilateral bargaining the average loser's curse bids are closer to the predictive naive bids and for English and Dutch auctions they are significantly above the rational bids. So, we discovered the interesting phenomena that when the parameters in an experiment were set so that the naive bidder's tendency to underbid dominates (the loser's curse treatment), bids were above the optimal level. Thus in English and Dutch auctions, a loser's curse effect is dominated by systematic overbidding due to increased competition. Consequently, a naive-bidding rule does not predict bidding quite well under the loser's curse.

5. Conclusions and further research

This paper makes three key contributions to the literature on electronic markets and chain management. First, we identify a series of distinct processes that underlie exchange

Table 2. Summary bid data by treatment.

	Bilateral bidding Average bid (standard deviation)			English Auction Average bid (standard deviation)			Dutch Auction Average bid (standard deviation)		
Calculation	Winner's curse	No curse	Loser's curse	Winner's curse	No curse	Loser's curse	Winner's curse	No curse	Loser's curse
Theoretical Prediction, Rational	3.00	2.00	1.00	3.00	2.00	1.00	3.00	2.00	1.00
Theoretical Prediction, Naive	3.56	2.00	0.81	3.56	2.00	0.81	3.56	2.00	0.81
Data (*n=13*)	3.64	2.10	0.89	5.01	2.67	1.06	7.30	3.93	1.36
	(0.69)	(0.39)	(0.68)	(1.60)	(0.71)	(0.19)	(0.38)	(0.21)	(0.06)
Holt & Sherman (1994) Experiment, Data (*n=50)*	3.78	2.03	0.74						
	(0.58)	(0.21)	(0.08)						

relations. We propose and illustrate the use of the process-stakeholder analysis for comparing different forms of trading, and evaluate the impacts on different market participants. The cross-case analysis of ICT initiatives in the Dutch flower markets results in a useful guide to evaluate or explain the successes and failures of ICT-based initiatives in new markets.

Second, we expect that in the near future the Dutch auction method will become popular on the Web. The Dutch auction method offers advantages, because it is much faster, and it tends to generate higher prices. The results of an experiment, comparing bilateral bidding with English auction and Dutch auction methods, illustrate the higher price proposition.

Third, the cases in the Dutch flower industry reveal that application of information technologies to trading can enable increased efficiencies and separation of informational and physical trading processes. This in turn will permit more varied forms of trading customized to different user requirements. The TFA case shows the impact of the electronic auction system on the supply chain configuration and its performance. In this case the use of electronic auctioning leads to simpler logistics and distribution processes and a better logistical performance of the total supply chain. For consumers it could mean fresher flowers for the same price.

The cases highlight new questions for research. As the Internet evolves into a powerful and reliable infrastructure for electronic commerce and business, Dutch auctions become more important as a trading mechanism. However, there is little empirical research on the Dutch auction mechanism and the effects of clock speed, transaction volume, and other information variables on prices, buyer strategies and net benefits. Further research will focus on experimental research which includes these variables.

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Appendix 1: Instructions

Introduction

This experiment deals with the economics of decision making under uncertainty. If you follow these instructions and make good decisions, you can earn a significant amount of money, which you will receive in cash privately at the end of the experiment. You are to act as a potential buyer in this experiment. You will be asked to choose an amount to bid on a product, without knowing the exact value of the product. The current owner of the product, who is the potential seller, knows more about the product's basic value than you know as the potential buyer. On the other hand, the product will be worth more to you than it is to the current owner. In this experiment three different price discovery mechanisms are investigated:

- Bilateral bidding
- English auction
- Dutch auction

Bilateral bidding

In a bilateral bidding game you will bid on an offer made by one seller. The potential transactions can be described in the following way. During each period, you may bid on a product. The product's value to its current owner will lie in a "Range" of values between a "Lower Limit" and an "Upper Limit." All penny values within this range will be equally likely. For example, if the Lower Limit is 1.00 and the Range is NLG 2.00, the product will be worth between NLG 1.00 and NLG 3.00 to its current owner. Every value in that range, such as NLG 1.00, NLG 1.01,..., NLG 2.99, will be equally likely. The product's value to you, should you acquire it, will be 1.5 times as much as the value for its current owner. The product's value to you, should you acquire it, will thus be calculated as follows:

value to you = 1.5 times the value to current owner.

For example, if the product is worth NLG 1.00 to its current owner, it will be worth NLG 1.50 to you should you acquire it; if the product is worth 2.00 to its current owner, it will be worth 3.00 to you if you acquire it. Your decisions will be recorded on a decision sheet (Table A1). Note that there are 5 numbered columns. Column (1) contains the period number. Column (2) contains the Lower Limit of the range of possible seller values. Column (3) contains the Upper Limit of the range of possible seller values. Once you have entered a bid, it will be recorded in column (4), labelled "your bid" on the decision sheet. In each period, you will make a single bid, which must be either accepted or rejected by the current owner. After you have entered your bid, the product's value for its current owner will be determined by a random number between the upper and lower limits. The value of the Lower Limit will initially be NLG 1.00, and the Range of seller values will initially be 2.00, so the random number will be between 1.00 and 3.00. Each number 1.00, 1.01,...,3.00 will have an equal chance of being selected. Then the value to you will be calculated by multiplying the seller value by 1.5. (This figure will be rounded off to the nearest integer number of pennies. This figure is, of course, your value for the product if you acquire it.) If your bid is greater than or equal to the product's value to its current owner, you will acquire the product. In this case, your gain or loss will be the product's value to you, which is 1.5 times the value to its current owner, minus your bid. If your bid is less than the product's value to its current owner, you will not acquire the product and will neither gain nor lose anything. Your earnings are zero in a period in which you do not acquire the product.

Value to current owner = random number between Lower Limit and Upper Limit

(1) If BID ≥ VALUE to current owner, EARNINGS=1.5 X VALUE to current owner - BID

(2) If BID < VALUE to current owner, EARNINGS=0

Please look at the decision sheet again. The seller value and the buyer value are recorded in column (5) and column (6). At the end of each period, your gain or loss will be recorded in column (7) on the decision sheet. You will begin the experiment with an initial earnings balance of NLG 10.00. When you gain money during a period, your earnings will

Table A1. Decision sheet.

(1) Period Number	(2) Lower Limit	(3) Upper Limit	(4) Your Bid	(5) Seller Value	(6) Buyer Value	(7) Gain/Loss
1	1.00	3.00				
2	1.00	3.00				

increase by the amount that you gain. When you lose money during a period, your earnings will decrease by the amount you lose. Your gain or loss will be recorded in column (5) for each period, and your cumulative earnings will be recorded in the bidding screen (earnings so far). At the beginning of the experiment, your cumulative earnings equal the initial balance of NLG 10.00.
At the end of the experiment, YOUR CUMULATIVE EARNINGS WILL BE MULTIPLIED BY A FACTOR OF 2.0, and the result will be paid to you privately in cash. If this product of 2.0 and your total earnings falls below NLG 10.00, then the experiment will end and we will pay you the amount NLG 10.00.

English auction

In an English auction game several bidders will bid on an offer of one seller. In an English auction mechanism the price is raised sequentially. During each period, you may bid on a product. The value rules are the same as in the bilateral bidding:
- The product's value to its current owner will lie in a "Range" of values between a "Lower Limit" and an "Upper Limit." All penny values within this range will be equally likely.
- The product's value to you, should you acquire it, will be 1.5 times as much as the value for its current owner.

You will acquire the product if you are the highest bidder (the last bidder). In this case, your gain or loss will be the product's value to you, which is 1.5 times the value to its current owner, minus your bid. Your earnings are zero in a period in which you do not acquire the product.

Dutch auction

In a Dutch auction game several bidders will bid on an offer of one seller. In a Dutch auction mechanism the price is lowered sequentially. During each period, you may bid on a product. The value rules are the same as in the bilateral bidding:
- The product's value to its current owner will lie in a "Range" of values between a "Lower Limit" and an "Upper Limit." All penny values within this range will be equally likely.
- The product's value to you, should you acquire it, will be 1.5 times as much as the value for its current owner.

You will acquire the product if you are the highest bidder (the first bidder). In this case, your gain or loss will be the product's value to you, which is 1.5 times the value to its current owner, minus your bid. Your earnings are zero in a period in which you do not acquire the product.

Common questions

Some common questions: How is the random value to the seller generated? The computer will first generate a random fraction between 0.00 and 0.99. The seller value is calculated by 1) multiplying the random fraction times the difference between the Upper and Lower Limits, and 2) adding this product to the Lower Limit. To summarize:

Seller Value = Lower Limit + [Random Fraction] X [Upper Limit - Lower Limit]

Since any fraction from 0.00 to 0.99 is just as likely as any other, it follows that any seller value in the range between the lower and upper limits is equally likely.

Another common question: What does "equally likely" mean? Suppose that there is a roulette wheel with 100 equally spaced stopping points, which are labelled: 0.00, 0.01, 0.02, ..., 0.99. Then a hard spin would make the chance of stopping on any one point exactly the same as the chance of stopping on any other, so all values are "equally likely". The computerized randomisation routine makes any fraction from 0.00 to 0.99 equally likely in this sense.
Are there any questions? [Two practice periods for bilateral bidding, English auction, and Dutch auction followed.]