Internet Trading System for Wholesale Flower Markets†

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Abstract:

JFE Engineering, a leading company in electronic auction systems for wholesale markets, has also developed an electronic commerce (EC) system for trading in horticultural products over the Internet, and recently introduced this system in leading wholesale flower markets in Japan. The system is designed to be compatible with traditional business practices in horticultural trading, while also realizing rationalization effects. The system demonstrated the expected results in actual application.

1. Introduction

Transactions for goods and services via the Internet and other computer networks, or electronic commerce (EC), have increased dramatically in recent years with progress in information technology and expansion of the network infrastructure. For example, since 1998, the scale of the business-to-business EC market in Japan has grown at an annual rate averaging more than 60%, even excluding financial transactions such as securities and foreign exchange. The types of product involved in EC transactions are still strongly biased toward electronic- and information-related hardware, automobiles, and auto parts, which account for 84% of the total. However, increasing adoption of EC can now be seen in industry as a whole, as shown by the remarkable growth of transactions in raw materials, chemicals, textiles, food products, construction, industrial machinery, and other sectors.[1)]

In these circumstances, a response to the EC needs of wholesale markets which mainly handle fresh foods and other perishables has become an urgent matter. JFE Engineering has already contributed to the modernization of wholesale markets by introducing advanced technologies, beginning with electronic auction systems,[2,3)] and is also active in EC system development. This paper presents an outline of a newly developed EC trading system for wholesale markets and describes its introduction in wholesale flower markets as an example of application.

2. Current Conditions in Horticultural Product Distribution and Aims of System

The modes of distribution used with horticultural products such as vegetables, fruits, and flowers are basically similar. A conceptual diagram of the distribution system in these industries is shown in **Fig. 1**. Flower consumption naturally assumes the purpose of aesthetic appreciation, and Japanese consumers also value variety in vegetables and fruits. Thus, a wide and varied line of products is an important requirement for trading in all these items. In this respect, the wholesale markets located in large consuming areas are unsurpassed and have come to occupy a large position in the distribution system. However, in recent years, an increasing percent-

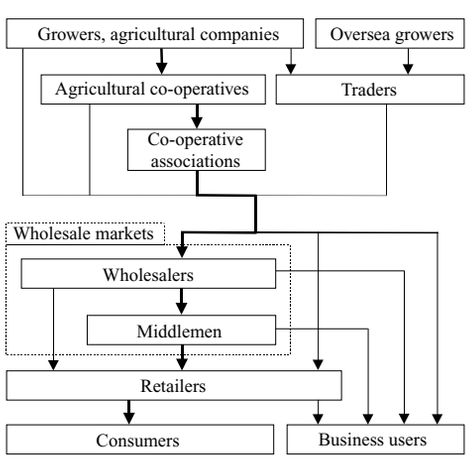

Fig. 1 Distribution way of horticultural products

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age of distribution has bypassed wholesale markets, as shown in **Fig. 2**.

Various reasons for this trend can be mentioned. Firstly, buyers now attach importance to planning in their businesses. While an abundant range of products is available in wholesale markets, quantities depend on the weather and are uncertain until immediately before trading. Likewise, prices cannot be determined in advance, as wholesale markets operate on the principle of competitive sales, in the form of auction or bidding. Thus, the uncertainty inherent in wholesale market trading is an impediment to planned purchasing.

Secondly, as one disadvantage of the multi-stage distribution system illustrated in Fig. 1, information on trends in production and consumption is easily lost. The multi-stage system of agricultural cooperatives, wholesalers, and middlemen has important advantages for distribution, as the quantities of multiple products can be adjusted to meet demand and products can be supplied quickly to multiple consumers, but on the other hand, information may not be transmitted effectively at every stage. For this reason in particular, while recognizing the wide product line available at wholesale markets, both sellers and buyers have turned to other direct business channels with a higher information density.

In responding to these changes, wholesale markets have bent the rule of bidding trading, and increasingly resort to negotiated trades (one-to-one transactions). In actuality, the percentage of bidding trades in all transactions at the Central Wholesale Markets has dropped sharply each year,[4] as shown in **Fig. 3**. However, to materialize a negotiated trade, all the product, parties, price, and quantity must be decided through detailed negotiations, requiring significantly more time and work than in simple bidding trades. This information must also be transmitted through the various stages of the distribution system.

The authors identified the problems in wholesale markets which can be solved by an EC system as follows:

(1) The results of trade (product type/quantity/price) must be as expected, and must be visible to the buyer in real time.
(2) The time and work required to materialize the trade must not be greater than at present.
(3) In commercial trades, seamless, leak-free transmission via the system must be possible, even in multi-stage distribution.

A system which meets these three requirements would maintain the superior features of wholesale markets, while also remedying their current weaknesses. At just this timing, in 1999, the Wholesale Distribution Law was revised, relaxing the principle of competitive bidding, and thus creating an environment in which this EC system could demonstrate its effectiveness.

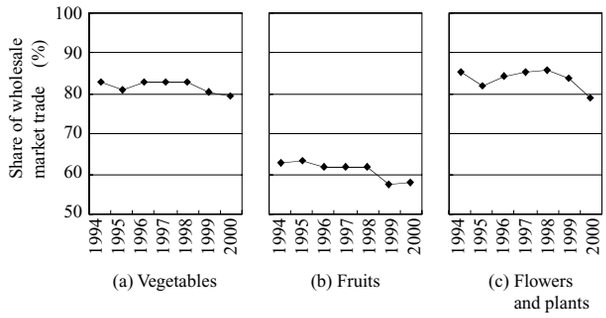

Fig. 2 Share of wholesale market trade in total distribution

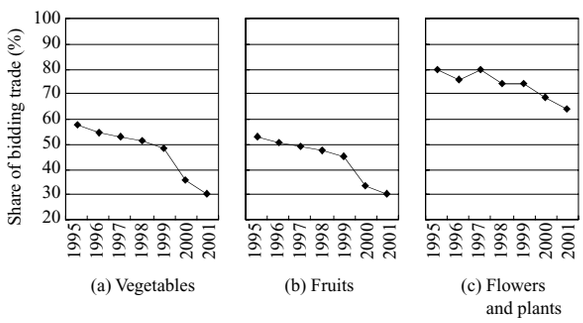

Fig. 3 Share of bidding trade in the Central Wholesale Markets

3. Outline of System

3.1 System Configuration

The system configuration is shown in **Fig. 4**. The wholesaler web system serves as the engine for transactions, while the middleman web system is an expansion of the wholesaler system. Backed by the basic information system, where information on all transactions at the wholesaler is finally collected, an electronic auction system is already used as a front system for auction trades. The present system is positioned as a new front system, generating EC trades via the Internet. In addition to auction trades and EC trades, the wholesaler also accepts human intermediary-type negotiated trades. They are handled directly by the basic information system.

The wholesaler web system comprises five stages: (1) a firewall server, which denies unauthorized access from outside, (2) a reverse proxy server, which increases page transmission efficiency, (3) a web server, which transmits pages, (4) a database server, which stores data on trades, and (5) an authorization server, which verifies the identities of authorized users. Data in the database server are synchronized with the basic information system.

The middleman web system (multiple systems are

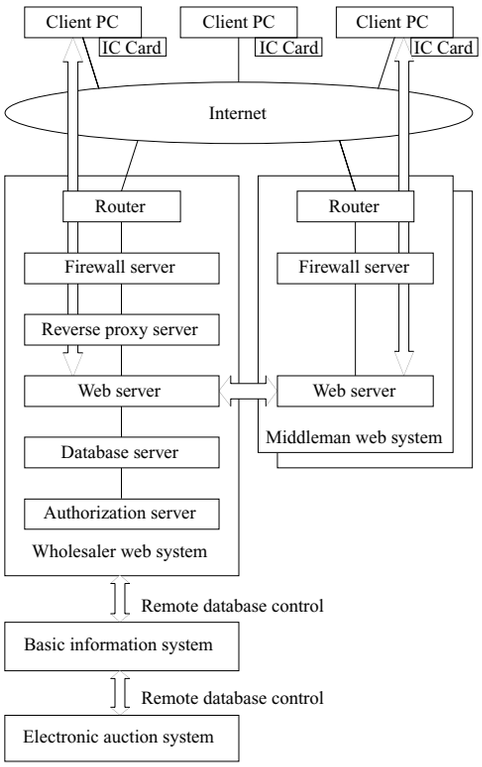

Fig. 4 System configuration

possible) is configured as a dedicated web server and, furthermore, is connected to the wholesaler web system as a front system to realize multi-stage distribution on the system. Although middlemen use their own individual web systems in trading with customers, a simplified response to EC trading can be achieved because detailed product information, etc. are dependent on the wholesaler web system.

Users who participate in trading access the system using standard personal computers connected to the Internet and authorization IC cards.

3.2 System Functions

The main functions of the wholesaler web system are as follows:

(1) Product List

This function allows buyers to browse products currently available for purchase. All product listings show the current prices and maximum quantities available for purchase in real time.

(2) Product Purchase Request

Buyers make purchase requests by clicking. Sales are made in the order in which purchase requests are received by the system. A transaction for the decided quantity and price is materialized virtually simultaneously with the buyer's click.

(3) Order List (Materialized Purchase Contracts)

This function allows the buyers to browse materialized orders among their own transactions.

(4) Transaction Status List

This function allows sellers (cooperatives, producers, etc.) to browse current availability and demand for their own shipped products.

(5) Security Check

Although IC cards are distributed to all users to prevent unauthorized access, the system checks authorized user information when information is browsed.

(6) Data Linkage with Basic Information System

In product information, prices are assigned and products are listed in the basic information system as deliveries are confirmed, including during trading hours. Order information is also transmitted to the basic information system as orders are materialized.

The middleman web system is linked to the wholesaler web system described above. The main functions of the middleman web system are as follows:

(7) Product List (Middleman)

Although basically the same as function (1), source information is received from the wholesaler web system. It is also possible to add on a margin, which is calculated automatically.

(8) Product Purchase Request (Middleman)

The buyer makes purchase requests by clicking. Requests are transmitted instantaneously to the wholesaler web system. When a purchase is concluded, two transactions, i.e., between the wholesaler and middleman and between middleman and buyer are both materialized.

(9) Order List (Middleman)

This function allows the buyer to browse materialized orders among his own transactions.

(10) Margin Setting

This function allows the middleman to set conditions for automatic calculations of the indicated price by product class and buyer.

(11) Page Design Customizing

This function allows multiple middlemen to demonstrate their uniqueness by web page design.

3.3 System Processing Performance

The general standard for response performance in EC sites is the "8 second rule."[5] It is an empirical rule for page display time to the effect that the probability of a purchase action at a site decreases sharply when the user's waiting time exceeds 8 s. Because the largest wholesale flower market in Japan handles approximately 12 000 trading items daily, the product information stored in this system is estimated at 6 000, assuming the EC listing rate reaches 50%. The system was designed to satisfy the 8 second rule under this presumed load, assuming 200 buyers access the system simultaneously.

4. Software Technology Applied in System

4.1 Open Source Software

In recent years, some makers have disclosed their source codes and encouraged business use of basic software free of license fees. This type of software, which is referred to as open source software (OSS), is utilized by many advanced system designers worldwide and has been improved when required based on practical tests in various situations. The authors judged that an established OSS offers relatively high operating reliability, even in comparison with commercial software produced by software makers.

The basic softwares applied to the respective servers in this system are shown in **Table 1**. Although implementation using a reliable OSS was adopted as a standard for this system, a commercial database engine was used only for the database server because importance was attached to real-time data linkage with the basic information system. However, as this should be determined by the relationship with the basic information system, it is also possible to adopt an OSS database engine for the DB server.

4.2 Linkage with Existing Trading Systems

Because the products involved in trading in these wholesale markets are perishables which should be cleared out on the same day, it is desirable to list the maximum possible quantity in electronic trading. On the other hand, ensuring reliability in trades is also a purpose of the system. Thus, the indicated quantities must not exceed the quantity which is actually available for sale (remaining number) at any point in time. This means that the remaining number must be determined accurately to the minimum transaction unit in the system in real time, with no excess or shortage.

However, even while trading is being conducted in this system, it is also possible that the wholesaler may accept transactions via conventional media (telephone, facsimile) in the basic information system. Multiple middlemen can also generate trades by simultaneous operation of their middleman web systems. In such cases, when trades for the same product occur simultaneously in multiple trading systems, special attention must be given to the remaining number.

In this system, two methods are used to solve this problem. One method uses remote database technology, while the other is a multi-stage linkage method, as described in the following section.

The former method is adopted to deal with competition among multiple trading systems (basic information system, auction, EC) within the wholesaler's operation. Specifically, a primary database is assigned to the server with the largest number of transactions, using divided time periods, and other systems run that database via a LAN. This guarantees that the remaining number of each product can be grasped 1-dimensionally in any time period.

4.3 Multi-stage Linkage between Systems

Because the wholesaler web system is the transaction engine, if the wholesaler system is in operation, middlemen can start up other subordinate EC sites using its functions. This is called the "middleman web system" in this system. Because simultaneous operation of multiple middleman web systems and subsequent addition of new middleman systems are conceivable, a unified data interface between wholesaler and middleman web systems is necessary.

As shown in **Fig. 5**, the wholesaler web system changes the format of data sent corresponding to the source of the page request. When a request is received from an ordinary Internet browser, page information is transmitted in HTML, as in Fig. 5 (a), but when the request is from a middleman, product and order information are transmitted in CSV in a predetermined format, as in Fig. 5 (b). The middleman web system con-

Table 1 Software applied to each function

Function	Applied software	OSS
Operating system	Linux	○
Reverse proxy server	Delegate	○
Web server	Apache	○
Web page generator	PHP	○
Database server	IBM DB2 for Linux	–

○ : Constructed with OSS

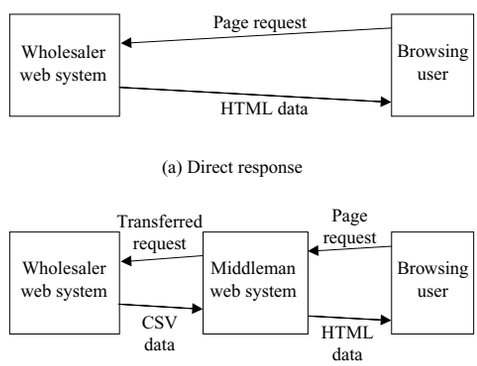

Fig. 5 Way of response to user

verts the CSV data into HTML, and then transmits it to the source of the request.

If a CSV data transmission function is provided not only in the wholesaler web system, but also in the middleman web system, it is possible to implement additional subordinate systems under the middleman system in several stages. This means that the developed system can be applied even in cases where the distribution process takes the form of 1-level/multiple stages, for example, where products are delivered to remote locations. This also ensures that detailed information concerning transactions is not lost in the distribution process.

5. Results of Application

This system was introduced at a wholesale flower market in Tokyo and at a flower middleman's operation, where it was applied in actual wholesale market trading.

At the wholesaler, the percentage of auction trades decreased after introduction of the system, and some existing negotiated trading also moved rapidly to EC. At present, more than 20% of total transaction value is materialized by this system, as shown in **Fig. 6**. New buyers using EC are also contributing to growth in total transaction value, which has increased by 4.8% while the national average of flower market transactions decreased at an annual rate of 0.4%.[6,7)]

At the middleman's operation, growth in EC has also been remarkable. As particularly important advantages, absolutely no transaction-related labor by the middleman is required when a customer purchases a product by EC, and the middleman incurs is no inventory- related risk. At a certain major middleman, EC purchases on the middleman web system amounted to 18% of the total value of stock purchased by the middleman, as shown in **Fig. 7**. In this case, if the middleman devotes his full efforts to deliveries of ordered products, he can often respond to a larger number of customers and/or more distant customers. In fact, virtually all new buyers using EC are developed by the middleman and make purchases using the middleman web system.

Looking at the number of page requests actually processed by the system, **Fig. 8** shows an example of a Sunday, which is the busiest trading day of the week. Although the time period for EC trading is from 16:00 to 23:00 on the day before product delivery, access is concentrated in the period immediately after the start of trading. The calculated response time on the same day is shown in **Fig. 9**. Response time is measured from the point of connection between the Internet and the system, and does not include delays due to the Internet telecommunication route with the actual buyer. Although response tended to be slower during the trading time period, response was on the 4 s level, and thus was within the allowable range. Because there was no change after 20:00, when the number of accesses decreased, it can be understood that the controlling factor in the processing capacity of the system is not the number of

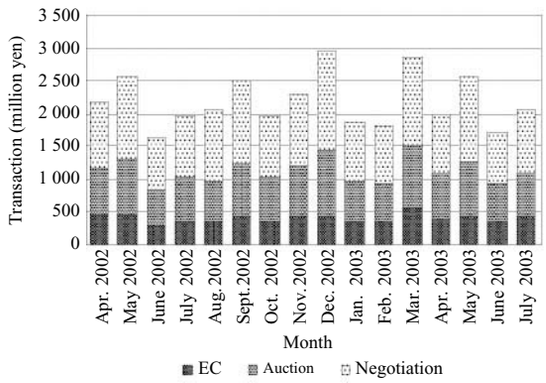

Fig. 6 Transaction by type of trade (Wholesaler)

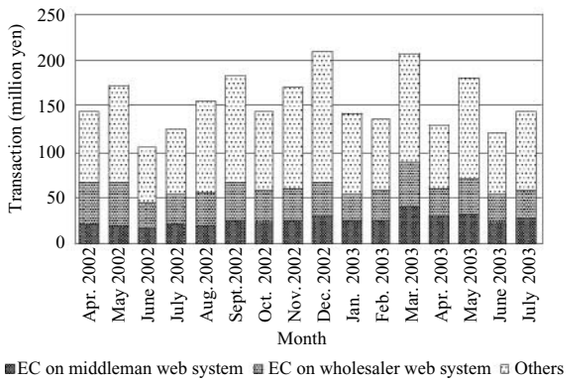

Fig. 7 Purchase transaction by type of trade (Middleman)

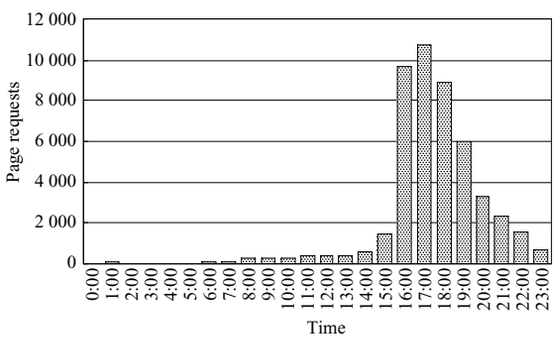

Fig. 8 Number of page requests (Aug. 17, 2003)

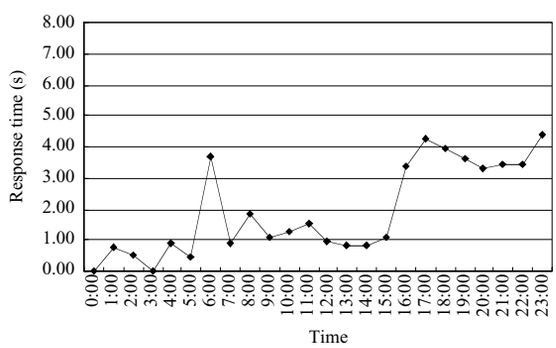

Fig. 9 Response time to page request (Aug. 17, 2003)

accesses but the number of listed products.

6. Summary

This paper has described an electronic commerce (EC) trading system developed by JFE Engineering to handle horticultural products in wholesale markets and presented an example of application to a wholesale flower market. This trading system is not simply an application of a generic EC system to wholesale markets. The aim was to develop a new trading system which can be used while maintaining the distinctive features of wholesale markets as they currently exist, and which also solves certain problems inherent in those markets, such as the multi-stage trading patterns characteristic of wholesale markets and indeterminacy with regard to quantities and prices. In the example of application presented here, the new trading system compensated for the weaknesses associated with multi-stage trading and achieved the expected rationalization effects.

The range of applications of the EC system in this paper is not limited to flower markets. The system is also applicable to the entire range of horticultural products which use similar modes of distribution, including vegetables and fruits. In the future, the authors hope to improve this technology, taking advantage of continuing progress in information technology, and increase the examples of actual application.

This paper includes the results of joint development by JFE Engineering and Ota Floriculture Auction Co., Ltd. and presented the system at Ota Floriculture Auction Co., Ltd. as an example of application. The authors wish to express their sincere thanks to the CEO of Ota Floriculture Auction Co., Ltd. Mr. Nobuo Isomura, and CIO at that company, Mr. Toshio Hirano.

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