Improving efficiency in business-to-business information transfers: a Web-based solution in the beef sector

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Abstract

Internet usage is growing rapidly among agricultural producers and processors, but little attention has been paid to the advantages of agribusiness firms using the Internet as an information exchange with other firms, such as input suppliers. A case study of a beef processor using the Internet to deliver information to input suppliers is presented to illustrate possible information transfer efficiency gains. The prototype information delivery system is a three-tier, Web-based product consisting of data, business logic, and presentation layers. Compared to a traditional client–server design, the Web-based system is more easily scalable as system demand increases, more easily managed whenever software is updated, more flexible, less costly, and more reliable. An overview of the system’s design is provided to facilitate information professionals developing a similar system, which is specific to their business model.

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1. Introduction

Internet usage has grown dramatically in recent years and the increase in usage has been particularly rapid among agricultural producers and in rural areas. Moreover, not only is Internet usage growing in rural areas, farmers’ use of the Internet for business transactions is becoming important. USDA’s Farm Computer Usage and Ownership survey revealed that 43% of all farms had Internet access in 2001 and that 3090 of farms with over $100,000 in sales had conducted business over the Internet (U.S. Department of Agriculture, 2001). Farmers’ use of the Internet for business transactions is expected to grow rapidly. Agribusiness firms responding to a survey of agricultural manufacturers, distributors, and dealers indicated that 1.8% of their sales were made
via the Internet in 1999, but that percentage was likely to reach 17% in 2002 (Henderson, Dooley, Akridge, & Boehlje, 2001).

Growth in Internet usage among agribusinesses trying to reach new and existing customers has paralleled that of farmers. Initially, the emphasis at most agribusiness web sites was on providing information about the firm and/or its products to potential customers and investors. Web site visitors were usually able to obtain the on-line equivalent of product brochures, which provided viewers information regarding a product’s features, advantages and benefits to users. Henderson et al. (2001) reported that 55% of firms responding to their survey had a Web site limited to features similar to those described previously. But some firms Web sites went further. For example, in the cattle sector, some innovators used Web sites to deliver video images to supplement written descriptions of feeder cattle for sale and allowed users to bid on the cattle. Again, Henderson et al. (2001) indicate that only 24% of the firms responding to their survey had what were classified as “power web” sites with features that went beyond the basic information category.

To date, most agribusiness Web sites have focused on firms using the Internet to increase the reach of their marketing programs. Little attention has been paid to the advantages of agribusiness firms using the Internet as an information exchange with other firms, such as input suppliers. As a result, many agribusinesses are overlooking a relatively easy way to strengthen their relationships with their input suppliers and customers. The purpose of this paper is to illustrate this concept by presenting a case study example of using the Internet to increase the efficiency of information transfer between a beef processor and their cattle input suppliers.

2. Sharing information

A growing number of agribusinesses are finding it advantageous to develop on-going relationships or alliances with their customers and input suppliers. Alliance participants share information to better coordinate vertical production and marketing activities (Ward & Estrada, 2000). In particular, some firms share detailed information regarding the raw materials used to produce their products with customers as well as details on inputs with their suppliers. Most information sharing has been done via traditional techniques such as verbal transmission via telephone; mailing or faxing information sheets; entering data in spreadsheets and sending them via diskette; or e-mail. But sharing information in this manner is inefficient because it can require considerable staff time, can be error prone because data is often entered into a computer more than once, and is slow resulting in information being gathered too late to improve management decisions (Keen & McDonald, 2000).

The Internet provides an ideal environment to facilitate information sharing among customers and suppliers. Firms can easily provide their customers and suppliers more detailed data far more timely via the Internet than via other data delivery techniques because the cost of data and information delivery can be much lower. In addition, an Internet-based data delivery system can be designed so users can convert data into information by conducting analysis on-line. Finally, if users need to conduct more detailed analysis, the Web site can be configured to allow data to be downloaded to conduct firm specific analysis. One important advantage to the firm providing the Web site is users can analyze the data and determine how to modify their production and
management practices to do a better job of providing inputs that meet the firm’s needs. Ultimately, adoption of an Internet-based information sharing system can help a firm better satisfy consumer demand and thereby improve its market position (Keen & McDonald, 2000).

3. An example system

The best way to gain an understanding regarding ways agribusinesses can improve linkages with suppliers and customers is to preview an example system developed for this purpose. This particular example summarizes how a large cattle processor has developed a Web-based prototype data delivery system to provide detailed data to cattle feeders.

4. Changes underway in beef cattle marketing

Traditionally, most fed cattle (i.e., cattle fed a high-energy grain-based diet until they reach slaughter weight) have been priced on a live weight basis with price negotiated between the cattle seller and the beef processor. However, cattle producers are moving away from selling slaughter cattle via live animal pricing to more value-based carcass grid pricing. Grid pricing systems consist of a carcass weight base price for a particular quality of carcass (e.g., choice yield grade 3) with premiums and discounts for higher or lower quality carcasses. Although USDA does not report the percentage of fed cattle marketed via a value-based carcass price grid, industry estimates suggest it may be near 40% of fed cattle slaughter and is expected to increase over the next several years.

Marketing cattle via a value-based carcass price grid offers advantages to both buyers and sellers. Procuring cattle via a price grid allows a cattle processor to pay for actual carcass value based upon known carcass characteristics instead of estimating value differences based upon live-animal visual appraisal. Selling cattle via a price grid allows cattle sellers to reap some of the benefits of improved breeding and management programs designed to produce the type of carcass desired by processors. In contrast, when cattle are marketed on a live-animal and live-weight basis, cattle producers receive very limited, and in some cases incorrect, price signals regarding carcass quality characteristics. For example, recent research indicates that when cattle are sold based on average live-weight versus value-based grids, average pricing error exceeds $30/head and, for individual carcasses, pricing error may exceed $150/head, all compared to their grid value (Schroeder & Graff, 2000). As producers become more aware of this foregone opportunity and learn how to develop production and marketing systems to capture some of it, an increasing portion of the cattle industry will adopt value-based individual carcass pricing.

5. Timely, detailed data are essential

In order to produce and market the type of beef carcasses demanded by beef processors, cattle producers need access to more information than was required for live animal sales. In particular, producers need timely, detailed, and manageable data from the beef processor regarding all
factors that influence the price and/or value of each carcass. This includes dressing percentage, carcass quality grade, yield grade, weight, base price, and price premiums or price discounts for each carcass with individual carcass identification back to the respective live animal. Data needs to be quickly transmitted to producers so they can analyze and interpret it. They can then use the resulting information to make production and marketing adjustments on future cattle deliveries.

Producers may make numerous modifications to their production and marketing decisions as a result of having detailed carcass slaughter data from the beef processor. Though this is not intended to be an exhaustive discussion regarding possible producer use of such information, some examples are worth considering because they impact the preferred method, timing, and necessary detail of data reporting by the processor. Producers need to know carcass yields as quickly as they can be transmitted. Expected carcass yield significantly affects the timing of cattle sales, especially when deliveries of cattle sold under a marketing agreement are generally scheduled one to two weeks in advance. Carcass yields can change significantly in a short time period when cattle are near their optimum finish point. If a producer delivers cattle before they are finished to their optimal weight, or holds cattle well past their optimal weight, it can result in a significant loss in profitability (Anderson & Trapp, 1999). Timely access to current carcass yields can help both producers and processors do a better job of scheduling cattle deliveries. Similar arguments can be made for timely receipt of average and individual carcass weight data. Over longer time periods, producers use quality grade information to alter feeder cattle procurement strategies and/or make genetic decisions. Although these longer-horizon decisions may not necessitate having data as quickly as for short-term decisions, they do require detailed analysis that often necessitates complete access to all of the data.

6. Prototype System design

To satisfy producers’ needs for timely access to detailed carcass data (and ultimately price data) on cattle sold to the processor, development of an Internet-based carcass data transfer system was proposed to the processor. An external team consisting of two computer scientists and two agricultural economists launched an effort to develop a Web-based carcass data transfer system to interface with the processor’s existing data collection system. Working with the processor’s cattle procurement and information technology (IT) staff, the external team determined what data were being collected by the processor, the format it was being stored in, and the amount of data the processor was willing to provide to its suppliers. Names of cattle feeders that were potential users of the system were obtained from the processor and informal surveys were conducted to assess users needs. Cattle feeders (users) indicated they needed to access data in two fundamentally different formats. First, users were interested in having access to data on screen via the Internet in both tabular and graphical formats. For some users this would be their primary method of accessing and using the data. Second, several users expressed a desire to download data for further detailed analysis on their own computers. Users wanted the ability to import data into spreadsheets and statistical packages such as SPSS. The data transfer system developed (and described in detail later in this report) accomplishes both of these objectives. Users can examine data in tabular format, several graphical formats or download the data in one of two industry standard data formats for importation into a spreadsheet or statistical package.
The system’s design philosophy emphasized expandability, maintainability, security, and functionality. To best accomplish these goals, the system was implemented as a three-tier, Web-based product (N-tier.com, 2001; Papows, 1998). As illustrated in Fig. 1, a three-tier system consists of data, business logic, and presentation layers (Salb, 2001). Tier 1, the data layer, employs a relational data base management system (RDBMS), Oracle’s 8i to store and manage raw data. The database is used to store all the data required by the system, including things like usernames as well as the transaction pieces. Tier 2, the business logic layer, encapsulates the organizational procedures, security model, and customer relations for the business. For example, this is where the code resides to determine exactly what information a producer is allowed to view, and to do any calculations such as weight averages or price totals. It could also do more sophisticated processing, such as checking payment status or inserting a customized marketing message for a particular producer. The business logic layer receives requests from the client, processes requests, and packages results for use in Tier 3, the presentation layer. The system’s Tier 2 business logic was written using Enterprise JavaBeans, which provides excellent support for both database access and Web-based application (Valesky, 1999; Kassem, 2000). The final level, Tier 3, is responsible for displaying the results and interacting with the user. Results in our system are designed for viewing via a web browser such as Internet Explorer, but the presentation target could also be a web-enabled cellular phone, a personal digital assistant, or another business’ computer system (Morgenthal & la Forge, 2001).

This Web-based system design philosophy is superior to a more traditional approach in several ways. The key advantage of three-tier Web-based systems over more traditional client–server or monolithic systems is the separation of functionality, allowing individual components to be replaced or upgraded with minimal effects on the rest of the system. For example, this system could have been developed as a traditional client/server design, which would have provided similar functionality to our prototype, using tried-and-true implementation techniques. However, compared to a traditional client–server design the three-tier Web-based system offers the following advantages (N-tier.com, 2001; Salb, 2001).

- **Scalability**: Although many firms that decide to set up a data information delivery and sharing system will start off with a small number of users, it’s important that the system be structured to
accommodate a large number of users without redesign. A three-tier Web-based design allows
the system to be easily split across multiple computers (say, for instance, a high-powered
database server and a cluster of computation servers to produce report content). When needed,
additional hardware can be added to the system with minor system changes and minimal
downtime. This allows companies to maintain a fast, user-friendly site in the face of rapidly
increasing demands, which is not possible with a traditional-client server system.
- **Management ease:** In a client–server system, each client must be updated whenever software is
  changed, which is a major drain on resources and provides a strong disincentive for system
  improvements. In contrast, software enhancements to the more centralized three-tier Web-
  based model do not require installation of new software on client machines, which actually
  encourages innovation and improved productivity.
- **Flexibility:** Typical client–server designs require specialized client software for each target
  machine—MS Windows, Macintosh, or Unix—leading to code duplication and large
  redevelopment costs for each computing environment (or, in the alternative, a failure to
  support some segment of the client base). By writing to Web-based standards, the same client
code can support all the systems listed which facilitates development of additional features,
reduces development costs and ultimately produces more reliable software.
- **Cost:** The cost of a three-tier Web-based system is often lower than a client–server design for a
  number of reasons. As mentioned above, code duplication (and hence development costs) is
  reduced. The Web-based model can also incorporate legacy systems, such as the existing
database or accounting system, into the data tier, eliminating the need for costly re-
implementation, which is not the case with a client–server design. Finally, with industry focus
and support firmly behind the three-tier Web-based model, the software and hardware
components for a Web-based system are generally less expensive than their client–server
counterparts (Papows, 1998).

A critical aspect of the system’s technical design was use of the eXtensible Markup Language
(XML) for internal data transfer. XML is far more flexible than traditional data formats, such as
comma or space-delimited, and allows the easy separation of content and presentation
(Morgenthal & la Forge, 2001). An XML-based data format was chosen for several reasons.
XML’s primary advantage is that it provides both device- and operating system independent data
transfer, with the ability to retain its semantic structure. This is a critical advantage over text files
or HTML. To see this more clearly, consider how data appears in XML versus a traditional
delimited format. In the prototype system, which uses XML, a carcass’ USDA quality grade is
stored as `<Grade>3</Grade>` whereas the same quality grade information stored in a delimited
format appears as `<bold>3</bold>` . Note that in XML the variable’s value and identity are
permanently linked. In contrast, when data is stored in a delimited format, determining whether
the value 3 in the example is to be associated with quality grade or another variable is dependent
on software making that determination based upon the value’s location within a string of values.
In addition, XML utilities facilitate the easy transfer of structured dynamic data. In the past,
sending data between programs meant using a fixed (e.g., comma-delimited) format, which meant
that adding new variables to the system would break any software programs currently using it
(Chang & Harkey, 1998). In contrast, use of XML makes it easy to add new variables, such as
support for biological/DNA tags or vaccination records, without requiring older software to be rewritten. In summary, using XML leverages a huge wave of support from throughout the industry in terms of tools and source code which helps reduce initial product development time and also helps reduce time needed to make future system modifications (Kassem, 2000).

Another key aspect of the system’s design is the use of a single module, which encapsulates business logic to generate the XML output (Fig. 1). The XML output can then be transformed for the display tier into user-oriented formats such as Word Rich Text Format (RTF) documents or HTML. As shown in Fig. 2, this is accomplished through eXtensible Stylesheet Language (XSL) stylesheets, which contain a set of templates to transform XML data into a target format such as WML for wireless phones, HTML for web browsers, or comma-delimited text for importing into spreadsheets (Gardner & Rendon, 2002). Since there is only one copy of the business logic, supporting new features is much easier than in older systems, where targeting output to specific devices (web browser, fax, etc.) required development of a separate software program and multiple copies of business logic. Additionally, this approach makes adding support for new presentation devices easy. For example, to add comma-delimited output to the system required adding the appropriate item to a menu and writing a 30-line stylesheet; no changes to the core system were needed.

7. System benefits

Potential benefits resulting from implementation of the Web-based information transfer system are many and accrue to both the processor and input suppliers. First, information delivery costs for the processor are much lower with this system than with alternative techniques. Previously, the processor manually downloaded each input suppliers data and then provided data to the supplier.
via telephone, fax, mail or e-mail. The new system automatically makes data available via the web site as soon as it has been input into the processor’s computer system. Thus, once implemented, the marginal cost of delivering data via the Web-based system is far lower than when using the processor’s previous delivery technique(s). Second, detailed information is transmitted much more quickly via the Web-based delivery system than with the traditional technique(s) and, importantly, input suppliers have round-the-clock data access, allowing them to download and interpret data at their convenience (Papows, 1998). Previously, input suppliers could only obtain access to data during regular business hours. The opportunity to evaluate information on recent shipments as soon as the data is available at the processor allows input suppliers to make both short- and long-term management changes that improve their ability to supply the type of cattle desired by the processor. In turn, this increases the probability that the processor will be able to supply its customers with the product quality mix they desire. Finally, since data is only entered into a computer once, chances for errors are greatly reduced thereby increasing the likelihood that the input supplier will be able to make appropriate management adjustments on future deliveries.

From the IT staff’s point of view, there are a number of advantages to the system. Utilizing a three-tier Web-based design allows for an easier, faster initial implementation and significantly reduces ongoing maintenance burdens. It also allows the system to be easily enhanced and modified, as business needs change. Using XML, which is fast becoming the standard for business-to-business information exchange, enables IT staff to program the core code once, but then easily reuse the output for new classes of clients via XSL stylesheets.

8. Conclusions

Today’s agribusinesses are operating in an interdependent environment where the value of information sharing is increasing. The ability to share information in real-time (or near real-time) with both customers and input suppliers can provide today’s agribusiness with an advantage over competing firms. This study detailed an Internet-based data/information sharing system, which allowed a cattle/beef processor to share data/information on cattle delivered to the processor with cattle suppliers in a near real-time framework. These types of systems offer a unique marketing opportunity as well as competitive advantage since these Web sites facilitate precisely targeted information flows which make it possible to quickly analyze the results of various management programs (Keen & McDonald, 2000).

Prior to development of this system, the processor primarily shared data/information with suppliers verbally over the phone or via a printed copy or diskette, which was then sent by mail or by faxing a printed copy of the data. Development of the Web-based delivery system makes it possible for suppliers to access detailed data regarding the quality of the cattle delivered to the processor and, in turn, to use this information to improve their decision making process with respect to future deliveries. The advantage to the input supplier is that it provides them with near real time access to the information they need to adjust production and marketing practices to more closely meet their customer’s (e.g., the cattle/beef processor’s) needs, thereby increasing the probability of their receiving price premiums and reducing risks of receiving discounts on future cattle deliveries. The advantage to the processor is that input suppliers will ship them the type of cattle they prefer, as denoted by the processor’s price grid. In the long run, this provides the
processor with an opportunity to improve its competitive position by better satisfying consumer demand.

This prototype data/information sharing system has the potential to serve as a starting point for other potential uses. For example, information gathered in the database could be used as a benchmarking tool enabling individual suppliers to compare their performance with that of other input suppliers. Longer term, a processor could even extend this system to implement a program analogous to Wal-Mart’s Retail Link program, where input suppliers self-monitor the processor’s need for particular inputs. In this instance, an input supplier could employ knowledge of historical quality data to identify available animals that meet the processor’s orders for a particular beef quality level and ship those animals to the processor on-time.

Prior to implementing a Web-based information sharing system, it is useful to consider the following points. First, to maximize system benefits a commitment to rapid, accurate, information collection and dissemination on a company-wide basis must be made. For example, if data is trapped on a remote site until a midnight upload to the central computer, valuable time to analyze and act on it is lost and benefits from implementing the system will be reduced. Second, adopting emerging technical standards early will pay dividends later on. In the prototype system an emerging standard for data storage, XML, was adopted even though it is not yet in widespread use. Adoption of this emerging standard will pay big dividends later as industry support for this standard grows. Moreover, use of this emerging technical standard ensures that the system will stand the test of time since support for the new uses and users, such as Web-enabled cell phones, can be added to the system with minimal modifications.

References


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