# Improving Efficiency in the Exploitation of the Information Super-Highway in Dairy Herd Improvement

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## Introduction

Information systems in the dairy industry involve individual participants that are dependent on each other to maintain, transform and exchange information (i.e., performance of basic activities). The information system for dairy herd improvement contains several sectors (including producer, DHIA, breed association, genetic evaluation centre, university and government) and it is within these sectors that the basic activities are carried out to maintain the functions of the information system.

One major force acting on the dairy breeding information system (DBIS) is technology. Information technology can benefit the main products of the dairy industry (eg. milk production) by improving the information system. One of the new technologies which has the potential to improve the dairy industry is the information-super highway (ISH). The ISH is composed of sophisticated digital systems for highly flexible and efficient information movement, through high speed transportation, common services and common communi-cations. The Internet is a major component of the ISH and a powerful tool for the treatment of information products. Its use is expanding in the DBIS as personal computer use increases and the Internet itself becomes more ubiquitous. However, the industry must incorporate these innovations intelligently for them to be used effectively. In using communication innovations one needs to rethink the use of data, information and knowledge. Otherwise re-sources will be wasted and there will be a failure to either reach clients or properly serve them through this medium.

## Objectives

This study examines the current impact of the Internet on the sectors, functions and effectiveness of the DBIS and discusses how current utilization can be improved.

## Experimental Procedures

The functions performed in the DBIS were examined by sector as primary and secondary functions. The primary functions are the main information products contributed by the sector to the DBIS, e.g. milk recording by the DHIA or regulation performed by the government sector. Secondary functions are important functions, but not characteristic of the sector.

On the Internet participants from different sectors create web-sites to serve information that they contribute to the industry through the World Wide Web (WWW). The following examines possible and current functions of the DBIS performed on the Internet, especially the WWW.

## Results and Discussion

The functions performed in the DBIS by sector are shown in Table 1. Functions that are currently being performed or potentially possible through the Internet are also cited in Table 1. It is possible to upload milking records from farms electronically to the DHIA sectors and to download test day results and reports. Test day data are transferred from DHIA to genetic evaluation centres and they in turn make their evaluations available through the WWW by reproducing the proofs electronically. This is a low-cost means of making information available rapidly (particularly text based, electronically stored information), where little adaptation has taken place from the hard copy version. Breed associations and AI units also provide genetic evaluations to their clients. However, most participants could take a more innovative approach to providing the latest proofs on-line, such as displaying proofs that represent various percentages of improvement expected over average production. Another function of the Genetic evaluation centres in Canada is to maintain an on-line data-base of the Canadian dairy herd through a WAIS (wide area information server), which can be used to verify animal pedigree and identification.

Breed associations and AI centres can provide other services to producers over the Internet as well, such as herd and sire analyses to assist their breed improvement decisions. The US Hosltein Association has developed software

to facilitate the registration of cattle through the Internet from the farm computer. They have also developed software to make sire recommendations to producers based on a number of preferences. They also offer software to assist farmers in managing their herds and the technology exists to network producers home computers with the association's data-bases for optimum information access. Many AI centres are using web-sites to market their top bulls. It is possible to sell semen and contract breedings on-line after producers have browsed the site, charging the transaction to a secure account using a private ID number and password. Other marketing functions such as on-line auctions are potentially possible as well.

Many universities and governments are active on-line, creating libraries and data-bases of agricultural resources, using WAIS and FTP sites. For example, extension papers, policy papers and news releases are available from the USDA's National Dairy Database and multimedia documents, research article archives, etc. are available through many university sites. Teaching and training functions potentially could be more completely developed through Internet courses or interactive extension sessions to expand their on-line involvement with industry members and producers through distance education, support up-grading and technology transfer (e.g. on-line help for installing and using new equipment). The major challenge is cost of development since specialized developmental teams and systems (hardware and software) are necessary. Telnet has been by scientists to remotely analyze data for research as well as by the genetic evaluations sector to process EBVs remotely on mainframes and supercomputers. Dairy cattle records, used for evaluations, can be exchanged between DHIA and genetic evaluation centres by FTP and the resulting proofs are similarly retrieved by AI centres and breed associations. The Internet seems destined to play an even greater role in international sharing of scientific data to publication of scientific journals.

The ISH's immediate impact on effectiveness is an increased availability of information to the user accessed with greater timeliness. A possible draw back to this result would be providers creating an "information jungle" because of the large volumes of information coming from an ever increasing number of sites. Providers can minimize the occurrence of this problem by providing participants information that is *necessary* rather than what is *possible* and by presenting it well. A change in timeliness represents a shift of scale in disseminating information since many information products in the DBIS (evaluations, herd reports, policy and extension, scientific information, etc) exchanged among sectors and participants will be less constrained by time required for distribution via the ISH.

**Improving Exploitation of the ISH**

The benefits to the effective use of information may be fully realized with philosophical changes of participants towards the provision and reception of information. Participants must think of physical entities (animals, resources and transactions), as corresponding to 'virtual' information entities, which exists in the DBIS, having value which is affected by their treatment (processing, storing, exchanging). Transition to this mind set can be difficult and consume resources as it challenges producers, researchers, and industry members to think of their contribution to the dairy industry in terms of information goods. The benefits of the transformation include better use of data and resources to produce specific information that is valuable to clients.

Both information servers and clients have roles to play in optimizing the use of the ISH. Servers, could provide a family of information products to clients by collaborating with other participants within and across sectors, so that consistent presentation is broadly maintained. For example, rather than raw EBVs being provided by AI centres, breed associations and Genetic evaluation centres at the same time, as is currently the case, these organizations should have different but related information at their respective sites. A main web-site could maintain the evaluations and a method of searching these files, and the other sectors could provide services that manipulate the indexes and individual traits for herd and individual animal needs. Clients currently acquire information from web-sites and FTP sites whereas with other media they are more passive. This allows them to make choices about the information they require: the clients should determine their need for information and possess the physical and organizational requirements for its integration into their internal information and data structure. A producer searching for the latest evaluations for his or her herd must be prepared with a knowledge of the information he or she requires, where to access it and how to retrieve and integrate it.

**Potential Improvements of the DBIS on the ISH**

The potential impact of the Internet on the timely movement of accurate information exchange in the DBIS could be made more profound by developing definitions for variables, protocols for exchange, and standard formats (e.g. forms) that are common to all participants. One approach to accomplish this is the use of electronic data interchange (EDI) in the DBIS. This method automatically exchanges information electronically between computer systems through structured standardised messages which could be applied over the Internet. The Dutch have developed an EDI system (Agricultural Data Information Standard) for their dairy sector and expect it to impact various functions both on-farm and among farms and support sectors organizations. Examples of its use include daily production monitoring and official herd reports. Electronic data interchange is useful for information systems like the DBIS, where data are being reused, speed is important, and a high volume of data are exchanged (i.e., production records) among many participants. It could reduce the delay in information exchange among sectors through quicker supply of information inputs such as test-day records and the simpler control of the data to promote efficiency of the basic functions by removing unnecessary human handling. The latter consideration would lead to optimized storing and processing, and more complete and accurate information. Standardization of the North American dairy industry could be more challenging than in the Dutch case, due to high level of regional autonomy that may inflate the costs of set up. Also, loss of local autonomy throughout the system may not be agreeable to all participants. Benefits will appear as EDI, used in conjunction with other emerging technologies such as remote sensing, electronic identification of animals and automatic event recording. The content of data recorded on-farm could be improved and the exchange of information to off-farm sectors becomes more cost-effective.

Another means of improving the DBIS on the Internet, that is currently under-developed, is the development of processing functions to assist human information treatment. Decision support systems (DSS), are knowledge-based frameworks that use human problem solving methods, such as heuristics, to pre-process information to help human decision making. DSS can be used in advisory, strategic planning and diagnostic processing functions. Decision-support systems have been developed for breed improvement, such as cow culling decisions and prediction of 305-day lactation yields. Using EDI on the Internet, a DSS could be used diagnostically, for example, to advise on the re-calibration economic weights for selection indices. The use of DSS on the Internet for the DBIS would be an appropriate way of implementing many human processing functions. The Internet ought to be suitable for DSS development since both technologies rely on well-structured information management techniques for their development. The use of DSS on the Internet should expedite the bringing together of up-to-date, distributed sources of knowledge and information to support various decision-making efforts throughout the DBIS, taking advantage of increased volume and sources of information. Given that dairy producers are remotely resident from experts in the industry, DSS distributed over the Internet should enhance the availability of expert reasoning to industry members.

**Impact**

The impact of the ISH on structure and function thus far has been limited but potential adjustments, in order to deliver dynamic information services to participants, are possible. To that end, there has been an increase in the content of the information available to industry members through the Internet and in a more timely way. Technologies such as EDI and DSS can improve the effectiveness of the DBIS through better storage and retrieval of information and increasing the capability of the Internet to carry more functions respectively. Expanding the functions of the DBIS on the ISH to include knowledge dependent functions will allow the Internet to support the full range of necessary functions making the Internet more attractive and useful to all participants. Resulting increased usage of the Internet decreases the costs incurred per user and improves the potential for highly developed and differentiated services to appeal to all members of the dairy industry.

**Table 1. Primary and secondary functions performed in dairy herd improvement and their execution on the Internet.**

| Sector | Farm | DHIA | CDN | Breed | AIC | University | Government |
|---|---|---|---|---|---|---|---|
| **Primary Functions** | a) sire selection<br>b) cow culling<br>c) cow replacement<br>d) sire/cow mating | a) milk recording<br>b) component analysis<br>c) herd reporting | a) genetic evaluations<br>b) national dairy database | a) herd book maintenance<br>b) type classifications<br>c) genetic evaluations | a) semen marketing<br>b) proven sire selection<br>c) sire analysis | a) research<br>b) education and training<br>c) technology transfer | a) regulation<br>b) regional integration<br>c) extension |
| **Internet** | | a) upload test-day data<br>b) download herd reports | a) quarterly proofs on-line<br>b) dairy cattle WAIS | a) on-line animal registration<br>b) proofs and evaluations on-line | a) on-line semen contracting<br>b) top bulls marketed | a) modelling /stat. analysis<br>b) on-line courses / teaching<br>c) on-line libraries | a) policies / regulations available<br>b) Internet support<br>c) Libraries (WAIS) |
| **Secondary Functions** | a) milking (records) | a) extension<br>b) technology transfer<br>c) research<br>d) marketing<br>e) regulation | | a) herd analysis (pedigree; genetic)<br>b) sire analysis<br>c) extension<br>d) marketing | a) genetic evaluations<br>b) training<br>c) technology transfer<br>d) research | a) extension | a) research<br>b) training |
| **Internet** | | a) management software acquisition<br>b) support software marketing | | a) on-line herd analysis<br>b) downloadable sire analysis software<br>c) support software marketing | a) on-line proofs and evaluations<br>b) chat-lines, guest books | a) on-line articles chat lines discussion groups downloadable learning aids | |