Information Technology in Agriculture

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Abstract
Information technology can be defined as the application of technologies to enhance information transfer and delivery. All information technologies have the potential to increase access to information. Decreased access time for information is a key factor. These technologies can be used to enhance economic activity in the province, as well as assist research and extension workers in agriculture to not only re-engineer how information is packaged and delivered but to enhance productivity during budget restraint and downsizing. This will also impact job descriptions as departments focus on future opportunities. Opportunities for information technology projects in agriculture are discussed.

Introduction
A fundamental change is taking place in the nature and application of technology in business. This change has profound and far reaching implications for every organization. Driven by the demands of the new, competitive business environment on the one hand and profound changes in the nature of computers on the other...the information age is evolving into a second era. Organizations that do not make this transition will fail. They will become irrelevant or cease to exist, Tapscott (1995).

While information technology has strong roots in computer science, the information technologist in agriculture will also require skills in the areas of computer connectivity, media and graphics, technology transfer, and specialized skills of information technology. Thus the core of the training will include courses in telecommunications, electronic imaging, information storage and organization, computer-human interaction, technology transfer, microcomputers, interpersonal communication skills, and computer programming.

Information technologists will become critical in many organizations. These people will be able to address human-computer communication more effectively because of their ability to understand people as well as computers. Thus they will be able to communicate with people in the industry to focus the technology on the issues. The information technologists will be the agents of change in many fields, including agriculture.

Telecommunications technology will provide the basic connectivity that is needed in departments that collect, analyse, and distribute information. Advanced knowledge of rapidly evolving storage technologies will be essential to accommodate voice, video, and other broad bandwidth sources of information. Courses in computer programming and computer organization develop the necessary concept mastery for structuring information in a functional and extensible manner.

Information technology differs from computer science in three very important ways. First, information technology does not focus on computing, but rather on distributing systems, often linking a variety of hardware and software in a single network. The fundamental basis is the
communication network and the utilization of its services, not exclusively the computer.

Second, the information in the process is no longer limited to text and some graphics, but encompasses a full range of human communications including animation, video and sound. The information technologist places a new emphasis on broad bandwidth communication to establish a richer interface between humans and information. This has implications for both information processing and information storage and telecommunications.

Third, information technology is concerned with the impact of technology on humans. Creating user friendly interfaces, designing solutions to human problems, and gaining acceptance for the solution all require a perspective that goes beyond the technical aspects of design. End users of information technology are likely to be less sophisticated users and they must be trained. First they must be convinced that information technology holds some benefit for them. Technology transfer is an important component of the field, R. I. T. (1995).

Technology transfer is the process by which developed technology is packaged, promoted, disseminated and adopted. Technology transfer is associated with the process of dealing with “technological change”- what makes farmers accept new ideas and tools, yet reject others? The area of technology transfer deals with these and other related problems, including utilization of change agent strategies to facilitate the process of implementing innovation, Poley (1993).

The focus of technology must be to provide access to information on demand and to decrease response time for information delivery. Improved service will be the key to survival in many organizations. Communication technologies for improving service include: telephone, answering machines, call answer, call waiting, fax machine, fax back, beeper pager, electronic organizer, 1-800 #, cell phone, conference calling, satellite conferencing, internet, cd-rom, etc.

Recent developments in technologies include: data entry, transaction processing, inquiry processing, decision support, expert systems, real-time control, document processing, electronic publishing, document storage and retrieval, graphics processing, image processing, sound processing, video processing, hypermedia processing, electronic mail, voice mail, shared screen conferencing, video conferencing, digital libraries, telecommuting, distance learning, video, etc.

This paper will focus on information technologies (Internet and Cd-rom) for agriculture, including references to challenges facing the industry including research, extension, & farmers and agribusiness. The key issues will center around the ability to organize and cooperate so that information can be available upon demand. The paper concludes with a suggested model for utilizing information technology in agriculture.

**Internet**

The internet was established in 1969 as a communications network by USA Department of Defense to exchange military and national security data. This was followed by additional networks for defense research to general scientific use. Universities and research groups began to develop in
house networks known as Local Area Networks (LAN’s). A LAN would connect one computer in an office or department with all other computers in the building, Krol (1994).

By the 1980’s networking was fast becoming an established tool for scientific endeavors. In order to expand information access to the research community, the National Science Foundation developed NSFNet. This allowed researchers to access supercomputers by way of high-speed phone lines. The NSFNet caught on quickly and Universities went on line. Networking followed throughout academia, sectors of government and private industry. Further proliferation of collective networks has resulted in an international electronic community of microcomputers known as the Internet.

Impact of Information Technologies

Research

Reduced budget for research and development has resulted in prioritization and downsizing of programs. Researchers know the benefits of getting information to the end user. Information technologies such as internet and cd-rom could prove useful for technology transfer especially since time and budget are limited for extension purposes. Several challenges will be encountered by researchers as we proceed. These are:

- to become familiar with the technology
- access to budget for the technology
- view the opportunity to partner for the success of the whole industry
- participate and prepare researcher profile
- answer e-mail on questions from extension staff and producers
- get research off the shelf (perception or otherwise)
- impact on future funding for research.

Extension

Information technologies can be used by extension to re-engineer the process. Extension continues to struggle with access to information and providing information to clients on demand. Extension techniques have not changed dramatically which is leading to a crisis of definition. In the past the focus was on information provision, handing out publications (if available), farm calls, telephone calls on appropriate pesticide application, field days, etc. These continue as common activities for extension today. Information technology can be used to improve information flow. This would free extension agents to develop educational programs so that rural residents could better apply the information. This would mean a changing role for extension from providing information to facilitating education.

Extension specialists have a tremendous wealth of information to share in preparing content for cd-rom, internet, etc. The construction of an electronic database to provide instant access to information for clients in the Rural Service Centers would be an initial step in this direction. Staff would also be able to focus on their specialty area, thereby contributing to content through mail list and discussion groups. The sharing of information among extension agents would be of mutual benefit. The data base should contain current research so this would be a tool for
“getting research off the shelf”. This database would also be made available to industry and producers who have adopted the technology. In addition the participation of extension and research in online discussion groups and mail lists would provide the necessary updates. Extension could use these tools for information delivery to cope with sudden pest outbreaks, i.e. information on demand.

**Issues for Extension**

Provincial Specialists could continue to play a lead role in developing information packages in their specialty areas. Additional support staff may be required during busy seasons.

What content is required? The challenge will be to collect and integrate the data and information prior to packaging for the system. Is there a role for current Advisory Councils? Some group must ensure that the information is technically appropriate. For example how do we distill ADF final reports to obtain useful information for producers?

Once information is placed on the system it will be important to monitor and update the information on a regular basis. This has implications for budget and job descriptions not only for existing staff but new staff focusing on technical support (information technologists). Can a user access fee be utilized to allow for continued support for the program? A fee structure will also provide excellent feedback on the usefulness of the information.

What new and existing partnerships will this require? Everyone including University, Agriculture & Agri-Food Canada, PFRA, Extension, etc. have contributions to make. There is need for a home for the system, staff, hardware/software and expertise to develop CD-Rom/Internet interactive programs.

There is concern that the current extension service doesn’t have current information and is becoming a vehicle to deliver provincial policies and assistance programs with decreasing effort in technology transfer. These limitations will be partly overcome when all the Rural Service Centers of Sask. Agriculture and Food will be on the Internet on March 31, 1996.

Can the Information Technology component of the Agriculture Innovation Fund be utilized to fund a cooperative project to develop and deliver the agriculture data base to the producers?

What do we do if the system goes down?

Security and confidentiality? CD-Rom is more secure than the internet. (See attached information on benefits of CD-Rom)

Intellectual property rights and copyright.

Can we develop content that people will pay for?

Extra workload for scientists for example, e-mail.
Farmer

Modern technology has dramatically increased individual productivity and crop yields. The use of new technology is not foreign to farmers. One can argue that the use of technology on farms is a continuous process. Examples are: new crop varieties, pesticides, fertilizers, equipment, etc. Information technology can be used to continue this process. Key questions about farming and the internet are: Where are farmers currently getting there general farm information and can the internet/cd-rom assist in providing that information with minimum response time. According to a South Australian Survey, Murray (1995) farmers get their information from:
- radio (72%)
- tv (19%)
- computers and satilite transmissions market prices (27%)
- newspapers and magazines
- neighbors and friends
- stock agents and industry exoerts
- field days
- dept of agriculture
- organized farm groups

Although some farmers are already on the net the vast majority will be challenged to do so. There is concern about the cost-benefit factor for investing in this technology. They require additional information on pay back time for investing in this technology and what the technology has to offer for their farm. The majority of other problems will relate to computing consulting, telephone lines, modems, software, transmission speeds, etc. Farmers on the net have shown that they are interested in:
- weather information
- livestock and crop prices
- marketing products
- machinery information (parts)
- new technologies (precision farming equipment)
- crop production information
- discussion groups, mail lists
- equipment purchase
- classifieds
- recreation, travel and tourism
- government information -publications
- distance education
- tax filing

Other computer uses on the farm include:
- decision aids - electronic spreadsheets, expert systems, electronic forcasting models
- livestock production control systems, such as environment control of high tech buildings, feeding systems, electronic identification and production records.
- crop production control systems such as GPS, yields and crop inputs
- yield mapping and interpretation
variable rate systems
remote sensing
electronic communication systems such as data networks for technical and marketing information (DTN, FBMINet)
computer aided learning material, such as distance education, short courses, and workshops.

Constraints to the use of communications technology include: fear of change, awareness, skill sets, money, access to communication technology, credibility, are we audio visual learners, computers seen as sort and retrieve, longevity of the provider, typing skills of end user, age makes a difference, ability of user to estimate return on dollars and time invested in the technology, information overload and thirst for knowledge, education skills, etc.

Telepublishing for Information Delivery

Telepublishing is the electronic transmission of material via computer network to be printed at a final destination. This allows for getting latest information out quickly. To accomplish this it would be desirable to have a full text database where every word is indexed and recipients can retrieve exactly what they want to print. In Sask we could have 36 RSC’s access to a computerized delivery system for telepublishing.

Current systems for information transfer can be improved. Current process for publishing is too time consuming and expensive. This involved procedure includes preparation, editing, proofs and printing. Often this 6-8 week preparation time is fine if the information is not time sensitive. Extension and producers are becoming sensitive to dated material

This will not eliminate the need to package information and deliver on a computer database. Once approved by the specialists, the information would be stored on a full text electronic database which could be updated daily. This could be accessed via computer network from any extension office or directly by producers. This could also be assisted with on line discussion groups and mail lists on specific topics. Single copies of required information could be printed locally on pre-printed letterheads via laser printer. Savings would occur since publications are not stored on shelves in a warehouse, in tiling cabinets, or publication racks in extension offices. It can be stored electronically where it can be updated daily as new information becomes available. Essentially this improved service is key to any company creating value for its customers.

Issues

Cost and speed of service to rural residents. Low cost service to rural residents would facilitate the adoption of information technology.

Education, training and support with respect to access and utilization of information technologies.

Challenges with respect to a shift to an information based economy and the enhanced role of communication and information as a strategic weapon of business. Also the emergence of a global
economy and hence the growing need to compete on a world wide basis. There is also a growing concern about the environment and the environmental costs of economic development. The information age does in fact present a number of opportunities for rural Saskatchewan. However, to capitalize on these rural communities must have access and the knowledge on how to use the technology.

**CD-Rom for Agriculture Information**

CD-Rom stands for a compact disc read only memory. It is similar to a CD-audio disc because both store information in digital format. CD-Rom technology is a means of managing, storing and distributing Extension related information. Manuals, technical documentation, product specifications and databases are some of the text and image retrieval applications currently using electronic delivery. The use of electronic capture and retrieval systems will require reformatting and packaging of information.

CD-Rom technology has been used in Extension in the USA. The conclusion reached from the experience in the Cooperative Extension Service was that CD-Rom is an appropriate method for distribution of extension information. Recently the ERU obtained copies of agriculture CD-ROMS from Virginia as well as food science CD-ROMs which are used for literature searches.

The Extension Service in Florida now provides extension literature (circulars, bulletins, etc) to county-level extension agents in the form of CD’s. When members of the public ask for publications, copies are printed off on the spot. This avoids problems of stocking bulletins at the county offices. The county offices are provided with replacement CDs (containing updates).

**Advantages of CD-Rom**

1. Allows access to data using the power that search, browse and hypertext provide. This should be supported by industry since hyperlinks would provide access to agriculture products.

2. It is the most effective way to deliver information that is not highly time sensitive. Other distribution media, including commercial on-line services and the Internet offer advantages but cost is not one of them. The cost of delivering 1 megabyte of information is $17.00, $3.50, $0.55 and $.0024 for on-line print, 3.5” diskette and CD-Rom respectively. CD-Rom offers the lowest cost storage and delivery of data.

3. CD-Rom is easy to use. Frustrations are minimized since there are no on-line delays in accessing and transferring information.

4. CD-Rom costs are low, with current manufacturing costs about $2.00 per unit when pressing quantities of 1000. Manufacturing costs are unaffected by the amount of data.
4. CD-Rom costs are low, with current manufacturing costs about $2.00 per unit when pressing quantities of 1000. Manufacturing costs are unaffected by the amount of data contained on the disc, which currently tops out at 700 megabytes without compression. This is in excess of 300,000 pages of text.

5. The hardware component is the CD-Rom drive which only adds approximately $200.00 to the cost of a new computer.

6. Packaging for CD-Rom and on-line (Internet) both require development and data preparation. These can be complementary with on-line servicing of the frequently asked questions for more timely, information and instant response to clients’ needs.

7. CD-Rom’s huge storage capacity allows text, images (both still and video) plus audio files to be combined, thereby providing the basis for interactive multimedia products. This type of information transfer is not easily done by means of standard phone lines. However, this will change as higher bandwidth communications are established.

8. CD-Rom offers total control of content and how information is presented. Information cannot be tampered with as is the case with on-line services. This will be a concern on pest control product labels and application rates, safety, etc.

9. Hybrid systems in the future will provide the capability for doing basic research on CD-Rom and updating information by means of on-line searches. The cost of on-line service in this system would be a fraction of a usual search, since telecommunications and connect time charges are kept to a minimum. Other options include the use of a communications module on the CD to transfer current information from a central server to the user’s hard disk by means of a modem link. This approach allows providers to integrate frequent updates with CD databases while maintaining control over the user interface.

10. CD-rom reader capabilities and disc capacity improvements (such as quadruple speed readers) combine with lower prices will offer better value to customers in the future.

11. Increased CD-Rom capacity will be achieved through use of high density video, multi-layering discs and double laser technology will further add to the Rom’s success as a low cost technology for information delivery.

12. CD-Rom content can be targeted.

Disadvantages of CD-Rom

1. Less than 10% of the US and Canadian households have a multimedia personal computer. Only a third own systems powerful enough to smoothly run today’s best software.

2. CD-ROMs are not generally available in agriculture. This technology may be suited for
agriculture Extension offices as the initial customer. The CD-Rom would also be available to producers.

3. This is a poor media for provision of timely information since the information is usually outdated as soon as the package is prepared. The timely information and frequently asked questions could be serviced more efficiently via the Internet. This could be a complementary initiative with the CD-Rom.

Summary of an Information Technology Option for Agriculture in Saskatchewan

It is recognized that there is difficulty in accessing quality information by extension, industry and producers.

The opportunity exists to organize agriculture information to provide access on demand through cd-rom and internet. This includes the development of a knowledge pool using the 3c’s (cooperation, collaboration, and communication) among research, extension, producers, grower associations and industry.

The goal would be to generate an electronic Guide to Farm Practice on CD-Rom with annual updates utilizing the information from a complementary data base on line which will be continually updated. This online Internet data base would be used for current updates and discussion groups monitored by staff.

The process would include organizing a team to develop, coordinate and update an agriculture knowledge pool with cooperation from provincial departments, university, extension and industry. The team would focus on technology, service process and procedure to complete the project.

Funding for this initiative could come from the Agriculture Innovation Fund.

Initial funding to develop Version 1 of agriculture multi-media cd-rom will be significant. The online version will require continual updates. Cd will be a tremendous asset at Rural Service Centers and industry offices, as well as to farmers who have computers with compact disc drives but no access to internet. This would be a major tool in providing access to information on demand.

Conclusion

Emerging technologies of the digital age including the Internet are very definitely going to be an aid to agriculture. It is just a matter of time and technology. Just as the personal computer revolutionized the way we work, the tools of the information age - which are even now, becoming everyday reality - will transform the way we make choices about almost everything, Gates (1995).
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