USE OF HANDHELD COMPUTERS IN AGRICULTURAL EXTENSION PROGRAMS

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Advances in the technology have triggered deep changes. Information Technology (IT) is a strategic in the successful deployment of new technologies and the international competitiveness of agricultural producers. This work overviews the use of IT in agriculture focusing on the experience of the land-grant university in Florida. The main focus is on the recent deployment of handheld computers. The strategy used in adoption is described. A group of early adopters were furnished with equipment and software for use in extension. A key factor for success was the involvement of the users in applications development. Rate of adoption of the target audience reached 82% penetration within a year of program initiation.

1. Information Technology in Agriculture

Up until about ten years ago, nearly all data processing could be summed up in a single word: computers. Today, this term has given way to the broader descriptor *information technology*, which has become generally accepted. It refers to a rapidly expanding range of services, methods, techniques, applications, equipment, and electronic technologies used for the collection, manipulation, processing, classification, storage, and retrieval of recordable information and knowledge. At this time, such technologies include, but are not limited to, computers, software, high-capacity storage, networks, telecommunications, databases, data warehouses, multimedia, training, the internet and its world wide web, geographic information systems (GIS), computer-aided design (CAD), online services, video conferencing, executive information systems (EIS), electronic mail, and expert systems: in short, all technologies related to the acquisition, storage, recovery, transfer, manipulation, and delivery of data, sound, and graphics, including video.

Nationwide, agriculture's adoption of IT continues to increase. In the early 1980s, less than 0.5 percent of farms (any establishment from which $1,000 or more of agricultural products were sold or would normally be sold during the year) used computers in agricultural production, including livestock and dairy operations (ECOP, 1980). In 2001, 55 percent of the 2,165,000 farms in the United States had computer access, and about 43 percent had internet access, compared to 12 percent in 1997. In addition, the percent of ownership, including owned or leased computers, increased from 31 percent in 1997 to 50 percent in 2001 (NASS, 2001).

Technology adoption is related to the farm's income level. In 2001, 54 percent or more of US farms earning $250,000 or more had access to a computer; 55 percent of them reported using computers for business, and 58 percent have internet access. Farms with lower incomes had significantly lower percentages.

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During the past few years, most likely because of increasing attention to the internet, the pace of IT adoption in agriculture was rapid. From 1997 to 1999, computer access on the farm increased by 53 percent; ownership increased by 75 percent; use of computers for business increased by 58 percent; and the number of farms with internet access increased by 250 percent.

2. IT and Agricultural Extension Programs

Extension recognized the importance of on-farm; computer-aided management for agricultural production soon after the desktop computer became available. As early as 1982, land-grant universities were conducting extension activities at a programmatic level to accelerate computer technology adoption. Early efforts in Florida took the form of state conferences on computers in agriculture, carried through 1992, and typically including a series of seminars, hands-on sessions organized by commodity, and trade shows. In addition, computer applications were incorporated into traditional commodity educational activities and, faculty were given credit towards tenure and promotion for developing and publishing agricultural software. In Florida, this effort was successful enough to staff and to operate a self-sustaining statewide Software Support Office, started in 1982 and absorbed into a newly created Information Technology Office in 1997. Software applications were diverse and included expert systems (ES), computer-aided design (CAD), computer-aided management (CAM), information delivery systems (IDS), simulations, and automated control. In particular, IDS evolved into rich content applications from desktop and mainframe databases into CD ROM and, eventually, web-based systems.

An important strategy for Extension is proactive support for emerging technologies that may give farmers a competitive advantage. Such a strategy was implemented when it became evident that the internet and world wide web were to play important roles in the marketplace. During 1994 and 1995, University of Florida/IFAS held fifty half-day workshops each year, directed at farmers, on using the internet for business. Today, Florida ranks at the top in internet purchases of agricultural inputs and second in marketing over the internet. In addition, electronic delivery systems have become essential for timely information distribution. The Extension Digital Information Source (EDIS) web page described below delivers more than 20,000 publications per day to University of Florida /IFAS's extension clientele.

As technology allowed for faster connections to the internet, hardware devices became smarter, and software development tools allowed faster prototyping and development, complex distributed systems emerged. Their application to agriculture exploited fast and reliable communication for the acquisition and delivery of real-time information for tactical management and medium term forecasting for strategic management. The FAWN project described below exemplifies the use of weather data for short-term decision-making and the use of El Niño-based climatic simulation for medium to long-term strategy selection.

3. Personal Digital Assistants and Hand Held Computers in Agriculture

Following the trend of miniaturization of computer equipment over the past few years the capacity of the personal computer has tended to migrate into handheld devices. With the convergence of PDAs with wireless, better software development tools, and a broad base of users that are skilled in using desktop and online resources, there is a clear trend towards nomadic computing.

Early uses of PDA focused on scheduling, note taking, email and storage of information such as telephone numbers and addresses. Maturity of PDA's was reached when they were able to run applications comparable in complexity to those executed on a notebook computer and to store substantive amounts of information. The term pocket computers sometimes used to describe the devices reflect this new generation product. Their compact size is convenient for the Extension Faculty that often moves from location to location from the office to the field.

4. Strategy Used in Deployment

To improve the odds for the success of the project, faculty known for being early adopters were identified. Equipment was provided to them as well as training in the use of the device. The participants, working as a team, were asked to identify relevant applications. Application requirements, particularly data content and interfaces, were determined in collaboration between the extension faculty and software engineers. Software was then developed by the software engineers and tested by the extension faculty.

4.1. Selection of the Platform

The process was initiated by conducting a review of available devices (see Table 1) in multiple platforms. A final decision was made to use Pocket PC devices primarily due to: 1) The small learning curve required for individuals already familiar with MS Windows, MS Explorer and MS Outlook; 2) easy integration with MS Windows platform, which is the enterprise level system used by University of Florida /IFAS Extension Faculty, 3) at the time, the high quality of the interface, particularly the color display and, 4) at the time, system performance. The specific hardware vendor chosen was Compaq[2].

4.2. Selection and training of early adopters

A group of 15 county faculty in the Northwest Extension District agreed to be part of a pilot on the use of HHDs in agriculture. The pilot included extensive training and participation in a software development program.

Training focused on acquiring skills in the use of the HHCs. This included becoming proficient with the PocketPC interface, setting up the device, using email, word processing, spreadsheets, presentation software, web browsing, document readers, downloading and installing new applications, synchronizing with a desktop machine and backing up data.

Because of the knowledge this group had of the MS-Windows environment, they were able to use the device very quickly, including moving some applications from the desktop that were more conveniently used on the HHC.

4.3. Custom software development

To ensure that relevant applications to the needs of the faculty were developed meetings were held with the county faculty, project leaders and software engineers. The group quickly focused on activity reporting. The Institute of Food and Agricultural sciences at TheUniversity of Florida requires that all faculty report in detail activities related to teaching, research and extension, including demographic data of the clients and outcomes produced.

2 The mention of trade names does not imply any endorsement, explicit or implicit, by the authors or the University of Florida.

This reporting procedure is generally considered a burden by the faculty and requires a substantial time investment. As a result a PocketPC version of the accountability system was developed that allow faculty to enter information as events occur and is uploaded through the web to a central database greatly reducing the effort invested in reporting..

Other applications that were developed included a set of tools for irrigation design and management. All software was developed using Embedded Visual Basic or Embedded C.

4.4. Adoption beyond the Pilot Group

Initially the main applications used were a Pocket PC version of FAS, the use of the included web browser to access extension information from EDIS and other web sites, the use of spreadsheets, and to explore other applications of the Pocket PC in agricultural extension programs. Figure 1 shows the adoption rate by Northwest District Extension Faculty. After the early adopter group that piloted the use of the devices in fall of 2000, rapid adoption took place from May through September of 2001 reaching a penetration of 80%. Thereafter the adoption rate slowed and reached 87% penetration in August 2002.

Most frequent uses of the Pocket PCs are email, tasks, contacts, notes, and calendar. These were followed by frequency of use by word processing and spreadsheet applications. Other applications include recording clientele contacts of group and individuals, mass media, volunteer and materials developed for posting to FAS. A growing number of Faculty are using the PC in land use mapping for geographic information systems (GIS) activity, remote web based information for weather and market data, and slide show presentations while teaching clientele.

Problems most often mentioned by extension faculty in the use of handheld computers are primarily the short battery life of the devices, synchronization problems with the desktop, limited internet access (lack of wireless service and modem problems), memory limitations found in some of the early models.

5. Where are we going?

Changes in technology will proceed with organizational and social change. The rapid evolution of hardware and software devices will increase consumer demand for timely and accurate information. If current trends in wireless broadband technologies continue, it is likely that, in the medium term, demands, beyond data, for on-field best management practices will increase rapidly. These developments, coupled with the rapid advances that are being made in human computer interfaces, are likely to make IT ubiquitous, enabling access to dramatically increased amounts of data, tools for analysis, and decision support systems.

Agricultural Extension programs at the University of Florida will take advantage of IT developments to enhance its ability to conduct nonresident education programs. This technology is particularly advantageous to deliver information asynchronously to widely dispersed clients. However, a full conversion to IT by Extension professionals will likely take a generation in most areas of expertise and be driven by client demands in other areas.

REFERENCES

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Table 1.
Partial list of Handheld Devices Reviewed

Family					
Palm OS	Zoomer	MSDOS	WinCE & PocketPC	Zaurus	Psion
Palm Pilots and clones	Nokia GRIDpad Gulliver Zoomer	200LX OmniGo	Cassiopeia Hewlett-Packard iPAQ Others	ZR devices	Series 3c & 5 Siena Geofos

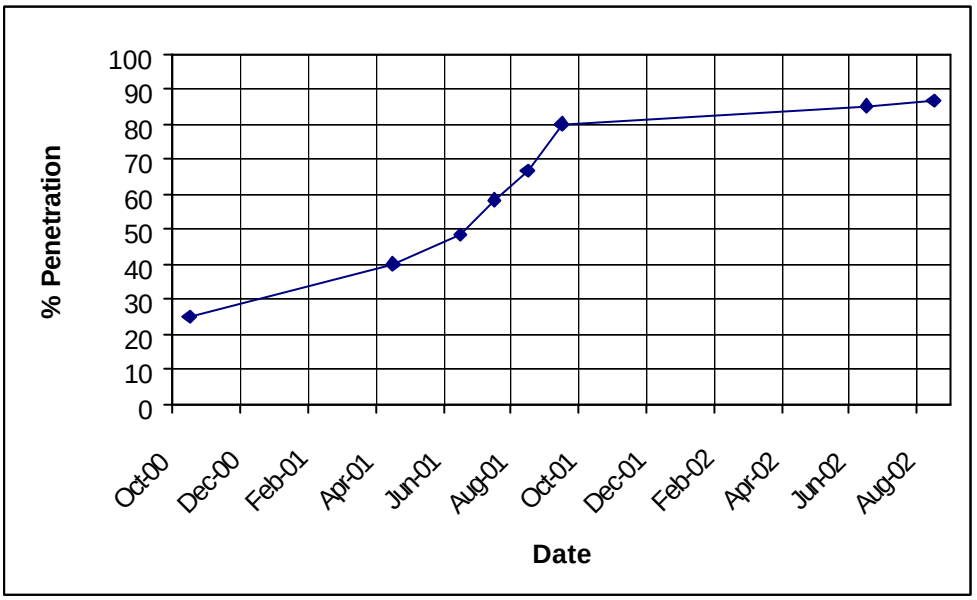

Figure 1: Percentage of faculty using a Pocket PC in the Northwest Extension District since the Pilot program was initiated in October 2000 (Note that only times at which equipment purchases were made are shown as data points.)