Efficient, Collaborative, Inquiry-driven Electronic Information Systems

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SUMMARY. Electronic information systems provide efficient information management—development, updating, storage, retrieval, and delivery. No more stockpiling of printed, going-out-of-date information when specific, concise, up-to-date information can be obtained just in time from the Internet. Authoring for electronic media is different than authoring for the printed page. To use unique characteristics of electronic information systems, information is presented in chunks, small units of information that can combine text, video, or sound to present one concept or to answer one question. A chunk may be linked to other chunks to provide definitions and further elaboration of terms or ideas. A chunk may be linked to related chunks to provide comprehensive information inquiry-driven by and tailored to the inquirer's interests and understanding. A chunk may be linked to other chunks to provide definitions and further elaboration of terms or ideas. Collaboration is facilitated by the World Wide Web (Web). Shared development reduces redundant efforts and costs and results in better products than can be produced by autonomous efforts. Continual, shared development and updating keep the individual chunks and the linked chunks (URLs) up-to-date and dynamic. Educators can thread (link) selected web modules or chunks (URLs) together into dynamic study assignments or dynamic textbooks for courses of study. To obtain the best of both media, CD-ROM software can be designed to interact with a Web site. The ways that CD-ROM and online are interacting are varied and evolving. Graphics-rich databases such as color photographs of plants or pests and related text that do not require continual updating are well suited to CD-ROM. Web links from the CD-ROM to additional, dynamic information and updates at the Web site keep the CD-ROM live and current. ASHS members are uniquely qualified to generate continually updated, peer-reviewed horticultural information on the web for continuous access by the interested learner whose pathway on the web will be inquiry-driven.

Electronic information systems can provide concise, up-to-the-minute technical information when needed by the inquirer for use in decision making—no more stockpiling of printed, going-out-of-date information in the warehouse, on the shelves, in the file cabinet, or in the library. The time has come when cooperative extension service and other purveyors of educational information can no longer afford to live with the old model of printed publications. In fact, states such as Florida and Colorado now print only a few extension publications. Most that are printed are offered as “for sale” documents. Most publications are only accessible through the World Wide Web (Web) or on CD-ROMs. If users desire a hard copy of specific information to meet a current question or to help make a decision, they print the specific information needed using their printer and paper—just-in-time to provide information about their current question. Many cooperative extension county offices in Florida print publications from the CD-ROM and use this as a master copy for duplicating. This saves money, reduces waste, and fewer trees are cut down.

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AUTHORING, ORGANIZING, AND LINKING INFORMATION CHUNKS. Authoring information for a CD-ROM or the Web differs dramatically from writing printed documents. For electronic media, information is developed as chunks, small units of information that can combine text, video, images, or sound to present one concept or answer one question. A chunk may be linked to other chunks to provide definitions and further elaboration of terms or ideas. A chunk may be linked to related chunks to provide comprehensive inquiry-driven information tailored to the inquirer's interests and understanding. The University of Florida has used a variety of mechanisms to prepare chunks over the last 10 years in this fairly new area of information preparation. The current mechanism provides faculty in each university department or unit enough training to prepare the chunks of information at the department level. In this way, the faculty developing the information modules or chunks can have direct influence and control over the design and flow of the information. This is important because the experiences students and other users gain by using the electronic information on the Web or CD-ROM are controlled by the design of the document. For additional information on authoring for the Web see Peet (1998) and for information on the concept of team authorship see Green et al. (1995).

CD ROM AND WEB INTERACTION—THE BEST OF BOTH MEDIA. One of the obvious advantages of the dynamic Web site is that new or volatile information such as pest control recommendations or evaluation of new plants can be updated rapidly and continually; whereas, once a manual is printed or a CD-ROM is pressed, the information is there forever and can not be changed unless the customer purchases an updated version. Printed pages and CD-ROMs have limited afterlife. However, graphics-rich databases, such as a collection of text, data, and color photographs of plants or pests that do not need to be updated for several years are well suited for CD-ROM. The high cost of printing often makes print-publishing large numbers of color photographs prohibitive, but this can be done at relatively low cost on CD-ROM.

CD-ROMs provide a convenient method of delivering information because of their tremendous storage capacity (650 megabytes). Newer digital versatile disk or digital video disk (DVD)

technology will increase the amount of information stored on a CD-ROM by about 15 fold. Current technology allows information providers to deliver high-resolution images and video on CD-ROM. Software delivered on CD-ROM can be graphics and interface intensive. There are few tools in common use today that allow for graphics-rich interfaces on the Web, and decision-based software such as an expert system often runs poorly or not at all from a Web site. This will probably change in the next 12 to 18 months as new tools become available. Although low-resolution (small) color images can be displayed fairly quickly over the Internet, video and high resolution graphics move slowly through telephone lines. Because of the slow speed of phone lines and modems, graphics-intensive material such as video, high-resolution photographs, and sound are best placed on CD-ROMs for quick access.

Until most of the country can receive information from the Web rapidly, i.e., not by relatively slow modems, CD-ROMs are likely to be an important method of delivering graphics-rich information. As an example of the current demand for CD-ROM technology, the University of Florida Cooperative Extension Service offers about the same information on its Web site (<http://hammock.ifas.ufl.edu>) as on its Disc 10 CD-ROM, yet visitors to the Web site continue to purchase the CD-ROM version of the information. County cooperative extension offices and many businesses need the CD-ROM version because of the slow speed of their modems and telephone lines. The CD-ROM version also allows the user to run several software programs, whereas current technology makes this difficult on the Web site. Efficient information storage, search, retrieval, and use can be designed within the defined, limited static information on the CD-ROM; library information strategies are more complex on the volatile, dynamic, delimited web (Matylonek et al., 1997).

To obtain the best of both media, CD-ROM software can be designed to interact with a Web site. In the most advanced applications, the user does not know that the CD-ROM software is interacting with the Web site. There are few horticultural applications that do this today.

However, we can envision a plant and pest CD-ROM database with text, data, and pictures that interacts with a

Web site similar to the operation of Microsoft's Encarta 98 Encyclopedia. Encarta 98 Encyclopedia downloads new Web links and article updates and automatically integrates them with the CD-ROM's content. Likewise, the pest Web site would provide up-to-the-minute pest control recommendations. Of course, for maximum benefit from the Web site, there must be commitment and infrastructure to maintain and update the information continually. The ways and extent that CD-ROM and online are connecting are varied and continually evolving (Reisman, 1995).

Collaboration on information

SHARED DEVELOPMENT, MAINTENANCE, AND USE OF INFORMATION. Collaboration in development, maintenance, and use of electronic information can occur among diverse individuals and institutions. It can bring new players into the action—new sources of funding, new authors, new users.

Collaboration is working together, especially in reference to literary, artistic or scientific work. The Web facilitates global access and the potential for global collaboration on information development and use. This shared development and use will reduce redundant efforts and costs, and can result in products that are better than those that can be produced by autonomous efforts.

Horticulturists, nationally and internationally, can create digitized chunks of information in various formats (video, graphic, text, photographs, etc.). The chunk will contain links to related information, to terminology definitions, to concept elaboration-explanation, or to other Web sites that contain reliable, useful information related to the topic. These chunks can be developed to link into a hot-net structure evolved through the national professional societies such as ASHS.

ASHS is uniquely qualified to provide a global hot-net structure and to provide professional society peer-review and validation of the information products. HortBase has a continuous, dynamic infrastructure: with the large, ever-changing volunteer pool of author, reviewer, and user talent of the ASHS membership working with HortBase, the information generation, renewal, and use will be continually

dynamic and self-perpetuating. Retiring member horticulturists will be continually replaced by new members. The reviewed, HortBase-tagged files will reside on the respective authors' servers; the costs will be dispersed.

Peer-reviewed, digitized information chunks will be interlinked within the global HortBase net. Currently, there is no nationally recognized method of providing professional society peer reviewed educational information resources to extension clientele and other interested learners. It is not the goal of HortBase to be all-encompassing or a horticultural information monopoly: there will be information that is not tagged by or linked to HortBase.

DISPERSED FUNDING. Just as horticultural researchers obtain research funding from diverse sources, so will individual information resource developers obtain funding from diverse sources. Funding for information development will be as diverse and dispersed as the individual information developers. Clientele-user groups, i.e., commodity commissions, grower associations, municipalities, and other interested learners can collaborate by assisting in identification of information needs, evaluation, and feedback of information presentation and applicability. Clientele-user groups are a potential source of grants to individuals developing information chunks that will be reviewed, tagged, and linked by HortBase. Users may also be information authors and reviewers. USDA-CSREES and other national funding agencies are potential collaborators to provide grants to support individual authors' information development and to fund information initiatives.

HortBase will provide the structure within which the individual information project will be a valuable addition. HortBase will be a net of hotlinks among the information resources developed by numerous individuals. This is in keeping with the dispersed philosophy of HortBase: dispersed funding, dispersed development, dispersed peer review system, and dispersed location of the reviewed, tagged, and linked information chunks residing on the respective authors' servers.

REDUCING REDUNDANCY. One of the more frustrating experiences a faculty member can have is to happen across an extension or class publication in print or electronic form that largely

duplicates what you have already done. As much as 90% of the material in both documents can overlap. Doesn't this strike you as pointless and a waste of time? Wouldn't it be more reasonable to place many of our information documents online in a central location, such as HortBase, so that others could see what has already been done. If an educator or user wants to add to his document or has a different viewpoint on the particular subject matter, he or she could contact the original author and collaborate on a revision of the information. Wouldn't the presentation of differing view points in the revised document help the reader decide how to manage their commodity? And, wouldn't this be of more service to our customers than wasting time reinventing the wheel developing a new document from scratch—especially when we are all working with limited resources?

Let me provide an example of how this could work. In 1993 the University of Florida produced a beta CD-ROM disc of a program called "Southern trees: An expert system for selecting trees." This piece of software was designed to construct a list of trees suited for planting in urban and suburban landscapes throughout the southern two-thirds (hardiness zones 5–11) of the United States. It was funded jointly by the USDA Forest Service (\$90,000) and the University of Florida (\$125,000) and took more than 8,000 person-hours split among nine people to complete. These people included a horticulturist, two computer programmers, a graduate student, and several dedicated support personnel. The program was circulated throughout the United States to many horticulture, entomology, and pathology faculty for peer review. Many practitioners and county cooperative extension agents also reviewed the program for about 1 year. Many provided input (Beck, et al., 1993) that was incorporated into the final CD released in early 1996. More than 1,500 copies of the program are in circulation. A number of community colleges and 4-year universities use this CD in their teaching curricula.

This database of 900 trees, more than 2,300 pages of printable, graphics-rich fact sheets, and 2,800 color photographs could be used as a starting point to create an expanded database of information regarding trees

nationwide. Chunks of this CD-ROM could be HortBase peer-reviewed, tagged, and linked. A comment and user feedback form to the Internet address could be provided for each tree in the software; this would allow users to type in their experiences with the tree. This input could take the form of a comment such as "My experience has been that this tree does not tolerate wet soil in poorly drained Texas landscapes," or a paragraph or more could be added on special pruning considerations or experiences the user has had with this tree. Users providing input could be identified along with their addresses. Users could view all of the comments added by other users. Amendments and new editions could be peer reviewed, tagged, and linked to the original CD-ROM. Push or Pull technology could be used to deliver new amendments or editions to the users of the original CD-ROM. Thus, this would become a central, dynamic, peer-reviewed system for contributing and accessing information on managing urban trees.

BUILD IN ENTICEMENT FOR COLLABORATION. The preceding was an example of giving users the ability to add new plants with data, text, and photographs, and of adding new photographs and information to existing plant files. An afterlife for the completed CD or initial information on Web site occurs through this collaborative, communal development of digitized information and the users become authors of new information (Rosebush and Watt, 1996). For example, over time the library of photographs and identification characteristics and discriminators for new or additional species, clones, or cultivars of plants could be uploaded by the user to the specific interactive Internet site for that Web site or CD-ROM. An ongoing cycle of creation, uploading, and downloading is set in motion to keep this information file dynamic. The ability to interact with the specific Internet site to download and upload modules can be imbedded in the CD-ROM disc or the Web site.

Use of the CD-Web information by teachers and interested inquirers

How can educators use the chunks (information modules) on the CD or Web? It is easy for the educator to thread (link) selected modules (URLs) together into a study assignment, es-

pecially if some of the modules were designed to be interactive. As an example, Microsoft includes a student and a teacher's guide (it is a printed book) with their Encarta encyclopedia—it is a study guide or lesson plan using the information on the Encarta CD-Web product. As a horticultural example, an instructor could create a student assignment by providing them a string of URLs to chunks of information in the HortBase net. Or, the instructor could use a reviewed, existing HortBase program string of URLs residing at HortBase that had been created by other authors or teachers. The student could be asked to create a report summarizing decisions made based on information in the URL string. Course outlines with hotlinks to information that is maintained up-to-date within HortBase by the respective authors of each chunk is the program or dynamic textbook aspect of HortBase.

Marketing and funding

To implement and maintain HortBase will require revenue generation. At the same time, potential authors have individual opportunities to publish privately and retain royalties or other compensation as they would through more traditional publishing channels such as the printed textbook. The need for HortBase to generate sustaining revenue and the potential for individual authors to retain royalties are not mutually exclusive.

HortBase can be an excellent marketing tool for for-sale information products: reviews of products or sample modules might be placed on HortBase along with links to ordering information. For example, a CD-ROM could be marketed through module access or distribution on the Web, i.e., post part of the CD-ROM product online. Modules posted online could be identical to modules on the CD to offer the consumer a taste—the CD-ROM purchase will be an economic ease-of-use decision (Rosebush and Watt, 1996). The sale of the disc and the online access are opportunities for commerce. HortBase could generate revenue by charging for the link or by charging for the hits on the specific item; the individual authors could still retain profits and royalties. Likewise, for information placed solely on the HortBase web, there could be links associated with the individual files to

related advertisers or there could be a user subscription to HortBase as there is for the ASHS printed journals. We need the creative ideas and input from ASHS members on potential means to implement and sustaining funding revenues for HortBase.

The time and technology are here for dispersed but collaborative development, maintenance, use and marketing of HortBase. ASHS members will make this work, or private industry will.

We think ASHS members are uniquely qualified to generate a great horticultural Web information system for decision support by providing unbiased, peer-reviewed information through a system with a dynamic infrastructure. We cannot think of another organization that can do this as well.

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