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**MICROCOMPUTER SOFTWARE DEVELOPMENT AND DISTRIBUTION****James M. McGrann**

The microcomputer is becoming an important tool for the land grant institution in serving agriculture. Its applications present clientele with unprecedented opportunities for increasing the use of information systems, analytical and record-keeping tools, and the research results reported by land grant institutions to improve the decision-making process in agriculture. The use of microcomputers can also effectively enhance classroom and extension education processes. But the full potential of this new technology can be realized only if appropriate microcomputer software can be developed and distributed to farmers and ranchers, agribusinesses and educators.

The potential of microcomputer applications has been projected by Kramer, who estimates that by 1990, 75 percent of all managers of midsized farms will use on-farm or ranch computers in making management decisions. The Extension Committee on Organization and Policy (ECOP) report points out that the microcomputer can bring management power to modern agriculture. Both projections recognize the necessity of land grant institutional involvement in software development and user education.

Agricultural extension and research in the southern region can be characterized as having a great deal of grass roots support as well as clientele involvement. There is, in turn, a clear recognition of the need for extension and research personnel to be responsive and accountable to clientele for their continued legislative support. The desk-top microcomputer offers an almost ideal tool to fit this institutional environment for computer applications; it meets identifiable clientele needs while making the institutions more operationally efficient.

This paper discusses microcomputer software development and support requirements and identifies factors to consider in developing a software distribution procedure for farmers, ranchers, and other end-user clientele. Information obtained from a fall 1982 survey of farm management extension specialists in each of the 13 states in the southern region is used to describe microcomputer software development and distribution activities in the Southern Region (McGrann, December 1982).<sup>1</sup>

**SOFTWARE DEVELOPMENT**

Land grant institutions are looked upon as the source of new technologies, analytical tools, and educational information for supporting the multiple goals of a strong, progressive agriculture. These institutions are now cast in a leadership role in the application and dissemination of new microcomputer technologies. Such a role can be defined in terms of (1) discipline, (2) leadership, (3) participation by research, extension and teaching staff, and (4) the interfacing of these activities with the private sector and clientele.

The agricultural economics profession is presently giving leadership to education in software development and microcomputer use as applied to agriculture. The 13 state survey of Southern Region extension farm management specialists showed that 8 states presently develop and distribute software for microcomputers, while one state only distributes software developed in other states. Of the 9 states involved in software distribution, 7 respondents indicated that the agricultural economics discipline had a leadership role in these activities, while two indicated that the discipline maintains a leadership role equal to that of other departments.<sup>2</sup> Eleven of the 13 states provide some clientele and staff education on microcomputers and software use; agricultural economics again plays an important leadership role in such education efforts. Professionals are also involved in developing the institutional framework for effective software development, distribution, and support at state, regional, and national levels.

Research in the biological and engineering areas, and activities that add the economic and management component in models and decision tools, will not necessarily change with the utilization of microcomputer technology. It is true, however, that as the opportunity to use analytical tools and research at the decision level expands, it will be necessary to broaden the involvement of staff in the applied extension-research user software development area (McGrann, August 1982).

Agricultural software presently distributed and under development in the private sector draws heavily upon previous research and extension work. Almost all

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<sup>1</sup> The states in the Southern Region are Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Mississippi, Oklahoma, North Carolina, South Carolina, Tennessee, Texas, and Virginia.

<sup>2</sup> The author recognizes that the survey results are biased in that only the agricultural economics discipline was surveyed.

research phases of software development are still supported by the public sector and private grants, such as the Kellogg Foundation, which has given substantial support to software development efforts (Kramer). Private software developers are not investing in creative research activities to develop analytical models or biological and engineering relationships.

It would appear that land grant institutions have the comparative advantage in using highly skilled, interdisciplinary teams in developing new models and analytical approaches that are incorporated into software. This same interdisciplinary capability is necessary for the evaluation of software, an important role of the land grant institution in the eyes of clientele.

The land grant institution can also support research and extension efforts to develop, distribute, and support user-friendly software that is not available to clientele (activities which are similar to present publication activities). This activity is complemented by the private sector's experience in repackaging and delivery of software and in servicing individual needs. Coordination between the land grant institution and the private sector is important in reducing costly duplications.

The farmer and rancher clientele of the experiment station and extension service in the Southern Region has been vocal in its request for accelerated involvement of land grant institutions in on-farm or on-ranch computer applications. They desire the objectivity, accountability, and educational support they have learned to expect from these institutions and expect such public-supported activities to reduce their risk and cost in adopting this new technology. Agricultural producers look to the land grant institution to evaluate software available in both the public and private sectors in terms of its subject matter, quality, and ability to meet their needs. They also desire objective information on appropriate hardware for their anticipated user and decision environment. Involving clientele in defining software needs, field testing, and educational efforts is an important role of the land grant staff and should be part of any software development effort. The land grant institution's role does not necessarily change, but microcomputer involvement must be added to ensure long-term clientele support.

There is one consensus of opinion among everyone involved in computer applications: software is the key to successful computer applications. This is a very costly activity in terms of both manpower and financial resources. Involvement in the development of applications software gives the professional an opportunity to not only learn computer application potentials and limitations, but also to express creative abilities.

Applications software development can be summarized in several steps: 1) problem definition, 2) review of relevant research and currently available software, 3) program design, 4) program coding, 5) program documentation, 6) program review, verification, field testing and revisions. This step-by-step approach is implemented in many land grant research-extension efforts.

The process of choosing specific software packages to develop requires a careful review of existing software, relevant literature, and communication with subject matter specialists and potential users. The identification and review of existing software is no simple task. Sources are available that identify available software (Doane-Western; Strain and Fieser), but the acquisition of software solely for review is much more difficult.

Software design is an extremely time consuming and tedious task. Subject matter specialists need close involvement with interdisciplinary and programming specialists for an efficient design and development process. Good flow charting or other planning and organizational design procedures can improve the efficiency of the programming phase of software development.

Software field testing can take place with the target audience, in the classroom and among professional staff. The land grant institution offers a highly appropriate environment for field testing software if extension, teaching, and research can all be involved.

The documentation of programs and preparation of user manuals are neglected steps in software development for much of the applications software currently available in agriculture. The inventory of agricultural software by Strain and Fieser found that less than 50 percent of the software available had any documentation. Lack of documentation and user manuals limits the usefulness and exchange of software and increases the time required for maintenance and support of software (McGrann and Griffin; Killcreas).

The North Central Computer Institute (NCCI) has defined a documentation procedure that appears to have many of the components that would be effective in overcoming software documentation inadequacies (NCCI). The focus on any user documentation is to prevent the "black box" problem, which occurs when users enter data and receive results with little or no understanding of the analytical process used in the computer program.

A number of factors need to be considered in evaluating software. These include performance, documentation, ease of use, and error handling (Robinson). Olson added education and economics or subject matter content and quality, while McGrann and Griffin included agricultural usefulness and solution reasonableness. Doane-Western adds "what if" capabilities and user modification potential, while *Successful Farming* includes installation time as a factor of consideration. All these are evaluation factors that should be considered in formulating standards for field testing and peer review.

Supporting software development with additional computer programmers and systems analyst specialists is critical. Having programmers work directly with staff is more effective than having them in a separate support unit. Respondents to the southern region survey indicated that programmer resources were the most critical limitation in software development. Professional technical writing support is needed to ensure the

development of good program user manuals and the preparation of educational materials.

Given the high cost of computer software development, it is highly desirable to utilize the same software in the classroom and extension education effort that it distributed to end users. This will economize on programmer resources, provided that properly coordinated and compatible hardware can be acquired. Classroom use of software is certainly a good first field testing phase for most software, and software designers can benefit from teaching staff participation.

Many computer applications are facilitated by electronic worksheets and data base management software in the programming phase. No doubt this type of software will become more important in the future. As this kind of software allows computers to become more user-oriented, emphasis will be placed on the transfer of models, analytical tools, and information dealing with subject matter, rather than on programming. User-programmable software will not, however, reduce the necessity of having the research results to formulate the proper algorithm to solve the problem in question.

Much work remains to be done to support regional and profession-wide recognition of professional creative activity in software development. This could be accomplished through peer review of applications software and documentation distributed through a journal-type publication. Researchers are reluctant to get involved in software development activities, no matter how useful it is to end users, if it does not fulfill their publishing needs for promotion. Peer review and software publication would help promote badly needed standards in the development and distribution process.

Survey responses from the states presently distributing software all indicated they would support a journal-type publication for agricultural management software if it could be useful to both professionals and clientele.<sup>3</sup> Some of this interest is related to the respondents' view of the professional reward system for software development efforts. Responses from the 13 states indicated that the present professional reward system is acceptable at the department level in 4 states, at the university level in 3 states, and at regional and national levels in 2 states. Such responses indicate that the reward system must be changed at all levels if more staff is expected to participate in microcomputer application efforts.

## SOFTWARE DISTRIBUTION

Distribution of software to clientele presents an opportunity for the land grant institution to assist clientele through providing software and educational support to meet their specific needs. A user software development effort can only be effective if software can be efficiently distributed to a broad clientele using a wide variety of computer systems.

Software distribution requires addressing a number of procedural issues that are similar to the distribution

of published materials from land grant institutions; other procedures are unique to computer software. As with any publication, distribution policy has to be made concerning who distributes and what support the distribution unit provides. Standards and procedures must be defined for review and in- and out-of-state software acquisition fees must be set. In addition, dealing with incompatibility problems must be considered and greater attention paid to software maintenance and long-term support than for most publications.

Two of the Southern Region states presently distributing software have formed a specialized distribution unit in extension that facilitates the distribution process. Several other states have indicated movements toward developing similar units, as these can relieve the authors and programmers of much of the day-to-day software distribution activities. This support is more important than for the normal extension and research publication activity presently supported by specialized units because of operational and incompatibility problems associated with microcomputer technology. Needless to say, any support the distribution unit can provide to the staff (i.e. computer specialists, technical writers, education) will encourage and facilitate staff involvement.

Establishing peer review, program documentation, and user manual standards is essential to insuring a quality product, facilitating communication, and providing compatible, user-friendly software. Programming standards are necessary if programmers are to be able to pick up a software package, understand the program, and make programming and subject matter enhancements. They are also important to establishing author contribution and credibility.

Software distribution is costly due to the necessity of distributing most software on diskettes, retaining specialized support staff to set up disks, and covering manual copying and mailing costs. Even if the institution has no intention of recovering development costs, it seems reasonable to recover distribution costs, just as is done for many publications. Having a distribution fee will also discourage requests for software from those who ask for it simply because it is available free of charge.

Software distribution fee policies differ between states. Procedures range from free setup on user-supplied diskettes to a setup and distribution fee charge to clientele. No state is presently attempting to recover a large portion of its development costs. Software is being exchanged between states for staff use free of charge—normally with a person at each institution identified to facilitate the exchange.

The supply of software to private commercial vendors follows a procedure similar to that for individual clientele. One state has the vendors pay a royalty of 10 percent back to the university. Supplying software to private vendors reduces some of the potential problems of "unfair competition" from the public sector. Selecting what software to develop to insure minimization of direct competition is also important.

<sup>3</sup> Such a publication must go beyond the microfiche-based system adopted by NCII and include peer review of operational programs.

Distribution policy also differs between states with respect to software requests by nonresidents. One state handles all clientele the same, one increases distribution fees by 50 percent, and another will not distribute out-of-state, making the software available to other states to distribute instead. Regional consistency would be helpful, as great potential exists for interstate software distribution and support.

Incompatibility of microcomputer languages, operating systems, and disk storage formats presents complications. These problems must be dealt with for a successful software distribution effort that supports end users. Nonstandardization in the microcomputer industry, a major market differentiation technique, is the source of most problems and will likely continue in the future.

Two approaches can be followed to meet the incompatibility problems of language and operating systems in software distribution: 1) choosing a particular microcomputer(s) to support or 2) choosing an operating system such as the CP/M<sup>4</sup> and supporting a number of microcomputer disk storage formats. Either approach requires the support of computer specialists in dealing with problems concerning upgrading or changing languages and operating systems. A number of CP/M operating systems are not exactly the same, meaning direct transfer of software is not always possible without minor programming.

Eight out of the nine states in the southern region distribute software for Radio Shack Model II systems. One state actively involved in software distribution provides software for a multiple number of computers using the CP/M operating systems. Three states indicated that efforts are being made to move toward use of the CP/M operating system that will allow continued use of Radio Shack systems, plus a wide variety of other microcomputers being purchased by clientele.

Disk drive formats and floppy disk sizes create serious compatibility problems for distributing software to meet the needs of clientele who purchase a wide variety of computer systems. One approach for efficient distribution of software is to provide access to a number of the microcomputers most widely used by clientele and also work directly with dealers to encourage them to transfer software onto different disk drive formats. Services are also available in the private sector to transfer software to different disk formats.

Publication of templates combined with user instructions and analytical procedures used in the analysis is appropriate for electronic worksheet software. This means of software transfer for decision aids has been widely used in agriculture computer newsletters and publications (Doane-Western).

One of the most important aspects of software distribution is meeting user-support requirements. As Fuller pointed out, this activity, which includes computer operation, software subject matter education, and revising and/or updating software, is frequently neglected in the private sector. Support has to be part of the distribution activity if it is to be a successful effort.

<sup>4</sup> CP/M is a trademark of Digital Research.

Ideally, the computer specialist should support computer use needs; subject matter specialists should deal with subject matter education needs.

Closely linked to software support is the policy concerning whether to provide source code to the user or only provide machine-readable object code that cannot be modified. Both alternatives are used in the Southern Region. If source code is provided, the distributor must be prepared to support user-modified software. This can be a problem for the original author. In any case, software documentation should provide the algorithm to facilitate exchange and modification of software by those who wish to create their own software from an original effort.

The problem of transferability of software between microcomputers is often overemphasized. The research to develop the engineering, biological relationships, and management framework in the program design and algorithm far exceeds programming costs if one accounts for the full cost of software development. The marginal cost of program transfer of well-documented and tested program is small relative to the total cost of developing the original program, even if it requires rewriting the entire code.

It is evident from the survey that the southern states have been reluctant to formulate standards and procedures for software distribution. Only four respondents out of the nine states distributing software indicated that they were satisfied with the distribution procedures. Efforts must be made to formulate distribution procedures as states become more active in software distribution. Regional efforts to make procedures compatible would facilitate software distribution within the region.

## SUMMARY

The microcomputer is becoming an important tool for the land grant institutions in serving agriculture. The potential of the tool to improve the decision-making process in agriculture can only be realized through software development, distribution, and educational support of clientele. The agricultural economics profession has taken a leadership role in software development, distribution, and educational support as well as development of the institutional framework for such activities.

A survey of farm management specialists in the Southern Region indicated that 9 of the 13 states distribute software.

Research and the biological and engineering areas and activities that add the economic and management component in models and decision tools will not change with utilization of microcomputers; instead, they will broaden the necessary involvement of staff in applied extension-research activities. No activity requires a stronger tie between research, extension, and clientele than software development. This is a source of comparative advantage in meeting the vocal clientele's

needs with the objectivity, accountability, and educational support they expect from the land grant institution. Supporting the new technology requires coordination of public and private activities to reduce the potential for costly duplication.

Opportunities exist for staff participation in all steps of software development. Current efforts lack the necessary peer review and journal-type publication opportunities available for similar professional activities.

Distribution of software requires coping with incompatibility of computer languages, operating sys-

tems, and disk drives. Developing standards and procedures and supporting distribution with a special unit provide the means to meet clientele needs efficiently and encourage staff participation in software development. States in the southern region are distributing software for the Radio Shack machines and/or using the CP/M operating system to support software for a number of computer systems. Regional cooperation could facilitate the standardization of procedures and provide for more efficient software distribution to clientele in the South.

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