A COMPARISON OF ALTERNATIVE REMOTE ACCESS COMPUTER SYSTEMS AND A CLOSER LOOK AT AVAILABLE SYSTEMS

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Today I would like to outline what I see as the alternative systems of remote accessing computers presently available, discuss what I see as the advantages and disadvantages of each and then outline some of the questions or unknowns about remote access systems that I believe need careful consideration and evaluation by agricultural economists.

Available Remote Accessing Systems

There are presently three remote accessing systems that could be used. These include (1) teletype, (2) touch-tone telephone, and (3) mail-in with batch processing. You might question inclusion of mail-in in this group in that it does not require a time sharing computer or allow interactive computing. However, it does allow use of the computer from remote locations and provides most of the user characteristics necessary for extension application. Thus, it is clearly an alternative to the teletype and touch-tone telephone. Although I am sure that most of you are familiar with these systems, I will describe each briefly to be sure we are all on the same footing.

Teletype. The teletype system uses a portable teletype unit which is essentially a typewriter with some special keys that can be controlled by both the operator using the system and the computer. The unit is connected to the telephone line either directly or via a coupling that the telephone receiver fits into. Messages are transferred between the teletype unit and the computer over the regular phone line. Using this system the operator types the data in and they are printed on a roll of paper and transmitted to the computer. Use of a unit with a paper tape device allows data for larger problems to be entered without being connected to the computer during the typing operation. The results or return messages are immediately sent back over the phone line to the teletype unit which prints the answers on the roll of paper.

A number of Agricultural Economics departments have made limited use of teletype units in their states. This often involves use of a program or two by state Extension personnel either on campus or at a few selected locations within the state. There is presently only one teletype network available through the university and extension system. This is the Computerized Management Network (CMN) being developed at Virginia Polytechnic Institute (VPI) with support of the Federal Extension Service. Programs used on the Michigan

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State touch-tone telephone systems can be accessed using teletype. However, this just replaces the telephone with a teletype and does not take advantage of some of the positive attributes of the teletype unit. The University of Minnesota also has a few programs which can be accessed by teletype from other states. There are, of course, a number of network systems maintained by, and available from, business firms or specialized consultant firms. The main problem with these systems is the limited number of programs applicable to agriculture which are available on them.

The primary advantages attributed to a teletype system are:

1. Immediate turn-around - as soon as the problem has been entered the computer calculates the answer and prints it out.

2. Allows interactive computing - an operator can put in a problem, get back an answer, and then change the input data to evaluate the effects of slightly different alternatives; for example, a different size machine, different feed price or more cows.

3. Will handle relatively large amounts of data - not as much as can be handled within a practical time span with batch processing, but more than can be handled with a touch-tone telephone.

4. Hard copy of results - printed out by machine.

The primary disadvantage attributed to this system is the cost. The rental cost of teletype machines, though going down, is still $60 to $300 per month per unit. In addition, a telephone call, usually at least 10 to 20 minutes long and usually long distance, must be made each time the system is used. A higher level of user capability may be required for a teletype system than with either of the other systems. This, however, depends on the design of the system. I can see no basic reason why this would necessarily be true.

Another potential disadvantage from a teaching perspective is the fact that only a limited number (two or three) people can view operation of a teletype unit at one time. This severely limits the use of this system in group training sessions compared to a touch-tone unit where output can be magnified for a group of almost any size. This problem may be at least partially solved by the use of Cathode Ray Terminal units (CRT's) where the output is shown on a screen much like a television picture and a hard copy similar to a thermofax copy is generated for that portion of the output selected by the user. However, reasonably priced operationable Cathode Ray Terminals are still in the development process.

Touch-tone telephone. The touch-tone system uses an ordinary 12-tone touch-tone telephone with a one-way speaker and usually a card dialer. Information is transmitted over normal telephone lines. Data is entered by the user, according to a pre-specified format, in the same way that a telephone number is dialed. Results and messages are converted to a spoken voice by a computer audio response unit and returned to the user over the speaker.

This system has been developed primarily at Michigan State University (MSU). Their Telplan network system is the only touch-tone telephone system in operation in the agricultural field. They have phone installations located in a large number of their county and district agent offices. A number of other states are using this network on some sort of limited or trial basis.

Like the teletype system, the touch-tone telephone system has the advantages of essentially immediate turn-around and interactive computing. From the users point of view this system handles a job in approximately the same way that the teletype system does. A further advantage at least compared to the teletype system, is its rather modest cost. Compared to the teletype's $60 - $300 monthly cost, the telephone system has an installment charge in the range of $15 - $75 and a monthly charge of $5 - $20. Telephone and computer charges are usually assumed to be slightly higher for the touch-tone telephone system than with a teletype system, but there is little real data to indicate the real magnitude of this difference. Extension workers have generally assumed that the extra telephone and computer charges are more than offset by the lower monthly rental fee for the touch-tone telephone as compared to the teletype. Although this indicates a lower total cost for a touch-tone system, it is still a large enough expense to represent a major cost in a county extension budget.

On the negative side, the touch-tone system is more limited in both type and quantity of input and output. Only numerical data can be entered and, at least in its present form, only numerical data can be received from the computer. All data must be transcribed from the speaker. Because of the errors that can occur in the transcription process, allowance must be made for double checking all output. This process limits the quantity of data that can be handled by this system. Although this may not be a serious limitation for many problems, it does limit the usefulness of the touch-tone network for a total management information system which includes information retrieval.

Mail-in. A mail-in remote access system is likely the easiest for most people to understand and the easiest to develop. This involves mailing the completed input forms to a computer center where the data is typed on cards, batch processed on the local computer and the results mailed back to the user. Depending on the design of the system, a computer center staff may review the input for completeness and reasonableness before punching and review the output for consistency and reasonableness before mailing. There are already a number of uses of this type of system. Electronic accounting and DHIA are examples.

Most applications of the mail-in system approach for other than record keeping systems have been on a rather ad hoc basis; a program, or a few programs, are developed and made available to the people within one state or region. There is presently no system developed where a large number of problem oriented management programs are made available to a state or group of states on a continuing formal basis.

A mail-in system will handle large amounts of data. A program of

practically any size can be run and the output mailed to the user with little more effort, except computer time, than would be required for a small program. Further, it can handle this data relatively inexpensively. The computer costs and data transmission costs of a mail-in system are lower than with either of the other two systems we have discussed. This makes this system easily the least costly in terms of costs directly incurred by users in the field. However, evaluating the system in terms of these costs fails to recognize the overhead costs incurred by maintaining a clerical and programming staff at the computer center to handle programs on a daily basis. Someone should be ready to process all problems as soon as they arrive at the center. In addition to the cost of supporting this staff is the continuing personnel problem of maintaining the staff itself, particularly for this type of a staff where the work load can be expected to be uneven, making efficient staffing difficult, and a fast turn-around on jobs (problems) submitted is a necessity.

A second disadvantage of the mail-in system is slow turn-around on jobs. You have to wait for the mails going both ways and it takes some time, even for an efficient staff to process data sent in. Even under excellent conditions turn-around time would be three to five working days.

The third disadvantage is the essential exclusion of interactive computing. When a user sends in data for a problem he must anticipate all potential alternatives he wants to consider. Unless he wants to work with the system for weeks, he will not be able to put in a set of data, get back the results and then ask a series of "if...then" questions by repeatedly making marginal changes in the input after reviewing the previous output. Lack of this feature can be a serious handicap. In many cases the best solution to a problem is suggested by reviewing the unsatisfactory results generated from evaluating the planned course of action. For example, in considering whether or not to buy a particular machine, the program might show it to be a very unprofitable investment and that a much larger acreage would be required to break even. This might suggest (or reinforce the county agent's suggestion) that a smaller machine would possibly be more profitable. Interactive computing may also help a person determine how risky a particular alternative is. By making successive runs with different price, production and technical coefficient assumptions many important characterisitics of a particular management alternative can be ascertained.

Important Unknowns or Questions

There are a number of important unknowns or questions about remote access computing which need to be answered by any institution considering adoption or development of such a system. Some of these are administrative level questions while others are much more operational or procedural. However, they are all important. I do not pretend to have all the answers but I will discuss some of the issues relevant to the questions raised.

Adopt and Adapt - or Develop. A major question facing many institutions who have decided that they want to do something in this field is whether to become a user of a network system developed by some other state, and adopt some programs, adapt others and develop a few new ones, or to develop a com-

plete new system for their state or region. A number of factors influence this decision. The most important of these is cost. Development of computer programs and a computer network system and maintenance of that system is a very costly process. This factor alone appears to be of sufficient magnitude to allow us to say that it makes little economic sense for all states, or even most states, to develop their own systems. Development of a large number of systems would involve a tremendous duplication of both program development and system maintenance costs. In my opinion efficient use of public funds dictates that most states adopt a system developed by another state or at least cooperate with a group of other states in developing a system for their use.

Now, when I say this, those involved in developing systems at their own institutions will agree very vigorously. They have immediate visions of their professional star rising and of money flowing into their institution. However, I think there are some factors that they will have to come to grips with if others are to use their system. These include:

1. The adaptability of programs. There are some programs in any state's program file that another state cannot or will not use. This means that provision must be made for modification and addition of programs. This has been handled quite well by most systems presently in operation. But, it also means that the system is not worth nearly as much to another state as it cost the developer to put together.

2. State image and control. Extension workers in most states will believe that it is worth something to have a system they can call their own and have complete control over. Involved with this is the assumption on the part of many institutions that they can do a better job than has been done by others.

3. Research application. Many of the programs developed have at least applied research application. If in using another state's remote access system a state is excluded from using the program on their own computer on a batch processing basis, they are giving up a significant product that they would have if they developed their own system. The only policy that makes any real sense to me in this regard is to have free exchange of programs between all land grant institutions. This has to provide the greatest return to public funds. Although the better funded universities have less to gain from this type of system, they do gain. This system also has the copyright problem of not forcing recognition of others work, but this is true of most of the other work we do and this should not be used as an excuse to protect fiefdoms.

Service or Education. Connected with the problem of whether to adopt or develop is the question of whether providing management programs via remote access computing really provides service or education. The service element

is certainly there. It would be hard to argue that analyzing an individual farmer's specific problem does not have a large service component. The real question is how important is, or could be, the educational component. This is not a new problem. The same question is involved in the development and operation of electronic farm accounting systems. There is a good deal of individual consulting done by many Agricultural College Departments now. It may be that we should not be so timid on this issue and recognize that good education requires a significant amount of individual consulting. And, that with the renewed social emphasis on people we should look at it as helping people in a most direct way. Or, we might recognize that being relevant to the problems of modern agriculture requires working with individual situations and that this provides an efficient way for the Extension service to help those top farmers that the Extension service has felt increasingly less able to help.

On the other hand, it may be that we should be supporting this type of system only if it will be used in ways that could be identified as primarily educational. The problems with this sort of pure approach are determining where education stops and service begins and determining whether the educational product is great enough to make this the best use of Extension resources. In my own view, I lean towards the latter approach of emphasizing the educational uses, but, at least, the presence of an important service component provides sufficient justification for charging farmers at least some portion, and maybe all, of the costs of using the remote access system.

Real Importance of Turn-Around Time. In choosing among the different available systems there are a number of factors that could be important. One is the real importance of speed in turn-around. How important is it, really, to provide the immediate turn-around that the teletype and touch-tone systems offer. When one looks at it analytically you see that relatively few management decisions need to be made within less than a weeks time. With any sort of planning at all, the delay of a week or two to get the computer results should not cause problems. Even further, one can say that because of the large investment involved in many management decisions, such as buying a tractor or barn, the decision maker should not force himself to make the decision in one day and that he should be willing to wait a few days for any information that might help him make a materially better decision.

However, we all procrastinate in our decision making. Farmers are no exception. When a farmer comes to the Extension agent for assistance he wants it now and not next week. Thus, both farmers and agents place a high priority on fast turn-around. And, this does not represent mere expediency or acquiescence to farmers' desires on the agents part. There is a rule in education that the most effective teaching can be accomplished when the student is vitally interested in the subject at hand. Some have called this the teachable moment. When the farmer comes in with a burning question he may be much more receptive to ideas presented at that time than if he has to wait for three days to a week to get them.

Importance of Interactive Computing. The real importance of interactive computing must also be evaluated. Although it is easy to see that superior alternatives may be suggested by the solution to an initial alternative, it is not clear to what degree these alternative solutions could be anticipated

by a farmer and/or agent if they were encouraged to try to do so. For example, a farmer with a small grain acreage attempting to evaluate the alternative of buying a combine rather than custom hiring might realize that a change in the custom rate or a significant misestimation of harvest losses with custom hire could change the result. He might, then, get all three alternatives analyzed. However, whether he would also make an analysis assuming a different size (smaller) machine, before he saw how unprofitable the machine he was planning to purchase was, is more debatable.

It is also possible that interactive computing may provide a more teachable environment. That is, if a farmer gets a computer answer to his question or concerns as they arise it may be possible for an agent to convince him of an important point, a result which might otherwise be impossible. There may be a gain from being able to involve the farmer, the agent and the computer in the teaching process.

Cost Differences. Possibly the most important factor influencing any choice of the alternative systems is cost. As I was reviewing the various systems I pointed out that there were known differences in certain costs, such as the remote accessing hardware. There are also other costs such as computer time, telephone costs and maintenance of a computer center staff to handle mail-in data for which we have no real estimate of the costs.

The general assumption of most people who know something about the available systems but are not vitally involved with any specific one is that the teletype system is most expensive, the mail-in system least expensive and the touch-tone phone system somewhere in between. There is, however, no comparable data to indicate whether this is true or not; and, if it is true, to indicate what the real magnitude of this difference is.

The relative magnitude of different types of cost is also important. Economic theory tells us that we may operate quite differently with a low overhead - high variable cost system than with a high overhead system. The costs involved with getting into and out of business are much lower when you adopt an ongoing system which charges totally on the basis of usage.

Free or Fee. An issue which must be dealt with in evaluating the cost of maintaining a remote access system is whether a fee is to be charged. Extension has historically offered its services free of charge so that even the poorest could afford them. Farmers have become used to this method of operation. However, as I mentioned earlier, I think the service component involved in these systems fully warrants the imposition of a fee. We have been charging a nominal fee for some workshops, publications and electronic farm accounting so that farmers are getting used to the idea. Purdue has been charging $8 per use for some of their programs. There also tends to be some feeling that things are going to be worth what they cost. I noticed in the Wall Street Journal a few days ago that Doane's has 15 customers for their comprehensive computer analysis at a cost of up to $3,000.

What we need is an estimate of the effective demand for this type of service. This includes not only questions of how many times farmers would use the systems given some reasonable pricing schedule but also to what degree would they use the results generated by the computer in their management decisions. If a computer analysis is a status symbol rather than a management

aid, we are not accomplishing much for the money and effort expended.

Agent Training. If it is decided that one of the remote access systems will be used in a state or region, one activity that must receive top priority is agent training. If agents are to make intelligent use of the system they must be thoroughly trained in how to physically operate the system, what is in each of the programs (including assumptions and constants) and how to use the programs. I have heard statements made that people could be trained to use this or that remote access system in 30 minutes or an hour. All that is taught in that period of time, of course, is how to get connected to the computer, how to access a particular program, how to input data and how to receive data. To call this agent training is like a father teaching his daughter how to start the car, how to put it in gear, how to press on the accelerator to go and how to apply on the brakes to stop, and then saying he had taught her to drive. Many fathers wish that is all there was to it!

The Cornell Study

As I went through this list of unknowns or questions, and I am sure it is not an exhaustive list, I am sure you noticed that I did not answer many of them. The reason for that is that I do not believe that the answers are known. I am sure that you will all be happy to hear that Cornell has a study just getting started that is aimed at providing some hard data on a number of the questions raised. Our hope is that because we do not have a vested interest in any of the systems presently available we will be able to conduct an unbiased comparative analysis of these systems. The universities that have been involved in developing these systems have been required to force their system out into their counties to test the feasibility and operationality of the remote access system developed. Thus, I feel that we can make an analysis that none of them can make.

Many universities are presently trying to decide what, if anything, they should do in this field. It is my opinion that at this time we do not have sufficient hard economic data to make a good decision on whether such a system should be offered and, if a system should be offered, which system should be used. We hope to provide data to assist in this decision process.

We are planning to divide a selected sample of our agents into three groups. One group will use the teletype system, one the touch-tone telephone system and the third a mail-in system. After all have used their system for some time, the mail-in system will be made available to all agents to provide a base for comparison. The agents will use the system on both an individual consulting and a teaching situation basis. We (State Extension personnel) will develop the materials and outline for the teaching situation workshops. By having the agents and the remote system operator keep detailed records, and possibly supplementing this with a survey, we hope to provide some comparable data on:

1. Costs.

2. Usefulness in education.

3. Importance of turn-around time and interactive computing.

4. Demand.

5. Actual use in management decisions.

6. Agent response.

7. Effect on agent efficiency.