Design Considerations for Computer Based Marketing and Information Systems

P.L. Nuthall

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THE AGRICULTURAL ECONOMICS RESEARCH UNIT
Lincoln College, Canterbury, N.Z.

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The AERU, the Department of Agricultural Economics and Marketing, and the Department of Farm Management and Rural Valuation maintain a close working relationship on research and associated matters. The Unit is situated on the 3rd floor of the Burns Wing at the College.

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PREFACE

This paper reviews two of the areas in which computer technology may assist farmers in the future. The first area is that of information supply to farmers. The second area is that of computerised marketing systems.

The paper has been written by Dr P. Nuthall, reader in the Department of Farm Management and Rural Valuation at the College. Dr Nuthall also heads the Kellogg Farm Management Unit at the College; this Unit is developing computerised management aids and systems for New Zealand farmers.

In preparing this paper, Dr Nuthall benefited from a study tour undertaken in 1981 when he visited the U.S.A. and U.K. This study tour was supported by the Trimble Agricultural Research Fund.

P.D. Chudleigh
Director

SUMMARY

Recent years have seen a major revolution in the world of electronics. Computers have increased in size and capability and at the same time decreased in cost. Equally as important, communication systems have improved, though not yet to the same extent as computers, and will continue to do so.

In contrast, the cost of providing farmers with information that is constantly updated using traditional methods is increasing. Similarly, the increasing cost of transport and personnel costs means marketing costs using traditional auction and contract arrangements continue to increase. To counteract these cost problems the agricultural sector is expressing considerable interest in the potential for replacing traditional information and marketing systems with computer based operations.

To satisfy this demand for information this paper contains a review of the alternative systems available. The different types of systems available are defined and their advantages and disadvantages listed. Probably more importantly, considerable attention is paid to design details and practical questions which, in the end, will determine whether the promise of cost economies are in fact achieved.

Finally, an argument is presented that for the success of electronic systems it is essential to have national integration through a co-operative communication system in contrast to government domination on the one hand or complete independence of competing systems on the other.

CHAPTER 1
INTRODUCTION

The rapid and far reaching developments in electronic communication and computer technology that have occurred in recent years, and are continuing to occur, mean that information can be manipulated and transmitted at ever increasing speeds and at a steadily decreasing cost. In contrast, the increasing cost of transporting people and goods, of employing professionals as well as maintaining the institutions to support complex marketing and information systems has meant many organisations are turning to the idea of using the new technology to automate marketing and information supply. This paper contains a discussion of these developments and provides a review of the many factors that need to be considered when evaluating the possibility of introducing computer based systems.

While the technology for sophisticated computing and communication systems already exists, it is likely to make still further advances in the next few years. Concepts such as bubble memory[1], packet switching communication systems[2], fibre optics[3], are all ideas which suggest to the non-technologist that an even more significant revolution in computer controlled communication is a possibility. Combine this with the characteristics of a computer (massive data storage, analytical power, speed, potential impartiality and freeness from errors, not to mention tirelessness) and the appropriate software (currently the weak link in the system), and it is not hard to imagine the farmers of the future facing totally different marketing, information and management systems compared to existing methods.

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1. A device for storing large quantities of data in a physically small component.
2. A network of computers that integrates and transmits packets of data to a range of destinations. Many different users can transport data using the same network.
3. A replacement for copper wire using light waves to carry data.

The electronic revolution is also affecting daily operations both on the farm and in related industries. Electronic devices mean data collection of, for example, wool weights, animal weights, fat depth, fibre diameter and so on is becoming increasingly straightforward so the requirement of computer systems for hard data can be satisfied. Such devices also bring problems of deciding the appropriate data to collect.

Already a large number of systems making use of the technology have been developed around the world. In Texas, for example, it is possible to buy calves for fattening purposes by pushing keys on a computer terminal hundreds of kilometres away from where the calves are located (Cattlex). In England the constantly updated weather map can be viewed on a modified T.V. set by pushing the appropriate keys on a calculator-like keypad (teletext). In Canada instant access to market information can be obtained through accessing, using telephone lines and converted T.V. sets, centrally based computer stored information (Telidon). And so the list goes on from sophisticated computer based systems through to relatively simple centrally organised operations using the telephone (possibly on a conference call basis), instead of face to face communication. Many of the schemes have not been operating for any length of time so there is still a great deal to be learnt. However, what experience has been gained should be used in designing the many schemes that will be developed in the next few years. While there is very little published data on the costs and benefits of the various systems it is clear that the massive investments involved will be justified on the basis of general logic and the convenience of electronic systems together with general observations from apparently successful systems such as the international airline booking system.

Most electronic systems involve considerable overhead expenditure so the potential population of users should be at least some critical number. Furthermore, users should have to interface with as small a number of different systems as possible to minimise the need for investment in different equipment sets and training. It

is, therefore, important to consider the feasibility of having an integrated approach to all three facets (marketing, information and management aids) of electronic based systems. This review contains comments on all three systems though the management aid area is only briefly considered in a general sense.[4]

The review is divided into three major sections, one each on information systems and marketing systems, and a section on an integrated structure. Each of the information and marketing sections contains comments on the advantages and disadvantages, potential problems, criteria for success, design considerations and transition methods for each system.

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4. See Nuthall (1979) for a more general review of the design considerations for computer based management aids.

CHAPTER 2
INFORMATION SYSTEMS

2.1 Definitions

A farm information system is any system which enables a farmer to acquire, on demand, on his farm, constantly updated farm related facts, opinions, figures, costs and prices using electronic devices. The information tends to be general in contrast to individual farm specific data though it is usually possible to choose items of specific interest.

The kind of information provided depends on the type of system but ranges from constantly updated (hourly in some cases) weather maps and price quotations through to detailed descriptions of diseases. The depth of the information available depends, to a large extent, on the method used to transmit it.

The most restrictive is the teletext system (the information is broadcast though the user is able to select which frames to view on his T.V. set) with a maximum of approximately 300 frames (T.V. screenfuls). Any more leads to excessive viewer frustration due to time delays. As it was the first developed (49,000 total users in 1979) the British teletext system[5] is probably the most advanced. One hundred frames can be transmitted in 24 seconds so if the maximum number of frames available is 100 the average waiting time for the selected frame is 12 seconds. Teletext is obtained by purchasing a modified T.V. set or having an existing set modified (cost NZ$320) and is worked by keying page number requirements onto a remote keypad. At the end of 1980 there were approximately 180,000 sets in use but this number is growing rapidly (8×10^6 predicted for 1985[6]).

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5. For a detailed description of teletext see Hobby Electronics, Sept. 1980 (pps 12-16).

6. See Morgan (1980).

At the other end of the spectrum is the viewdata (or videotex) system in which the user is connected directly to a computer based data set using a terminal (possibly a modified T.V. set but not necessarily) and, most commonly, a telephone linkup. Due to the massive storage capacity of modern computers the potential size of the data base is only limited by the ability to keep up a current and relevant set of information. In this system the farmer selects the information required by punching in selected code numbers after connecting his terminal through to the central computer. Some systems are constantly on line while the viewer is looking at the information (e.g. Britain's Prestel, which has 2000 agricultural frames), while others require the user to select the screenfuls required prior to transmission and once the terminal's memory has received all the data the telephone connection is broken leaving the farmer to view the stored information at leisure (The University of Kentucky's 'Green Thumb'[7] system is an example). Many commercial organisations, particularly in the U.S.A., are planning to offer extensive agricultural data bases over the next few years (Gardner, 1981; and Raglan, 1981). One that is already operating is 'Instant Update' based in Iowa and operated by Professional Farmers of America at a cost of NZ$130 per month plus telephone toll charges as well as the capital cost of the equipment (NZ$600). Britain's Prestel, currently being used by twenty farmers on a trial basis, has a charge of 0 to 10 U.K. pence per screenful as well as the telephone charges and equipment rental ($750 per year which includes a normal T.V. set).

Besides these localised systems internationally accessible systems are also available. Prestel International is currently available in Britain, U.S.A., Sweden, West Germany, Holland, Switzerland and Australia through locally based nodes.[8] It is also possible to access data bases world wide using an international toll line - one Australian farmer, for example, uses a micro-computer as a terminal to a Chicago data base to obtain updated beef prices.

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7. See Raglan and Warner (1980) for a detailed description of the system.

8. A node usually refers to a locally based computer.

The two systems described rely on a visual approach. Alternatives such as radio and the direct use of telephone are also possible. The Illinois Farm Bureau (Gardner, 1981) is experimenting with a F.M. radio based system and a most successful cattle marketing information system (Cattlefax), potentially serving all U.S. beef producers, is based on direct telephone communication. Such a system, however, tends to be relatively costly per user so the information provided must have considerable value.

2.2 The Advantages and Disadvantages

The value of information depends on timeliness, accuracy, form (whether the farmer can understand it) and obviously, relevance. Furthermore, unless the information system is easy to access it will have no value, despite any other characteristics it might have simply because it will not be used. If properly prepared, it is clear electronic systems can satisfy most of these criteria. In a general sense, this has been shown by Britain's teletext. A survey (Anon, 1981a) recently showed that the users (primarily urban based) classified its usefulness as:

(i)	extremely useful, couldn't do without it	34%
(ii)	most useful; a good source of information	41%
(iii)	quite useful as a second source to paper, T.V. and telephone	20%
(iv)	purely a luxury, seldom used	5%

The survey also showed the most popular information was news updates, sport, T.V. guides and indices. The typical viewer uses teletext 77 times per week to access 29 different frames involving a total of 116 minutes.

Specific advantages of a viewdata system include (after Jones and Davis, 1981, p.8):

" (i) data will be more current and more localised than (if it is) obtained from other sources such as radio and television:

(ii) users may obtain data on an "on demand" basis anytime they desire;

(iii) data will be presented in a condensed manner without extraneous material:

(iv) extension recommendations can be delivered to users in a fraction of the time as compared to public meetings or distributing publications. Potentially, extension specialist time and expense can be saved. "

Furthermore, both viewdata and teletext systems are selective (the farmer does not have to 'listen' to the pig market reports while waiting for the ewe sale reports as he does on radio ...), provide speed of access and enable information to be rapidly and constantly updated as required (editing can occur at any time through a terminal), and rely on visual interpretation which can be left as a display as long as the user requires. This is in contrast to radio reports.

Jones and Davis (1981, p.9) list the following disadvantages:

" (i) updated or additional data requires an additional phone call;

(ii) users face the limitation of viewing data on a television screen without hard copy;

(iii) participating states (extension regions) face the problem of co-ordinating a system of rapid updating of computerised data;

(iv) users must be educated as to how to access and use the system; how to interpret data and use data to make decisions. "

None of these disadvantages are serious. In fact, it is technically possible to obtain hard copy though the additional equipment necessary

will increase the investment. Point three above involves accepting that a new system involves a re-deployment of resources including providing training programmes on information collection and presentation methods.

It is also a mistake to assume a machine based information system can replace face to face contact in the extension process. The decision making process frequently involves interactive dialogue as various ideas and plans are evolved. This lack of interaction in a simple information system is certainly a disadvantage and has implications when deciding on the appropriate information to include in the data base.

A further major technical problem in viewdata systems is the quality of telephone lines. In general most voice grade lines can provide data transmission speeds of approximately 30 characters per second with reasonable accuracy but some country lines (party lines) will not be of sufficient quality to support even this rate. Another problem is that without special data transmission systems heavy use of lines for long periods will cause overloading.

Clearly the overriding disadvantage of any system is the cost. It is not clear yet what the costs will be for an agriculturally based system though when the major review of the Green Thumb project currently being undertaken is released this should provide some urgently required assessments. A computer installation for around 4,000 users could involve approximately $1,500,000 (a central machine together with 20 nodes each servicing 200 farmers together with the associated software). Probably of more significance will be the cost of the personnel to collect and update the information as well as to keep the system operating. This system could require, say, six people together with part-time local node input so an annual operating cost could be around $350,000. Taken together the operating and annual capital costs might amount to approximatey $190 per user. Economies of size are clearly a vital factor. On top of this the farmer must also meet his toll charges and equipment charges. As a

minimum the farmer's individual capital cost could involve approximately $1,000.

More detailed research is required before it will be possible to be more specific about all the advantages and disadvantages. Equally as important is research into the kind of information that should be provided on an electronic system compared with other media in relation to the relative costs and benefits.

2.3 Problems

The question of reliability is a problem that should be stressed. Reliability is partly related to adequate staffing to ensure the information is updated immediately conditions change. There is nothing worse than turning on the system expecting to obtain, for example, an updated weather map only to find that it is several hours old. Equally, if the whole system is non-operative more than some critical proportion of the time users will become frustrated to the point of becoming non-users. Equipment used must clearly be as reliable as possible with adequate backups and must make allowances for special local conditions such as extreme thunderstorm activity (an initial problem with the Green Thumb project).

Legal liability is another problem that needs addressing. If data are incorrectly entered into the system, can a user claim damages, and who is responsible - the organisation or the keypuncher? If the system breaks down and a user claims he has lost profit, is the organisation liable? Any agreements and contracts prepared must clearly cover all these aspects.

Finally, it must be recognised that information supplied, while correct in itself, may be misleading for any one farm situation as each has its own unique problems. It may not be possible to provide sufficient detail and qualifications to overcome this problem in some areas of information.

2.4 Criteria for Success

If the system is easy to use, provides the information required by the farmer and can be accessed when the user decides he needs the information (not when somebody else decides) the system will be used. An urban based simple example of what is possible if these criteria are met is the telephone based local weather forecasts available in many cities throughout the world. By providing twenty four hour access to a brief forecast voiced in laymen's terms local authorities have found significant demand exists. (In Christchurch, for example, the number of lines had to be increased from 6 to 10 after a year of operation.)

Similarly, if provision is made for the farmer to enter information as well as receive it (e.g. local weather data, insect count information ...) the system can potentially provide more personalised and accurate information compared with a one way flow system. This can lead to greater acceptance as the usefulness of the data may be enhanced.

For widespread use the charging method adopted must clearly be related to the apparent value of the information. At this stage there is a paucity of evidence on the economic benefits of providing instantly available constantly updated information so it is impossible to objectively comment on the charges that could be economically justified. However, it must also be recognised that information may be demanded for more than its economic value. Simple curiosity may, for example, be a reason for seeking contemporary data.

2.5 Design Considerations

Aspects of design fall into the three major categories of physical equipment, type of information to be provided, and the overall system design.

2.5.1 Equipment The equipment configuration primarily must ensure reliability. This may involve having a dual system including at least two phone numbers to reduce the chance of equipment faults making the system inoperative. Depending on the expected number of calls at peak times each computer must have an appropriate number of incoming lines. In the Green Thumb project (Raglan, 1981) with 200 farmers using two nodes each with seven lines this number proved insufficient at peak demand times. Peaks tended to occur around 10.00 a.m., 12 noon, 3.00 and 4.00 p.m. as well as 8.00 p.m., though the distribution proved to be relatively flat between 7.00 a.m. through 11.00 a.m. (Raglan and Warner, 1980). The system used gave a 90 percent success rate for the calls and the terminals proved to be reliable after the first few months. The terminal arrangement relied on using existing household equipment (T.V. sets) combined with a 'black box' to minimise the capital cost. The equipment, however, could not be used for other functions as would be the case where micro-computers are used as the terminal. It is not clear yet what is a critical reliability rate though the Green Thumb experience indicates a 98% call success rate is possible and desirable.[9] Ensuring this level of success is likely to involve using a system dedicated solely to the information system rather than relying on a shared computer. With a range of systems operating the chance of a software and, or, a hardware failure is increased.

To minimise the need for human intervention the equipment should allow automatic receipt and updating of information already available in electronic form (price and weather data in many cases) and where a node system is used the nodes should have their data base updated automatically from the central computer on a regular basis. Similarly digitising equipment (transforming non-digital information into a form directly transmittable by the computer system) is likely to be an important component of any system.

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9. Raglan, J. (1981) University of Kentucky, (pers.com.)

As already stressed, it is desirable to utilise equipment providing an interactive capability where possible. Experience with a successful telephone based system providing cattle marketing information (Cattlefax) indicates part of its success is due to the obviously interactive nature of a telephone conversation[10] enabling personalised answers catering for whether the user requires a simple, in contrast to a reasoned, answer. Furthermore, the farmer can provide local data, often subjective, increasing the awareness of the person providing the information of, in this case, the local cattle market.

If a system is based on T.V. sets it will not be possible to obtain the high resolution necessary to provide detailed pictures necessary to provide, for example, disease recognition capabilities.

Once viewdata information systems are widely accepted the problem of telephone bottlenecks will require the organisations responsible for public utilities to consider a range of possible systems. One possibility is to position localised node computers at key telephone exchanges and for these machines to hold the most commonly accessed information whereas calls requiring less commonly requested information can be directed to a second level computer using special data transmission lines.

2.5.2 Type of Information Consideration must be given to the type of information that it is most appropriate to provide via an electronic system compared with other media. The electronic medium is best suited to information which changes rapidly though the convenience aspects, particularly the selective capability, may mean other information may find a place on electronic systems. There is very little published information indicating farmer requirements.

10. T. Thorpe (1981), Cattlefax Organisation, Denver. (pers.com.)

Furthermore, there is a lack of basic research on what information farmers actually use when making decisions[11] so guidance is not available in this area. However, the Green Thumb experience does give some initial pointers. Raglan (1981) reports the following percentage use of the various categories available (after 10 months trial):

Market information	50.2%	Home economics	2.1%
Weather	31.9%	Rural sociology	0.9%
Local information	3.9%	Plant disease	0.9%
Agr. economics	3.8%	Agronomy	0.7%
List of information available	2.2%	Entomology	0.7%

It is doubtful whether the lower figures are significant. These could be a reflection of the need to learn what information out of, for example, the available entomological data, the farmers require and how this should be presented. Simply repeating excerpts from written material may be inappropriate. Experience also indicated that farmers tend to view most frequently the information which changes most frequently. If information only changes every six months it is unlikely to be suitable for a restricted information system data base.

Equally as important as the data content is its presentation. Because the electronic medium is new there is considerable experience to be obtained in this regard. Some of the British work does, however, indicate the importance of presentation and the kind of factors that are important. Reynolds (1979) concludes that presentation has a marked effect on the ease and speed of observing the material and whether in fact the information is correctly observed. Reynolds also lists many of the factors that should be considered when designing screens. These include, to give some examples, considering the luminance of different colours when attempting to stress different components of a message, no more than

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11. P. Warner (1981), Sociologist, University of Kentucky. (pers.com.)

three colours per screen should be used, each screenful should be self contained, and certain punctuation rules should always be followed.

2.5.3 System Design Many of the aspects raised in the previous two sections can have implications in the system design area. For example, to enable automatic information updating, computer programs designed to accept the new information and integrate it into the data base with the minimum of human input must be designed, developed, tested and slotted into the overall computer system.

However, before deciding on system design, decisions about the type of information to be included in the alternative information media must be addressed. What kind of agricultural information should appear in a teletext as against a viewdata system? Teletext is cheaper but very much more restricted than viewdata in quantity and selectivity. This suggests agricultural information that changes very rapidly and has wide general application is the obvious choice for dissemination on teletext. Recent technological improvements make it possible to broadcast approximately 1,000 pages per channel so, given the importance of the agricultural sector in the New Zealand economy, an appreciable number could be devoted to agriculture. Just how many must depend on the demands of other sectors and the real gains that are possible from providing constantly updated and readily available information in each case.

Turning to specific design considerations a number of factors should be allowed for. It will be important to ensure sufficient and properly trained personnel are appointed to maintain machinery, software, data collection and presentation. It must be appreciated that information systems are specialised operations that cannot be run with a reliance on spare time labour. Another factor is deciding who should be allowed to provide information and how the costs should be allocated. The British viewdata system (Prestel) is an example of a flexible system in that it is organised by the national Post Office for general public use. Anyone can maintain frames on the system at a specified cost and can decide whether or not to charge users for

viewing the information. All billing is carried out by the Post Office. A public organisation such as an extension agency can therefore supply information to the farmer at no cost whereas a commercial organisation with valuable information can be paid for supplying it. This system also allows restricted entry (through user codes) to information so a commercial firm could restrict entry to only their particular customers (e.g. a feed supplier). In that there is likely to be considerable interest from commercial organisations[12] the British system enables this interest to be catered for without equipment duplication. Equally, it allows for subsidisation where required.

Users of Prestel indicate[13] it is crucial that the menu system[14] be easy to use so it is possible to obtain the information required without difficulty. They also indicated that information must be updated regularly. In a large data base this has implications for its design.

A hierarchical system is a possibility with increasing detail being presented as a user moves down a conceptually pyramid like arrangement.

2.6 Transition Methods

It may be necessary to approach the final system through a series of phases due to financial or personnel availability reasons. Even without these constraints it may be important to evolve a suitable system for local conditions through a transition trial and error system. It is also clear that local research on information requirements must be carried out.

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12. See Lenhert (1981).
13. See Butterworth (1981).
14. A list of items (the menu) is presented on the screen. The user selects an item by typing the number associated with his choice.

Computer equipment can initially be shared, possibly through adding disk packs and ports to an existing computer, until the system is established. Similarly, existing extension people can assist with the data base until specialists are trained (though the Green Thumb experience suggests adding to their work load in this way does not promote high quality and relevant information), and certainly existing price and weather forecasting information, for example, should be utilised wherever possible. While specialised farm based equipment may be desirable, using existing T.V. sets reduces the capital cost. Another temporary possibility is to use a telephone based system in lieu of terminals - the farmer could phone a central terminal where the operator reads off the information after punching the appropriate keys.

In the long run, however, Green Thumb, Prestel and teletext experience indicates information systems are specialised operations requiring specialist staff and equipment backed by a competent management structure. It is towards such systems that transitional methods must be planned.

CHAPTER 3
MARKETING SYSTEMS

3.1 Background and Definitions

Electronic marketing systems have been in operation for many years (the simple use of a telephone could be described as an electronic marketing system) but it is only in recent years with the rapidly changing cost structures and improved computer technology that serious consideration is being given to developing major marketing systems. It was in 1961 that the first recorded system was started (pig marketing in Ontario using teletypes). This was quickly followed by a similar system in Virginia in 1962. Since these early beginnings there has been a steady, if unspectacular, increase in the number of permanent and trial systems leading to the current situation. Ward (1981) traces this history and lists the currently operating and proposed systems in North America. To date, no international systems have been developed but there are clearly prospects for internationally traded commodities (Sporleder, 1980b).

An electronic marketing system is defined as any marketing operation that cannot operate without electronic devices. This involves a much wider range of systems than is the case in electronic information systems but in most cases the eventual aim is to move into a computer based system with buyers and sellers using terminals and some kind of electronic devide to communicate in contrast to face to face contact. Other features of these systems may include centralised pricing, well defined operating rules and product descriptions, and pictures, rather than direct visual inspection for assessing the product, whether objective or subjective.

To date most developments in this area have occurred in North America where there are a wide range of systems operating though many are still at the experimental stage. These include simple telephone based conference call systems, central auctions after viewing video tape screenings of the product, through to computer based totally

remote operations with buyers and sellers interacting through terminals.

An example of a telephone based system is the Oklahoma slaughter lamb tele-auction (Ward, 1980a). Sellers notify the organising co-operative when they have lambs available for sale. A representative visits the farm to inspect and classify the animals. On the day of the auction each prospective buyer is contacted and those interested are connected through a telephone conference call. A conventional auction then follows with the auctioneer describing each lot and each buyer bidding via a code number. After the auction, delivery arrangements are organised by the co-operative. Where the lots differ from the original description standard adjustments are made to the price. Currently the system is working satisfactorily.

At the other end of the spectrum is Cattlex (Sporleder, 1980a), a computer terminal based system for marketing store (feeder) calves in Texas; a similar system (Telcot) for a crop product - cotton - is also operating in Texas (Ward, 1981).

Cattlex is based on the Texas A & M University's central computer and has permanent lines through to a number of terminals located in both the feeder cattle and feedlot areas, these areas being spatially separated. Auctions and contract selling occur every day over the terminals at specified times. When feeder cattle are of a saleable weight the seller contacts a third party grader who visits the farm and prepares a standard report. This is entered into the computer system by a trained terminal operator. The animals, normally, do not leave the farm until sale has been consummated. When looking for cattle, buyers go to a terminal where they view (on the visual display unit) written descriptions of all the lots on offer. If any of the lots (described by number of animals, weights, breeds, and grades as well as seller supplied comments) are of interest, the buyer can then enter the auction system or, if the animals are being offered on contract, put in an offer; if it is

above the reserve price a sale is made. In the auction system lots appear on the screen for a given time. During this period bids can be made at any time - the screen shows the highest bid on offer at the current time together with the particular buyer's highest bid, which may, in fact, be the current high bid. At the end of the specified time the lot is knocked down to the highest bidder provided the reserve is reached. To assist the buyer, details, including price, of lots sold over the last few minutes are displayed on the screen at the same time. To further assist in the price setting procedure buyers and sellers can obtain on the screen information on prices and numbers sold and prices over the recent past as well as general cattle market information from around the country. As sales occur the computer system updates all the historic sales information and constantly amends the reports available. After a sale, printed notices are prepared and forwarded to the buyer and seller. When the cattle change hands at an agreed time and place the cattle are weighed on tested scales and adjustments may be made to the price using standard factors if the lot does not exactly meet the original description (numbers, weight). Funds change hands through a central clearing bank.

After a slow start (Schotsch, 1981) Cattlex appears to be gaining acceptance after a year of operation and it is now planned to increase the number of terminals throughout Texas.

In considering the prospects for electronic marketing it is useful to list features of what might be regarded as an ideal marketing system and then to assess whether these can be achieved. A desirable system should:

(i) provide buyers and sellers with information on the location, grade and price of all items to be traded;
(ii) enable buyers and sellers to negotiate on an equal basis;
(iii) provide historic information on the price and quantities traded;

(iv) provide estimates on future supplies and demand; and
(v) provide clear information on the trading rules and regulations.

The discussion which follows should make it clearer whether electronic marketing can provide these requirements. It should be recalled that many of the comments already made about information systems, particularly about user orientation, and equipment and system requirements, apply to some extent to marketing systems.

3.2 The Advantages and Disadvantages

As far as sellers are concerned the primary concern must be whether they receive increased prices, whereas purchasers have the opposite concern; in both cases questions of convenience and resultant economic effects are also important. There is insufficient evidence available, as yet, for totally computer based automated systems to be properly evaluated. Furthermore, each particular market situation will have its own specific costs and benefits. Assessments at this stage must rest on weighing the advantages and disadvantages.

The advantages include the following factors:

(i) trading is centrally organised through a defined set of rules so it is clear to the users how they should operate;
(ii) rapid access is assured thus saving considerable time;
(iii) in geographically dispersed markets not only is there a time saving but traders are made aware of opportunities which would otherwise go unnoticed;
(iv) both small and large traders are given equal access to the market;
(v) potentially, traders have access to information on historic prices and volumes, market news and forecasts;

(vi) transport costs (for both product and personnel) can be markedly reduced. If the product can stay on the farm until sold there is no need for transport to auction places or other intermediate points. If a sale does not occur there is obviously no need to transport the product back to the farm (also meaning less pressure to sell). In a widely dispersed market, price differentials due to transport costs can be automatically programmed into the system.

(vii) due to the minimisation of transport distances and time there will tend to be less transit damage and lower transit weight losses in the case of livestock;

(viii) with access to a wider market and improved information buyers can better organise delivery schedules to optimise plant use, and minimise storage costs;

(ix) quality margins are more likely to be reflected due to the accurate and more extensive information available compared with traditional marketing systems. An electronic system forces objective grading into the market.

The little evidence that is available on the effect of all these advantages on pricing efficiency[15] does indicate that price and cost advantages accrue. This evidence includes work from Canada (Lu, 1968; Lowe, 1968) on hog marketing and from Oklahoma (Ward 1980a and 1980b) on lambs and wool. Sporleder[16] maintains that cattle prices have increased $1.25-2.00 per 100 pounds on Cattlex. The Canadian work has also shown transport cost savings. These advantages must be compared with the operating costs. Again, little published evidence is available to make an assessment. Ward (1980b) reports that charges in a tele-auction arrangement are somewhat less than conventional

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15. See Sporleder & Chavas (1979) for a discussion on pricing efficiency and electronic marketing.

16. Sporleder, T.L. (1981) Texas A & M University. (pers.com.)

stock yard sales but most information at this stage is based on budgeted data (Baldwin, 1980; Anderson, 1979).

If, in fact, there turns out to be an appreciable number of markets in which positive gains occur the family farm will be more likely to survive. The fact that an electronic system provides equal opportunities for both large and small traders provides this potential competitiveness for small farms; systems providing input purchasing capabilities could also be useful in this regard.

Social aspects also give rise to one of the disadvantages of electronic systems. Traditional marketing systems have usually involved face to face contacts of, in many cases, a large number of people at, say, a regular auction market. These meetings have not only provided a medium for exchanging ideas and solutions but also an opportunity to mix socially. Remote access marketing systems will destroy these particular meeting grounds though they could be replaced by other meeting opportunities.

Other disadvantages include the removal of direct visual product inspections and therefore the opportunity to form a subjective impression of quality. Traditionally many traders have believed they have special abilities in this regard. Furthermore, objective marketing systems remove some of the gamble out of the system so that those buyers and sellers that relied on being better judges of the product to make windfall gains will no longer be in this position.

The existence of equal opportunities for both large and small means that some of the large buyers that could dominate the market will no longer be in this position. They will see electronic marketing as a backward step unless some of the convenience factors give sufficient compensation.

Another disadvantage of importance is that electronic markets are likely to have large price swings relative to traditional systems (Henderson, et al., 1979) due to the ease of access and extent of

information available. Traditional markets tend to have lags in the information flow and, furthermore, it is not always easy to quickly get into the market, so price swings tend to be dampened.

Finally, it should be noted that much of the give and take associated with marketing systems based on personal contact will be lost (electronic systems do not allow the rules to be bent), this being particularly important in situations where several generations of fathers and sons have traded with a particular marketing organisation. Furthermore, marketing representatives often obtained a subjective feeling of what was happening in the market as a result of these contacts thus providing a market intelligence function for their organisation. This subjective assessment will be lost in electronic systems.

3.3 Problems

The primary and overriding problem involves ensuring the integrity and reliability of the system. If the number of traders necessary to give reasonable economies of size are to be attracted they must have confidence in the system despite any major price, cost or convenience advantages. This involves having adequate backup systems, legal protection, and so on. To assist in detecting problem areas it is essential to have a reasonable trial period before commencing operation. The Cattlex experience showed it was necessary to allow one and a half years for setting the system up as well as a further six months of field testing.

This time should be used to ensure that things like the terminal lines and connections are functioning adequately (one particular information system, for example, had considerable difficulties with incorrect insulators on the telephone lines[17]), that

17. L. Busse, (1981), FACTS system, Purdue University, Indiana. (pers.com.)

all the backup systems work efficiently in case of machinery malfunction and that all the other procedures and systems operate effectively.

Other potential problem areas that should be stressed include:

(i) farmers placing too high a reserve price on their products in the hope that this new system might just produce a very high price (they have nothing to lose). In this case buyers quickly become disillusioned;

(ii) having sold or purchased, there is a considerable temptation to renege if subsequent sales, which can be readily observed, prove to be a better trade. To overcome this problem binding contracts must be organised;

(iii) terminal operators (if not the buyer or seller in person) must be carefully trained if disastrous mistakes are to be prevented. Similarly, where third party graders are used training must ensure consistency and objectivity as far as possible. In that mistakes and dubious grading will occur from time to time adequate consideration must be given to the legal responsibilities of terminal operators and graders[18] as well as other people and organisations involved;

(iv) developing an acceptable charging system that is not too different from the existing but also puts the cost onto the users in relation to their gains.

This latter point is important for ensuring a sufficient number of users convert. It is likely growth will follow a sigmoid curve as once a critical number of users exist it will be important for the rest to follow. There could well be a case for initial subsidisation by government or specific groups likely to eventually gain to ensure

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18. See Fambrough (1981) and Anon (1981b), for a legal discussion of liability in Texas.

this critical number is attained as quickly as is reasonable in markets where long term advantages lie.

As with most new technologies there will be resistance to change and employment implications. Traditional auctioneers and market people will undoubtedly have to be retrained and in some cases even moved out of the industry. One of the reasons for considering electronic systems will, in fact, be savings in personnel costs and this may mean redundancies.

3.4 Criteria for Success

The existing market must have flaws, at least perceived flaws, before a desire for change will exist. Without this it is unlikely an electronic system will succeed. Equally, there must be price variability over time and space (Sporleder, 1980b) in contrast to a fixed price situation. Other necessary requirements include having a market which is dispersed (otherwise, conventional systems can provide an efficient market), having trade that is not essentially reliant on personal contacts (Schrader, 1980), having a product which is objectively gradeable at least to some minimum level in a generally acceptable way, and is not marketed on a brand basis unless the primary distinction is on grade.

Any system that is organised will certainly not succeed unless the marketing procedure, and all its associated rules and regulations, is acceptable to both buyers and sellers, at least to a reasonable degree. In that many users will have slightly different requirements, it is important to have as flexible a system as feasible. For example, small as well as large lots should be capable of being handled, though it may be necessary for very small producers to accept pooling (Glazener & Sporleder, 1979). For convenience terminals must be located in appropriate places though eventually heavy users will undoubtedly have their own. Initially, existing sale yards may be an appropriate location.

While it will take longer to develop it is likely farmers will accept a system if it is possible to carry out all activities associated with the production and sale of a product using the one system. For example, in seed production that requires certification, it would be logical to have certification as well as marketing procedures all operated through a single terminal; where a product is subsidised the act of selling through the electronic system should automatically involve all the applications and other formalities associated with the subsidy.

The need to develop, at least initially, a system with rules and regulations similar to the existing system means it is important to involve current users, as well as professionals, who fully understand the particular market. However, no matter how well organised and conceived a new system might be, if the potential users are not psychologically ready to use electronic marketing it is doubtful whether it will be successful. This implies early attitude surveys and adequate publicity are important as well as training workshops. It is clear that traditional markets that require very little change to their structure to make them suitable for electronic marketing should be converted first. This probably means an adequate grading system already exists.

In the long run, however, success depends on whether price, cost and convenience advantages will accrue. As Davis (1980) states:

> " The reason that TELCOT (Texas cotton market) is moving ahead ... is simply because TELCOT is a more cost effective solution to our marketing problems than the system that it replaces. It saves the shipper money; it saves the producer money; and it creates an open, honest market that everyone perceives as giving them their total due. "

3.5 Design Considerations

3.5.1 System Design The particular design must depend on the particular product and the existing market structure. Questions such as whether to have a range of selling options on the system (contract, auction, futures), what kind of auction to have (ascending or descending), and options for product delivery, must all be considered. These factors must be related to equipment considerations including the question of whether special terminals should be used so that, for example, keys are labelled solely for the marketing operation. A major policy question is involved here as a special terminal probably cannot be used for other functions, such as connecting to an information system, whereas a system which uses a standard terminal and communication protocol may allow many different terminals or micro-computers to access the system. A further question is whether the user must be constantly on line as this may involve expensive toll calls once farmers' have their own terminals. Alternatively, a farmer could enter product information while off-line so that when the connection is made the information could be transmitted at electronic speeds. The farmer could then reconnect later to review reserve prices, make delivery arrangements and so on.

Other policy factors include whether to allow traders to buy and sell lots, or part lots, after they have initially purchased but have not yet taken delivery, and whether in fact to allow part lots to be sold on the basis of, for example, sex, weight or possibly breed. An appropriate grading system and how it should be administered must be developed. In cases of live animals that are not being killed, grading is likely to involve third party graders though it might eventually be possible to transmit electronically sufficiently detailed video shots of the animals (videos are already used in Oklahoma but through bringing people to a central location to view them). Slaughtered animals, on the other hand, are relatively easy to grade.

Despite the grading system used in many cases the product actually delivered will differ from the original description. Accordingly, it is necessary to have some form of agreed premium and discount payments to cater for the discrepancies. Recent sales for different grades can be used as the basis for the adjustment formula. If actual delivery information is entered into the computer, payment and receipt notices can be automatically prepared. However, no matter what system is devised it will probably be necessary to have penalty payments for excessive differences between the product offered and that actually delivered on top of any premiums and discounts to prevent exploitation and retain system credibility. This will be particularly important where the quantity supplied is markedly different from the agreed contract.

The other major decision is whether to have a totally integrated system. Should, for example, the system be connected electronically (or possibly through automatically printed notices) to the users' banks so that funds are transferred without further action? Should the change of ownership be automatically recorded where this is required? Clearly, if it can be organised, automation is as many areas as possible is desirable though it must be remembered that software design will be complex and not all users will agree to handing over all control to the machine.

3.5.2 Details of Procedures and Regulations Something as complex as a commercial marketing system requires considerable attention to detail. Anderson (1979) gives some indication of this in reporting on an initial design for a pig marketing system. The following list includes some of the factors mentioned, as well as a number of others, that need to be considered:

(i) design of displays shown on the terminals, particularly to ensure a clear and easily understood picture of the relevant lots in a quickly moving auction system. Questions of what to include are also relevant (should owners' comments be displayed?);

(ii) the ordering rule that should be used in listing lots for auction - random or some other system;

(iii) whether or not to record the highest bid if this is below the reserve price and therefore give the seller the chance to re-set the reserve;

(iv) whether to have a fixed time for each lot to be auctioned or keep auctioning until there is, say, a thirty second lapse after the last bid;

(v) whether to have a standard bid jump or to allow a specific figure to be entered (with some kind of test procedure to prevent mistakenly entered excessive amounts being accepted);

(vi) whether to build in automatic adjustments for transport costs so the price offered is the delivered price at some ready reference point;

(vii) organising a computer and software system to ensure a response time that is no more than some critical maximum;

(viii) whether to build into the system the ability to organise the delivery arrangements;

(ix) whether to provide a facility for purchasers and sellers to obtain listings of the details of all trades they have entered over some period (though individual sale confirmations would have to be printed);

(x) deciding on the number of days a lot can be offered before another entry charge is made;

(xi) organising standard, and constantly checked, scales for weighing the product at delivery, and advertising their locations;

(xii) organising a system to issue code numbers to buyers and sellers that have been judged acceptable to join the system. This may involve obtaining credit ratings and putting purchase limits on some users.

3.5.3 Associated Activities Besides the actual marketing system many closely related activities must be designed and organised.

These include the need for a training centre at which graders, terminal operators and buyers and sellers, if different from the terminal operators, can be trained and given the opportunity to experiment with the system. Grader schools should be designed to ensure as much consistency as possible. In that the ideal is never totally achieveable, it is usually desirable for graders to be identified so buyers can make appropriate allowances. Wherever possible, it is also useful for traders to be able to meet face to face at some stage so that when a breakdown or a misunderstanding does occur there is likely to be rather more tolerance exhibited. A further matter is the arranging of an arbitration system to handle any disputes. This might involve ensuring the availability of an independent person to be on hand at delivery points to arbitrate on, for example, weighing discrepancies.

Finally, particularly because transport savings are a crucial element of electronic systems, it could be useful to link transport operators into the computer system to facilitate efficient transport scheduling, particularly where the possibility of backloading exists. Where the product does not leave the farm before sale it could even be worthwhile to co-ordinate delivery dates to ensure utilising available transport space.

3.6 Transition Methods

While a totally automated computer based system is likely to give the greatest benefits in the long run, in many cases it will be undesirable or infeasible to implement such a scheme at the outset. A number of transition arrangements are possible though the particular product and the existing arrangements will dictate to a certain extent an appropriate development path. The likely time span involved will similarly vary and may take as long as ten to fifteen years. Sporleder (1980b) suggests, for example, that implementing a grain marketing scheme could take as long as a decade.

In many cases it will be necessary to first introduce an acceptable grading scheme. While this is being introduced it may be possible to introduce traders to a computer based system by operating a simple electronic noticeboard which enables sellers and buyers to list details of product availability and demands so that a user can request a listing of the lots that meet given specifications. Actual trading is then dependent on the trader making his own contact with the other party.

Rather than use a computer various telephone or teletype based systems can be used as an interim measure. This means, however, that the power of the machine to rapidly provide updated market information is lost. Such systems mean the traders do not have to be brought together. Alternatively, it might be appropriate to bring the traders together for the actual auction after introducing a grading system that removes the need for the product to be inspected. The Queensland pig marketing system (Llewelyn, 1981) is an example.

Even where a fully integrated computer based system is operating it will often be necessary to begin in a restricted way. An example is the location of terminals at existing sale yards. While stock are still physically delivered for weighing and grading, buyers from a wider area than is traditional can take part in the sale through terminals located at other sale yards.

These examples serve to indicate some of the possibilities. Whatever system is used there is likely to be a considerable investment required before a positive cash flow will eventuate. Accordingly, large co-operative organisations and government subsidies need to be carefully considered in any proposals.

CHAPTER 4
AN INTEGRATED STRUCTURE

One of the important attributes of electronic systems is the ability to have nationally, or even internationally, co-ordinated systems which give all potential users the opportunity to participate. The overriding question with nationally integrated systems is whether farmers and related groups are more likely to actually use the systems and achieve positive benefits from this use compared with a non-integrated structure involving a number of competing systems organised by different groups. In reality greater use and benefits are likely to occur as integrated systems can provide relative ease of access (only one system to become familiar with) and cost economies as well as the benefits of specialisation. Furthermore, while individual groups and organisations may initially demand their own systems with a view to obtaining a competitive advantage, eventually this advantage will be lost once most of their competitors have followed suit.

Specifically, information system data bases are likely to be more extensive and professionally prepared if specialisation can occur. Equally as important, an integrated system can lead to uniform procedures for obtaining information making it easier for the farmer to access the data bases. For marketing systems co-ordination can lead to improved price discovery through limiting the number of competing systems selling the same product. The primary disadvantage of having competing systems is the lack of combined market statistics which could be automatically updated and displayed as sales proceed.

With respect to computerised management aids it is likely, in the foreseeable future, that farmers will move towards operating their own systems using individual micro-computers due to the many benefits of having an independent system. However, it will not be long before it will be useful for programs to be downloaded to the micro-computers from a central library and for a two-way data flow to be possible. This might involve the farmer using the power of a large computer for assistance in decision problems that are too large for a micro-

computer. (See Debertin et al., 1979.) Clearly, it would be of considerable benefit for users to be able to connect into an integrated system that offered these services as well as the information and marketing systems. One of these benefits would be the ability to pool summary data (e.g. financial information from a detailed enterprise accounting system) for comparative purposes.

Another concern is whether specifically agriculturally orientated systems can be integrated with computer based schemes designed for general business and community use. The crucial factor is the spatial one as well as the quality of telephone lines. Because of the relative isolation of farms and the consequent distances involved, the cost of communication becomes a much more important factor compared to the urban situation. A solution is to make use of sophisticated urban communication systems as far as possible but to superimpose on this additional facilities specifically designed for agriculture.

Given the communication problem as well as the fact that it would be difficult to organise and manage a single entity[19] with the responsibility of running a nationally integrated information, marketing and management aid system, the most likely structure to obtain the benefits of integration would be a co-ordinated national communication system specifically designed for agriculture. This should be available for use by all organisations to run their particular system. For all groups using the communication system there should be co-operation between groups with similar interests through consultative committees.

The most feasible organisational structure to implement the agricultural communication system would be a co-operative made up of all the groups interested in using the network. The co-operative

19. For a discussion on some of the difficulties associated with operating a relatively small system see Anon (1980).

should be self supporting, once established, through charging each member on the basis of its use. Farmers should pay their individual user fees directly to the supplier of the information or marketing system used. The dispersed nature of agricultural users means the communication network should consist of small computer nodes throughout the countryside linked by high speed lines. The nodes should be located according to potential user densities and the relative cost of toll calls, in comparison, to the cost of node computers and the associated high speed links. Natural marketing and farm type boundaries will also be relevant.

This specifically agriculturally based system should probably make use of any specialised urban orientated data communication lines set up by utility groups, either private or national, for communal use.

Given this co-operative communication system any member should have the right to use it through investing in a mainframe computer connected to the network. This mainframe would then be the effective controller of the particular system set up by the member. In the case of information systems the data base would be downloaded at regular intervals (or parts of it) to the localised node computers so that farmers can get local access through a standard operating system set up by the co-operative (if his nearest node was out of order the farmer could phone the next closest thus giving considerable reliability). For marketing or management aid systems the node computer would act as switching controllers to direct the farmers call through to the mainframe on which the particular market or management aid was based. Depending on the communication charges there would be an 'optimal' configuration and location of the machines and personnel involved.[20]

The advantage of the proposed system, besides direct cost advantages, is its flexibility. Provided an organisation joins the

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20. See Anderson (1979) for a discussion on some of the location questions.

co-operative any number of groups can become involved but at the same time, through co-ordinating committees, an attempt to rationalise the number of competing information and marketing systems can be made without being unduly restrictive and bureaucratic - two potential dangers of a single system controlled by, say, central government. Furthermore, as marketing has been the prerogative of private enterprise and co-operatives, there would be considerable resistance to any suggestions of a single, government controlled, agricultural information and marketing system. If a government believes, however, that there should be a single market for some commodity, legislation can be passed that gives the rights to a single organisation (perhaps a statutory marketing authority).

Countries in which information and marketing systems already exist are clearly restricted in what immediate action can be taken. However, due to the cost advantages of a co-operative communication scheme, potential groups would tend to join the co-operative in time. The problem in all cases, however, is to initially organise the base system. In many cases it may be necessary and appropriate for central governments to foster and subsidise the initial operation. Universities may well be (as they have in the U.S.) catalysts in the development phases, particularly through setting up trial operations. In any particular country, farm population densities may well influence whether this is a single national co-operative or whether a number with loose links would be more appropriate. This will largely depend on the natural information flow and marketing boundaries.

In the proposed arrangement no mention has been made of teletext (T.V. based) information systems. Due to their limited and unselective nature it is unlikely that commercial organisations will want to utilise them except for straightforward advertising. They should therefore be under the control of national departments of agriculture where it is clearly demonstrated there is a real demand for the information provided.

Allowance needs to be made for small commercial firms or co-operatives with insufficient resources to set up a mainframe based system connected into the communication system. In this respect the communication co-operative could maintain an information system with purchasable frames. Similarly, small market operations could be organised on a cost basis by the co-operative.

Forecasts of technological developments are crucial to the conclusions drawn. If, say, radio based (or perhaps laser beams off satellites) data transmission systems enabling a farmer to log into any remotely located computer at a competitive cost were developed there would no longer be a need for a co-operative communication system. Such a co-ordinating body, however, would be most useful in bringing together the various groups involved to avoid fragmentation.

CHAPTER 5
CONCLUDING COMMENTS

A large range of computer based systems have been, and are being, developed. The experience obtained should be used in designing and modifying these systems. The objective of this review has been to bring together this experience with a view to providing general design criteria and conclusions.

Undoubtedly there will be more systems proposed and developed in the near future. In most cases decisions to proceed will be based on cost estimates rather than cost records and some kind of general belief about the extent of the benefits. Whether many of these beliefs will be realised can only be assessed after a number of years. However, it is interesting to note that if formal cost-benefit studies were a pre-requisite neither the automobile nor the aeroplane would have been developed. It must also be recognised that it is the users that will decide whether the systems are useful. Already some have decided positively if the number of users of Telcot and Prestel, to give two examples, are any indication. Certainly, the electronic revolution has meant many activities and functions that were previously impossible or impractical are now a reality leading to many exciting developments and the capturing of the imagination of developers and users alike.

These developments have proceeded at such a rate that the necessary evaluative and basic research effort has been left behind. Well designed ex-post studies need to be initiated as well as work on, for example, a better understanding of how farmers formulate decisions. Results of this basic research should lead to an improved design of the various electronically based systems. The capabilities of this new technology also means that what were previously theoretically based concepts and models can now be tested on the farm. This should lead to a narrowing of the gap between practice and theory.

It has been stressed that a nationally integrated system can lead to a number of benefits. However, it must also be recognised that it is not always possible to suppress the inherent independence of people and institutions making it unlikely for a single national scheme to succeed. This means a co-operative communication system with the capability of allowing a number of independent groups to interface with the farmer is most likely to be accepted but at the same time provide cost economies, ease of use and flexibility.

Probably the most crucial element in all the electronic aids is that they allow the farmer access when he himself believes the time is right, and, furthermore, enable him to obtain information, in its broadest sense, on just what he himself believes is required. In essence, the farmer controls the system to obtain that vital element to improved decision making and marketing - namely information. As Benjamin Disraeli said:

> " As a rule the most successful man in life is the man who has the best information. "

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