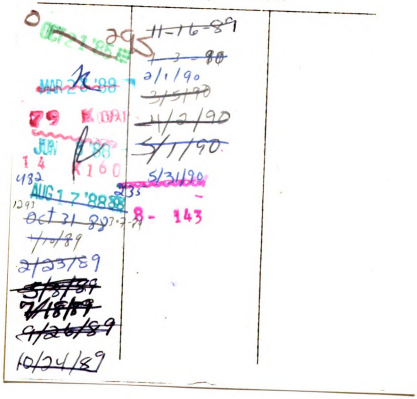

DECISION MAKING IN AN INTEGRATED SHELL EGG PRODUCING FIRM WITH THE AID OF SMALL COMPUTERS

By

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ABSTRACT

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The face of the United States egg industry has been characterized by continual change during the last forty years, with a movement from small back-yard flocks to huge production complexes involving many thousands of dollars of investment. As a result of this change, firm management has become more complex; and this complexity has brought about the need for a great deal of timely, clearly set forth information to aid in the firm's decision making. Fast and accurate flows of information enhance the decision making process. The computer can be an important tool in faciliting the accumulation of data and flow of information within the firm.

Since modern day egg producing firms are becoming more and more complex, attempts were made to identify the problems which managers face in the operation of the firm, and to identify the information which managers need to make the correct decisions to solve these problems. Since the

information needed for decision making should be encouraged and enhanced in such a way that decision making is facilitated, and since the computer is an excellent tool to be used in aiding this flow of information, the possible uses, in firm management, of today's small computer systems was studied in an attempt to match specific types of small computer software with the needs of particular levels of managers within the firm.

The dissertation concludes that there are three levels of decision makers within the integrated shell egg producing firm, and that the types of decisions which are to be made, the information needs for making these decisions, and the possible uses of the small computer in manipulating and generating this information are all dependant on a particular managers level of decision making.

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Most of all, the author wishes to thank his parents for their moral support throughout the course of his graduate study, and for teaching him, at an early age, the importance of an education. This dissertation is dedicated to them.

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CHAPTER 1

INTRODUCTION

1.1 Increasing Complexity of Poultry Business Management

The face of the United States egg industry has been characterized by continual change during the last forty years. Egg production has changed from small back-yard flocks to huge production complexes involving many thousands of dollars of investment. In the period from 1964 to 1969 the number of U.S. farms reporting laying birds declined more than 60 percent; in the period from 1969 to 1974 this trend continued with a drop of about 32 percent from 1969 levels (Schrader et al., 1978). This trend has not been brought about by a reduced U.S. egg producing flock, but by increasing concentrations on the part of the egg producing subsector of U.S. agriculture. A 1978 survey indicated that 25 percent of U.S. laying hens were controlled by the 34 largest egg producing companies (Anonymous, 1978). Due to better bird management, better nutrition, and a better genetic base, today's layers produce far greater numbers of eggs than did those of just a few years ago. This rapidly changing technology within the egg production industry has resulted in economies of egg production which have allowed

the real price of eggs to decrease over time (Anonymous, 1966; Schrader et al., 1978).

These production efficiencies would not have come about as rapidly if traditional agriculture, independantly organized into autonomous decision making units, had prevailed. New technologies in production made it possible to separate out the routine, repetitive jobs so that they could be centrally supervised and efficiently performed by relatively unskilled labor. Skilled management could thus be spread widely over the firm while less skilled managers took care of individual production or processing tasks (Anonymous, 1966). This separation of skilled and unskilled managerial functions in egg production led to horizontal integration, which is the replication of production units at the same stage of production (Mighell and Jones, 1963).

Because of the competitive nature of the egg industry, new efficiencies have had to be continually introduced into the system. Efficiencies associated with horizontal integration were somewhat limited and firms in the egg production business had to expand into other areas of the market channel in order to achieve a greater number of efficiencies.

Vertical coordination is the forward or backward movement, in the market channel, of a firm in order to gain some cost advantages in production or marketing. Vertical

integration is a form of vertical coordination, but is characterized by the degree of control. A vertically integrated firm has a great deal of control over its supplies and/or its markets because of the fact that it owns them or maintains a strong contractual or managerial arrangement with them (Nelson et al., 1973). The increased effectiveness of the firm's performance comes as a result of increased economies of size or of the control of more market variables (Jones and Smalley, 1966). An egg producing firm which has reaped the benefits of integrating horizontally can become a more effective competitor by moving backward in the market channel into feed production and/or pullet production, or forward in the market channel into the processing, wholesaling, and retailing of eggs.

1.2 Increase in Amount and Types of Information

As a result of integration in the egg industry, firms have become larger and much more complex. This complexity has brought about the need for a great deal of timely, clearly set forth information to aid in the firm's decision making. In years past, before the onslaught of integration, one person could directly oversee the management of the whole system with which he was involved. Now, with the entire system typically encompassing several stages of the market channel, it is not within the abilities of one person

to remain completely in control of all of the firm.

To maintain control of the entire system, the scope and timeliness of information moving between one area of the firm and another has become crucial. Fast and accurate flows of information enhance the decision making process.Barriers to fast and accurate flows of information should be at a minimum to achieve a well managed integrated shell egg producing firm.

1.3 Computer as a Tool in Making Decisions

A computer can be an important tool in facilitating the accumulation and flow of information within the firm. The potential role of the computer has changed from that of a large adding machine used almost exclusively for keeping accounting records to that of a very viable tool in aiding managers in the decision making process.

Since the mid 1970's, the development of micro processor technology has put the purchase and operation of a computer within the grasp of even the smallest firm. These "microcomputers" have become increasingly powerful as well as less expensive (per unit of memory) and now can become an integral part of the firm's decision making team.

Whereas the availability of computers to take part in the decision making process has increased, the availability of computer software to aid in decision making has lagged, somewhat. Prior to the introduction of microcomputer

technology, computer usage by poultry businesses had often been limited to financial record keeping by the firm's accountant, in a time sharing mode of operation, or to the use of simulation-type programs provided by Land Grant universities. With the advent of the new small computers, software will have to be designed which will allow the small computer to become an essential tool for the firm's decision making team.

1.4 Objectives

Since modern day egg producing firms are becoming even more complex, a study of the decision making process at each level of firm management can aid scientists and university extension specialists in identifying the needs and problems of managers. Therefore, an objective of this dissertation will be to identify the kinds of decisions which must be made at each level of an integrated egg production firm.

Effective decision making relies heavily on the flows and types of information available to the decision maker. For this reason, a second objective of this dissertation will be to identify the types and flows of information needed to make each of the types of decisions, at each management level of the firm.

Once the types and flows of information needed in the decision making process are defined, then scientists can

find ways to encourage and enhance them. One way of aiding the flow of information to the decision maker is with the help of the computer. Since new technology has brought about the possibility of many new uses for the computer, a last objective of this dissertation will be to identify the possible uses of the small computer in the decision making process.

CHAPTER 2

Review of Literature

This review of literature will be presented in three sections, each of which is related to one of the three objectives of this dissertation. The first section of the Review of Literature pertains to decision making. Whereas there are several works to be cited, they are for the most part from texts pertaining to decision making rather than from scientific articles. Citations are more definition oriented than are they to report the result of a particular study.

The second section of the review of literature deals with information systems. This section is similar to the section on decision making in that most of the citations define the author's concept of an information system rather than describe the results of a particular study. Although there is a great deal of textual material dealing with either of these subjects, scientific literature (literature describing the results of a particular study) pertaining to either of them is lacking.

The third section of the review of literature deals

with computer uses in agribusiness. Much of the literature cited describes past applications, when computer usage in agriculture usually took the form of farm business simulations run on a large mainframe computer by the state agricultural extension service. Present and future trends in farm computer applications are also presented.

Note that for the purposes of this dissertation, wherever the word "farm" is used, the word "firm" could just as well be used. The converse is also true.

2.1 Decision Making

Decision making, as defined by Tosi and Carroll (1976), is the act of choosing among alternatives. Decision making is just one aspect of problem solving. The four steps to problem solving are problem recognition, identification of probable causes, generation of alternative solutions, and deciding upon and implementing the chosen altenatives. Tosi and Carroll state that the function of a manager is to recognize a problem and make a decision. To do this, the manager must know what the situation is like at the current time, and what the situation should be like.

Johnson (1963) states that there are five steps in problem solving. They are: observation, analysis, decision making, action, and responsibility bearing.

According to O'Connor (1973), there are five steps to

the management process. These are: observation, analysis, decision making, action taking, and acceptance of responsibility. Decision making is the most important of these managerial functions, but is not complete until action is taken. It is in the action taking stage that most managers fail.

The decision maker must define the problem very carefully. Failure of the decision maker to make the correct decision often stems from poor problem formulation due to the conditions of imperfect knowlege under which the decision maker must work. The decision maker should carefully obtain as much relevant information as possible in defining and stating a specific problem which must be solved.

Many people equate management with decision making (Wills, 1973). Decision making is actually part of the management process. Wills places five steps within the management process. They are: define the problem, assemble data pertinent to developing the solution, consideration of various alternatives, data analysis and decision making, and living with the decision.

In Managerial Decision Making, Morrell (1960) states that decision making is the heart and core of administration. It is the key to business success and to the job of the manager. Decision making can only be as good

as the process used to reach it.

The decision making process includes four stages (Morrell). The first stage is the stage of uncertainty, when problem formulation takes place. The second stage is the stage of analysis and definition, when relavent facts are discovered. The third stage is the stage of proposal of alternative plans of action. The fourth stage is the stage of verification, which is the period of uncertainty prior to setting the decision into process when the decision maker wonders if all the facts collected during stage number two are correct.

Newman (1971) defines decision making as a process that includes: recognition of a situation that calls for a decision, identification and development of alternative courses of action, evaluation of alternatives, choice of an alternative, and implementation of a selected course of action. The choice of an alternative would be the actual act of decision making, in this process.

In their book on decision making and management for the farm and home, Malone and Malone (1958) define the decision making process as a series of five steps. These steps are: problem definition, data gathering and analysis, formulation of choices, making a decision, and taking action. Decision making, itself, is the process by which one choice is selected from among those that are available, and is the

heart of management.

The Malones say that in decision making there are four main ideas which farm family members should keep in mind. The first idea is that there is a need for a system to follow which will be flexible enough to suit the family. The second idea is that there is a need to understand the process by which good decisions are made. Related to this is the third idea: that there is a need to understand and be able to use the fundamental principles that influence the making of good decisions. The fourth idea is that there is a need to understand the role each individual in the family group plays and the way each member of the family group functions in the decision making process. Keep in mind that where the Malones talk about the farm family, we should be able to substitute in the idea of the firm.

According to the Malones, all decisions affecting the farm family fall into four decision groups. Price/market decisions are those dealing with the purchase of production inputs or the sale of the product of the farm family's labor. The second group of decisions is that which deals with the adoption of new methods or practices. Decisions dealing with individuals outside the farm family circle make up the third decision group. The fourth, and last, decision group is that which deals with decisions within the farm family circle. Again, the word "firm" can be substituted

for "farm family", for the purposes of this dissertation.

Kepner and Tregoe (1965) see the problem solving process as a three part proposition. The process starts with problem identification, moves on to analysis of the problem, and ends with the act of making a decision. The problem solver must select the deviations from the norm upon which to work. If the cause of the problem is known, the problem solver can directly make a decision. If the cause of the problem is unknown, then the problem solver must systematically gather and evaluate the information necessary to indentify the cause of the problem.

This gathering of information pertinent to identifying the problem involves four steps. First, the deviation must be described by asking, "What is...what is not; where is...where is not; and when is...when is not?" The second step looks for distinctions between "is" and "is not". Next, the problem solver must look for possible causes for the deviation. Fourth, the problem solver must test for the probable cause of the problem. Managerial ineffectiveness in problem solving is usually the result of failure to correctly identify the causes of the problem. This failure to correctly identify the cause of the problem is the result of a failure to obtain, to use, and to process, systematically, the necessary information.

The decision maker must choose one of three possible

courses of action in correcting a problem. Interim action results in a temporary solution which gives the decision maker time to determine the cause of the problem. Corrective action eliminates the cause of the problem. Adaptive action changes the environment such that the problem can exist with no disrupting influence on the system.

Bentz and Hinton (1964) categorize decisions as either short, intermediate, or long range. Short range decisions are day to day general flock management decisions. Intermediate range decisions deal with the operation of the system for as long as two or three flock production cycles. Such decisions as the length of time to keep a particular flock in production or the brand of feed the farmer purchases fall within this category. Short and intermediate range decisions tend to keep managers busy. These types of decisions make up the vast majority of all the decisions with which the manager must be concerned. Long range decisions are usually "one-shot" and either cannot be changed or cannot be changed quickly without having ill effects on the financial position of the firm. Flock size is a long range decision. Once this decision has been made, and the house built, it cannot readily be changed until the house, or equipment within the house, is replaced.

To be of value, say Bentz and Hinton, decisions must be

based on expected returns and expected expenses. This can be difficult with short range decisions since they tend to deal with day to day operations within the firm. Intermediate range decisions, on the other hand, are often issued specifically in regard to the measurement of costs and returns. Long range decisions usually are made in response to expectations of the relationship of total cost to total revenue.

Heinzelmann and Bender (1975) discuss three types of decision making within integrated broiler firms. Strategic (long range) decisions on the inputs, outputs, and facilities of the firm are all considered to be variable. They are concerned with setting the firm's objectives, changing those objectives, and the development of policies for the acquisition, use, and disposition of facilities.

Tactical (short range) decisions can change the volume of production but not the physical size of the plant. These decisions are concerned with planning and adjusting the level of output according to seasonal variations in demand.

Operational decisions are suboptimal and concerned with the day to day operations for sustaining and coordinating the work flow for a fixed volume of production. This level of decision making is primarily concerned with control, making sure that each function has carried out its mission successfully.

Heinzelmann and Bender introduce the computer into decision making. They say that the computer will induce rationalization and quantification of the decision making process leading to programming all or portions of the process. Second, closely related independant decision processes tend to consolidate into integrated decision processes. This causes the boundaries of decisions to become broader, reversing the organizational concept of the division of labor. Third, broadening the scope of a decision tends to push the decision to higher levels of management. This upward push in decision making creates new activities, particularly in the middle management level, expanding the scope and comprehension of middle management jobs. Finally, when computers induce integration of decision processes, but decision points remain unchanged, decision making becomes group oriented. That is, the overlapping effect causes the need for increased coordination between managers.

Brady (1967) did a study to determine whether or not the use of computers has changed the manner, form, or content of top level management decision making. He concludes that the computer has not had much impact on the procedure of decision making, itself. Computer usage, however, has resulted in increased time to make decisions,

and more alternatives to consider. Because of computer usage, decision makers can now make some decisions at an earlier date, gain time in which to consider some decisions, consider more thorough analyses of some situations, review several courses of action before deciding, examine analyses of the impact that recommended courses of action will have on the problem, and obtain additional detailed information. The computer has not changed the decision making process itself, but is has taken on some of the work.

In a paper on planning for commercial egg production, Sheppard and Ridlen (1977) list some typical management decisions that must be made in planning a commercial egg producing firm. First the firm must decide whether or not it should go into the egg producing business. If the firm does decide to do so, it must then decide on where production should take place. Then the firm must decide on the type and size of house and equipment to buy. The next decision should concern the strain of pullets to use and whether to buy them ready to lay or at day old. The kind of feed to use and whether to buy it whole or mix it at the farm also must be decided upon. How and where to market the eggs is another important question which must be answered. The poultryman must also decide upon a vaccination schedule. Another important question which is often overlooked in planning for commercial egg production, is the method of

waste disposal.

All of the authors cited seem to agree that the decision making process is a multistep proposition. Whereas the authors may have combined steps together, in some cases, the decision making process encompasses problem realization, problem identification, alternative solution formulation, alternative solution evaluation, decision making (alternative solution selection), action taking (solution implementation), and solution evaluation. Several of the authors take decision making a further step by categorizing the type of decisions which must be made within the firm as either long range (strategic), which affect the firm for an extended period of time and, if made, are very difficult to change, without adversely affecting the firm; short to medium range (tactical), which affect the firm for a period of from several days to several production cycles; and very short range (operational), which must be made on a daily basis.

2.2 Information Systems

A management information system provides information for management decision making (Mason, 1975). If the quality of the information provided is poor, the decision will be poor also. This is true to such an extent that improving the

quality of decisions within a firm generally comes as a result of increasing the efficiency of flows of data.

Mason talks of two approaches to studying management information systems. The first is to study and refine existing data flows. The second approach analyzes management decision problems and breaks them down into essential elements. By doing this, parameters may be set for each variable which serve to specify information requests at each stage.

There are five components to the management information/decision making system. The first component is the source of activities and objects related to the business. The second component is data, which is observed and measured from the source. The drawing of inferences and predictions from the data collected makes up the next component. Evaluation of these inferences with regard to the values of the organization and the choosing of a course of action makes up the fourth component. The fifth, and last, component of the management information-decision making system is the actual taking of a course of action.

Another view of a management information/decision making system (Gallagher, 1961) states that external information added to a manager's own ideas and experiences leads to a plan of action, which leads to a decision, which leads to a directive for the implementation of the plan. For good

management decision making, the flow of external information must be accurate, adequate,and swift. Often, businesses are too complex for these ideal conditions of information flow to exist. A firm, therefore, should work to minimize the barriers to information flows such that the ultimate goal of an effective management information system can be to keep all levels of management completely informed on all developments in the business which affect them.

Because of three basic processes, if the information flow within a firm improves, the management decision making process will also improve. The first process by which management decision processes improve is due to the increase in quantity and quality of information pertinent to the decision. Secondly, decision making will also be based on the evaluation of a wider range of alternatives and of current factual data, rather than of intuition and extrapolation of historical data. Last, the impact of a decision in one functional area on other functional elements of a business will be more easily measured and a more comprehensive view of the business can be taken.

According to Gallagher, the computer can be a very useful tool in aiding the flow of information within the firm. This usefulness comes chiefly through the orderly and swift preparation of information for managerial planning and control. When a firm becomes so complex that it is

continually faced with extremely varied problems which require large amounts of information, a computer may be installed to prepare reports and solve problems.

Heinzelmann and Bender (1975) state that adapting the computer to perform the same tasks as previously had been accomplished by manual means will have little effect on decision making, except to improve the accuracy and timeliness of information. However, when the patterns of information flow are redefined and the decision processes are integrated, the capabilities of the computer can be exploited and further organizational changes induced (redefining information flows, itself, is an organizational change).

Crampon and Schweizer (1961) looked at the informational needs and problems of small businessmen. They concluded that, overall, small business use of management information is generally inadequate. There is inadequate use of the information available, small businessmen have inadequate knowlege of their own problems, there is inadequate knowlege of the existance of information which might assist in the solution of problems, and there is an inadequate understanding of the potential value and place of information in the total business picture.

Crampon and Schweizer concluded that it appears that if small businessmen are to be helped to any major extent, in

regards to management information, they must first be convinced of the existence of a problem, second they must be convinced that assistance is available, and third they must be taught to make proper use of the information itself.

Riemenschneider (1978) says that in agriculture, information systems are designed to help decision makers make decisions to solve problems that arise at the farm, farm industry, or at the national economy level. He suggests that any theory of information should focus on problem solving. In problem solving, the information gathered is the result of some basic process of inquiry. There are three steps to this data collection. The first is conceptualization of information, the second is operationalization of the concept, and the third is actual measurement.

In farm management, collection and analysis of farm records are essential preliminaries to an appraisal of technical and managerial efficiency (Clayton, 1967). This appraisal is preliminary to remedying deficiencies prior to farm planning. Records and analysis are again required to assess the effects upon farm income of any adjustments made.

Bentz and Hinton (1964) also talk of the uses of farm records. They say that records such as daily mortality, daily production, daily feed intake, daily water consumption and daily temperature variation are all examples of records

that poultrymen should use. They say that most records of this type aid in intermediate range decision making. These records are the diagnostic tools of management, and are used to evaluate overall business success, trace the sources of the strengths or weaknesses of the firm, and guide day to day operations of the business.

Purcell (1969) developed a conceptual basis for examining the effectiveness of information patterns in the beef marketing system. His interpretation of the information system for beef marketing is more related to a communication system. He identifies barriers to effective communication within the beef marketing system. Purcell states that any communication system entails a source, channel and receiver. The differences between communication systems lie in the channel of communication.

Purcell says that for effective communication the source must understand the needs of the receivers, and since needs change, this understanding must be constantly updated. For the source to realize that a change is needed, feedback loops must be present and functioning. The receiver must have adequate means of returning his reactions to a message back to the source. Each participant in the communication system must recognize the importance of the operating environment as a determinant of role conception and performance. Habitual action, within the communication

system, must be avoided. Each party of the communication process must recognize that symbols, not meanings, are transferred.

The information needed by problem solvers for their decision making tasks should be timely, of good quality (descriptive and broad enough that decisions can be made, given its usage), and pertinent to the problem area. If the problem solver cannot utilize the information which has been gathered, then the decision maker will have to go in search of additional information, and hope that this additional information will be of use.

2.3 Computer Usage

Many of the early uses of computers in agriculture were of the form of systems simulation models. A systems simulation has two distinct operations (Dent and Anderson, 1971). First, there must take place the development or synthesis of a model that adequately represents the system under study. Second, the simulation allows the examination of the behavior of the model in reaction to changes. The systems simulation has been a viable tool in studying agricultural systems at many different levels, from a particular animal to the agricultural subsector as a whole.

Manetsch (1970) sees simulation as a repetitive problem solving process involving problem formulation, mathematical

modeling, computer implementated solutions of resulting models, and creative design and execution of simulation experiments which provide answers to the questions posed. Output of a simulation is usually a set of plans and/or management strategies which, in some sense, will result in good or better system performance.

In deciding whether of not to go ahead with the construction of a simulation model, several things must be considered (Manetsch). The first consideration concerns the expected payoffs from successful implementation of the model. The second consideration is whether or not it is possible and/or economically feasible to acquire the information necessary for model construction. Next, the possibility of bringing together decision makers, economists, and systems analysts in a viable team effort must be considered. The last consideration is whether or not it is politically or economically feasible to implement the results of the analysis.

The systems simulation serves as an important tool in the teaching of farm management (Connor, 1970; Vincent, 1970b). The simulation is essentially an extension of the case study approach to learning, which has long been part of the educational process. The simulation is of particular use in helping the student gain experience in such areas as decision making and observing the consequences of

alternative decisions. The "gaming" which can be played through the use of a simulation closely approximates real world decision making.

Candler (1970) discusses the potential use of computers as an aid in farm planning. He states that using the computer to aid with repetitive real life farm management decisions is very different from using the computer to solve one time research problems about the management of farms.

Candler also states that computer programs should be such that data can be put in the form most convenient to the farmer and that the results of the program should be reported in a form which will be the most easily understood by the farmer and/or his immediate advisors. There are three reasons for this. First, the farmer must "trust" the computer to some extent, the more familiar are the numbers going into the program, the more trust will the farmer have in the numbers coming out. Next, the machine, once programmed, is much more efficient at manipulating data than is the farmer (farm manager). Last, infrequent users of computer programs are unlikely to be able to enter data in the right spot, unless they have clearly defined data forms to use.

Vincent (1970a) outlines some of the assumptions which had to be made in building a simulation for problem solving in the poultry industry. He had to assume that the industry

structure would be changing such that the actions of those in a position to exert power (feed manufacturers, hatcherymen, etc.) would more nearly explain the future state of the poultry industry than would historical phenomena, or the plans of those now counted as poultry producers. He had to assume that even if the total system could be identified, many important subsystems would have to be ignored or treated as exogenous in order to select a set of subsystems which could receive more intensive treatment. It had to be assumed that the model could never be complete since it would be subject to modification with improved information. It was assumed that even if the simulation could answer questions on how the industry "does" or "might" behave, the model could still not answer questions of how the industry "will" or "should" behave.

Other authors have written about computer usage in agriculture. Candler et al. (1970) write that the use of computers in agriculture has been limited because computer programs that are almost ideal for the solution of research problems are almost totally useless to extension workers attempting to help farmers solve similar problems on a day to day basis. The major reason for the difference in software requirements between research and extension is the difference in types of questions asked. To adequately solve extension problems, software must have the characteristics

of clarity, speed and reliability.

Erickson et al. (1971) say that the high cost, in money and time, of computer service had been the main reason for the comparatively minimal use of the computer as a management tool in farm business planning. The authors developed a single period linear programming model and sequential cash flow projection program for farm decision making. The major limitations of the program were the problem of incorporating sufficient detail and individuality into each farm business model.

Harsh (1970) used a computer/ touch tone telephone/ audio response data concentration unit system for farm level problem solving. The touch tone phone was used as a remote input/output terminal. The low cost of the touch tone telephone made it a greater asset for field operation than did its liability as a limited input/output device.

There were several reasons for using a remotely accessed computer rather than making the farmer send in his data through the mail. First, this system was expedient, Second, farmers had to supply all critical information; information could not be discounted because it was time consuming or difficult to obtain. Third, since the farmer had to input data and received the results immediately, he felt "closer" to the analysis and (fourth) had more confidence in the results. Fifth, by using computer models

the farmer was able to undertake complex or time consuming analyses. Last, the computer was reliable; errors were reduced.

Harsh also listed several disadvantages. First, software design is expensive. The types of problems on which a computer analysis can be obtained are limited to those problems which are repeatedly faced by large numbers of farmers. Second, it is difficult to define problems and design a model such that farmers can understand and supply data, and interpret the results. Third, the farmer is faced with the problem of identifying errors.

Huffman and Carville (1965) write of a computer program designed to assist farmers in keeping accurate and useful records in the management of the farm business and to provide accurate and timely farm business information. The emphasis of the program was on teaching farmers to keep records which are useful for making management decisions and teaching them to use records in evaluating their farm business.

In a paper on alternative systems for trading shell eggs, Schrader et al. (1968) developed a computerized egg trading system and evaluated its feasibility as an alternative to the then present egg trading and pricing methods. The computerized egg trading system was designed to provide for centralized ownership transfer while the

actual physical movement of eggs was direct from the seller to the buyer by the lowest cost means. The major advantage to this system was the potential for expanded exposure given to bids and offers.

Holder (1970) looked at the feasibility of a computerized forward contract market for slaughter hogs. The study had three objectives, first to identify the market coordination problems of hog producers and packers; second, to design a computerized forward contract market capable of alleviating the coordination problems identified; and third, to evaluate the economic feasibility of such a market by comparing it with the alternatives currently in use. The computerized forward contract system used a computer link similar to that described by Schrader et al. (1968).

Dale (1974) described a computerized prediction model for egg production management decisions. The model was developed to test the hypothesis that egg production, egg size, and mortality could be predicted, and, if the hypothesis was true, if the prediction equations could be incorporated into a dynamic simulation model to aid farm managers in their flock replacement decisions. The simulation model developed performed very satisfactorily. Dale states that like any other forecasting and planning tool, the results obtained, compared to actual results, were only as good as the input data.

Jacobs (1978) developed a computer simulation model to project future receipts and expenses for egg production complexes. The model was designed to be used as a tool in the decision making process and was built to be used when changes in variables dictated. The model was designed to be used for making projections with respect to egg production parameters.

Rahn (1978) writes of a capital expenditure analysis program which can be used to look at the financial attractiveness of an investment. By varying equity financing percentages, interest rates, depreciation schedules, and income tax rates, a potential investor can use the program to see whether or not an investment is attractive, or under which combination of variables the project makes the most sense.

From the private sector, several companies have tried to provide computerized flock management programs to poultry producers. All three systems mentioned here have relied on incoming data from client firms, have run the data on main frame computers, and then have returned the output to the client firms. Agrimetrics Associates (Anonymous, 1981a) has 15 years of experience in measuring the "efficiency" of the poultry industry. They have done this through improving management information systems so that firms can monitor day to day operations.

In 1975, Chilson's Management Controls, Inc. (Anonymous, 1982a) began a service to run flock management records, provided by clients, on an in-house computer. The output generated provided producers with flock, company, and national comparisons. The national comparisons were based on the data of all of Chilson's clients.

Recent rapid advancement in technology has opened up small businesses to the use of computers. Five years ago the microcomputer industry did not exist. Now there is an installed base of over one million of these personal computers, and the forecast projects a growth rate of as much as 50 percent per year for the next decade (Ditlea and Tangorra, 1982). Sales of software for these small computers totaled about 500 million dollars in 1981 and is expected to range between one and five billion dollars per year by 1985 (Ditlea and Tangorra, 1982) and could increase to as much as 20 billion dollars per year by 1990 (Alsop, 1982).

Hughes (1981) mentions a study which indicates that as high as 64 percent of beef producers interviewed were planning on buying a microcomputer within the next five years, and 27 percent said they will purchase a computer in one to two years.

Beef producers ranked business record keeping as the number one management function which they wanted the

microcomputer to perform. Hughes mentions a study from Alberta, Canada of beef producers owning microcomputers which stated that the main uses for microcomputers were farm planning, financial record keeping, physical record keeping, and analysis of farm records.

Hughes lists six steps the prospective purchaser should take in buying a microcomputer. First, study management information needs. Collection and analysis of management information requires time and money and the buyer cannot afford to collect management information that he does not use or need. Second, the purchaser needs to identify available software that might meet his management information needs. Third, the purchaser needs to determine the hardware specifications required to execute the needed software. Next, local hardware dealers should be contacted who can make the purchaser aware of the viable hardware alternatives. Fifth, estimate the cost/benefit ratio of the proposed computerized management information system. Last, make the decision to set up or not to set up the computerized management information system.

Andre (1981) says that in the near future cattlemen are likely to consider their microcomputer as the most valuable production tool they own because of the help provided in making management decisions vital to the success of the agricultural enterprise. The microcomputer can do nothing

that cannot be done with a hand held calculator, but it can do it faster. Even with this, says Andre, time savings is not the big advantage in having a microcomputer, the advantage comes in the reports generated that will tell exactly the state of the firm and help the firm make a decision.

Andre says that the largest problem with microcomputer use is in the area of software development. Good software development with extensive data bases is extremely expensive. In software development, the priority should be on a program that an inexperienced person can run, and on a program that is written in such a way so as not to be confusing.

Hinman and Willet (1981) say that the feature of microcomputers which will most strongly attract farmers is the ability to store and process farm records. Farmers have a high appreciation for the role of records in improving control over their businesses. The authors feel that the most intensive operations will find that the greatest benefit from using computers will be to analyse day-to-day problems.

Hinman and Willet list three things at which the farmer must look prior to making the computer purchasing decision. First, the farmer needs to decide what he wants the computer to accomplish for him. Second, he needs to look at the

availability of software which is useable to him. Third, the farmer needs to look at the availability and usefulness of microcomputer hardware.

Processing of dairy herd records on the computer over the last 20 years has resulted in a wealth of information to help with herd management, breeding, and nutrition (Bath, 1980). Programs utilized for more efficient feed formulation are the most recent programs to be developed for dairy farm usage. When properly used, these programs can result in significant increases in income above feed costs from the dairy herd.

Smith (1980) says that dairy records have been computerized for about 25 years. Because of the increasing accessibility to computers by individual dairy farmers, computers will play a greater role in the decision making process. Smith says that increased attention is being given to computerized dairy management because new technology has provided necessary instrumentation, the cost of computer usage is declining at the same time that herd size is rising, the computer can serve to extend the memory of the manager, and that computer usage can be extended to farm financial accounting.

In an article on on-farm computer usage (Anonymous, 1981b), Wisconsin dairy farmers tell that they incorporated a microcomputer into their operation to help make themselves

more sophisticated financial and herd managers. Their uses for the microcomputer are many and include: general ledger accounting, gross income and expense statements, enterprise accounting, depreciation schedule maintenance, inventory of current assets, budgeting, balance sheet, herd health records, production information, and as an aid in making financial decisions. These dairy farmers believe that the greatest advantages of having the operation's accounting system computerized are the savings of time and that the accounts are presented in a neat, detailed fashion. In making decisions, with the aid of the computer, the farmers feel that the biggest help comes from the speed with which the computer runs. If you are not satisfied with the results of the output of a decision making program you can quickly rerun the program with new data and "fine tune" the decision.

Chapter 3

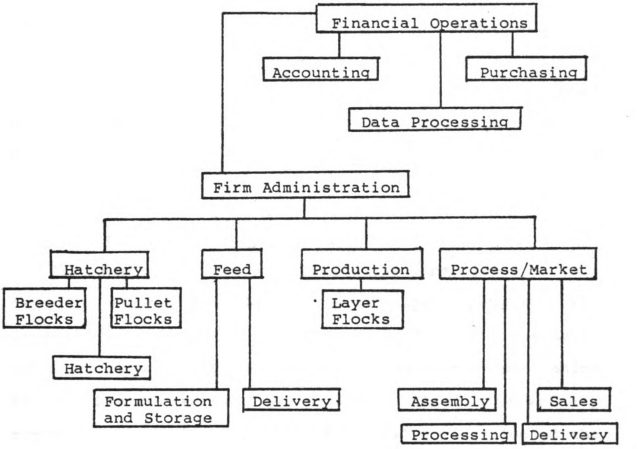
The Integrated Shell Egg Producing Firm, Firm Decision Making, and Computers and Software Design

This section deals with the definition and identification of the entities which will be integrated in the discussion chapter of this dissertation. The first part of this chapter defines the different parts of the integrated egg production firm and identifies the decision makers at each level of the firm. The second section looks at the decision making/problem solving process and identifies the types of decisions which must be made at each level of the firm. In the last section of this chapter, a look is taken at areas in which the computer can assist in the decision making process, and at the types and design of software.

3.1 An Integrated Shell Egg Producing Firm

An integrated egg producing firm consists of administration, financial operations, hatchery operations, feed production, egg production, and egg processing/marketing (Figure 1). Each of these units can be broken down into subunits based on the functions performed. For example, the hatchery operation can be broken down into breeder flocks, the pullet rearing operation, and into the

Figure 1. Firm Structure of an Integrated Shell Egg Producing Firm.



hatchery operation itself. The number of functional subunits will be dependant on the needs, size, and plans of the firm. For example, if the firm has access to a ready supply of hatching eggs and/or if the firm is relatively small, the breeder flock subunit may be done away with.

Since each unit of the integrated egg production firm has a unique function, each unit can be discussed separately. Because the decision makers are an integral part of each of the units of the firm, they will also be identified at this time.

3.1.1 Firm Administration

Firm administration consists of the upper level of firm decision makers and their direct support people. The general manager of the firm is at the head of this unit. Decisions made in this unit generally affect the functioning of the firm for an extended period of time. The primary function of this level is the general administration of the firm. This includes overseeing and coordinating the functions of each of the various units from which the firm is formed.

3.1.2 Financial Operations

The financial operations unit of the firm is concerned with the actual flows of revenues in and out of the firm. Subunits contained within financial operations include

accounting, data processing, and purchasing. Each of these subunits may have its own manager. Each of these managers will work closely with the other two in order to keep track of the firm's financial and operating numbers. Each section of the financial operations unit of the firm must work closely with all other units of the firm for the smooth, unobstructed transfer of information.

3.1.3 Hatchery Operations

Hatchery operations are made up of three basic subunits. These subunits consist of breeder flocks, the hatchery unit, and pullet rearing. Breeder flocks supply eggs to the hatching unit for the production of pullets. The function of the hatching unit is to gather, sort, incubate, and hatch the eggs. Procedures such as sexing, debeaking, dubbing, and Marek's disease vaccination are part of the hatchery's duties. Pullet rearing takes the young pullets from the hatchery to sexual maturity when they are ready to be moved to egg production units.

Note that except in a very large firm the hatchery operation (especially along with breeder flocks) will probably not exist. Generally the firm moves into pullet growing as a means of reducing its costs, but purchases the day old chicks.

3.1.4 Feed Production

The feed production facility has two functions. The first function of the feed production unit is the manufacturing offeed and the storage of feedstuffs. The second function of this unit of the firm is feed delivery. Because of the large number of different types of flocks (breeder, pullet, and layer), each requiring a different type of feed, the feed production facility must work closely with both the hatchery unit and with the egg production unit.

3.1.5 Egg Production

Egg production facilities take care of the production of eggs which are channeled to the processing facilities. The egg producing unit of the firm consists of some central unit headed by the general manager in charge of production, and the individual production units, consisting of either flocks or complexes, also headed by managers who oversee production.

3.1.6 Egg Processing and Marketing

The firm's egg processing and marketing division should consist of four subunits, each of which is based upon the function which is performed by that subunit. The four subunits are egg assembly, egg processing, egg sales, and egg delivery. The organization of egg assembly and processing has the potential to vary greatly from firm to

firm. In an integrated shell egg producing firm in which production and processing are located in one large complex, the assembly function may be very small and will be absorbed directly into the processing facility.

The egg processing facility puts the shell eggs in some final form from which the eggs will be consumed. For general consumption, this final form will probably be sized and cartoned in some fairly standard package which will facilitate the movement of the eggs to market, and the final purchase by the consumer.

The egg sales subunit of the firm is in charge of locating markets which will purchase the eggs produced by the firm. This subunit's egg sales will be controlled by the sales manager. Sales will be done by the firm's sales force.

The subunit in charge of egg delivery must make sure that the eggs reach their final destination promptly and in good quality. The manager in charge of this area of the firm must not only oversee the scheduling of deliveries but also must make sure that trucks are in good mechanical repair. Another duty of the manager of this area will be to act upon the complaints and suggestions received from the customers with which the firm deals.

3.2 Decision Making and Problem Solving

Several of the authors cited in the Review of Literature section of this dissertation use the terms decision making and problem solving almost interchangeably. In actuality, decision making is a single step in the whole chain of steps which constitute the problem solving process. This section of the dissertation sets out to define the problem solving process and look at the flows of information between each of the steps of this process. Since there are several different types of decisions to be made by managers within different areas of the firm, this section will also identify those types of decisions and the managers within the firm who must make each type of decision.

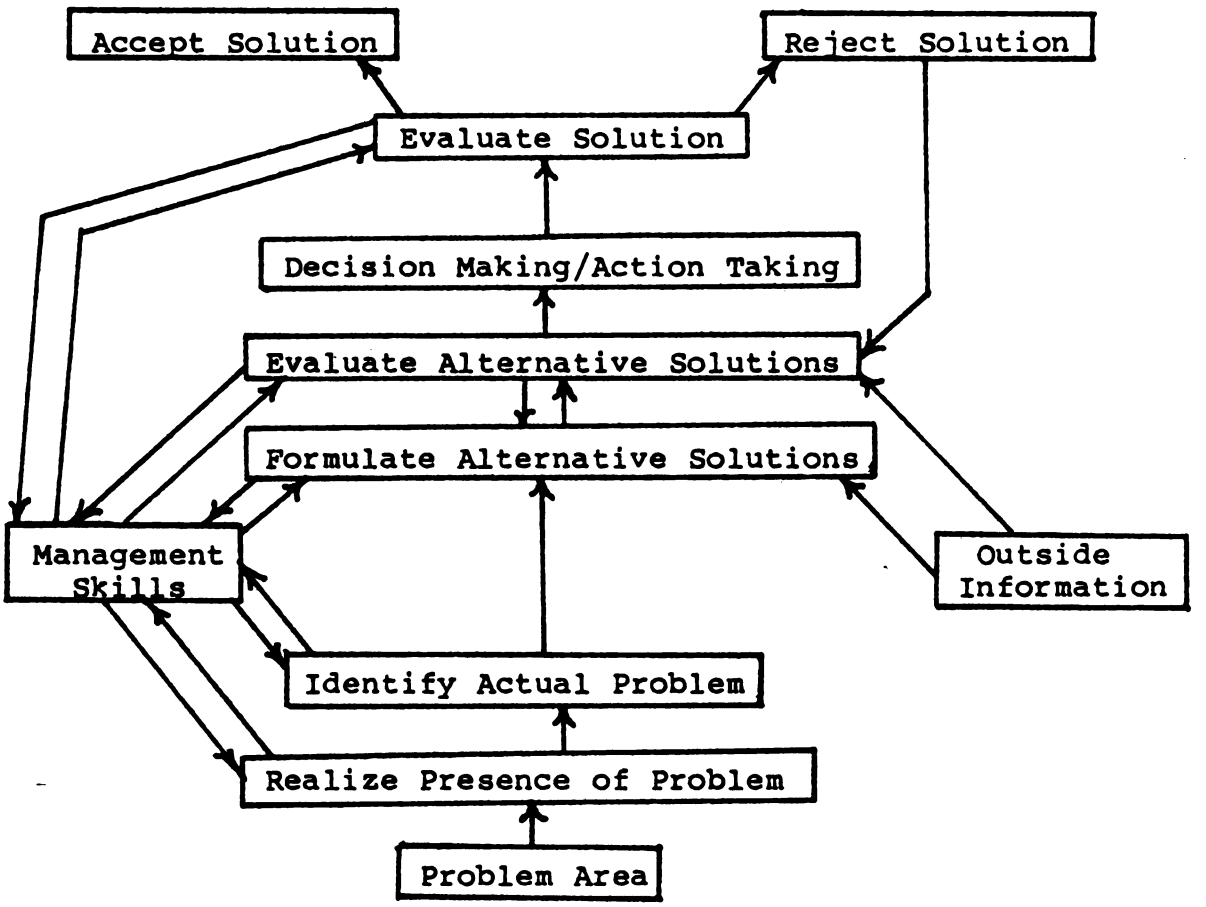
3.2.1 The Decision Making/Problem Solving Process

3.2.1.1 Problem Area

The first step in the problem solving process (Figure 2) is the problem area, itself. If there is no problem area, there is no problem to be solved, and the problem solving process need not be put into motion

The problem area in an integrated poultry firm can cover a complete spectrum from something as insignificant as a dripping waterer to the problem of meeting the firm's demand for eggs several years in the future. The problem area, itself, varies by decision maker in the firm, and will be covered in depth in the next chapter of the dissertation.

Figure 2. The Decision Making/Problem Solving Process With Information Flows Between Steps.



3.2.1.2 Problem Realization

The problem area may exist, but until the presence of the problem is realized, nothing can be done in order to rectify the problem. A flow of information must exist between the problem area and realization of the presence of the problem. A flow of information from the store of management skills of the decision maker allows perception of the presence of the problem. If the problem is different from what has been previously seen by the decision maker, a flow of information will also go back to the store of management skills, updating what the decision maker had previously known to be true.

3.2.1.3 Problem Identification

Once the problem solver has realized the presence of the problem, the actual problem, itself, must be identified. For example, if a flock manager recognizes the existence of wet manure (realizes that a problem exists), the next step is to identify the actual problem itself. In this case, the actual problem could be a leaking waterer, too little ventilation, high in house temperatures causing overconsumption of water, etc.

Information flows come from the previous step in the problem solving process, allowing the problem solver to realize the presence of the problem and to identify the actual problem itself. The problem solver must rely on a

flow of information from his store of management skills to aid in the identification of the problem. A flow of information also goes back to his store of management skills to update the information stored there.

3.2.1.4 Alternative Solution Formulation

After the actual problem has been identified, the problem solver must formulate several alternative solutions to rectify the problem. In our example set forth in the previous step, if the problem solver has identified the problem as a leaking waterer, possible alternative solutions may be to replace the leaking waterer, replace the entire watering system for the house, or to do nothing at all.

The problem solver relies on a flow of information from the previous step in the problem solving process to bring to him the identity of the problem. Next, in formulating alternative solutions, the problem solver must rely on flows of information from the problem solver's own store of management skills, on information from other parts of the firm, and on information from outside of the firm itself. The problem solver's degree of reliance upon information from any one of these sources is dependant on the problem itself. Some problems may be solved with a total reliance on the decision maker's store of management skills, while others may rely very heavily on information from

outside of the firm.

3.2.1.5 Alternative Solution Evaluation

Each of the alternative solutions must be evaluated before the problem solver can make a decision as to how to rectify the problem. The first information flow comes from the previous step in the process, which formulates the alternative solutions. The next information flows are inward and bring information in from the outside, and from the problem solver's store of management skills in order to evaluate the alternative solutions. If the problem solver feels that the alternative solutions are inadequate, reverting to the solution formulation step of the problem solving process to formulate more alternatives is possible. The last flow of information will be one which will update the problem solver's management skills.

3.2.1.6 Decision Making/Action Taking

Decision making, itself, is the simple act of picking the best of the alternative solutions evaluated in the previous step. The sole information flow comes into the decision making step from the step which evaluates the alternatives. The decision maker in our example concerning the leaking waterer has to choose the best possible alternative of replacing the leaking waterer, replacing the entire watering system, or doing nothing at all. Once a

decision has been made, some form of action must be taken to instigate the chosen alternative.

3.2.1.7 Solution Evaluation

Once a decision has been made and some form of action taken, the problem solver must evaluate the effectiveness of the solution in solving the problem. Flows of information in this step of the problem solving process consist of a flow of information from the decision making/action taking step and a flow from the store of management skills. The flow of information from the store of management skills would be made up of information with which the problem solver could compare the results of his action. If the results of the action taken compares favorably with the expected, then the decision maker will accept the solution. If there is no favorable comparison with the expected, then the problem solver will have to move backward through the problem solving process to a point where the reevaluation of the alternative solutions or even the formulation of new ones will take place. For example, if our problem solver decides to replace the leaking waterer only to have problems with other individual waterers occur within a short period of time, his best course of action may be to reevaluate the alternatives and decide upon complete replacement of the watering system. A flow of information outward to update the store of management skills will occur regardless of

whether or not the problem solver accepts or rejects the solution.

3.2.2 Decision Making

Decisions are categorized as either short, intermediate, or long range. Short range decisions, also known as operational or technical decisions are concerned with making sure that every day actions within the firm flow without disruption. In an integrated poultry firm, general flock management decisions fall within this category.

Intermediate range, or tactical, decisions affect the workings of the system for a longer period of time than do the operational decisions. Tactical decisions can affect the firm for up to two or three flock production cycles (Bentz and Hinton, 1964). Decisions such as the length of time to keep a flock in production, or whether or not to molt a particular flock, or which strain of laying hens to purchase and use are all tactical decisions.

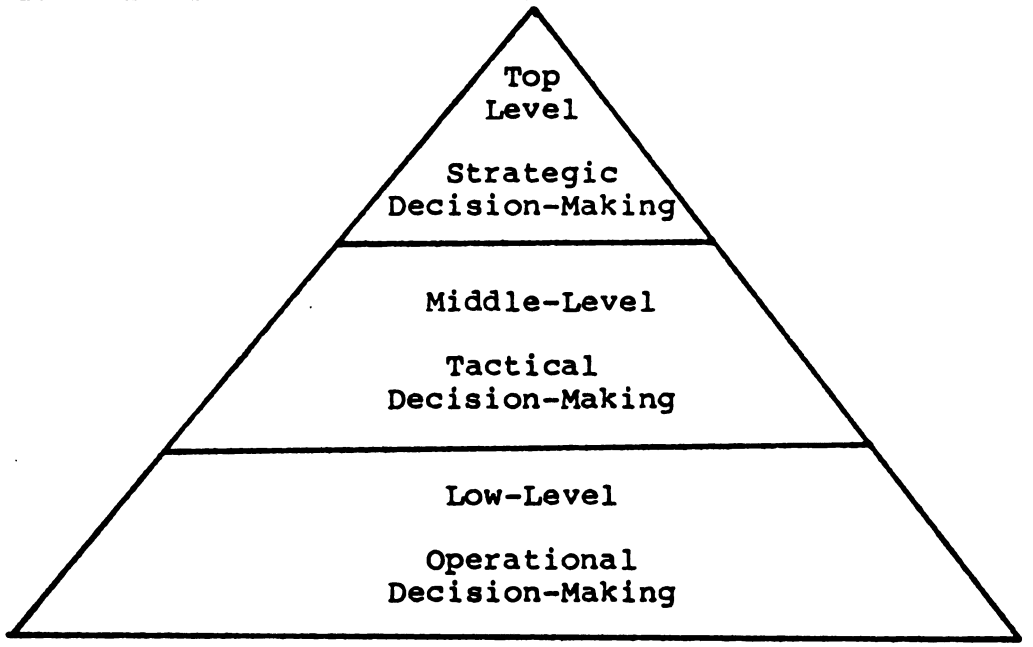
Long range decisions are also called strategic decisions. Strategic decisions affect the long term picture of the firm. These decisions are usually made only once in connection with a given problem, and once made are not easily changed without adversely affecting the firm, in some way. Strategic decisions could include such things as those concerning the size of a poultry house, whether or not to

move vertically into pullet hatching or feed manufacture, or whether or not the firm should abandon egg production and move into swine.

Both strategic and tactical decisions are often financial in nature and are concerned with the financial well being of the firm over an extended period of time. These decisions are usually made with the idea that they will either help to maximize the firm's receipts and/or minimize its costs, thereby maximizing the firm's net revenues, or profits.

The three types of decisions can be tied very closely to the three different levels of management of the firm (Figure 3). Strategic decisions are often made to affect the firm sometime in the future and are made in the face of a great deal of uncertainty. Strategic decisions are made by the upper level of firm managers and affect the firm for an extended period of time. Decisions dealing with firm expansion, flock size, and type of production and processing are all strategic decisions and are made by the upper level of firm management.

Figure 3. Levels of Decision Making.



Source: Mandell, Steven L. COMPUTERS AND DATA PROCESSING: Concepts and Applications. West Publishing Co. St. Paul, Minn., 1979, p377.

Tactical decisions emphasize the activities required to implement the strategies that have been determined at the top level of management. These decisions are made by middle level managers. Since middle level managers are responsible for coordinating the production of all areas of the firm they must be aware of the master plan put forth by the upper level managers, as well as each other's needs.

Operational decisions are made by the lowest level of managers (flock supervisors, processing line foremen, hatching facility foremen) and are made to insure that specific jobs are done. The characteristic differences in the different levels of decision making are set forth in Table 1. These differences in decision making, when applied to the levels of management of the firm make the information needs of the managers more apparent.

3.3 Computers and Software Design

Small computers can be used in the management of an integrated shell egg producing firm as an aid in gathering and processing information which can be used by the problem solver in decision making. The types of information manipulated by the computer are dependant on the type of decisions which the manager must make. Information about trends in pricing for eggs may be important to one decision maker in the firm, but not to another. Since there are

different levels of managers in the firm making different types of decisions, the use of the computer in information generation will differ based on the type of manager.

Table 1. Characteristic Differences in Levels of Decision-Making.

Characteristics	Levels of Decision-Making		
	Operational	Tactical	Strategic
Time Horizon	Daily	Weekly/Monthly	Yearly
Degree of Structure	High	Moderate	Low
Use of External Information	Low	Moderate	Very High
Use of Internal Information	Very High	High	Moderate/Low
Degree of Judgment	Low	Moderate	Very High
Information on Line	Very High	High	Moderate
Level of Complexity	Low	Moderate	Very High
Information in Real-Time	High	High	High

Source: Mandell, Steven L. COMPUTERS AND DATA PROCESSING: Concepts and Applications. West Publishing Co. St. Paul Minn., 1979,p379.

In the past, the computer has been used by the integrated shell egg producing firm chiefly as a manipulator and storer of financial, accounting, and inventory data. The tasks associated with the firm's accounting and finance areas, and with its areas which must monitor inventories, are tedious and repetitive. The repetition and tedium of these tasks have made the use of the computer readily accepted by the personnel within these areas, and the computer has become a valuable tool on which the firm has come to rely.

Since the adoption of the computer, by the firm, the computer has been used almost exclusively in accounting and finance, and in inventory management. The computer has remained a somewhat mystical entity housed within the confines of the firm's data processing section. Use of the computer has required a great deal of skill, and a number of sophisticated, expensive computer programs. Because of these requirements, the use of the computer as a decision making aid by the firm's management has been very limited.

Beginning in the mid 1970's several companies developed and began to market small, relatively inexpensive, personal computers. These small computers were originally meant for hobby and home use. In a relatively short period of time these computers developed in power and capability and their value was discovered by the business community. As

computers have developed, so has the software applications for which they might be used (Table 2 and Table 3). These small computers now can be used as a tool in the decision making processes in nearly all of the areas of the firm. For a listing of several of the small computer systems which have emerged as industry leaders, see Table 4.

There are three broad categories into which the types of software which will be used with the small computer can be classified. There is operating systems and systems utilities software, there is widely functional software, and there is applications software which serves a specific function. The following sections of the dissertation will look at each category separately, and at some examples of the programs which belong in each category.

3.3.1 Operating System and System Utilities Software

This type of software is used to direct the action or operation of the small computer in order to make the computer operate more efficiently. Increased efficiency in computer operation tends to make the users of the small computer appreciate and increase its role in the management scheme.

Table 2. Application Software Evolution

Hardware	Software Evolution 1975	1980	1985
Small Business Computers	Accounting Vertical Applications	Accounting Vertical Applications Word Processing	Accounting Vertical Applications Word Processing Teleprocessing
Personal Desktop Computers	Hobby Software development Entertainment	Accounting Word Processing Financial planning Data Storage Education Entertainment	Financial planning Word Processing Data Storage Teleprocessing Accounting Education Entertainment
Word Processor	Word Processing	Word Processing Accounting	Word Processing Accounting Teleprocessing
Intelligent Terminal	Teleprocessing Data Base inquiries Local Processing	Teleprocessing Local Processing Word Processing	Teleprocessing Word Processing Data Processing

Source: ICP Software Business Review. published by International Computer Programs, Inc. Indianapolis, In. 49260., Autumn 1982 p.7

Table 3. The Growth in Personal Computers and Personal Computer Software from 1979 and Projected to 1990.

Year	Personal Computers Installed	P.C.* Software Packages Sold in U.S.	Dollar Value of P.C. Software Sold in U.S.
1979	250000	1000000	$200 Million
1981	750000	2150000	$600 Million
1983	2000000	4750000	$950 Million
1985	4500000	10000000	$ 2 Billion
1987	10100000	25300000	$ 5 Billion
1990	33750000	100000000	$ 25 Billion

* P.C. is the abbreviation used for Personal Computer.

Source: Palmer, Scott D. "PERSONAL COMPUTERS: Not just for whiz kids anymore", ICP Software Business Review., International Computer Programs,Inc., Indianapolis, In. 46240, Spring, 1982., p.88

Table 4. Selected Small Business Computers.

Small Computer	Standard Memory	Maximum Memory	Mass Storage: Floppy Disk	Mass Storage: Hard Disk
Olivetti M20	128K	512K	320K	11MB**
IBM PC	64K	512K	160K	none
Apple III	28K	256K	140K	5MB**
Xerox 820	64K	64K	92K	none
TRS-80 Model 16	128K	512K	1.25MB	8.4MB**
Zenith Z-100	128K	728K	640K	5MB**

** Mass storage device is hard disk.

Compiled from information in:

BYTE, BYTE Publications, Inc., Peterborough N.H., 03458. Vol 7, No. 11, Nov. 1982.

Radio Shack 1983 Catalog, Number 354 andy Corporation, Ft. Worth, Tx., 76102.

Heathkit Mail Order Catalog, No. 859, Heath Company, Benton Harbor, Mi., 49022.

3.3.1.1 Operating System Software

Operating system software directs the computer's efforts to either store information on, or retrieve information from, a mass storage device (floppy disk, hard disk, or cassette tape). The operating system should allow the small computer's operator to carry out a number of functions dealing with file information manipulation, and file maintenance.

In the past, most small computer manufacturers developed their own operating systems which were sold along with their computers and were computer specific. Thus an operating system designed for one brand of computer would probably not work on another brand.

Because the operating system is essential to storing and retrieving information, computer programs are generally written to be compatible with a particular operating system. This high degree of compatibility between most computer programs and a particular operating system (and, therefore a particular computer) have often limited the transferability of computer programs from one computer to another.

This lack of transferability of computer programs between operating systems and/or the small computers manufactured by different companies has led to the emergence of one operating system as the industry leader. The CP/M

(Control Program for Microcomputers) operating system developed by Digital Research, is the most popular operating system, both from the standpoint of related applications software and from the standpoint of compatibility with a number of small computer systems (Simpson, 1982). This operating system became the industry leader due to its early emergence in the market and to its easy adaptability to new hardware. Several operating systems are listed in Table 5.

3.3.1.2 Utilities Software

Utilities software includes that group of computer programs which is used as a subsystem of the operating system and which is capable of performing specialized, often repeated functions such as sorting, merging, and transferring data (Mandell, 1979). These programs act to make the operating system more versatile through the addition of functions which enhance its useability to the small computer user.

An example of system utilities software would be a telecommunications software package. This type of software allows the firm's computer to communicate with another computer over the telephone lines. Information can be transferred and stored, or directly used at the receiving end of the transmission. Telecommunications software, for the firm's computer, can greatly increase the amount and type of outside information which goes into the firm's

decision making process. Commodity price information is a good example of the type of information which can be brought over the firm's computer when it is outfitted with a telecommunications software package. Table 6 lists several telecommunications software packages.

3.3.2 Widely Functional Software

Widely functional software is generally purchased from a vendor and is used for a specific type of job. Software in this category provides the user with the ability to make use of the small computer without having to develop software for a specific function. Functional software greatly enhances the worth of the small computer by making the computer easier for non-computer oriented people to work with. Software which is part of the functional software category includes data base management software, word processing software, and computer worksheet software.

3.3.2.1 Database Management Software

Database management software helps the firm manage the information which it needs to keep on hand to aid in the decision making process. A data base can be set up which will allow the firm's decision makers to store data until it

Table 5. Selected Disk Operating System Software, Software Developer, Availability, and Price Range.

Program Name	Developer and Availability	Price Range
CP/M (Control Program for Microcomputers)	Digital Research, 160 Central Ave. Pacific Grove, Ca. 93950. And various vendors.	$125-150
PCOS (Professional Computer OperatingSystem)	Dacutel/Olivetti Corp. 155 White Plains Rd. Tarrytown N.Y., 10591	Included with Olivetti M20 Prsnl Cmptr
HDOS (Heath Disk Operating System)	Heath Company, Benton Harbor Mi., 49022.	$150
TRSDOS (Radio Shack Disk Operating System)	Tandy Corporation, Ft. Worth	Included with Radio Shack Computers
MS-DOS (Microsoft Disk Operating System)	Microsoft Corporation 10700 Northrup Way Bellevue, Wa. 98004	Included with IBM Personal Computer

Compiled from information in:

BYTE, BYTE Publishing, Inc., Peterborough, N.H., 03458, Vol 7, No. 11, Nov., 1982.

Radio Shack 1983 Catalog, Number 354. Tandy Corporation Ft. Worth, Tx., 76102.

Heathkit Mail Order Catalog, No. 859, Heath Company, Benton Harbor, Mi., 49022.

Mini Micro Systems, Cahners Publishing Company, Boston.,Vol. XV, No. 6, June, 1982, p.311.

Table 6. Selected Telecommunications Software, Software Developer, Availability, and Approximate Price.

Program Name	Developer and Availability	Approx. Price
TERM II	Supersoft, P.O. Box 1628 Champaign, Il. 61820 and various vendors.	$170
SuperTerminal	Instant Software, Peterborough, N.H., 03485, and various vendors.	$ 95
LogOn	Ferox Microsystems, Inc. Arlington, Va.	$150

Compiled from information in:

Farm Computer Software handout presented by Dr. Sherrill Nott, Agric. Econ. Dept., M.S.U., Farmer's Week, 1982.

ICP Software Business Review, International Computer Programs, Inc., Indianapolis, In. 49260, Autumn, 1982.

BYTE, BYTE Publications, Inc., Peterborough, N.H., 03458, Vol 7, No.11, Nov., 1982.

is needed and then manipulate it in such a way that it can be used. Database management software generally organizes the data that is input into a number of records (Peterson and Brook, 1982). Each record is a set of data items related to a particular thing, place, or time. Because of the way each record is set up, the user has the capability of sorting on a particular item, adding, averaging, and generally manipulating the data such that it might be useful in the decision making process.

Flock production records, processing plant data, and other historical records are examples of the types of data which can be kept and manipulated by a data base management system. The capablility of sorting and analyzing records is the major attraction of data base software and can make the computer a useful tool to even small firms who wish to purchase a computer system. Data Base Management Systems are listed in Table 7.

3.3.2.2 Word Processing Software

Word processing software can help the firm generate letters and reports. Attractiveness of word processing software comes chiefly from the ease with which written material can be generated, manipulated, corrected, and copied. Word processing software acts chiefly as a labor saving aid for the secretarial personnel. Selected Word Processing Software packages are listed in Table 8.

Table 7. Selected Data Base Management Software, Software Developer, Availability, and Price Range.

Program Name	Developer and Availability	Price Range
dBASE II	Ashton-Tate, 9929 Jefferson Los Angeles, Ca. 90230, and various vendors.	$429-700
Condor	Condor Computer Corp. Ann Arbor and various vendors.	$795-899
Profile IIIplus	Tandy Corporation, Ft. Worth, Tx., 76102; Radio Shack Stores, and various vendors.	$199-300
DataStar	MicroPro, 33 San Pablo Ave. San Rafael, Ca. 94903, and various vendors.	$225
FMS80	DJR Associates, 303 S. Broadway Tarrytown N.Y., 10591, and various vendors.	$595-995

Compiled from information in:

Farm Computer Software, handout presented by Dr. Sherrill Nott, Agric. Econ. Dept. M.S.U., Farmer's Week, 1982.

BYTE, BYTE Publications, Inc., Peterborough, N.H., 03458, Vol. 7, No. 11, Nov., 1982.

Info World, Popular Computing, Inc., Framington, Ma., 01701, Vol. 4, Number 41, Oct. 18, 1982.

3.3.2.3 Computer Worksheet Software

Computer worksheet software allows the user to set up tables and reports, do simple calculations, and manipulate rows and columns of data. In general, software of this type allows the small computer user to carry out complicated tasks without having to go to the effort and expense of designing complicated software.

In addition to being versatile in its application, Computer Worksheet Software is relatively easy to learn to use. These two features have made computer worksheet software very important in the growth of the small computer industry. As small computer manufacturers have switched the target market of their product from home/hobby use to small business applications, the existence of computer worksheet software has given businessmen the opportunity to purchase a small computer and begin using it immediately. Table 9 lists several popular Computer Worksheet Software packages.

3.3.3 Applications Software

The specific applications software which will be used in any given problem situation will depend on the questions which must be answered. Software which answers questions concerning the current state of a situation is descriptive software. Descriptive software includes financial accounting software which tells the problem solver of the current state of the firm, intra-firm monitoring software

Table 8. Selected Word Processing Software, Software Developer,Availability, and Price Range.

Program Name	Developer and Availability	Price Range
Wordstar	MicroPro, 33 San Pablo Ave. San Rafael, Ca., 94903 and various vendors.	$289-450
Scripsit	Tandy Corporation, Ft. Worth Tx., 76102; Radio Shack Stores.	$399
Easywriter	Information Unlimited Software, Inc.,281 Arlington Ave., Berkely, Ca., 94707.	$250
Apple Writer	Apple Computer, Inc., 10260 Bandley, Cupertino, Ca., 95014.	$ 75

Compiled from information in:

Farm Computer Software, Handout presented by Dr. Sherrill Nott, Agric. Econ. Dept. M.S.U., Farmer's Week, 1982.

BYTE, BYTE Publications, Inc., Peterborough, N.H., 03458, Vol. 7, No. 11, Nov., 1982.

Info World, Popular Computing Inc. Framington, Ma., 01701,Vol. 4, Number 41, Oct. 18, 1982.

Radio Shack 1983 Catalog, Number 354, Tandy Corporation, Ft. Worth, Tx. 76102.

Table 9. Selected Computer Worksheet Software, Software Developer, Availability, and Price Range.

Program Name	Developer and Availability	Price Range
VisiCalc	VisiCorp. 2895 Zanker Rd. San Jose, Ca., 95134, and various vendors.	$159-190
Super Calc	Sorcim, P.O. Box 32505 San Jose, Ca., 95152, and various vendors.	$199-295
Calc Star	MicroPro, 33 San Pablo Ave. San Rafael, Ca., 94903, and various vendors.	$185-296
T/Maker II	Lifeboat Assoc. 1651 Third Ave. New York, 10028, and various vendors.	$209-275
ScratchPad	SuperSoft, P.O. Box 1628 Champaign, Il., 61820.	$295

Compiled from information in:

Farm Computer Software, Handout presented by Dr. Sherrill Nott, Agric. Econ. Dept. M.S.U., Farmer's Week, 1982.

BYTE, BYTE Publications, Inc., Peterborough, N.H., 03458, Vol. 7, No. 11, Nov., 1982.

Info World, Popular Computing, Inc., Framington, Ma., 01701, Vol. 4, Number 41, Oct. 18, 1982.

which tells of current feed and water consumption or current housing and environmental conditions, sales analysis software which can relate current sales by product or by customer, and inventory control software which allows the problem solver to note and make decisions based on the state of the inventory in question.

Software which is diagnostic in nature tells the problem solver what is wrong with a given situation. This type of software often has to compare the current state of a situation with the normal state, or with a standard of some sort. Diagnostic software includes software which stores flock records and allows the comparing of current production with that which is normally expected, or with some production standard.

Another area in which software is useful to decision making, within the firm, is in prediction. Predictive applications software can be used to answer "what if" questions. Simulations and projections are examples of predictive software. The use of predictive software within the firm has a wide range, including predicting daily feed intakes or egg production, and predicting market prices or future sales.

Prescriptive applications software helps the decision maker to find an actual solution to a problem. Software serving this function is often designed to allow the

decision maker to arrive at the optimum solution to a problem which has a number of possible alternative solutions. Least cost feed formulation or least cost truck routing programs are examples of software which allow the decision maker to arrive at an optimum solution to a problem which has a number of viable alternatives.

Applications software is specifically designed to carry out a single function for the small computer user. In many cases, in areas in which the task to be accomplished is widespread from firm to firm, applications software may be available from a vendor. In tasks specific to the user firm, applications software will have to be designed by the firm, or by someone hired for that purpose.

The specificity of applications software is its main strength as well as it main weakness. The strength of applications software lies in the fact that it is designed to do a specific task. Generally, applications software should be able to do this task relatively efficiently because of its specific nature. Since the software is being designed specific to the needs of the user, it can make the computer a powerful tool in the decision making process of the firm.

The weakness tied to the specificity of applications software is derived from the great expense in time and money by the user firm in developing the software which it needs.

If the software proves to be applicable frequently within the firm, or if it proves to be saleable to other similar firms, the development costs of the software can be reduced, on a per use basis, or retrieved through the sale of the software.

Two types of applications software which are important to the shell egg producing firm include financial analysis software, and poultry management software.

3.3.3.1 Financial Analysis Software

Financial analysis software is the grouping of computer programs which is concerned with the dollars and cents of the firm. The most obvious financial analysis software which might be useful to the firm is the group of computer programs specifically designed to aid in the accounting functions. These programs would include general ledger, accounts payable and receivable, and payroll. The programs involved here could also be used to generate the reports which normally are a function of the accounting department of the firm. In effect, these programs could be used by the firm as a labor saving device for the personnel of the financial operations section.

Financial analysis programs which could be used more directly in the decision making process of the firm would include cash flow projections, company sales projections,

and industry growth projections. Least cost truck routing and least cost feed formulation programs are financial analysis type programs which can potentially help the firm cut its costs. Financial records from the production level can aid the firm in deciding whether each flock, processing line, or salesman is performing up to potential. Other financial analysis type programs which might be of aid to the firm in the decision making process might include capital expenditure analysis programs which help to evaluate investment attractiveness (Rahn, 1978). Table 10 lists several Accounting Software packages for small computers, and some of the vendors from which they may be obtained. Table 11 lists several Financial Analysis Software packages which might be useful to shell egg producers.

3.3.3.2 Poultry Management Software

Poultry management software allows the managers within the firm to use the computer effectively to keep track of those factors which indicate the performance of the flocks within their charge. This software can be designed to compare current flock management figures with past flock performance figures or with those of some expected standard. Other poultry management software which can be of help to flock managers include production projection software, flock simulation software, and flock scheduling software. All of these software types can be used to aid in the effective

management of the firm's flocks. Examples of Poultry Management Software are listed in Table 12.

Table 10. Selected Accounting Programs for Small Computers and Vendors from Which They May Be Obtained.

Vendor	General Ledger	Accounts Payable	Accounts Receivable	Inv	Payroll
Peachtree 3445 Peachtree Atlanta, Ga. 30326	Yes	Yes	Yes*	Yes	Yes
Chilsons Mgt. Controls. Rancho Cucamonga, Ca., 91730	Yes	Yes	Yes	Yes	Yes
Radio Shack Tandy Corp. Ft. Worth Tx., 76102	Yes	Yes	Yes	Yes	Yes
Heath/Zenith Heath Co. Benton Harbor Mi., 49022	Yes**	Yes	Yes*	Yes	Yes
TCS Acctg. Texas Cmptr Systems, Arlington TX., 76004	Yes	Yes	Yes	Yes	Yes

*Sales invoicing is a separate program from accounts receivable.

** Accounting software sold by Heath/Zenith is actually by Peachtree Software, Inc. and requires the purchaser to sign a software sublicensing contract with the dealer.

Compiled from information in:

ICP Interface: Administration and Accounting., International Computer Programs, Inc., Indianapolis, In., 46240, Vol. 7, No. 3, Autumn, 1982.

Radio Shack TRS-80 Computer Catalog, No. RSC-4, Tandy Corporation, Ft. Worth, Tx. 76102, 1981.

Heath/Zenith Computer Systems Mail Order Catalog 800, Heath Company, Benton Harbor, Mi. 49022, 1982.

Table 11. Selected Financial Management Software for Small Computers Which May Be Useful to Egg Producers.

Program Name	Program Function	Program Language	Available From
Flock Budgeting Model	Used in scheduling flock placements to maximize net receipts per thousand hens.	Fortran	Allan Rahn Animal Sci. Dept. M.S.U. East Lansing
Firm/Flock Budgeting Model	Used in estimating firm net receipts given the firm's flock placement schedule.	Fortran	Allan Rahn
Cash	Calculates discounted cash flow, depreciation schedules, debt payment. Used in firm investment decision making. Unlimited asset categories.	Basic	Allan Rahn
Drain	Calculates discounted cash flow, debt payment, depreciation for one asset. Used in investment decision making. Buy versus lease.	Basic	Allan Rahn
SClayer	Evaluate contractor egg laying contracts	Basic	John Welter Poultry Sci. Dept. Clemson Univ. Clemson S.C., 29631.
SCplayer	Evaluate producer egg laying contracts	Basic	John Welter
NEhenbud	Budgets capital/cash flow for layers	Basic	Dan Bigbee Animal Sci. Dept. Univ. of Nebraska Lincoln, Ne. 68583.
NChic	Tracks poultry enterprise cash flow	Basic	J. D. Dodson N.C. State Raleigh, N.C., 27650.

Table 11. Selected Financial Management Software for Small Computers Which May Be Useful to Egg Producers. (Continued 1.)

Program Name	Program Function	Program Language	Available From
PAeggbud	Projects egg production/cost/returns	Fortran	Forest Muir Poultry Sci. Dept., Penn. State Univ. University Park, Pa. 16802.
MIplan72	Analyse 5-year farm plan/cash flow/profit	Fortran	Sherrill Nott Agric. Econ. Dept., Mich. State Univ. E. Lansing, Mi. 48824.
MIplan03	Evaluate capital investment feasibility	Fortan	Sherrill Nott
VAdecal	Evaluates business alternatives	Fortran	Craig Woods Extension Service, VPI Blacksburg, Va. 24061.
VAinvest	Analyses investment net present values	Fortran	Craig Woods
MNcshflo	Budgets farm cash flow/credit needs	Fortran	R. Hawkins Dept. of Ag. Econ. U. of Minnesota St. Paul, Mn. 55108
MNpvbud	For present value investment analysis	Fortran	Earl Fuller Dept. of Ag. Econ. U. of Minnesota

Table 11. Selected Financial Management Software For Small Computers Which May Be Useful to Egg Producers. (Continued 2.)

Program Name	Program Function	Program Language	Available From
SCirr	Calculates internal rate of return for annual net cash flows	Basic	M. Leafgreen Agric. Econ. and Rural Sociology, Clemson Univ. Clemson, S.C. 29631.
OKdepn	Calculates alternative depreciation schedules	Basic	T. Nelson Ag. Econ. Dept. Okla. St. Univ. Stillwater Ok. 74078
NCproceg	Biological/Economic analysis of different groups of layers		G. Martin Pltry. Sci. Dept., N.C. State Univ. Raleigh, N.C.

Sources:

Dr. Allan P. Rahn, Animal Science Department, Michigan State University, East Lansing, Mi. 48824.

Strain, J. Robert and Sherry Fieser, Updated Inventory of Agricultural Computer Programs, Food Resource Economics Department, Cooperative Extension Service Circular 531, University of Florida, Gainesville, March, 1982.

Table 12. Selected Small Computer Software Which May Be of Use to Egg Producers.

Program Name	Program Function	Machine Desgned for	Available From
Eggs	Calculates weekly egg egg summary, flock financial analysis	Radio Shack I	Al Tinsley Clemson Univ Clemson, S.C.
Commercial Pullet Controller	Record keeping/management system for commercial pullet flocks	Apple III	Agrimetrics P.O. Box 34190 Richmond, Va.
Commercial Layer Controller	Record keeping/mngmt system for commercial layer flocks	Apple III	Agrimetrics
Nest-Run Val-U-Calc	Calculates value of eggs on nest run basis	Apple III	Agrimetrics
Laying Breeder Controller	Record keeping/mngmt system for commercial layer breeder flocks	Apple III	Agrimetrics
Least Cost Feed Formul.	Searches all possible combinations of feed ingredients to arrive at a finished least cost feed formulation.	Apple III Radio Shck Model II IBM-5120	Agrimetrics
C.M.C. Pullet System	Series of menu driven pullet flock management/ record keeping programs	Datapoint	Chilsons Mgt. Cntrls, 9645 Arrow Rancho Cucamonga Ca., 91730
C.M.C. Weekly Management System	Series of menu driven weekly layer flock record keeping/management programs	Datapoint	Chilsons Mgt. Cntrls,
C.M.C. Egg System	Series of menu driven programs for egg grading and processing	Datapoint	Chilsons Mgt. Cntrls,

Table 12. Selected Small Computer Software Which May Be of Use to Egg Producers. (Continued 1.)

Program Name	Program Function	Machine Desgned for	Available From
C.M.C. Daily System	Series of menu driven programs for daily recording and updating of production and inventory figures.	Datapoint	Chilsons Mgt. Cntrls.
C.M.C. Feed Mill and Feed System	Series of menu driven programs which include report generation and least cost feed formulation.	Datapoint	Chilsons Mgt. Cntrls.
Poultry Programs	Series of poultry recrd keeping/management programs.	Rdio Shck Model I	Tam S. Hutchinson P.O. Box 248 N. Wilkesboro N.C., 28659
SCeggs	Analyses egg laying enterprize/costs	Rdio Shck Models I, II, III	J. Welter Poultry Sci. Dept. Clemson Univ. Clemson S.C. 29631
PAchicfd	Calculates least cost poultry feed formulas	Rdio Shck Model II	F. Muir Poultry Sci. Penn State University Univ. Park, Pa. 16802
Flock Modeling	Projections and comparisons to standards for flock production and economic parameters	Digital	Computone Systems One Dunwoody Park, Atlanta Ga., 30338
Flock Record Keeping	Creates daily flock production reports. Compares to previous week, month of prod. Regional, National Comp.	Digital	Computone Systems

Table 12. Selected Small Computer Software Which May Be of Use to Egg Producers. (Continued 2.)

Program Name	Program Function	Machine Desgned for	Available From
Hatchery Space Management	Helps provide comprehensive management of all aspects of hatchery operation.	Digital	Computone Systems
Flock Summary	Series of flock mngmnt programs for generating flock reports and comparisons	Hewlett Packard; IBM	Agri-Data P.O. Box 625 625 Snowhill Rd., Alamo, Ga., 30411

Compiled from information in:

Chilson's Management Controls, Promotional Literature. C.M.C., Inc. 9645 Arrow Route, Rancho Cucamonga, Ca. 91730, 1981.

Agrimetrics Associates, Promotional Literature, P.O. Box 34190, Richmond, Va. 23234.

Survey of Availability of Micro and Mini Computer Software. J. Robert Strain. Food and Resource Economics Department, Institute of Food and Agricultural Sciences, University of Florida, Gainesville. October, 1980.

Computone Systems, Promotional Literature, One Dunwoody Park, Atlanta, Georgia, 30338.

Agri-Data, Promotional Literature, P.O. Box 625, 625 Snowhill Rd., Alamo, Georgia, 30411.

Chapter 4

Decision Making and Computer Usage Within theFirm

The last chapter of this dissertation defined and identified the three separate entities with which the dissertation deals. These entities consist of the integrated egg production firm and its decision makers, the decision making/problem solving process, and computers and software design. This chapter of the dissertation will take these three entities and integrate them.

This integration of the three entities will take the form of a separate look at each manager within each level of firm decision makers, a discussion of the types of decisions which each manager must make, the identification of the flows and types of information which must be used in the decision making process, and judgement as to the possible role of the computer in aiding in decision making and problem solving.

The appendix at the end of this dissertation takes a more detailied look at information needs and computer usage in the egg production subunit of the firm. An example of the use of the computer in making a forced molting decision is used as a clarifier.

4.1 General Manager

The general manager of the firm is responsible for decisions which guide the long run functioning and operation of the firm. The decisions made are generally strategic in nature and are often made to affect the firm sometime in the future. A decision to locate an egg production complex in south central Michigan, in 1982, with the expectation that the comparative advantage for egg production would shift from the southern U.S. to the Midwest by 1987 is a good example of a strategic decision which will affect the firm sometime in the future.

The decisions made by the general manager are often made in response to information which fosters the belief that a problem will arise in the future. Trends, both economic and physical, lead the general manager to efforts to take advantage of a favorable situation, or to decrease the effects of some adversity. The information flow which fosters the general manager's belief can either come from within the firm hierarchy, or from outside the firm, as is the case with economic indicators. As examples, information from the lower levels of the firm's management may lead the general manager to believe that the firm's started pullet costs are too high, or information from outside the firm could lead the general manager to expect a dramatic increase in per capita egg consumption in the near future. Both

cases present a problem area in which the general manager can work.

Once the problem area has been presented to the general manager, identification of the actual problem must take place. In the example of high started pullet costs, the actual problem may be one which can be solved by managers at a lower level of the firm, or it may indicate the need for expansion by the firm into the hatching and growing of pullets. In this case the general manager must correctly identify the problem before the act of formulating alternative solutions can begin.

Formulation and evaluation of alternative solutions draws upon the manager's store of management skills and on information from extraneous sources. Since the wrong decision at this level of the firm can often adversely affect the entire operation, the manager must be especially careful that the alternative solution which is chosen is the correct one. Because of this, outside information becomes much more important to the decision maker, at this level, than at lower levels of the firm. The extraneous information used in the decision making process can come from lower levels of decision makers within the firm and will be based on their management skills and on outside information at their disposal, or based on information which comes from outside the firm that is available directly to

the general manager. By pulling together all of the information needed to make the decision, the general manager hopes to choose the correct alternative and facilitate the long run operation of the firm.

Computer usage at this level of the firm decision will often be to make information available to the general manager. Information can be made available to the manager directly, as is the case with economic outlook statements or commodity and brokerage house prices, through the use of telecommunications software. Because of the limited number of supplies of information the manager has very little choice as to the type of information received from telecommunications software. Therefore the use of the information received may be limited.

The information received through telecommunications software, through other managers or divisions of the firm, and through other sources outside the firm may be manipulated through the use of specific applications software such that the information might be more useful in the decision making/problem solving process. The general manager may use predictive software such as financial projections, simulations, and other types of applications software in the decision making process, depending on his needs. Projections and simulations should take existing information and relationships, and manipulate them such that

the decision maker can receive some idea of what can be expected from a given situation. With a simulation the decision maker can conduct a sensitivity analysis by varying the inputs and noting the outcome of each successive trial in order to get some idea of the range over which the outcome will vary in response to the varying inputs. Once this range has been defined, the decision maker can make the decision with some degree of certainty that the alternative solution chosen is the one which is correct. In this case the computer acts as a prescriptive tool.

The major problem with the adoption of the computer as a decision making aid, at this level of firm decison making, is the specificity of software which will be utilized in the problem solving process. Given a problem solving task in which the computer might be used, the probability of the existence of software which can be used directly in the decision making process is very small. Software design is expensive, therefore the firm will probably not spend the money for bringing into existance a piece of software which it will probably only use one time, and in one situation. In a case such as this, computer worksheet software can be especially useful in aiding the small computer user. By using this type of software in calculating and presenting data, often the decision maker can get the information needed to aid in the decision making task.

4.2 Financial Operations

Since the financial operations unit of the firm was presented in the methodology section of the dissertation as being made up of three subunits (accounting, data processing, and purchasing), the decisions, information flows and software needs for each subunit should be presented separately. Since the chief financial officer of the firm would head this section, this decision maker will be segreted and treated separately. Note that this dissertation deals mainly with the use of small computers in the decision making processes of an integrated shell egg producing firm; in the case of two areas of the firm dealt with in this section, accounting and data processing, small computers may not lend themselves very well to application due to their small size and lack of power. As the small computer industry is growing and the technology involved is advancing, this limitation may not hold true in the future.

4.2.1 Chief Financial Officer

The chief financial officer is the head of the financial operations unit of the firm and must oversee the operation of this unit and guarantee the smooth, unobstructed flow of financial information from one subunit to the others. Responsibilities undertaken by this

decision maker will include overseeing the accounting subunit, preparation of financial reports, payroll records, budget preparation, and the calculation and payment of taxes. The chief financial officer of the firm will also be responsible for the allocation of the firm's financial resources. The chief financial officer will maintain banking relationships, manage the firm's cash reserves, obtain financing, manage pension and insurance plans, and manage the firm's relationship with creditors. Large firms may even allocate the financial information management and financial resource management duties to two separate individuals, the controller and the treasurer, respectively (Brealey and Myers, 1981).

Decisions as to the allocation of the firm's financial resources will come in response to problems put forth by the firm's general manager. If the general manager has decided that the firm must expand its operations, it will be the responsibility of the chief financial officer to arrange financing for the project. Information will have to come to the chief financial officer from other areas within the firm, outlining what is needed. This information will be used along with information from outside the firm to formulate alternative solutions to the problem of financing the project. Information from outside the firm may include interest rates, the availability of money for financing long

or short term projects, and the general financial environment in which the firm must operate. Once the financial officer has developed the alternative solutions, the next step will be to contact the financial institutions involved to arrange for financing.

In the other role of the chief financial officer of the firm, as manager of the firm's financial information, the actual decision making function is fairly limited. The job of the officer in this area is data manipulation such that the data can be presented in a form to be used in the decision making process of other areas of the firm.

The computer can be a very important tool to the chief financial officer of the firm. The firm's manager of financial resources can use the computer (in conjunction with telecommunication software) to gather information on interest rates, bond yields, stock prices, etc., in an effort to achieve the best possible financial position for the firm. Projections and simulations can be used as a tool in obtaining loans from financial institutions or in convincing investors to put their monies into the firm.

Software which will be used by the manager, in this role, will be of two types. The first type is telecommunications software which will facilitate the collection of data from sources outside the firm. This data will more than likely come from services which specialize

in this type of data which is needed for firm decision making. In this case, the telecommunications software acts as an aid to the decision maker by bringing in information which can be used in describing the current operating environment of the firm.

The second type of software which will likely be used by the financial manager is specific applications software for making projections and simulations of the financial movement of the firm. This type of software will probably have to be designed specifically for the firm. Since the chief financial officer will use this type of software often, its design should be more generally applicable than that which will be used by the general manager of the firm. This applications software used by the manager will probably be used as either diagnostic or predictive tools designed to identify what is wrong (or right) with the financial health of the firm, or to allow the financial manager to chart the movement of the firm given a set of varying parameters.

In the chief financial officer's other role, as the manager of the firm's financial information, software will be used for data manipulation and output in such a form that it might be used for decision making by other managers within the firm. Software for financial report generation, tax calculation, insurance and payroll generation will be used within this area of the financial manager's duties.

These types of software are designed for specific applications, but are in such general use from firm to firm that they should be able to be purchased and used "as is", or with minor modifications. Here, again, the software is descriptive in nature, and is used to describe the current financial status of the firm.

4.2.2 Accounting

The accounting manager of the firm oversees the financial accounts of the firm, oversees the generation of the firm's financial statements, and generally tries to maintain adequate, accurate financial information for firm decision making. Information flows come from the chief financial officer of the firm, data processing, purchasing and egg marketing. Information will take the form of data which lists transactions and their dollar amounts, and should be used for updating the accounts of the firm.

The functioning of the firm's accounting department has been greatly enhanced by the advent of the computer. More information can be collected, generated and made available, in a shorter amount of time, for firm decision making than was true before the computer became of use in the accounting functions. The computer is used by the accounting department to describe the current state of the firm and

generate reports which will be used in the decision making of others.

Accounting software is fairly standard from firm to firm and should be able to be purchased and used by the firm with little or no modification. The most difficulty the firm will have in purchasing accounting software will be from selecting from the many software packages available from many different vendors.

4.2.3 Purchasing

The purchasing subunit of the firm is in charge of all purchases which must be made by all of the other subunits of which the firm is formed. Purchasing must also keep track of inventories of stocks of purchased inputs which will be used over time. When these stocks become low, purchasing should reorder them automatically.

Problem solving in this subunit of the firm takes the form of what to purchase, how much to purchase, and at what price purchasing should take place. Information flows come to purchasing chiefly as orders from other areas of the firm, prices of purchased goods from outside the firm, and purchase price limitations from the chief financial officer.

The computer can be used by purchasing as an aid in account maintenance, inventory control, and in the buying functions. The account maintenance and inventory control

functions should be able to be handled by data base management software which is fairly easy to adapt to tasks such as these. Here, the computer is used in decribing the current state of accounts and inventory stocks, and gives the firm more control by making it more informed. The buying functions can be enhanced by telecommunications software which is also used as a descriptive tool to tell purchasing of current prices, and current availability of some of the purchased inputs which the firm needs.

4.2.4 Data Processing

Data processing is the subunit of the firm in which the computer is actually located. Though data processing is an entity separated physically from either accounting or purchasing, the function of the data processing unit cannot be separated from either of these other subunits of the firm. The data processing unit of the firm actually maintains the financial accounts of the firm and manipulates them when transactions occur. Data processing also maintains the inventory list of the firm and updates it when stocks are exhausted, or repurchased and brought in.

Decision making and problem solving are minimal in this subunit of the firm since the function of data processing is

simply to carry out the instructions of accounting or purchasing on how to store and manipulate data.

4.2.5 Computer Adoption and Software Design

The financial operations unit of the firm will probably be the first of all the units of the firm in adopting and using the computer as an integral tool in the management of its operations. Personnel in this area will much more readily adapt to its usage. This is chiefly due to the fact that the computer is acting, in many cases, as a simple adding machine and is not functioning in an area in which personnel do not think that it belongs. In this area of the firm, personnel will see the computer as an aid, rather than as a replacement for the human entity.

Much of the software which will be used in this area of the firm is readily available from vendors who specialize in software for a firm's financial operations. Financial analysis software, including account maintenance, general ledger, accounts payable and receivable, and payroll are all available to the firm. Software for inventory control, purchasing, billing, etc., is all available and ready to use. Data base management software that is both easy to use and readily adaptable to a particular function can be obtained by the firm and introduced into the firm's operations without a great deal of effort.

Specific applications software, such as that which will be used by the chief financial officer of the firm, may be general enough that it may be purchased and used, rather than having to be designed specifically for the firm, at great expense. Even if the software must be designed specifically for the firm, the financial officer may be able to use the software package often in making similar types of decisions and thus bring down the per use cost of the software.

Other than for the chief financial officer, who can use the computer in predictive and diagnostic areas, the use of the computer, within the financial operations section of the firm, is limited to descriptive functions such as describing the current financial state of the firm or describing the current state of inventory.

4.3 Hatchery Operations

Hatchery operations consist of the firm's breeder flocks, the hatchery unit itself, and the firm's pullet flocks. At the head of these subunits is a manager who oversees the operation of this subunit of the firm. At the head of the entire hatchery operation is a general manager who oversees and coordinates the operation of all three of the division's subunits. This section of the dissertation

will look at the hatchery operation as a whole, the general manager in charge of it, and then at each of the subunits, separately.

4.3.1 General Manager of Hatchery Operations

The general manager of hatchery operations must oversee the long term operation of each of the subunits of this division of the firm and coordinate the activities of each of them. Through these actions, the activities of each of the subunits should mesh with the activities of each of the others such that there is no wasting of the firm's resources. The general manager must coordinate the placement of breeder flocks with hatching egg production, hatching egg production with hatchery operations, and hatchery operations with pullet growout. A lack of coordinating effort can lead to unused resources which are costly to the firm.

The general manager must also coordinate the activities of this division of the firm with the activities of the other units of which the firm is made. The firm's feed mill will have no idea of how much feed to mix or which special ingredients to order, or which diets to formulate if the manager of the hatchery unit does not communicate with it in an effort to coordinate feed production. If there is no coordination between the egg production unit of the firm and

hatchery operations, egg production facilities can stand idle for want of pullets, or pullet flocks can grow old waiting for a place in which to be housed.

Last, the general manager of hatchery operations must coordinate the activities of this division of the firm with the long term plans for the firm's operation, which have been developed by the firm's general manager. If the long term plans of the firm include expansion, the hatchery unit needs to look for excess capacity in its existing facilities, and decide how this excess capacity might be used to its best advantage. If no excess capacity exists, then hatchery operations must begin to look at the possible expansion of its own facilities.

Each coordinating activity which the general manager must make affects his division for an extended period of time. Decisions at this level of the firm are tactical in nature and will affect the firm for a period of from only several days to several production cycles.

Information flows exist in both directions between the manager of hatchery operations and the subunits in this division of the firm, the general manager of hatchery operations and the other divisions of the firm, and between the general manager of hatchery operations and the general manager of the firm. These information flows, together with information from outside the firm and information from the

manager's store of management skills, are used to help the manager to pick the correct alternative solution to any problem.

The small computer can best be used as an aid to the general manager by making projections of expected egg and hatched pullet production, keeping production records, and allowing the general manager to make quick comparisons to strain standards. Through the use of the small computer, the general manager can coordinate production of the expected number of pullets needed in the future with the placement of breeder flocks, know how many fertile eggs a particular breeder flock has laid, or see that a pullet flock is lighter in weight or higher in mortality than strain standards would predict.

Computer software to aid the general manager in decision making would take the form of specific applications software for production predictions and strain standard comparisons, and data base management software for keeping production records. In this case the functions performed by the data base management software are descriptive. The data base created by this software can be used, however, in conjunction with applications software in the diagnostic and predictive functions associated with comparing and predicting breeder flock production.

4.3.2 Breeder Flocks

The breeder flocks subunit of this division of the firm furnishes eggs for the hatchery. The manager in charge of breeder flocks is concerned with the day to day activities associated with these flocks and thus is an operational decision maker. The manager is concerned with the health and well being of the flocks, and most of the problems which must be solved are associated with them.

The information flows associated with this decision maker come from the flocks themselves in the form of daily egg production, feed and water consumption, air movement, house temperature, and mortality figures. The manager should keep and study them to discover anything out of the ordinary. Other information flows come down from the general manager of hatchery operations in the form of breeder flock schedules, hatching egg orders, and feedback from the hatchery as to the hatching quality of the eggs received. Information from outside the firm comes to the manager in the form of publications, extension meetings, etc., and is used to update the manager's store of management skills.

Data base management software is probably the most applicable to the breeder flock manager's usage and should be used to keep daily flock management data. If such data

as hatching egg production, feed and water consumption, house temperature, and mortality are gathered on a daily basis and made easily retrievable through the use of data base management software, the manager can easily look at, and compare, today's figures with those from the immediate past in order to discover unusual numbers which might indicate problems. This software which describes the current state of the breeder flocks will probably need to be used in conjunction with applications software to allow the flock manager to diagnose any problems which might exist.

4.3.3 Hatchery Unit

The hatchery unit actually hatches the eggs and produces the chicks used by the firm for egg production. Decisions made by the manager of this unit are operational in nature and are made in conjunction with the daily running of the hatching unit. Information flows consist of data generated within the unit, directives from the general manager of hatchery operations, and information from the manager's store of management skills. The manager has the option of seeking information from outside of the firm, either in response to a particular problem, or as the result of a desire to expand the store of management skills. Information flows from the general manager deal with scheduling of hatches, problems with hatchery operations,

and generally deal with the minimizing of any barriers to the flow of production from the hatchery unit.

Data generated within the hatchery unit might consist of the number of pullet chicks hatched, fertility, hatchability, chick weights, debeaking and vaccination information, general thriftiness of the chicks, and incubator and hatcher data such as temperature and relative humidity. All of these data can be used by the manager to determine whether or not hatching unit operations are working as they should. As with the manager of the breeder flocks, data base management software, describing the current state of the unit, could be used for keeping these types of data.

4.3.4 Pullet Growout

The pullet growout section, of this unit of the firm, is in charge of maintaining a favorable environment for the growing chicks in an effort to deliver to the egg production facilities the best possible started pullets. Again, at this level of the firm, decisions which must be made by the manager are operational in nature and deal with the day to day operations of this subunit of the firm. Information flows to be used in the decision making process consist of data generated within the flocks themselves, flows from the

manager's store of management skills, information from outside the firm, and information from the general manager for hatchery operations.

Information generated within the flocks on a daily basis consists of mortality, feed and water consumption, air movement, and house temperatures. The manager might weigh a representative sample of pullets weekly to check the progress of their growth. The manager might also note such things as vaccinations, specific illness or general unthriftiness of the flock, and touch-up debeaking on a per incidence basis. Information gathered from the flocks can be stored and later utilized in the decision making process through the use of data base management software, and applications software which will allow the manager to compare current production to a standard.

4.4 Feed Production

The feed unit is broken down into two subunits, one dealing with feed manufacturing and storage and the other dealing with feed delivery. Each subunit is headed by a manager, who must oversee the operation of his own subunit and coordinate the flows of resources within. The general manager of the feed unit is in charge of the entire unit and oversees the operation of each of the subunits and

coordinates movement between them, and between them and the other parts of the firm.

4.4.1 General Manager of the Feed Production Unit

The general manager of the feed unit is in charge of overseeing the actions of the entire unit as well as coordinating the interaction between the unit and the other areas of the firm. Information flows exist between the general manager of the feed operation and the subunits (feed formulation and storage, and feed delivery) of the feed operation, and between the general manager of the feed unit and most of the other areas of the firm (the one area of the firm to which the feed unit will have the weakest link, if a link exists at all, is the egg processing and marketing unit).

Particularly strong information flows exist between the feed facility and the egg production unit of the firm and between the feed facility and the hatchery unit. The correct feed must be provided to the birds whether they are breeder birds, growing pullets, or laying birds.

Another strong link exists between the feed unit and the financial operations unit of the firm. The feed unit must work closely with all three subunits of financial operations (accounting, data processing, and purchasing). Orders for feedstuffs must go through purchasing. When a

feed delivery is made to a particular flock of birds, the feed unit must inform accounting so that the flock can be charged for the feed. As the result of any interaction, data processing has to be informed so that account files and inventory data bases may be updated.

Decisions made by the general manager of the feed unit are tactical in nature and affect the operations of the firm for an extended period of time. A decision by the general manager to not make pelleted feed, or not deliver feed in bags, or not deliver feed in less than ten ton units could have a marked effect on the flocks for which the feed is made.

The general manager of the feed operation must make sure that orders for feed are correctly formulated, that feedstuffs are stored properly, that mixed feed is delivered promptly, and that feedstuffs are purchased at the lowest price (in conjunction with purchasing). If these things are not done, the firm can be affected for an extended period of time.

The computer can be an effective aid to the general manager in feed formulation, making purchasing decisions, and projecting the future needs for feed by the firm. Any of these uses calls for specific applications software which must be designed with the specific use in mind. Since feed formulation is fairly standard from one firm to another,

software for feed manufacturing may be available from a vendor or from a Land Grant university. Software is used by the manager of the feed operation in describing the current state of the unit, diagnosing what is wrong, predicting future uses and needs for feed and ingredients, and prescribing possible solutions to a problem.

4.4.2 Feed Formulation and Storage

This subunit of the firm is in charge of the manufacturing and mixing of feed, and the storage of feedstuffs in such a way that they maintain their nutritional value. Decisions made by the manager of this subunit of the firm are operational in nature and will have to be made on a day to day basis. Decisions made by the manager will involve making sure that the correct feed formulation is used in mixing an order of feed, that the correct feedstuffs are used, that the general manager of the feed unit is notified as to which feedstuffs in inventory are in short supply and need to be ordered, and that the feedstuffs in inventory are stored correctly to avoid mixups.

Information to aid in the decision making process is generated from within the subunit in the form of daily operating information such as the amounts and types of feed

which must be mixed, what feedstuffs are involved in the formulation, and the state of the inventory of individual feedstuffs. Information also comes from the general manager of the feed unit in the form of new feed formulations, orders for feed, and substitutions of one feedstuff for another.

The computer can be an aid in the decision making process particularly as an information keeping tool for the manager of the feed mill. The computer, with data base management software, can be particularly adept at describing current inventories of feedstuffs so that the manager can know which feed ingredients are on hand. The computer can be used to store different feed formulations so that they may be prescribed in the future in response to new parameters put forth by the general manager of the feed operation. If none of the feed formulations which have been stored are suitable, the computer can be used with feed formulation software to develop new feeds using different feedstuffs or feeds with different nutrient limits.

4.4.3 Feed Delivery

This subunit of the firm is involved with the prompt and timely delivery of feed for the adult birds and growing pullets which are owned by the firm. Problems which must be solved by the manager of this area of the firm are

operational in nature and are involved with the day to day running of the feed delivery unit. The problems involve feed delivery, truck routing, and truck maintenance. The problems associated with feed delivery involve getting the correct amount of the correct feed to the correct flock at the appointed time. In truck routing the manager must be concerned with the delivery of a maximum amount of feed for a minimum number of miles driven or a minimum amount of time. If the manager sees that two batches of the same feed are to be delivered on a particular day to two separate facilities, it is likely that by delivering both batches in one trip some effort may be saved. The manager must be sure that scheduled truck maintenance takes place in a preventative effort against costly breakdowns, and should they occur, the manager must make sure that breakdowns are fixed as promptly and as efficiently as possible.

Information comes from the general manager in the form of feed type, batch size, and delivery destination. This information is used along with internal information on destination distances and other feed orders for identical feeds in order to arrive at truck routing schedules which do away with duplication of effort, thereby reducing the cost of the operation of the firm. Other information generated within the feed delivery unit involves the truck maintenance schedules which the manager will follow.

Data base management software can be used by the manager of the feed delivery unit for keeping truck maintenance schedules and truck histories. Specific applications software can be designed (or may be available from a vendor) for least cost truck routing to either minimize the numbers of miles driven, or the amount of time needed, per ton of feed delivered.

4.5 Egg Production

The function of the egg production unit is to provide the eggs which the firm will process and attempt to sell in the marketplace. The egg production unit consists of a number of separate flocks of varying ages and stages of production, which are located on one or more production sites. The firm hierarchy will contain a general manager of the egg production unit whose duties will include coordinating the activities within the egg production unit, itself, coordinating the activities of the egg production unit with the activities of the other units of the firm, and coordinating the activities of the egg production unit with the long range plans of the firm, as a whole. Each flock (or group of flocks in an egg production complex) will have a manager who must oversee the operation of the production unit and ensure the well being of the birds.

4.5.1 General Manager of the Egg Production Unit

The general manager of this area of the firm is in charge of coordinating the activities within the egg production unit, and coordinating the activities of the egg production unit with the rest of the firm. Information flows exist between the general manager and each of the production units which make up the egg production area of the firm.

The general manager of this unit of the firm has informational ties with each of the other areas of the firm in an effort to coordinate the needs of the egg production unit with the production of the hatchery unit, to coordinate the needs of the egg production unit with the production of the feed unit, and to coordinate egg production with the needs of the egg processing and marketing facility. The general manager must make future pullet replacement needs known to the hatchery unit, the need for feed known to the feed production unit, and expected egg production numbers known to the egg processing and marketing facility so that that area of the firm can plan its own workings.

The general manager of the egg production unit also maintains a strong informational tie with the general manager of the firm. If the firm's long term plans involve

expansion, the general manager of the egg production unit needs to be involved in the planning. This flow of information is chiefly outward moving, toward the general manager of the firm, and contains the information which the general manager of egg production feels is the best way to expand production. This information is used by the general manager of the firm in making the strategic decisions involved in expansion.

Decisions made by the general manager of the egg production unit are tactical in nature. These decisions affect the firm for an extended period of time. Decisions such as whether or not to molt a particular flock, or to what level should the protein in a flock's feed be adjusted, or should the firm try intermittent lighting with a flock are all examples of the types of tactical decisions which the general manager has to make. In many cases the decisions to be made involve interactions with the other areas of the firm; this is the case if the general manager decides to lower the protein level in a flock's feed and has to let the feed production unit know of the decision.

The computer can best function as an aid to the general manager of egg production through its ability to keep production records, make production projections, and compare current and past production records to each other and to some set standard. Production records for each flock can

best be recorded with the aid of data base management software. This type of software will allow the manager to keep a great deal of information on each flock. Such information items as egg production, mortality, feed and water consumption, current feed specifications, vaccination and medication histories, etc., can all be recorded with this type of software and can later be used in the decision making process.

Production projections and comparisons between current and past production, or between actual production and a standard, all need specific applications software. This type of software will probably not be available to the firm from a vendor, and its design will have to be contracted out to a programmer. If the software will be used by the general manager often in his decision making, the cost will be worthwhile and the manager's decision making abilities will be enhanced.

4.5.2 Egg Production Flocks

The manager of each egg production flock is in charge of maintaining an environment which will enhance the production of the firm's laying hens. The flock manager must be familiar with the everyday happenings within the flock in order to realize the presence of a problem and act upon this realization.

Two types of information flows help the manager in his decision making. The first type of information used is that which is generated within the flock. Such items as egg production, mortality, temperature, air flow, and feed and water consumption fit within this area and help in the day to day operations of the flock.

The other flow of information comes from the general manager of the egg production unit. If mortality is higher than should be expected, the general manager should arrive at a solution to the problem and give directions to the flock manager on how to effect a remedy. A similar process will take place if the egg processing unit should inform the general manager that the quality of eggs from a particular flock is much lower than should be expected.

Decisions made by the flock manager are operational in nature and deal with the day to day layer flock management. The computer can be of benefit to the flock manager chiefly as a storer and retriever of information. Data base management software is ideal for this purpose and should be readily available from a vendor. By using this type of software, and by setting up the data bases correctly, the flock manager should be able to store information easily and quickly, and then retrieve it at a time when the information can be used in the decision making process. If data base management software is not available to the flock manager,

applications software programs will have to be developed which will allow the collection and use of flock management figures.

4.6 Egg Processing and Marketing

The egg processing and marketing unit of the firm must put the eggs in the final form in which they will be purchased by retail consumers, make the eggs available to the market at which they are targeted, and deliver the eggs to that market so that they may be consumed. This unit of the firm consists of four subunits, each of which takes on a different function. The subunits are egg assembly, egg processing, egg marketing, and egg delivery. Each subunit of the egg processing and marketing division is headed by a manager who oversees the operations of that subunit. The operations of the egg processing and marketing unit, as a whole, are watched over by the general manager of the unit.

4.6.1 General Manager of the Egg Processing and Marketing Unit

The function of the general manager of egg processing and marketing is to coordinate the activities of the subunits of this division, coordinate the activities of this division with the activities of the other divisions of the firm and coordinate the activities of this division with

the over-all operating of the firm. The general manager is directly answerable to the general manager of the firm, and on the same plane of the firm's hierarchy with the general managers of the other divisions.

Decisions made by the general manager of egg processing and marketing are tactical in nature and serve to enhance the general flow of the workings of this operation, alone, and within the firm, as a whole. Examples of the decisions to be made by the general manager of this division would include the decision to pack eggs for retail in two-dozen cartons or the decision to purchase two 70 case per hour egg packing machines rather than one 140 case per hour machine. In either case, the decisions made by the general manager will affect the firm for an extended period of time.

Flows of information exist between the general manager of the egg processing and marketing unit and the general manager of the firm, the general manager of this unit and the general managers of the other units of the firm, the general manager of this unit and the managers of the subunits over which he presides, and the general manager of this unit and information sources from outside the firm. All of these information flows will aid the general manager of this unit in decision making, or aid the other managers of the firm in their decision making.

The computer can be of use to the general manager of

the egg processing and marketing unit as an aid in projecting and planning the future workings of this unit of the firm, and as a tool for comparing the present performance of the unit with past performance or expected performance standards. Software for making comparisons between present performance and some other performance standard, and software which can aid the general manager in making plans for the future of this area of the firm, will more than likely be applications software which will need to be designed specifically for the needs of the general manager of the unit.

4.6.2 Egg Assembly

In the modern integrated egg production firm, which is often characterized by an egg processing plant situated at the same location as the egg production facilities, the egg assembly function is minimal and can often be done away with as a separate entity within the firm hierarchy. If the egg assembly subunit does exist, its function will be to bring the eggs together from several widely scattered locations, to one central point, at which time their care will be turned over to the egg processing subunit of the firm.

The manager of the egg assembly subunit is an operational decision maker. The problems dealt with, which

will have to be acted upon, concern the day to day operation of this subunit of the firm. The problems with which the manager must be involved include egg assembly, truck routing, and truck maintenance. The problems associated with egg assembly involve getting the eggs from the production unit to the processing plant promptly and with no detrimental effect on their general quality. In truck routing, the manager must be concerned with bringing together the maximum number of eggs at minimum expense. Lastly, the manager needs to be sure that scheduled truck maintenance takes place in a preventative effort against breakdowns.

Information used in the decision making process comes from the general manager of the unit, and is used to coordinate the actions within this unit of the firm. This information takes the form of expected egg numbers and pickup locations. This information is used along with information from within the subunit concerning distances to the pickup location and other egg pickups within the same general location to develop a truck routing scheme. Other information used within this subunit will involve the truck maintenance schedules which the manager will need to follow.

Data base management software can be used by the manager of the egg assembly subunit for keeping truck maintenance schedules, truck histories, and egg pickup

locations and distances. Specific applications software will need to be designed for least cost truck routing. Least cost truck routing software may be available from a vendor.

4.6.3 Egg Processing

Egg processing receives the eggs from the egg assembly subunit and processes them into a form which will be acceptable to the consumer. The egg processing subunit of this division of the firm is headed by a manager who oversees the day to day operating of the subunit and helps to ensure that operations take place in a smooth and orderly manner. The manager of this subunit is directly answerable to the general manager of the egg processing and marketing unit and will involve the general manager in solving any problems other than those dealing with day to day matters.

Information to help in the decision making process is generated within the subunit in the form of production figures, data related to the operating of the processing machinery involved, and egg cooler inventory figures. These data can be stored and then retrieved to be used in the decision making process with the help of data base management software.

4.6.4 Egg Marketing

The function of the egg marketing subunit of the firm is to find buyers for the firm's product at the best possible price. The manager of this subunit will need to be concerned with the number of eggs available to be sold, the price of eggs, established customers, new accounts, marketing strategies, and sales efforts. In a very large integrated egg production firm, this subunit may become an entity separate from the egg processing unit, and the manager of the egg marketing subunit may become the general manager of a division of the firm with managers in charge of each of the marketing functions.

In this case, however, the manager of the egg marketing subunit is an operational decision maker and is concerned with the day to day functioning of this subunit of the firm. Problems which must be solved include finding buyers for the eggs which have been produced and processed in other areas of the firm, getting the best possible price for the eggs produced, overseeing the sales and marketing staff, and working with the general manager to develop new marketing strategies to allow the firm to increase its market share or increase the egg price achieved.

Information used in the decision making process comes from the general manager of the unit in the form of figures on the number and size of eggs available for sale at any

given time. Information generated within the subunit, itself, includes feedback from the sales staff, orders placed for eggs, and egg prices actually achieved. The egg marketing subunit relies more heavily on information from outside the firm in its decision making than do other subunits within the firm. Pricing information comes in in the form of Urner-Barry reports or government publications. Feedback from customers through this subunit gives the entire firm some idea of the quality of the job that it is doing.

The computer can be an effective tool in the management of the data used in the decision making process. Data base management software can be used to keep track of individual sales by the customer, salesman, size of the sale, egg size breakdown, price, and feedback from the customer in connection with the individual transaction. At any time, the data can easily be retrieved and used in the manager's decision making. Telecommunications software can also make the small computer an important tool to the manager of this division. Since this division relies heavily on information from outside the firm, the computer can play an important role in data collection.

4.6.5 Egg Delivery

The egg delivery subunit of the firm receives the eggs

from the egg processing subunit and delivers them to a customer who has purchased the eggs through the egg marketing subunit. The manager of this subunit is an operational decision maker and is concerned with the day to day operation of this area of the firm. Problems with which the manager must deal involve transporting the firm's finished product to the customer promptly, safely, and with no detrimental effects to quality, delivering a maximum number of eggs per unit of expense, and maintaining the trucks used by the subunit of the firm in a condition which prevents breakdowns and assures the maximum useful life of the asset involved.

Information used in the decision making process includes information from the general manager of the unit on delivery locations, and egg shipment sizes and dates. Information generated within the subunit would include truck maintenance schedules, truck histories, distances to delivery locations, and other accounts in the same general area. Customer location data can be used in routing trucks in a manner that reduces the cost to the firm.

Data base management software can be used to keep track of truck maintenance schedules, and to keep track of truck histories. Specific applications software must be developed which can provide the manager with truck routing schedules which allow the delivery of a maximum number of eggs with a

minimum number of miles driven or a minimum amount of time used. Truck routing software may be available from a vendor which will fit the needs of the egg delivery subunit. If truck routing software is not available to the firm, the firm can have a truck routing software package developed which will be useable to all three of its transportation related subunits (feed delivery, egg assembly, and egg delivery).

Chapter 5

SUMMARY

The fully integrated egg producing firm is made up of a number of units, each specializing in a different phase of the firm's production process. Each of these units is made up of several subunits which break that unit's main functions up by major task. At the head of each subunit is a manager who is in charge of making the decisions associated with the operation of that subunit of the firm. These managers must oversee the activities within each of their respective subunits and make sure that each of these subunits performs up to the firm's expectations.

At the head of each of the units of the firm is a general manager. The general manager's duties include coordinating the activities between the various subunits within the unit, and coordinating the activities of the unit with the activities of the other entities of which the firm is made. The general manager of each of the firm's units must be concious of the types of decisions made in each of the other areas of the firm in order to better coordinate the interactions between the unit and these other areas of the firm.

The general manager of the firm is responsible for guiding the firm's long term functioning and operation. Duties of the general manager of the firm include making sure that a coordination of activities exists between the different units of the firm and planning the future growth of the firm, whether that future growth takes the form of the expansion of existing facilities or movement into other areas of the production/marketing process.

The firm is thus managed by three different levels of decision makers, the general manager of the firm, the general manager of each production unit, and the manager of each production subunit. Decision makers within each level need to make similar types of decisions in fulfilling their management duties. Since many of the types of decisions to be made are similar, they can be categorized by type. The three categories into which the decisions to be made within the firm can be placed are strategic, tactical, and operational.

Strategic decisions guide the long run operation of the firm. Decisions which are made in conjunction with planning the future course of action which the firm must take are strategic decisions. These decisions would include those dealing with the firm's expansion, movement into different areas of production, movement out of an area of production, or the decision of whether or not to move out of the

production process, altogether.

Strategic decisions are very difficult to reverse without having negative effects on the firm, if the decision maker discovers that a mistake has been made. For this reason, the general manager of the firm must exert special care in choosing the correct alternative from all of the possible courses of action which might be taken. In choosing the correct alternative, the general manager must rely on management skills, information from managers at a lower level of the firm, and information extraneous to the firm, itself. Since it is imperative that the general manager choose the correct alternative, information from others within the firm and information from outside of the firm become especially important in the decision making process. The greater the amount of pertinent information which the general manager has to work with, the greater are the chances of choosing the correct alternative.

The small computer can be a great deal of help to the decision maker, at this level, through the gathering and manipulating of information which can be used as an aid in the general manager's problem solving task. Projections and simulations can be used to manipulate information and present it in a form in which it might be used in decision making. Of particular importance to the manager are financial simulations which can be used in investment

decision making. Computer worksheet software also may be helpful in this area. Information can be gathered by the computer from outside of the firm through the use of telephone connections and telecommunications software. This information can be used by the general manager in decision making.

Tactical decisions affect the firm for an extended period of time. This time period may vary from several days through one or two production cycles. Tactical decisions are more easily changed than are strategic decisions, and the effects of a mistake in decision making will not be as great, nor will they be as long lasting as are the effects of a poorly made strategic decision. Tactical decisions are made at the middle level of firm management, by the general managers of the various production units.

Tactical decisions would include those made by the chief financial officer concerning the financing of a particular project, those by the general manager of the hatchery unit concerning the coordination of breeder flock placement with the future need for hatching eggs with the future need for started pullets by the egg production unit of the firm, and that by the general manager of the egg processing and marketing unit to purchase two 70 case per hour egg packing machines rather than one 140 case per hour egg packing machine.

Tactical decisions are made based upon the problem solver's store of management skills, information from other areas of the firm, and information from outside of the firm. Information from outside of the firm is less important, and a reliance on the manager's store of management skills is more important, to the decision making process than was true in the case of the general manager of the firm.

The computer can be used by the managers of this level of the firm as a tool in planning, by making projections and simulations, and by making comparisons between the actual performance of a particular unit and what is expected. Here, the value of the computer is as a manipulator of information. The computer manipulates the information and presents it in a form in which it might be used in the decision making process. The small computer can also be used in making those financial decisions which the manager of this level must make. Capital expenditure analysis software can advise the manager of the financial attractiveness of a potential investment which he may make.

Operational decisions are made on a daily basis by the managers of the individual production subunits of the firm. They are very short term in nature (daily), and once made are easy to reverse. Typical operational decisions would include decisions as to whether or not a laying house is too warm or has too high a concentration of ammonia in the air,

whether or not a truck engine needs to be overhauled, or whether or not the temperature and humidity within an incubator unit are correct for embryonic development.

In making operational decisions, the manager relies on information from a store of management skills, information from the general manager of the division of the firm, information from within the subunit, and on information from outside of the firm. Information coming from outside of the firm is far less important and information coming from the problem solver's store of management skills is far more important to the manager, at this level of the firm, than is true with managers at a higher level.

The small computer can be important to the manager as a storer of information. Once stored, the information should be able to be easily retrieved to be used in the decision making process. The use of this stored information takes the form of as a comparison between the present performance of the subunit and some expected performance standard. By using this information the manager may be able to discover a deviation from the normally expected performance of the subunit, and take some form of corrective action.

The computer can also be used in the scheduling of daily activities. By allowing the manager to see, on any given day, those duties which are pressing, the computer can make the manager more effective in the use of time. The

computer can also serve the manager as a reminder of the jobs which are easily neglected or postponed.

Table 13 summarizes, by level of management, the different types of decisions to be made within the firm and the informational and software needs for making these decisions.

Table 13. Decision Types and Examples, Information Needs, and Software Needs by Level of Management of the Integrated Shell Egg Producing Firm.

	Level of Management		
	Upper (Firm Genrl Mngr)	Middle (Unit Genrl Mngr)	Lower (Subunit Mngr)
Type of decisions made:	Strategic (Long Range)	Tactical (Intermediate Range)	Operational (Short Range)
Examples of decisions:	Expansion of existing facilities. Movement into (or out of) other areas of production/marketing channel. Decisions dealing with long range operation of the firm.	Decisions to coordinate opervarious subunits. Decisions to coordinate operof unit with units of the firm. Breeder flock, layer flock placement decisions. Decisions affecting intermediate range market strategies.	Decisions about daily operation of subunit. Hse environmental factors. Decisions about whether or not facility is functioning up to the expected.
Information needs:	Relies heavily on information from managers at lower levels and information from outside of firm.	Relies on information from above and below in firm hierarchy, on information from outside of firm, and on own store of management skills.	Relies on information from managers at higher levels of the firm, and on information from store of skills.
Software needs:	Telecommunications software for gathering information. Worksheet software for manipulating and presenting information for making decisions. Application sftwr.	Telecommunications software for gathering information. Database mgmnt software for recording and manipulating data. Worksheet sftwre for presenting and manipulating data. Applications sftwr.	Data base man agment software for storing and manipulating daily flock management figures. Specific applications software designed to serve as acalendar

Chapter 6

CONCLUSIONS AND COMMENTS

This dissertation set out to satisfy three main objectives. The first objective was to identify the type of decisions which must be made at different levels of the integrated egg producing firm. The second objective was to identify the types and flows of information needed to make each of the types of decisions, at each level of the firm hierarchy. The third main objective of the dissertation was to identify the possible uses of the computer in the firm's decision making process.

Decisions made within the firm can be separated into three categories which are grouped by the period of time over which the decision will affect the firm. The three decision types are strategic (long range decisions), tactical (short to medium term decisions), and operational (daily decisions).

Each of these three types of decisons is closely tied to a particular level of the management of the firm. Strategic decisons are made by the firm's general manager. Tactical decisons are made by the middle level of management of the firm. This level of management consists of the general

managers of each of the production units of the firm. Operational decisions are made by the lowest level of managers of the firm, the managers of the individual production subunits.

Whereas each of the three types of decisions is tied closely to one of the levels of management of the firm, it is not unforeseeable that there will be some interchange of decision making duties within the normal operating of the firm. It is not unexpected that the general manager of the firm will need to make some operational decisions in the course of managing the firm, or that the general manager of the egg processing and marketing unit, for example, will have to make some decisions which border on the strategic decision classification. It is not expected, however, that a manager at the lowest level of firm management will ever have to make a strategic decision in conjunction with the operation of the subunit of the firm.

The types and flows of information used in the decision making process differ by type of decision, and by level of decision maker within the firm. The general manager of the firm, who is involved in strategic decision making, relies heavily on information from the general managers of each of the production units and on information from outside of the firm. The information from sources external to the general manager's own store of management skills is used in

selecting the correct alternative in the decision making process.

The general managers of the production units also rely on information from elsewhere in the firm (from the firm general manager level, and from the managers of the individual production subunits), information from outside of the firm, and on information from the general managers' stores of management skills in aiding in the decision making process.

The individual managers of the various subunits of the firm rely on information from above them in the firm hierarchy (information from the firm general manager comes down, indirectly, through the production units' general managers), information from outside of the firm, information from within the production subunits, themselves, and information from the managers' stores of management skills to aid in choosing the correct alternative solution to a problem.

The degree of a decision maker's reliance on either outside information or information from the decision maker's store of management skills varies by the level of the decision maker within the firm. The general manager of the firm relies much more heavily on information from other managers within the firm and on information from outside of the firm, in making the correct decision, than do the

general managers of the production units and the managers of the individual production subunits. Similarly, the managers of the production subunits rely more heavily on their own stores of management skills in making decisions than do managers at a higher level of the firm hierarchy.

Computer usage as an aid in the decision making process varies by level of the firm. The general manager of the firm can best use the computer as an information gatherer and as a manipulator of information. Projections and simulations tell the general manager how, given a set of parameters, the system should act. If the simulation correctly manipulates a number of variables which have been accurately input, the simulation should be accurate and of a great deal of value to the decision making actions of the general manager.

Computer usage at the middle level of firm management takes the form of projections and simulations which allow the manager, at this level, to chart the expected performance of the unit and decide whether or not the actual performance differs significantly from the expected. Projections allow the general manager of the production unit to plan future production around the needs of the unit, or other units with which it must associate.

At the lowest level of firm management, the computer can be used chiefly as a storer and/or comparer of information.

If daily production records are kept on a flock of laying hens, the manager should be able to retrieve past information pertaining to the flock, and then compare it to present production or to some production standard. The manager, at this level of the firm, can also use the computer to aid in the scheduling of daily activities within the manager's subunit.

The fully integrated egg producing firm is a complex, ever changing entity which must depend on the unencumbered flow of information for use in the decision making process. Since the firm is so changeable, sometimes the flows of information between different decision making entities within the firm can be slowed. When this happens it is impossible for the firm to react to a situation in a manner which will allow for the avoidance of a problem or for the taking advantage of a positive situation. Because the flow of information is so important to the efficient management of the firm, the managers within the firm should be concerned with encouraging and enhancing this flow. The computer can best be used in firm decision making as an aid in encouraging and enhancing this flow of information.

APPENDIX

Small computer systems can play an important role in both the production and economic management of an egg producing firm. The computer can be used by managers to obtain, store and manipulate information which can be used in decision making. This appendix will explore the decisions which must be made in the egg production unit of the integrated shell egg producing firm, the information needs for decision making, and how the small computer can be used.

There are three broad categories into which the types of software which will be used with the small computer can be classified. First, there is operating System and System Utilities Software which is used to direct the action or operation of the small computer and its peripheral devices, to make the computer operate more efficiently. This includes operating systems, themselves, which include several brands and types, and system utilities such as telecommunications software.

Second, is Widely Functional Software which provides the user with the ability to make use of the small computer without having to develop software for a specific function. Widely functional software includes database management software, word processing software, and computer worksheet software.

The third type of software is Specific Applications Software which is written for a given problem situation and whose design is dependant on the particular questions which must be answered. Included in this category is financial management software such as accounting software, cash flow projection generators, and capital expenditure analysis software; and poultry management software which can generate flock production records, compare production records to some standard, or project flock production for some period in the future.

In many cases, especially with flock production management, the computer will act as a storer of information. Records should be kept by the manager which concern many of the factors used in decision making. Records which might be maintained concerning the eggs produced include egg numbers, egg quality, shell quality, and egg size. Records which concern feed include feed consumption, and consumption of various nutrients and ingredients (protein, energy, water, calcium, amino acids). The manager might also record environmental information such as house temperatures, air movement, and humidity. Mortality, disease histories, vaccination histories, and vaccination schedules should be maintained by the manager to use as a guage of flock health.

All of this information can be recorded and stored using

either database management software or applications software which has been designed specifically for the purpose of creating a data base. Database management software is nearly ideal for storing and manipulating this sort of information. If specific applications software is used, the manager should be prepared for the large investment in time and money needed for the design of software to do the task.

The computer can also act as a storer of information which pertains to the economic management of egg production. Records can be stored which involve costs and incomes incurred in the management of the flock. Egg prices (including prices by size), egg receipts, and spent hen receipts can be stored. Cost information which includes feed prices, costs of supplies, utilities, insurance, labor, pullets and depreciation can all be stored and utilized at some later time in the decision making process. Here, again, for storage of information, database management software is nearly ideal.

Once the types of data to be recorded have been selected and the data base set up, then information can be generated and used for decision making. If the data base is set up correctly, current figures can be used in conjunction with past figures, or figures which represent some standard of production, to act as a guage of the performance of a particular flock. If current production does not meet

expected performance, then it is possible that the manager may be able to remedy the situation.

Database management software has limited application in manipulating data such that it can be used. Applications software, which deals with the generation of production figures from raw data in such a way that they might be used in decision making is probably more applicable to this type of work.

For example, if yesterday's production figure from a flock of birds was 60 eggs and the initial flock size was 2000 birds, this is only 30 percent production (on a per hen housed basis), and does not seem very good. If the mortality, to-date, on the birds in the flock has been very high, and only half of the original flock has survived, then the hen day production figure is 60 percent. The 60 percent hen day figure seems much better than 30 percent hen housed, though 60 percent still does not seem like very good egg production. If the production age of the bird is noted to be 52 weeks of lay, however, the 60 percent hen day production figure seems very close to what should be expected.

In another case, a 60 percent hen day production figure is about five percent below that which the strain standards indicate should be the case. This could be a signal that there is some problem with the flock that could be corrected

by a change in management procedures. If, however, data indicates that the flock has historically produced at a rate of about five percent below the expected, then it can probably be assumed that there is no deviation from the flock's normal performance, and therefore no problem (or the problem is such that there is no immediate solution-- poor water quality, insufficient ventiliation, crowding, etc.).

In each instance the value of the information to the decision making process came from the comparison of a current production figure to some other figure. This allowed the current figure to be guaged as to the presence of a possible problem.

The computer would serve, in this situation, as a manipulator of information. The number of eggs the flock produced did not provide much information as to the performance of the flock, when used by itself. When used with the number of hens housed, and the number of hens surviving, to calculate hen housed and hen day production figures, much more meaningful (to the decision making process) information was generated. In addition to this, when these flock production figures were compared to information about expected egg production based on the age of the flock, the 60 percent hen day production figure no longer seemed to indicate the presense of a problem.

The following is a list of flock management information which should be recorded, with a description of how each piece of information will be used:

Management Information	How Information will be Used
Current Date	Used to guage currentage of birds, current production period.
Date Beginning Production	Used with current date to calculate current age of birds and current production period.
Age of Flock Week of Production	Used to compare current performance of flock to expected performance as set by some standard of procuction.
Hens Housed	Used to calculate production figures to be expressed on a "per hens housed" basis.
Mortality	Used to calculate percentage mortality (current and to-date), number of "hen days" (current and to-date). Compare mortality figure to past flock performance to determine if different from long term. Compare mortality to strain standard for same age flock.
Pullet Weight	Use as guage of health of bird, presense of problem with over eating. Compare to standard of body weight for flock of same age and strain. Used with spent hen price per pound to calculate expected spent hen receipts.
Egg Production	Calculate "per hen housed" and "per hen day" egg production figures. Compare current figure to past flock performance. Compare to strain standard for same age flock. Will be used in calculating costs on per dozen basis.

Egg Size Distribution	Compare to past production or to strain standard to determine if distribution meets expectations. Distribution will be used with egg price per size to calculate egg receipts.
Checks, Loss, and Undergrades	Compare to past production and to strain standard. Variation could indicate problem, past disease problem, warm temperatures, or age of flock.
Feed Consumption	Calculate feed conversion per dozen eggs, feed consumption per bird. Compare to past performance and to strain standard. Variation could indicate problem such as illness, extreme environmental temperature, or incorrect energy composition of feed.
Estimated Nutrient Intake	Intake of various nutrients such as metabolizable energy, calcium, and methionine can help to diagnose a feed related problem if egg production,egg quality, or feed consumption figures indicate that a problem exists.
Disease/Vaccination History	A disease history of the flock may explain some of the flock's problems which are indicated by poor egg production, egg quality, or feed conversion. A vaccination history may indicate that the time has come for revaccination of the flock.
Environmental Factors	Environmental factors, such as house temperatures or air flow through the house, may help to explain or diagnose problems which exist with the flock.

Database management software can be used to store financial information generated by the egg producing firm. This information then will probably need to be manipulated in some way such that it can be used. This manipulation may be through the use of applications software designed to perform accounting functions such as payroll, billing, check writing and report generation; through worksheet software which allows the user to answer "what if" questions; or through applications software designed to aid in financial decision making.

The accounting functions are fairly standard. Because of this, software to perform these functions should be available from many vendors. The particular accounting software package which is purchased will probably depend on the compatibility of the package with the small computer, and on how well a given software package meets the user's needs.

Minor projections and simulations can be done very quickly with computer worksheet software. This software is relatively easy to use, available from a vendor, and can be easily programmed. This software allows the user to easily answer questions which pertain to the resultant change in one variable due to the change in another (sensitivity analysis). An example would be taking note of how the firm's projected profit status would change as a result of a

change in either egg prices or feed costs.

Other software for financial decision making includes software for doing simulations and projections, software for analysing investment attractiveness, and software (other than accounting software) which pertains directly to the financial status of the flock. This last type of software would need to be designed to utilize both flock management figures (egg production figures, mortality, flock age, feed consumption, etc.), and flock financial figures (egg income, pullet prices, feed prices, and other production and housing costs and incomes) to calculate flock financial information such as egg income per bird, per dozen, per period, or per flock-to-date. Any of these figures which have been calcualted can be used as a guage as to the flock's financial performance.

The following list presents flock financial information which should be recorded, and tells how this information can be used:

Financial Information	How Information will be Used
Egg Prices	Will be used in conjunction with egg production figure to calculate egg income, if eggs are sold on a "nest run" basis. An egg price breakdown by size would be needed for use along with an egg size distribution if egg income is not calculated on a nest run basis. If egg price consists of a "per-dozen" contract payment, this figure could be used for calculating egg income. Egg income figures should be maintained for the current period and for flock-to-date.
Spent Hen Price	Used in conjunction with weight and number of spent hens sold to calculate income from sale of spent hens.
Feed Cost	The feed price per ton will be used with the number of tons consumed for calculating total feed cost on both current period and flock-to-date bases. These figures will then be used with egg production figures and bird numbers to calculate feed cost per dozen and feed cost per bird.
Pullet Cost	The cost of pullets should be allocated such that the cost of the pullets is spread out over the entire laying period. This may be done on a per dozen basis, per week of production, by percent of total expected eggs, or by some other method.
Other Costs	Other costs (housing and equipment, utilities, labor, insurance, taxes, supplies, packing materials, trucking and miscellaneous) should be calculated on both a per dozen and on a flock-to-date basis. These cost figures will be added to other cost figures to arrive at total production costs. These total production costs then will be subtracted from total receipts to arrive at net receipts figures for the flock--both per dozen and flock-to-date.

A specific example of how the computer can be used in the manager's decision making can prove the usefulness of the small computer in poultry firm management. The decision of whether or not a particular flock should be molted and allowed to produce through a second egg production cycle is a good example.

The manager must isolate several pieces of information before the decision can be made. One type of information to be isolated is that which can be obtained from the flock's own production records; flock age and flock history are good examples. If the flock is too old at the time of molting, the increase in egg production and the increase in egg shell quality may not be sufficient (or of sufficient duration) for the recovery of costs incurred during the molt rest period. The flock's history, the performance of the flock during the first laying cycle, will be indicative of the expected performance of the flock during subsequent laying cycles. Thus, a flock which has been an average producer or has experienced higher than normal daily mortality can be expected to continue in the same manner.

If the computer has been used throughout the flock laying cycle, the manager should be able to tell (with no additional calculations) the age of the flock and the flock's past performance. In addition, the capability of the computer (if the software to be used has been so

designed) to compare past performance to some standard (strain, company, or based on the usual performance of flocks housed in that particular building) allows the manager to make a decision as to whether or not past production trends indicate that the flock should be molted and allowed to continue through another production cycle.

If trends indicate that the flock should be considered for molting, then the computer should be used to make a flock production simulation. The software used will have been designed to utilize a number of production parameters in order to project the expected production figures from the flock for the period of time following the molt. These production figures should include expected egg production (including size breakdown), expected mortality, and expected feed consumption. These figures will allow the manager to assess the expected performance of the molted flock.

Costs and incomes must be projected, also, for the molted flock. The expected price of eggs (by size), in conjunction with the expected egg production figure (by size) will give the manager an estimate of the total egg receipts to be expected from the molted flock. In the same way, summing all of the expected costs will yield a total cost figure. By subtracting the total cost figure from a summation of total egg receipts and any other receipts associated with the molted flock, the manager arrives at a

net receipts figure which becomes the real measure of the expected performance of the molted flock.

Even though molting the flock might significantly increase the percent production figure or the egg shell quality (and therefore, egg receipts), if the cost of production from the molted flock increases so dramatically that the increase in receipts is wiped out, the manager's decision would probably be very different than if only the change in production performance associated with molting was considered. Here, the flock molting decision is based on comparing expected performance of the molted flock to expected costs and incomes associated with production.

To this point, the manager's use of the computer in making the flock molting decision has been limited to storing and manipulating information to arrive at a specific net receipts figure. The computer has done nothing that the manager could not do; given that the manager had the time, a pencil, and a basic understanding of arithmetic. The computer's real advantage in decision making comes from the ability which it gives the manager to assess the performance of the molted flock, given a set of key assumptions. By changing one of these assumptions, by a measured amount each time, the manager can arrive at the solution which yields the greatest possible net receipts figure for the flock. The alternative solution yielding the greatest net receipts

figure will be the one chosen as the correct alternative by the manager.

Rahn (1977) used a computer model for strategic planning for commercial laying flocks. Holding all other laying flock production, cost, and price assumptions constant, the number of molted lay cycles (from zero to two) and the length of each cycle (from nine to fifteen for the pullet lay cycle, either zero or from six to nine for the first molt lay cycle, and either zero or six for the second molt lay cycle) was varied. The results of the simulations showed the maximum average net revenue from the option which consisted of only a pullet production cycle, which was fifteen periods long. If this were an actual flock molting decision, this is the option which would be chosen by the flock manager. Note that this is the correct option, given a set of unchanging production, cost, and income assumptions. If any of these assumptions should change, the resultant decision might be very different.

The uses of the computer in making a flock molting decision vary from storing and manipulating information, to projecting figures based on parameters selected as true estimates of future performance, to formulating a number of alternative solutions based on slightly different assumptions. These uses increase in complexity from the manager deciding whether to consider molting, to the manager

deciding that molting could have a significant effect on net receipts, to the manager deciding upon which flock molting alternative is the correct one. In all of these cases, the computer acts as a tool to present information to the decision maker such that the correct decision can be made.

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