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## EVALUATING MANAGERIAL EFFECTIVENESS

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## EVALUATING MANAGERIAL EFFECTIVENESS

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### INTRODUCTION

This research was motivated by a desire to develop computerized information systems and farm management tools adapted to the needs of small farmers. The level of adoption of such tools would depend upon their perceived benefits to farmers. It was hoped that by looking at how the computer benefited larger farms, inferences could be made for smaller operations. However, the studies available focused on qualitative and not quantitative benefits. Therefore, it was apparent that there was a need for research on the quantitative benefits of computerized decision aids.

Many of the computerized decision aids are merely computerized versions of the same decision aids advocated in the past by farm management professionals before the advent of microcomputers. Therefore, another approach explored was to examine research findings that had quantified the benefits of non-computerized farm management tools. However, this approach did not yield sufficient information in this area.

Since the subject matter information on quantified benefits of computerized or non-computerized farm management tools was not available, the next step was to determine how to develop such information. This led to a search for the appropriate methodology for determining the value of such tools. Focus now centered on the

literature pertaining to the value of information. Previous attempts at determining such value can be categorized into the bayesian approach, the production function approach, the residual analysis approach, and the experimental approach. However, none of these approaches seemed sufficient to determine the value of information or an information system in a multi-decision environment.

In the process of investigating the different approaches to measuring the value of information, it became apparent that there was a need to clarify the concept of "management" which is at the center of the measurement problem. Therefore, managerial behavior itself became a primary subject for investigation.

The major thrust of this research is to clarify and measure the concept of management as it relates to farm decision-making, to identify the areas of managerial effectiveness that can be measured, and to identify areas of managerial ability that can be tested.

### **Problem Statement**

In defining the role of a business or organizational entity Campbell, Dunnette, Lawler, and Welck (1970) have distinguished among the concepts of behavior, performance, and effectiveness. Behavior is simply what people do in the course of work. Performance is behavior that has been evaluated (i.e. measured) in terms of its contribution to the goals of the organization. Effectiveness refers to some summary index of organizational outcomes for which an individual is at least partially responsible such as profits, debt ratios and productivity. Most of the performance measures used by finance or business analyst are considered effectiveness measures by these definitions, while the behavioral aspects of performance are not generally considered. In other words, performance deals with how a manager gets the firm to a position that can be evaluated in terms of effectiveness measures.

The distinction between behavior, performance and effectiveness is important for

our investigation since in the short run a manager's behavior may change without immediate results being measured by performance or effectiveness of the organization. That is, many external factors affect the outcomes of the farm system.

Therefore, to thoroughly evaluate the benefits of an improved decision-making system we should measure the manager's decision-making behavior and performance as well as relevant system performance criteria (effectiveness measures). While previous studies have developed performance measures of physical and financial status of a farm, less attention has focused on the difference between "right" and "wrong" decision-making behavior. Furthermore, the long time lag between action and result in agriculture makes it difficult to determine improvements in effectiveness measures unless considerable time has elapsed. However, if a combination behavioral/performance oriented measurement system could be developed that would give some indication of possible future effectiveness, such a measurement system or test could help in evaluating decision support tools and educational programs designed to aid the manager.

### **Behavioral Analysis**

Measuring the Effectiveness phase of the model is presented next. The output of the behavioral analysis is an instrument or test used to predict managerial effectiveness. By observing the decision-making behavior of the successful farmers, critical incidents of common behavior can be detected that can be used as indicators of success.

To develop an appropriate open-ended questionnaire for soliciting behavior, a set of the major decisions made by the manager must be developed. Information for such a set could come from previous studies on decision-making, extension personnel, or by observing farmers' decision process. The questionnaire could be developed around key decisions to obtain information on how the farm managers solve problems. The questionnaire is open-ended to allow for as much farmer input as possible without leading

them into preconceived ideas about how they should make decisions.

This evaluation process can produce a clearer understanding of the decision-making behavior of farmers along with getting a feel for what they use as criteria for evaluating effective management. Information on decision-making behavior can then be used to develop a more structured instrument to act as a test or managerial index designed to differentiate between "good" and "poor" managerial behavior and performance. Since the function of decision aids is to change managerial behavior, information on decision-making behavior is necessary for selection of proper aids.

Knowing the criteria farmers use in defining a successful manager is essential for testing the validity of an effectiveness measure. Therefore, one output of the system is the development of valid and reliable measures of managerial effectiveness.

### **Measuring Effectiveness**

This phase is designed to select and validate measures of managerial effectiveness. The major input in this phase is the farm type selected for analysis and the output is a set of measures that have been tested for coherence, workability, validity and reliability.

A major problem with selecting an effective measure is identifying a set of farmers with historical records that are both compatible and complete enough for further analysis. The effectiveness measure chosen must be a valid measure of performance. Of course, the measure chosen will depend on the type of farm analyzed and on whether the analysis is to be a cross-sectional comparison or a comparison over time.

Once a measure is chosen it must be further evaluated in terms of validity and reliability. Since one set of possible benefactors of the end product of measuring the value of decision aids is the farmers themselves, it is important that the measure be relevant to their value system. Therefore, information obtained from the open-ended questionnaire to the successful farmers should show how they evaluate the effectiveness

of another manager.

Other tests for validity could be statistical tests that check if the measure actually measures what it is posited to measure. In other words, a measure of managerial effectiveness should not be dependent on factors outside of the manager's control such as soil type or closeness to markets.

The measure should be reliable in that one should be able to replicate the measure and arrive at the same conclusions. Statistically, the test for reliability could be accomplished by seeing if the measure can classify managers into levels of effectiveness over an extended time, since one would expect the relative position of management abilities to be somewhat constant over time, unless severely disturbed by educational programs to change the level of management. Once a measure has been tested for scientific objectivity, it can be used to test the relationship between managerial behavior and effectiveness.

## **IMPLEMENTATION AND RESULTS**

### **Selection of Farm Type**

According to the 1985 Michigan Agricultural Statistics, field crops (grains, beans, sugar beets, etc.) accounted for 7.724 million harvested acres of the 7.939 million total crop acreage in 1984. In dollar terms field crops represented \$1.5 billion out of the total \$1.79 billion in crop receipts for the same year. The remaining crops are fruit, vegetables and specialty crops. Therefore, field crops ranked first by far in importance of the crops grown in Michigan. Cash receipts from cattle and calves were \$248 million in 1984 while receipts from hogs, sheep and lamb, poultry, and milk were \$203 million, \$4.6 million, \$29.4 million, \$724 million respectively. Therefore, as a category, field crop production ranked first in Michigan in terms of gross receipts.

Historical records on the farm system performance is essential for selecting the proper effectiveness measure by which a farm manager is evaluated. Some farmers keep

accurate records of their past performance; however, relying on records kept by farmers can pose some problems in terms of reliability and comparability. Fortunately, Michigan State University has an on-going farm recordkeeping system called TelFarm in which a number of cash crop farmers have participated in over the years. The records kept by TelFarm are based on standard recordkeeping procedures which allow for comparability across farms and over time. There are 84 cash crop farms which have continuously participated in the recordkeeping system from 1981 to 1984. The information available on these farms include: production performance such as yields, labor use and efficiency, and financial information such as net income, returns to assets and debt ratios. Therefore, the availability of this information makes the selection and analysis of effectiveness measures possible for farms primarily engaged in crop production.

The third criterion for selection is that the major decisions for the specific farm type can be isolated and analyzed. Fortunately, Hepp and Olson (1980) have investigated what were the important decisions made by Michigan crop farmers. This information can act as a basis for determining the decision-making system of crop operators to be used in the Behavioral Analysis phase of the methodology. However, the ability to isolate and analyze these decisions can only be determined through the actual implementation of that phase.

Therefore, crop farms are selected for implementation of the following phases of the analysis. The farm type selected is now used in both the Behavioral Analysis and the Measuring Effectiveness phases which follow.

### **Behavioral Analysis**

#### **Selecting Set of Successful Farmers**

Although the term "successful" farmer may be both ambiguous and subject to differing interpretations, one must start somewhere. The first step in the selection process begins with a tentative definition of what is a "successful" farm manager. In this



case "successful" manager can be defined as one whose farm seems to stand a better chance of survival while accomplishing both individual and family goals.

Michigan crop farmers are divided into two main categories based on topography and crop mix. Saginaw valley farmers have the opportunity to grow sugar beets, which is a high value crop, while other parts of Michigan produce grain crops. The majority of Michigan's cash grain operators are found in the lower half of the state. For these reasons it was decided to concentrate in two major areas - south central Michigan and the Saginaw Valley. Ingham County in central Michigan and Tuscola County representing the Saginaw Valley were selected based on location, accessibility, and willingness of Extension personnel and farmers to participate in the study.

Seventeen farmers were interviewed. One of the cash crop operators was a hybrid seed producer. Nine were chosen from central Michigan and eight chosen from the Saginaw Valley. The size of operations ranged from 400 to 4,600 acres for the 1985 crop season.

### **The Decision System**

Research has identified a number of important and often made decisions by farm managers. Important decisions as determined by Hepp and Olson (1980) include:

1. Purchase or rental of machinery and equipment
2. Repairing or building new buildings
3. What to plant
4. Whether to purchase land
5. Whether or not to rent land
6. Sale of land
7. Whether or not to expand
8. Whether or not to quit farming
9. Marketing the crops

The element of time is important in classifying decisions and determining the effect of such decisions. The above decisions can be classified according to their short and long run effects and the frequency that they are made. Determining what to plant, whether or not to rent land, determining prices and marketing can be classified as short-run decisions by the manager. The sale of land, expansion, and staying in farming are decisions which can definitely be classified as having long term consequences. Other decisions such as the purchase or rental of machinery and equipment have intermediate impacts on the business.

Since the goal of this analysis is to measure possible benefits of computer aided decisions, the question of comparability is important. It is more difficult to measure the effects of long run decisions because of both the non-recurring nature of such decisions, and the possibility of environmental or exogenous effects distorting such comparability. Therefore, the short and medium range decisions will be the focus for developing the measurement system.

With this in mind the areas of decisions explored by this study include:

1. Determining the portion of crops to produce
2. Adding a new crop or substantially changing the cropmix
3. Determining corn variety
4. Determining when to purchase inputs
5. Determining when to sell corn
6. Determining the adequacy of on-farm storage capacity
7. Estimating the price you expect to receive for corn
8. Determining whether to participate in government corn programs
9. Determining whether to purchase a piece of land
10. Determining how much to pay for rental land
11. Determining the need to replace equipment

### Design Instrument to Determine Behavioral Incidents

In the developmental stage of scale evaluation, analysis of the decision function was done by asking a set of questions for each of the decisions analyzed. This phase of the research can be considered a "fishing expedition", in that we are putting out a big net of questions to possibly retrieve only a few areas that may distinguish the better farmers from the rest of the pack. These questions included:

- A. What factors would a "good" decision maker in comparison to a "poor" decision maker consider in making this decision?
- B. What calculations would be appropriate for solving this problem?
- C. Do you spend a lot of time collecting and analyzing information for this decision?

How much?

- D. How constraining are the following factors on making a good decision:

(Classified on a scale from 1 to 5)

- 1. Knowledge of how to make decision
- 2. Internal data from farm
- 3. External data (prices, quality etc.)
- 4. Government (policy, taxes etc.)
- 5. Data Processing capabilities
- 6. Time to make decision
- 7. Uncertainty from results of prior decisions
- 8. Uncertainty from outside sources
- 9. Other - specify

- E. What are your major sources for external data?
- F. How would you or what would you need to help you improve the way you make this decision?

The above decisions can be categorized as predominantly affecting production, marketing and financing; as stated, these decisions have a short to medium time horizon. The successful farmers were asked to evaluate possible philosophical and procedural differences about particular decisions within the areas of production, marketing and financing. The set of questions designed to get at possible behavioral incidents include:

A. Production

1. What do you consider the keys to getting good yields in corn/ wheat/ soybeans?
2. How do you ensure that you will have enough time to get your planting and harvesting done ?

B. Marketing - Crops

1. What is your general philosophy about crop marketing?
2. Would you consider either production or marketing as more or less important for the overall success of the farm business?
3. What marketing alternatives do you feel most confident with, i.e. forward contracting, cash, hedging etc.?

C. Financing and Capital Investment

1. What is your general investment strategy for land?
2. What is your general credit policy?

These questions may only scratch the surface as to how farmers make decisions. However, if the successful farmers can identify key decisions that differentiate farmers by managerial success, then a more intensive evaluation of those decisions are warranted. In fact, the more interesting questions may deal with how the manager decides on a decision rule rather than comparing the decision rules themselves.

Also, this research only emphasizes one management function--planning, excluding the other aspects of monitoring, control, evaluation and learning. Of course, there are some managers that may be very good at planning but not so good at follow through.

**Evaluate Decision-Making Behavior of  
Successful Farmers and Develop Instrument  
to Measure Behavior and Performance**

This section presents the results of administering the open-ended questionnaire to the successful farmers. The responses are then utilized in developing the instrument to measure managerial behavior and performance. The responses are grouped according to areas of general philosophy, production, marketing, finance and information processing.

**General Philosophy**

**Keys to Successful Farming**

Most of the farmers were reluctant to consider themselves successful and even more reluctant to judge other farmers. However, the farmers offered forty-two different keys to successful farming. These statements can be grouped into eight categories and ranked according to the number of times mentioned. The categories are: financial management(19), production(10), timeliness(9), reacting to changes (decision-making)(9), attitude(8), communications(7), marketing(4) and general(4). It seems that financial management has become the most important key to successful farming and this is in accord with current financial conditions in agriculture.

Although marketing was viewed as important by farmers, they felt that they could not do very much about it and, therefore, to be successful, they had to do a good job at the other aspects of farming. Also, none of the farmers mentioned the importance of doing their own repair work on machinery. However, from subsequent questions it was found that all the farmers could and did do most of their repairs outside of major overhauls on engines and transmissions with two even doing those. Therefore, this item just may be taken for granted by farmers. From this analysis, it seems that a test for measuring managerial success should emphasize financial management, production and timeliness.

### **Criteria for Manager Evaluation**

Related to the "keys to success question" was the idea of setting criteria on which to evaluate a manager. The responses to this question were categorized objective, subjective and behavioral. The objective factors included profitability, production costs, assets and liabilities, yields, and financial returns on assets. Of these objective measures, profitability was chosen most by the farmers as a criteria for evaluation.

Among the subjective factors, appearance seemed to be an important evaluation criteria, which would indicate that the farmers felt that looking prosperous was a good sign of being successful. The fact that the more successful farmers also felt that one could evaluate a farm manager by observing his managerial behavior, encourages the development of a managerial index.

### **What Farmers Like and Dislike About Farming**

From the farmers' responses it seems that independence, the challenge or feeling of accomplishment that farming offers, along with the love for the outdoors and closeness with the family seem to be the major motivating factors for farming. However, uncertainty and unpredictability generated by the market and weather along with the high asset requirements tend to reduce the level of enjoyment of their profession.

These motivating factors should effect the decision rules chosen and the amount of time spent in collecting and analyzing information for decision-making. The responses to a set of questions on goals and perspectives could be tested as to their discriminating ability in relation to decision rules used or factors analyzed.

## **Production**

### **Good Yields in Corn**

The fourteen farmers that responded to this question indicated that the most important keys to getting good yields in corn were fertilization, variety selection, timing of planting, improved soil productivity and pest control.

### Having Enough Time for Planting and Harvesting

Timeliness was earlier depicted by these farmers as being most essential for success, therefore they seem most sensitive to unanticipated delays during planting and harvesting. To ensure against such delays they indicated that having adequate and reliable equipment, along with preseason preparations, diversity in crops and maturing dates, the willingness to 'run until done', experience, and two way communications equipment were essential. Of course there may be a thin line between having adequate equipment and being over- equipped.

### Proportion of Crops to Produce

The factors which are predominant for determining crop mix are rotation, government programs, returns per dollar, and in the case of the sugar beet producers, obtaining a sugar beet contract. The rotational considerations are most important because the farmers felt that a good rotation could help in controlling pests, increasing overall soil productivity and reducing erosion. In other words, they felt that long term benefits outweighed the benefits of trying to receive maximum profits each year by changing crop mix in response to yearly price changes. Government policy and programs along with their prior participation in these programs set constraints on their acreage allotments to corn and wheat. In fact, it seemed that farmers spend a lot of time trying to guess what the government was going to do since they felt that government programs set the market price. Government policy was stated to be the biggest constraint to making the crop mix decision. In particular, a delay in the releasing of quota, loan price and set-aside information delayed the crop mix decision which added uncertainty to other phases of the planning procedure.

### Substantially Changing Crop Mix

The farmers in general expressed great reluctance in substantially changing their crop mix in response to short term fluctuations in prices received for commodities. They would consider such changes only if they could be guaranteed an extremely high contract

price. Government programs would have to be considered along with the effects that such changes would have on available labor and equipment, the riskiness of the changes and the erosion or weed problems it might introduce.

### **Determining Corn Variety**

In determining corn variety, maturity dates as well as performance and quality were important factors to consider. As sources of information, MSU yield trial results were the most frequently mentioned followed by on-farm test plots, experience and dealer recommendations.

### **When to Purchase Inputs**

Cash discounts along with income tax considerations seem to be the most predominant factors which effect the timing of input purchase. Other factors considered are the interest rates for borrowed funds, the availability of the input along with expected price changes, the effects on cash flow and the desire to have the inputs far enough in advance as not to pose problems at time of use.

## **Marketing**

### **Crop Marketing Strategy**

The basic strategies for crop marketing are knowing the cost of production for each crop, evaluating the advantage of entering the government programs and staggering sales during the year so as not to get stuck with corn for more than nine months and not being forced to sell at harvest. "Trigger selling" guides the selling decision in that they sell when prices reach the trigger price and do not wait for a better price.

### **When to Sell Corn**

The farmers emphasized the necessity of knowing cost of production before being able to make the sell decision. After knowing the cost of production, including storage and government interest charges, strategies ranged from trigger selling to selling when funds are needed to pay off creditors or scheduled sales spread out over the year. Again



the emphasis was put on getting rid of the commodity and not carrying it over into another season.

### **On Farm Storage**

For most of the farmers, on farm storage was looked at as a method to ease harvest bottlenecks more than as a marketing tool. However, farmers did mention that on-farm storage could provide some bonuses in prices received by holding until elevators were short. Some felt that it was cheaper to store on the farm, and on-farm storage gave them the option of selling either on the market or to the government. Another interesting strategy was to have enough storage to cover the production from owned land while selling at harvest the production from rented acreage. This allows for matching fixed asset capacities to assured volumes, allowing the rented acreages to fluctuate without adversely affecting fixed asset utilization.

### **Price of Corn**

It seems to be the very strong opinion of these farmers that it is a waste of time trying to guess corn prices. The best one can do is to use the government loan rate as the bottom floor for corn prices and use that figure when forecasting expected returns.

### **Participation in Government Programs**

The majority of the farmers always participated in the government corn program and would not grow corn without such programs. Some of them would at least pencil in the anticipated income comparing "in" versus "out" of the program, but seldom came up with figures that would indicate not to participate. However, they indicated that they put their marginal land in the conservation program in order to qualify. In determining how much they would pay in rent for a piece of land, the ASCS corn base yield was often considered.

## **Financing: Investment and Money Management**

### **Land Investment Strategy**

The farmers indicated that the land investment decision was more of a response than a plan since land could only be purchased as it became available to allow family members to get into farming. The expansion process usually started with renting more land and then purchasing that land when it came up for sale. Some farmers would evaluate the land price against the expected returns for that land, while others would look at their present income generating potential and asset position to see if they could subsidize the purchase of that land.

### **Credit Policy**

From the seven farmers that responded to this question, the only predominant response was a policy to use one lender to ensure against becoming over extended and loosing track of one's debt load. The most striking observation about their responses was the diversity of opinions about the use of credit and rules of thumb used to deal with the credit issue. Opinions ranged from "...never use credit to purchase inputs" to "...borrow to maintain cash flow." This area seems ripe for further evaluation of both the positive and normative aspects behind the selection of such diverse methods of handling debt.

### **Buying Land**

Although most land purchase decisions were not considered until a particular piece of land became available, the farmers indicated that they would match expected returns against the costs of that property. They would test the quality of the land by getting soil tests or use prior experience from renting the property.

### **Pay for Rental Land**

The most important factors for determining how much to pay for rental land were rental terms, the quality of land and expected yields. Reasons for renting land included the desire to lease first in order to test the productivity of the land before purchase, and taking a longer lease in order to build up the productivity of a piece of land.

### Equipment Replacement

The major considerations in determining whether to replace a piece of equipment were the perceived productivity differences between the old versus a new piece of equipment, the ability to afford the replacement, and the dependability of the machinery during prime utilization periods. Indicators of productivity included the size of repair bills and constantly being behind on job completions. Other rules of thumb for equipment management included running machinery until it dies, buy only used equipment, buy back up equipment for parts, take good care, purchase for expected growth in acreage, size for the job and knowing your capabilities for doing repair work.

Fifteen out of seventeen farmers interviewed could and did do all of their repair work except major overhauls to engines and transmissions, while the other two even did the major overhauls. Therefore it seems that the ability to do your own repair work is an essential ingredient in farming success.

### **Information Processing**

Of the twelve specific decisions analyzed some seem to require more calculations than others and some require more internally generated historical data than others. Theoretically, computerized data storage and processing equipment should be most useful where the decision requires either/or extensive and accurate calculations and/or extensive records.

The decision on when to sell corn was mentioned most by the farmers as one where calculations are very important. In particular, figuring the cost of production for each crop is both crucial and difficult. Only after costs of production are known can the manager set price thresholds for the sell decision. However, a number of managers expressed their skepticism towards sophisticated charting or forecasting models for corn and felt that the combination of the government loan rate and futures market prices were sufficient for estimating future prices within the growing season.

Next on the list is the land investment decision where forecasting future cash flows and the effects of the land purchase on other fixed asset capacities are important areas for doing calculations. When to purchase inputs along with the decision to change crop mix follow in line as to the necessity of calculations. Calculations seemed to play the smallest role in the storage decision, determining expected corn prices, determining corn variety, and whether to rent versus buy a piece of land.

Determining the proportion of each crop to grow was a decision that farmers felt would be most aided by extensive internal historical records including acreages grown and performances on each portion of land along with optimal input requirements for each parcel. Historical records from the farm could aid the corn variety determination decision along with helping determine the level of participation in government programs.

The equipment replacement decision was most dependent on the performance and reliability of the machinery. Therefore, records on break downs, repair expenses and field performance information such as time per job and fuel consumption would aid greatly in determining whether a newer or larger piece of equipment was warranted.

#### **Constraints on Making Good Decisions**

Due to the length of the questionnaire all of the specific decisions were not analyzed to determine constraints to making those decisions. However, of the ones analyzed, proportion of crops, changing crop mix, corn variety, input purchase and when to sell corn seem to be most affected by the availability of external information on prices, the government programs, and tax policy. The timing of government programs is a major determinant of management strategy in these key decisions.

#### **Measuring Effectiveness (System Performance)**

There are 84 crop farmers that have been involved in the Michigan State TelFarm recordkeeping system for at least four years. These farmers were chosen as the subjects for implementation of the Measuring Effectiveness and Testing Behavioral Predictors of

Effectiveness phases of the methodology. Among the information collected and stored on these farms are yields, net income, acreage planted to specific crops, production costs, assets and liabilities, and financial returns to assets.

TelFarm net farm income is determined by subtracting costs against value of production. Cash expenses and sales are adjusted for inventory changes for inputs and outputs. After net farm income is calculated, charges for unpaid family and operator labor and operator's average capital (equity) are subtracted to arrive at a residual which measures the value of the management input. Management income dividing by crop acres is a measure comparable across farms of similar types. This we will call "Management Income per Acre".

### **Test for Reliability**

Any measure must stand up to the test of scientific objectivity. An important issue arises as to the validity and consistency of the measure, or reliability. Does it measure what it portends to measure and is that measure a consistent indicator of that attribute over time?

One way of testing the consistency of management income per acre is to first assume that managerial ability does not change very much over a short period of time, since agricultural production is faced with long lags. Therefore, even though the level of management income may change on a yearly basis due to influences outside of the control of the manager, for a set of managers facing similar circumstances, the relative position of these managers as measured by a managerial variable should show signs of consistency. In particular, if we measure a farmer's relative position to the average or mean, the relative position should not change drastically over a relatively short period of time - say four years.

Analysis of variance is the statistical technique used to determine the consistency over time of management income per acre as a measure of managerial performance. Analysis of variance (ANOVA) compares the variance of a group from the mean to

determine whether the differences of means of the groups can be attributed to differences between the groups or just a factor of random occurrences (noise).

The results of ANOVA (Table 1) indicate that the variance attributable to management group membership was significant to at least the 0.001 level of probability; whereas, the variance attributable to time was not significant. In other words, it is very unlikely that the variance observed as being attributable to differences between the three management groups happened by chance. Furthermore, management grouping accounted for 36.7 percent ( $R^2=.367$ ) of the variance in management income per acre, while grouping by year accounted for only 0.16 percent of the variance.

Therefore, although we cannot say categorically that management income per acre is a perfect indicator of managerial performance, at least it seems to be able to consistently group farmers over time. Of course differences in the levels of this variable can be attributable to other factors beside managerial ability. Factors such as differences in primary resource qualities, in particular, land and climate. The extent of some of these other factors which question the validity of this measure will be addressed later.

Table 1: ANOVA OF MANAGEMENT BY GROUP AND YEAR

## A. One way ANOVA: Management Income Per Acre by Management Group

## ANALYSIS OF VARIANCE TABLE

	Degrees of Freedom	Sum of Squares	Error Mean Square	F-value	Prob.
Between	2	749512.8111	374756.41	71.10	.000
Within	245	1291435.4056	5271.16		
Total	247	2040948.2167			

$$R^2 = \text{Sum of Squares Between} / \text{Sum of Squares Total} = .367$$

=====

## B. One way ANOVA: Management Income Per Acre by Year

(1981 to '84)

## ANALYSIS OF VARIANCE TABLE

	Degrees of Freedom	Sum of Squares	Error Mean Square	F-value	Prob.
Between	3	3329.1226	1109.71	0.13	.99
Within	244	2037619.0941	8350.90		
Total	247	2040948.2167			

$$R^2 = \text{Sum of Squares Between} / \text{Sum of Squares Total} = .0016$$

### **Testing Behavioral Predictors of Effectiveness**

The farmers chosen to participate in this phase of the analysis are the same set used for validating management income per acre as an effectiveness measure. These were the 84 crop farmers that participated in the TelFarm record keeping system from 1981-1984.

Out of these 84 farmers there were 47 usable questionnaires returned for a response rate of 56 percent. "Usable" means completely filled out.

The method of scoring the test is based on the principle adhered to throughout this analysis, that is, the behavior of the more successful farmers is the key to their success as measured by effectiveness.

The questionnaire itself was divided into five parts including: 1) Background Information, 2) Production Decisions, 3) Marketing, 4) Investment and Money Management and 5) General Management. The area soliciting background information was not scored as such, in that no score was given them other than a numerical code representing the raw responses given.

#### **Hypotheses to be Tested:**

**Hypothesis I:** There is no relationship between MIA (management income per acre) and any set of questions on the managerial test.

**Hypothesis II:** There is no relationship between MIA and non- managerial variables.

The managerial variables were:

MI/A = average management income per acre (1981-1984); dollars,

ORGAN = The organizational structure of the farm,

ACQUIRE= How the farm was acquired,

COSTPR = The aggregated variable measuring the performance of the farmer in measuring and using his cost of production information,



- FINBP = The aggregated variable measuring both behavior and performance of the manager when faced with financial and money matter type decisions.
- YIELD = The farmer's average corn yield for 1981-1984,
- PRICE = The average corn price received by the farmer for 1981-1984.

The non-managerial include:

- YCORN = Average county corn yields (1981-1984);
- CTY = Location (1=Saginaw Valley, 0=Not in Saginaw Valley),
- CAPAC = Average dollar value of total capital per acre (1981-1984),
- ACRE = Average acres farmed per manager (1981-1984),

### Results

Table 2 presents the results of multiple regression analysis of alternative models designed to test the above hypotheses. Immediately, one can reject the null hypothesis of no relationship between MIA and our set of managerial variables, since the F statistic for equation 1 was 6.48, which represented a probability smaller than .001 for type I error. The equation itself according to the coefficient of determination accounted for over 38 percent of the variance in management income per acre. The variable showing the greatest association with MIA was FINBP or the variable representing the farmers, scores on the questions categorized as pertaining to finance and money management.

Therefore, this analysis indicates that this sub-set of variables from the original management test instrument may indeed be predictors of managerial effectiveness as measured by management income per acre. In particular, higher scores on the questions pertaining to determining the cost of production, making financial, investment and money management decisions are positive indicators of increased management income per acre. Further, the organizational structure of the farm, and how the farm was acquired influence the ability of behavioral and performance variables to predict management income per acre.

Table 2: Testing Behavioral Predictors of Effectiveness

EQUATION	1	2	3	4	5
ORGAN	11.910 * (1.663)a		12.130 (1.604)	10.534 (1.483)	
ACQUIRE		21.18 (1.509)			
COSTPR	.6749 (1.539)	.5619 (1.277)	.6146 (1.340)	.6998 (1.521)	
FINBP	1.173 ** (3.019)	1.151 ** (2.906)	1.2098 ** (2.834)	1.2273 ** (3.184)	
CTY			-12.887 (-.575)		-16.261 (-.719)
ACRE			-.0111 (-.214)		.0687 ** (2.337)
PRICE				72.178 (1.575)	
YIELD				-.1523 (-.396)	
YCORN					1.7039 (1.247)
CAPAC					-.0061 (-.463)
INTERCEPT	-233.404	-265.146	-230.007	-407.463	-248.721

SUMMARY  
STATISTICS

R2	.320	.313	.294	.339	.041
F	8.22	7.98	4.83	5.72	1.74
SIG.	.000	.000	.001	.000	.151

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a T-statistics are in parenthesis

\* Sig. at .10 level

\*\* Sig. at .05 level

Further analysis showed that one could substitute ACQUIRE for ORGAN (equation 2) without either significantly reducing the coefficient of determination, increasing the standard errors of COSTPR and FINBP, or substantially changing the magnitude of the coefficients on COSTPR and FINBP.

The addition of PRICE and YIELD (equation 4) did not substantially increase the predictive power above equation 1, while at the same time not substantially changing the coefficients on ORGAN, COSTPR or FINBP. This would indicate the robustness of the variables in equation 1.

Equations 3 and 5 test the association of non-managerial variables with MIA. Results indicate that when CTY, ACRE, YCORN and CAPAC are looked at separately from our managerial variables, the equation (5) accounts for only 4 percent of the variance in MIA and is not statistically significant to the .10 level. However, ACRE (the size of the farm) does produce a significant t-statistic at the .05 level.

Equation 3 adds CTY and ACRE to the managerial variables ORGAN, COSTPR and FINBP. The t-statistic for CTY and ACRE are extremely low while the t-statistics and coefficient levels on the managerial variables are not substantially altered which would further verify both the validity of MIA as a measure of managerial effectiveness and the managerial indexes as indicators of effectiveness.

Equation 1 can be interpreted in terms of the value of managerial capacity to farm effectiveness. In particular, for each point scored on the composite index measuring a managers knowledge of his cost of production corresponds to an increase of 0.67 dollars of income per acre. Financial managerial ability as measured by FINBP returns 1.17 dollars per point scored on this portion of the index.

In conclusion the first null hypothesis was rejected and hypothesis II was accepted. In analyzing hypothesis I, it was discovered that sets of questions on the managerial test were found to be significant indicators of MIA. In particular, questions dealing with the farmer's ability to calculate and use cost of production information, along with the

ability to solve financial, or money decisions, were found to be significant predictors of management effectiveness. A qualifying demographic characteristic, organizational structure or how the farm was acquired, added to the predictive ability of the two managerial characteristics.

Therefore, in future evaluations of the possible benefits of computerized decision aids, the areas of management that may show significant improvements are cost of production determination and utilization along with the ability to make sound financial decisions. Such an evaluation should include measuring differences in behavior possibly through an appropriate set of test questions and problems as well as comparisons of farm system performance (effectiveness) over time.

### **Summary of Major Findings**

As stated in the objectives, the major purpose of this research was to develop and test a model which would measure the potential value of planning tools to farm decision-making. The systems approach was used to develop the Management Systems Research model as a methodology for measuring such potential. In accomplishing the primary goals other products were produced including a validated managerial effectiveness measure, common behavioral attributes of effective farm managers, use of economic tools by farm managers, information on the relationship between behavior, performance, and effectiveness, and information on the criteria for decision aid selection.

The Management Systems Research model developed included four major activities: 1. Behavioral Analysis, 2. Measuring Effectiveness, 3. Testing Behavioral Predictors of Effectiveness, and 4. Quasi-Experiment.

An open-ended questionnaire was developed and administered to a group of successful cash crop farmers as identified by extension personnel in Ingham and Tuscola counties. Information from the interviews was used to develop a managerial index

questionnaire, and determine the appropriate effectiveness measure for the farm manager.

The farmers selected profitability as the most important criteria for evaluating a farm manager. Therefore, management income per acre was chosen as a measure of effectiveness, and this measure was tested for workability, reliability, and validity. The reliability test consisted of testing for consistency of the measure over time in identifying the Telfarm cash crop farmers in terms of managerial groups. The results of ANOVA showed that the management grouping accounted for 36.7 percent of the variance in management income per acre over the four year period between 1981 and 1984, while grouping according to the year accounted for only 0.16 percent of the variance.

Management income per acre was checked for validity by testing the relationship between the average management income per acre for each of the farmers against locational and farm size variables. The results of multiple regression demonstrated that the average county corn yield, location, capital invested per acre, and average acres farmed per manager were poor predictors of the average management income per acre over the four years tested.

With a validated managerial effectiveness measure and a managerial index developed, the next step was to administer the test to TelFarm cash crop farmers and test the relationship between behavior, performance and effectiveness. The results of the analysis demonstrated that managerial effectiveness could be predicted by a subset of managerial questions focusing on cost realization and financial decision-making. The specific financial questions included in the financial management index (FINBP) were 19, 27, 29, 30, and 31.

**Question 19:**

19. Assume that interest rates are 12%, and your fertilizer dealer is offering a 10% discount in December for fertilizer that you would use on corn in the spring. Would you?

(Select one)

- a) Borrow money to take advantage of discount
- b) Wait to purchase until spring

The more successful farmers chose "a" which showed their ability to use credit wisely to take advantage of discounts. Therefore, they expressed an understanding of the present value concept in evaluating short-term purchasing decisions.

**Question 27:**

27. A good reason for renting more land would be: (Rank 3)

- a) Spread fixed costs
- b) Increase labor utilization
- c) The rental land is close to own land
- d) To test productivity before deciding to purchase
- e) Act as buffer while making equipment systems change

The more successful farmers chose "b" and "a" in that order. Therefore, these farmers expressed the need to maximize labor utilization and to use rental land for a flexible way to expand in order to better utilize equipment. They also showed a preference for expansion through renting instead of buying and the use of rental land as a way to control a piece of property for future purchasing. The decision rule then filters down to using rental land as a flexible way of expanding to better utilize intermediate assets and labor.

**Question 29:**

29. If at the end of tax year you had \$20,000 more taxable income than expected, would you? (Choose one)

- a) Purchase machinery or equipment to get tax credit
- b) Pay taxes on the income and put the rest on the mortgage
- c) Invest in more land
- d) Spend more on consumption
- e) Buy more inputs for next year to reduce this year's taxes

The more successful farmers chose "e" - to buy more inputs for next year, and "b" - put the rest on the mortgage. These farmers would not reduce taxes by increasing their long-term debt load. In fact, the more successful farmers would use unexpected profits to reduce their debt and increase short-term assets. Therefore, the decision rule seems to be not to make long-term investment decisions based on the desire to reduce short-term taxable income.

**Question 30:**

30. Indicate how many years you would finance the following items: (If less than one year indicate with a fraction)

Years

- a) Production Equipment      3.5
- b) Land                      22
- c) Production inputs  
    used up in one year      .5
- d) Machinery shed            5
- e) Personal car                .5

The conservative use of credit by the more successful farmers is expressed through the short length of time they would be willing to finance long-term assets. This conservative nature conflicts with the economic or financial management suggested policy of matching long-term financing to long-term assets. The unwillingness of the more successful farmers to use such a principle reflects their understanding of another finance principle of matching risk with returns. These farmers understand the variable nature of the returns to agriculture, and are not willing to over-extend themselves facing such variability. The benefits of financial leverage are discounted by the more successful farmers with their knowledge of the riskiness of that leverage. Investment discipline as a managerial quality is highlighted by their response to this question. As a decision rule, these farmers finance a long-term asset for a considerably shorter length than the expected life of that asset.

**Question 31:**

31. Assume you have the option of renting land from someone on fixed cash rent or shares. Choose the alternative you would prefer under the following conditions. (Indicate "F" for fixed cash rent and "S" for shares.)

S Prices are volatile

F Prices are stable and high

S Prices are stable but low

S The land is not well drained

S The land does not have a ASCS corn basis

S Don't know productivity of land



The more successful farmers chose fixed rental arrangements only with a high degree of confidence in expected favorable returns. Therefore as a decision rule, the lack of knowledge of the productivity of the rental land and/or volatility in prices is a cue to seek crop sharing type of arrangements which would allow them to share that risk with the landlord.

The farm organizational and historical development variables also played significant roles in predicting MIA. In particular, the farms that were purchased instead of inherited and the incorporated or jointly owned seemed to have higher management incomes per acre. This could have some serious implications toward the viability of sole proprietor farms in comparison to their more organized counterparts. It may be that the inclusion of other people into the decision-making process increases the managerial resource pool which in turn increases the viability of the farm. It also seems that the farm managers that purchased their farms instead of inheriting them do a better job at managing.

Now that it seems possible to make apriori predictions of managerial success using an index, the stage is set for using such an index for measuring the possible benefits of improved decision aids. The remaining test is to compare the measure obtained from the management index against observed differences between a set of farmers over time: one set using the computerized system and the other without such aids. One such quasi-experiment is set to be conducted in North Carolina with the farmers involved in the North Carolina A&T Farmer Opportunities Program.

### **Recommendations**

The research results have significant bearings on how the Land Grant University conducts extension, research and teaching especially in the management or economic areas. In general, the focus of efforts with farmers should be on profitability rather than increasing output. The farmers analyzed in this research were homogeneous in the

production and marketing decision-making. Their effectiveness could be predicted by their measured ability to answer financial management and cost of production type questions. However, since all of these farmers were on a particular record keeping system, one might suspect that this group was biased toward the more sophisticated set of farmers. In other words, a more random group of farmers may show more variance in their production and marketing decision-making. On the other hand, since these farmers were on a recordkeeping system one could argue that the sample was biased in a direction that would minimize the difference in financial decision-making or any other type of decision-making that required financial data.

Therefore, although we can not be sure that this group is representative of all cash crop operators, the evidence points to certain adjustments in the emphasis placed by the Land Grant University on production agriculture. Replication of this methodology over a broader area or in different parts of the country should add to the reliability and applicability of the findings to a wider audience.

### **17.1 Extension**

The findings of this research point to the Extension service providing more training to farmers on financial decision-making. Particularly, emphasis needs to be placed on investment analysis, credit policy, organizational structure, and determining cost of production. This probably means an increase in the number of trained Extension personnel in these areas.

The question remains as to the level of involvement of Extension personnel in the role of consulting. The accepted role of Extension has been to educate, not advise, particularly when it comes to financial matters. Extension can walk that thin line between education and consulting by providing the tools and helping in their application without giving specific advice. In making decisions, the successful farmers exhibit similar decision rules which Extension personnel could suggest as useful tools for managers with similar problems. The computer could be a useful tool in storing such

decision rules, i.e. expert systems, and applying such rules through appropriate software. This is not to suggest that Extension should not continue to be involved in educating farmers on new production technology, but such education should include how to measure the profitability of such technology.

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