12-1968

The identification and evaluation of managerial behavior

William Ruthvan Morrow

To the Graduate Council:

I am submitting herewith a dissertation written by William Ruthvan Morrow entitled "The identification and evaluation of managerial behavior." I have examined the final electronic copy of this dissertation for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Agricultural Economics.

Luther H. Keller, Major Professor

We have read this dissertation and recommend its acceptance:

Thomas J. Whatley, Charles L. Cleland, Hans E. Jensen

Accepted for the Council:

Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

August 12, 1968

To the Graduate Council:

I am submitting herewith a dissertation written by William Ruthvan Morrow entitled "The Identification and Evaluation of Managerial Behavior." I recommend that it be accepted in partial fulfillment of the requirements for the degree of Doctor of Philosophy, with a major in Agricultural Economics.

Luther H. Keller
Major Professor

We have read this dissertation
and recommend its acceptance:

L. J. Whitley

C. L. Cleland

Hans E. Jensen

Accepted for the Council:

Hilton A. Smith
Vice Chancellor for
Graduate Studies and Research

THE IDENTIFICATION AND EVALUATION OF MANAGERIAL BEHAVIOR

A Dissertation

Presented to

the Graduate Council of

The University of Tennessee

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Philosophy

---

by

William Ruthvan Morrow

December 1968

ACKNOWLEDGEMENT

The writer wishes to express his sincere appreciation to Dr. Thomas J. Whatley, Dr. Charles L. Cleland, and Dr. Hans E. Jensen for their comments and suggestions regarding the writing of the manuscript.

Special gratitude is expressed to Dr. Luther H. Keller for his guidance throughout the entire research project. His criticisms and suggestions were constructive and never restraining in their effect.

Acknowledgement is also made of the assistance provided in data collection by H. Lamar Spangler, the invaluable assistance provided in computer programming by Victor Skullman and Mrs. Barbara Bridges, and the assistance provided in factor analysis interpretation by Dr. Edward E. Cureton.

Finally, I wish to dedicate this manuscript to my wife, Nancy. Her love, devotion, and patience have remained steadfast for seven long years and the sacrifices both she and the children made on my behalf can never be recovered. She has been my constant source of enthusiasm and perseverance, and to her I am eternally and gratefully indebted.

ABSTRACT

The efficient combination of land, labor, capital, and management resources in agricultural production requires the specification of the qualitative and quantitative characteristics of these resources. A limiting factor affecting efficient resource combinations is a greater lack of knowledge of the characteristics of one of the resources relative to the other resources. In agricultural production this limitation is imposed by the inability to specify the characteristics of the management resource.

The present study had as its broad purpose the specification of relevant mental processes involved in the operation of a farm business. The specific objectives of the study were: (1) to isolate, from observable and relevant management behavior of farm operators, basic mental processes explaining such behavior; and (2) to analyze the relationship of variations in such processes to variations in managerial performance criteria. Factor analysis was used with respect to the first objective, and regression analysis was used with respect to the second objective.

Data were collected from a random sample of 123 commercial farm operators located in the Elk River Watershed. The data consisted of 100 descriptive items of observable behavior of farm operators. The items were designed to indicate the extent to which the operators exhibited such behavior in managerial processes.

A factor analysis of the observed behavior of farm operators indicated that 11 processes accounted for the behavior. This analysis indicated that (1) observation and analytical ability, (2) off-farm activity participation, (3) self initiative, (4) systematization of farming operations, (5) attitude toward physical labor, (6) communication with off-farm environment, (7) use of market information as a criterion of operational adjustments, (8) verbal communications ability, (9) detail mindedness, (10) community influence, and (11) orientation toward farming as an occupation, are processes involved in carrying on the managerial operations of a farm business.

Scores were computed indicating the extent to which each of the 110 farm operators exhibited each of the 11 processes. A correlation analysis indicated that (1) observation and analytical ability, (2) self initiative, (3) low value placed on physical labor, (4) high degree of communication with total environment, and (5) verbal communications ability, were all significantly and positively related to years of education. This relationship was suggestive of the mental nature of the processes identified. The analysis also indicated that age was significantly and negatively related to (1) a low value placed on physical work, and (2) a high value placed on farm management as a professional business occupation. Experience as a farm operator was negatively related to detail mindedness but positively related to community influence on farming operations.

A regression of returns to management, net farm income, and size of operation on the 11 processes resulted in the processes

explaining 12 percent, 17 percent, and 42 percent, respectively, of variations in these criteria of managerial performance. The regression analyses indicated that (1) observation and analytical ability, verbal communications ability, and orientation toward farm management as a professional occupation, were among the more important processes affecting managerial performance, with a positive relationship being suggested; and (2) that participation in off-farm activities was negatively related to managerial performance.

The findings of the study, although inconclusive without additional validation, supported the initial hypotheses of the study which stated that: (1) basic mental processes relevant to the management function of the commercial farm operator can be isolated from observable behavior of farm operators; and (2) variations in such processes will explain some part of the variation in managerial performance of farm operators.

TABLE OF CONTENTS

LIST OF TABLES

TABLE PAGE

TABLE PAGE

TABLE PAGE

CHAPTER I

INTRODUCTION

> Measurement is more than the pedantic pursuit of a decimal place. Its vital and absorbing aspect emerges most clearly perhaps when it becomes a question of measuring something that has never been measured. Or better still, something that has been held to be unmeasurable.
>
> S. S. Stevens

The concept of the term "management" is probably the most ambiguous or meaningless term used in the vocabulary of professional agricultural economists. As a point in fact one noted agricultural economist stated that "the ever broadening sequence of definitions has now gotten to the point where management is defined so broadly that it encompasses everything from everyday getting out of bed to development of mathematical logic and daydreams of the philosopher."[1] Although the preceding statement is not without basis, a review of prominent farm management text books indicates that things are not so chaotic as often implied. Such a review shows not so much a change in the definition of management but rather a change in the depth of viewing the management process.

Farm management text books written during a period from the early twenties to the late forties defined management in terms of "art." Management was viewed as a combination of inherited and learned skills of

---

[1] Albert N. Halter, "The Challenge of Management in Agriculture," Describing and Measuring Managerial Ability and Services, Report No. 4, Conference Proceedings of Farm Management Research Committee (Denver: Western Agricultural Economics Research Council, 1962), p. 1.

organizing and operating a farm business. Successful farm management during this period was associated with such criterion as biographical characteristics, use of specific farm practices, and observable personal characteristics of farm operators. G. W. Forster's definition exemplifies the predominant approach to management during the period. He defined farm management as "a study of the ways and means of organizing land, labor and capital, and the application of technical knowledge and skill in order that the farm may be made to yield the maximum net returns."[2] Research related to the management function was, as would be expected, designed around the "art" concept of management. Emphasis was placed on "gathering, systematically recording, analyzing, and interpreting data relating to the details of organizing, managing and operating specific farm units or properties."[3]

The preceding brief review of farm management science content and research does not imply a lack of imagination or professional responsibility on the part of professional farm management workers, but rather is an indication of the state of development of the area of study referred to as Farm Management. Such an approach to farm management was a natural response to the need for viewing the individual farm unit as a total operation rather than a combination of unrelated crop and livestock enterprises. With the rapid development of the agronomic and animal

---

[2]G. W. Forster, Farm Organization and Management (New York: Prentice-Hall, Inc., 1938), p. 27.

[3]Andrew Boss and George A. Pond, Modern Farm Management (Saint Paul: The Webb Publishing Company, 1947), p. 8.

husbandry sciences individual farm operations had reached a point where they resembled an organization of uncoordinated enterprises more than a commercial farm business. The natural outgrowth of such a situation was the development of an agricultural science to coordinate the various enterprises, along with the integration of business principles, on individual farms.

Using farm management text books as a source of information, there appears to have been a shift in emphasis from management as an "art" to management as a science in the early 1950's. Although Hudelson related management to decision-making in 1939,[4] it was not until such text books as Bradford and Johnsons' Farm Management Analysis,[5] and Case and Johnstons' Principles of Farm Management,[6] both printed in 1953, that decision theory became an integral part of the content of farm management texts. A similar shift in research emphasis from the "art" of organizing and operating the physical resources of the farm to the science of decision-making was in evidence. Where before management had dealt with such observable phenomena as practice use, field arrangement, farmer's characteristics, etc., it began to deal with unobservable mental processes and human behavior. Where before the study of farm management was centered around

---

[4]Robert R. Hudelson, Farm Management (New York: The Macmillan Company, 1939), p. 7.

[5]Lawrence A. Bradford and Glenn L. Johnson, Farm Management Analysis (New York: John Wiley and Sons, Inc., 1953), Chapter 1.

[6]H. C. M. Case, and Paul E. Johnston, Principles of Farm Management (New York: J. B. Lippincott Company, 1953), p. 4.

the farm operation, it become centered around the farm operator. The change in emphasis is nowhere better portrayed than in Bradford and Johnsons' definition of management in terms of a "mental process, a concentration of desires, a willpower."[7] This new emphasis, centered on mental management processes, became the foundation upon which management is presently defined. The processes of observation, analysis, decision-making, action taking, and acceptance of responsibility, first outlined by Bradford and Johnson still serves as the basic framework around which much of the current managerial research has been designed.[8] A glance at current farm management text books would lead to the same realization that the decision-maker has become the focal point in the area of farm management.

Although the transition from management as an "art" to management as a science has been complete, progress beyond the transition has been slow with regard to knowledge concerning managerial behavior. Researchers continue to study and re-study the contributions and rewards of land, labor, and capital resources and the reasons for variations in their contributions and rewards, with the results being that often a large part of the variation remains unexplained. Many researchers have hypothesized that much of this unexplained variation can be attributed to the management factor or function.

Here then is the problem faced by production and farm management researchers, and educators; returns from research directed toward learning

---

[7] Bradford and Johnson, op. cit., p. 3.

[8] Ibid.

more about the non-human resources in agriculture are unlikely to increase further without increased knowledge of the management resource and methods of appraising the effects of this resource. Similarly, efforts to improve the quality of the managerial resource is stymied by the lack of knowledge regarding what it is that needs the improvement. As Kelso stated, "in spite of all the advances our discipline has made, the man in our models is still a far cry from a fully human figure."[9] It is toward reaching the goal of increased understanding of managerial behavior that the present study is aimed.

I. THE PROBLEM

The preceding review of the development and progress of farm management research and education was a necessary prelude to the problem now confronting farm management researchers. It should serve to place in context the importance of the problem with which this report deals; the identification and evaluation of managerial behavior. Even when the importance of this problem is stressed there still remains the need to classify the problem into smaller areas of study due to its immensity. Such a classification has been offered by Thomas[10] and by Bailey[11] on

---

[9] M. M. Kelso, "A Critical Appraisal of Agricultural Economics in the Mid-Sixties," Journal of Farm Economics, 47:1-16, December, 1965.

[10] D. Woods Thomas, "Agricultural Economics Research Related to the Measurement of Managerial Ability," A Symposium on Measuring Managerial Ability of Farmers (Chicago: North Central Regional Research Committee on the Management Resource in Farming, and the Farm Foundation, 1962), pp. 3-11.

[11] Warren R. Bailey, "Where Do We Go From Here?," Describing and Measuring Managerial Ability and Services, Report No. 4, Conference Proceedings of Farm Management Research Committee (Denver: Western Agricultural Economics Research Council, 1962), pp. 91-92.

two separate occasions. A synthesis of these two classifications suggested that there should be a minimum of three areas of study regarding the management resource: (1) studies to develop and validate concepts concerning just what management is; (2) studies designed to measure and predict managerial performance; and (3) studies designed to treat management as a factor of production. The author feels that the priorities for these various areas of study should be ordered in the same manner as listed above.

In summary, it appears that management cannot be treated as a variable factor in production until it has been quantified, and it cannot be quantified until it has been developed to the point where its dimensions or processes are meaningful. From the standpoint of the current state of knowledge regarding the stages of research on the subject, it appears that we are somewhere between the area of basic research and the area of measurement and prediction. There still remains a need for testing current concepts and searching for newer and more meaningful concepts, but it is pertinent to begin to test and develop methodologies relevant to the measurement and prediction of managerial performance. The implication here is that any attempt to measure or predict managerial performance at this stage will be exploratory in nature but will be useful as a starting point for the development of more precise procedures in the future. As Thomas stated, "it appears doubtful to me if it will be possible to measure management in a satisfactory way without (a) taking into full consideration the nature of the management function and (b) devising means by which its various

components might be quantified."[12] Such reservations have been indicated by other noted researchers in this area and certainly cannot be construed as indicating a defeatist attitude. Moreover it implies a responsible research format for studying the managerial resource and points toward basic research as the first priority.

Having examined the classification and priority problems, there remains the problem of orientation of such research toward solving agricultural economic problems. Unless such research is carried out in the context of real agricultural situations the end results are not likely to be useful. As Thomas has warned, we may end up evaluating and conceptualizing management for management's sake rather than for the purpose of providing assistance in solving real agricultural economics problems.[13] Because of this danger it is necessary for the individual researcher to keep before him the ultimate reasons for involvement in the area of managerial research.

The ultimate goal of research regarding the management resource is the acquisition of the ability to evaluate, both qualitatively and quantitatively, this resource. However, any such research must be justified on the basis of the need for such an ability. Evidence of this need is present in at least three areas of work: (1) theory development; (2) agricultural policy; and (3) agricultural extension education.

---

[12] Thomas, loc. cit.

[13] Ibid.

As was previously implied, there is a definite need for a more realistic model of the human actor in economic theory. The inadequacy of the assumption of profit-maximizing behavior seems especially valid in farm management due to the close and often inseparable roles played by the farm manager as he is faced with decisions concerning his business, his family, his community, and other decision groups of which he is an integral part. Such an assumption fails to recognize the presence and importance of non-pecuniary motives and satisfactions. This has tended to stagnate farm management research and extension approaches to problem solving oriented around the farm rather than the manager. A greater knowledge of the manager's behavior is a prerequisite to solving this problem.

The formulation of effective agricultural policy is dependent upon the ability to evaluate managerial behavior and performance. Given the ability to evaluate the decision-makers' behavior, more accurate estimates of the response to governmental policy become possible, thereby increasing the efficiency and, in fact, the validity of specific policies. Such an ability would also provide a means of classifying managers relative to their capacity, making possible an inventory of management resources and the development of policies and programs more suitable to these resources.

Perhaps the greatest need for the ability to evaluate the management resource is in the area of farm management extension work. A primary responsibility of farm management extension personnel is the improvement of the management resource. Presently there exist few objective

criteria by which farm managers can be classified for purposes of educational training. The ability to evaluate managerial capacity would facilitate the selection of farm managers for purposes of training, on the basis of their understanding of management concepts. Such an ability would also provide the extension worker an indication of the success of his performance since he could evaluate the level of management ability obtained by his trainees through time. From a more economic viewpoint the ability to evaluate managerial capacity would allow for more optimum resource combinations in farm program development by providing a basis for equating returns from management and other resources.

The need for research regarding the evaluation of the management resource is evident. The lack of knowledge regarding this resource acts as a constraint to the progress of complete resource development and use. The problem is simple to state, but complex to solve. It is not likely to be solved by the endeavors of a single researcher because of its complexity and because progress in one phase is dependent upon the progress in the previous phase. It is not the purpose of this study to undertake such an immense task but rather to contribute to the basic store of knowledge concerning the managerial resource.

II. OBJECTIVES OF THE PRESENT STUDY

Due to the progressive nature characterizing the study of the managerial resource, it is necessary that the objectives of such study be consistent with the most apparent needs and priorities. As previously mentioned, research concerning the management resource is primarily

in the "basic" phase with exploratory work being extended into the "methodology for measurement" phase. The objectives of the present study were developed to meet those needs having the highest priorities and implied by the existing research format.

Basic Research Objectives

The objectives of this study were as follows: (1) to empirically investigate the presence of selected hypothetical management processes in the everyday behavior of farm managers; and/or (2) to discover or develop more useful ways of describing the processes of management for the investigation of such behavior, assuming that management as a mental process is manifested in the everyday behavior of farm operators.

Methodological Objectives

The methodological objectives of the present study were exploratory in nature and were: (1) to develop scores to measure selected processes of management; and (2) to evaluate the extent to which such scores are related to variations in selected managerial performance criteria.

III. THE THEORETICAL FRAMEWORK

Due to the exploratory nature of the present study it was difficult to describe a specific framework or theoretical model around which the study was designed, because "we cannot say that there exists a

completely satisfactory concept of management."[14] As a matter of fact, it was toward this end that the present research was directed. If, however, the present study must be related to a specific framework, it can best be accomplished by reference to an adaptation of the managerial performance model developed by Nielson and shown in Figure 1.

This model consists of three distinct sets of variables. The first group of variables, shown at the extreme left portion of the model, represent the physiological, sociological, and psychological characteristics of the manager. These characteristics include what psychologists and educators term the cognitive and affective domains of human behavior, where the cognitive domain is comprised of an individual's total set of attributes such as level of intelligence, ability, and skills. The affective domain is comprised of the interests, values and attitudes of the individual.[15] As indicated in the model, the total set of attributes of the individual manager act as a conditioning influence on the managerial processes of the manager, which in turn determine the outcome of the manager's efforts. The outcome further influences the affective and cognitive attributes as well as the managerial processes, through a feedback system.

In terms of this model, the present research was primarily concerned with conceptualizing managerial processes and with the relationship between such processes and their outcome. This is research dealing

---

[14] Ibid.

[15] H. J. Klausmeier, Learning and Human Abilities: Educational Psychology (New York: Harper and Brothers, 1961), pp. 5-10.

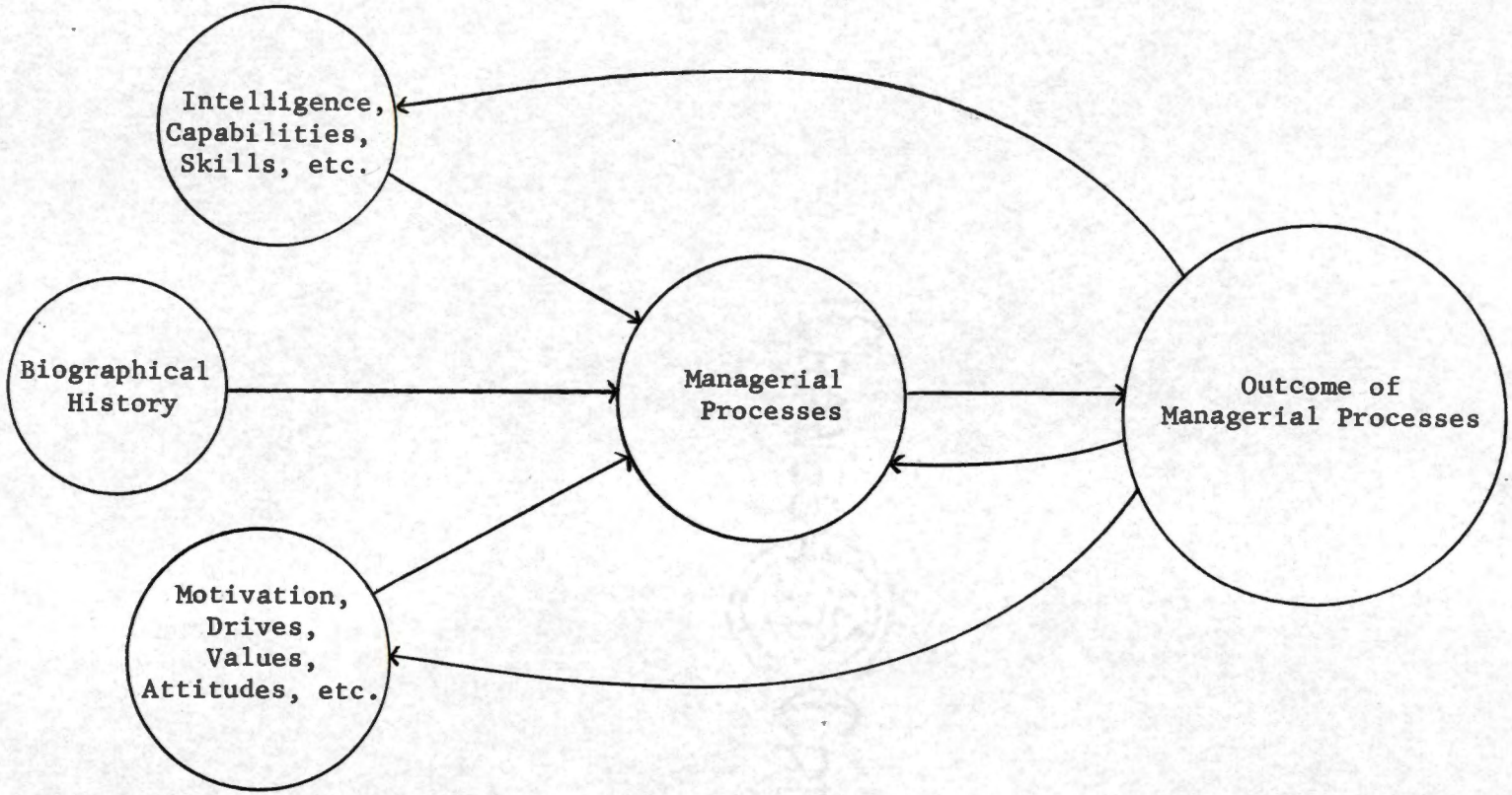


Figure 1. Managerial Performance Model.

Source: James Nielson, "Aspects of Management of Concern to the Basic Researcher," Describing and Measuring Managerial Ability and Services, Report No. 4, Conference Proceedings of Farm Management Research Committee (Denver: Western Agricultural Economics Research Council, 1962), p. 67.

with the essence of management; research which in a sense attempts to develop a definition of management. Recognition of the fact that the present study dealt with the processes of management required a decision regarding which hypothetical processes to include for study. Such a decision was a matter of judgment. However, this judgment did attempt to take into consideration the present state of managerial concept development, as well as past research relevant to the subject.

The managerial processes hypothesized for this study were as follows: (1) organization: a process involving the development of systematic ways of doing things, methodical treatment of problems, and standard operating procedures; (2) planning: a process involving the development of foresight, goal selection, establishment of priorities, and forward projection of thoughts; (3) environmental communication: a process involving the flow of information from manager to off-farm environment, person-to-person communication, and verbal expression; (4) representation: a process involving social participation, and projection of farm and farm family image to off-farm environment; (5) managerial professionalism: a process involving the development of an orientation toward farming as an executive profession, and a satisfying and challenging occupation; (6) observation: a process involving gathering of information, recognition of relevant facts and occurances, and awareness of affairs pertaining to the farm business; (7) analysis: a process involving reasoning behavior, analytical approaches to solving problems, and calculation; (8) initiating action: a process involving motivation toward change, ability to take action, and origination of new ideas and approaches.

These processes were hypothesized by the author to constitute some part of a total set of managerial processes, and originated from a synthesis of processes implied in early farm management studies, described in leadership studies, and existing in current farm management literature. The processes defined constituted the starting point of the present research. They provided the following general hypotheses of the study: (1) such processes do exist; (2) these processes can be observed either directly or indirectly; and (3) these processes will explain some portion of the variation in managerial outcomes.

IV. CONTENT OF THE PRESENT STUDY

The remainder of the present report will deal with the following aspects of research concerning the managerial resource: Chapter II consists of a review of past and current research on the identification and measurement of managerial behavior. This review attempted to indicate the important findings of such research as well as the shortcomings. Chapter III will describe the methodology used to collect and analyze the data; included is a description of questionnaire development and administration, and brief description of the respondents sampled. Chapter IV presents the findings regarding the conceptualization of management processes using factor analysis. Chapter V presents the findings regarding the relationship between managerial process scores and specified managerial performance criteria. Chapter VI presents a summary of the findings of the investigation along with the implications of such findings.

CHAPTER II

REVIEW OF LITERATURE

The present chapter is a review of pertinent literature and/or research concerning the management resource in agriculture. Such a review serves both to add substance to the historic development of farm management literature and research presented in Chapter I, and to provide a means of evaluating the progress which has been made. It should also provide some indication of the types of research presently needed.

Literature and research concerning the management resource in agriculture can be conveniently categorized as (1) that dealing with the process of management; and (2) that dealing with attempts to measure or develop indices of managerial ability or performance. It is within the confines of this categorization that the present review is presented. Although such a classification provides a satisfactory criterion for purposes of review it must be recognized that some individual pieces of literature and research cannot be neatly placed in either one or the other categories. Where this appeared to be the case the author relied on his own judgment for so classifying the individual pieces of literature or research, fully realizing that some overlapping of objectives were in evidence.

The exclusion of any individual researchers work in this review should not be construed to mean that such research or publication is unimportant. Rather, the research and literature reviewed should be

viewed as a representation of the kinds of research which have been conducted. Such an approach was aimed at guiding the present researcher toward a meaningful and useful research project.

I. RESEARCH AND/OR LITERATURE RELATED TO THE MANAGEMENT PROCESS

The prevailing concept of management among agricultural economists is one which conceives management as being a series of interrelated mental processes by which the farm operator approaches the point of decision, makes the decision, and evaluates the consequences of the decision. The model of this process was outlined by Johnson and Haver in 1953 in the form of the following list of managerial functions: (1) observation; (2) analysis; (3) decision; (4) action-taking; and (5) acceptance of economic responsibility.[1] This model served as the starting point for a large portion of the research dealing with the processes of management, and to date the model has remained intact with only a few alterations, these being mostly in the form of changes in terminology. The major substantive change made in the model was the addition of the process referred to as problem recognition. The addition of this process was the result of research conducted by

---

[1]Glenn L. Johnson and Cecil B. Haver, Decision-Making Principles in Farm Management, Agricultural Experiment Station Bulletin No. 593, The University of Kentucky, Lexington, Kentucky, January, 1953, p. 8.

Chastain in 1956,[2] and by Lee and Chastain in 1959.[3] Chastain's contribution was notable from the standpoint that he showed that problems themselves are variable with regard to their magnitude, their longevity, their reversibility, and the amount of knowledge required for their solution.[4] Further research regarding the problem recognition process indicated that: (1) farmers vary in their ability to recognize problems and opportunities; (2) this difference affects their ability to adjust to change; and (3) their problem recognition ability is related to such biographical characteristics as formal education, off-farm work and experience, and stage of the family cycle.[5]

The addition of problem recognition to the management process appeared to have reduced the extensiveness of research designed to expand Johnson and Havers' model and at the same time pointed toward the need for increased emphasis on research aimed at discovering what causes variations in the management process among individual decision-makers. Before reviewing this type of research it seemed pertinent to investigate the continued relevancy of the basic management process model.

The continued relevancy of the management model which defines management as a process of problem recognition, observation, analysis,

---

[2]E. D. Chastain, "An Empirical Study of the Decision-Making Process in Farm Management," (unpublished Ph.D. thesis, Purdue University, Lafayette, 1956).

[3]John E. Lee, Jr., and E. D. Chastain, Problem Recognition in Agriculture, Agricultural Experiment Station Bulletin No. 319, Alabama Polytechnic Institute, Auburn, Alabama, November, 1959.

[4]Chastain, op. cit., p. 49.

[5]Lee and Chastain, op. cit., pp. 33-34.

decision-making, action-taking, and responsibility bearing, appears to have been the result of two situations. First, the model itself, from its conception, seems to have been a synthesis of theories and models of human behavior developed in such other disciplines as psychology, education, and industrial management. Secondly, the meaningfulness of the management processes has, to some extent, been substantiated by research.

Johnson reported in 1954 that case studies of four farms in Kentucky, followed by an interview of thirty-one farmers in the same state, "confirmed the realism of the managerial concepts and principles," which he had previously outlined.[6] The importance of this study can only be realized when it is related to a much larger, much more elaborate, and much more comprehensive study entitled the Interstate Managerial Study (IMS). The results of this study are published in a book entitled Managerial Processes of Midwestern Farmers.[7] This study, based on data collected from 1075 farm operators in Indiana, Iowa, Kansas, Kentucky, Michigan, North Dakota, and Ohio, had as its broad purpose evaluation of the applicability of the management process model for describing the actual decision behavior of farm operators.[8] However, the study went

---

[6]Glenn L. Johnson, Managerial Concepts for Agriculturalists, Agricultural Experiment Station Bulletin No. 619, The University of Kentucky, Lexington, Kentucky, July, 1954, p. 46.

[7]Glenn L. Johnson, et al., Managerial Processes of Midwestern Farmers (Ames: The Iowa State University Press, 1961.)

[8]Ibid., pp. 16-17.

beyond this purpose to explore such things as: (1) the role of information in decision-making; (2) analytical methods used by farmers; (3) expectation models used by farmers; (4) problem classification by farmers; and (5) use and extent of insurance and chance-taking principles.[9] The study fulfilled its purpose, and in a sense, can be viewed as a significant shift toward a human behavior approach to the study of farm management. A quick review of the content of this study indicates a sharp change in research emphasis from the exploration of differences between farms to an exploration of differences between the decision-makers of the farms.

Although the remainder of the literature reviewed under this section may often seem far removed from the study of the management process as outlined in the IMS, a relationship does exist when such research is viewed as attempting to get at the essence of the management resource. The major objective of the following individual contributions seems to have been aimed at providing some initial insights into the management process as well as generating hypotheses for further study. The fact that much of the findings were inconclusive and as yet have not been further strengthened by additional research is an indication of the embryonic stage of this type of research.

In 1961, an article written by Nielson appeared in the Journal of Farm Economics, entitled "Improved Managerial Processes."[10] The

---

[9] Ibid.

[10] James Neilson, "Improved Managerial Processes," Journal of Farm Economics, 43:1250-1261, December, 1961.

article was not concerned with reporting results of any particular research but rather attempted to develop a normative model of a "superior" manager. In general Nielson hypothesized that the "superior" manager behaved as follows: (1) he establishes or is aware of a definite set of goals and he attaches priorities to these goals; (2) he is quick to recognize problems and opportunities; (3) he possesses the ability to apply abstract theoretical concepts and principles to problem solving; (4) he concentrates his energies on solving a problem but intermittently detaches himself from the problem; (5) he applies simplifying techniques to complex problems; (6) he uses economizing principles in determining which problems are more important and how much energy to delegate to problems; (7) he makes use of outside help in solving problems when such help will lead to more efficient problem solving; and (8) he evaluates the consequences of his decisions and develops a store of information useful in solving future problems.[11] These hypotheses are worthy of note because they imply that the variation in managerial performance among farm operators can be partly explained by variations in human behavior. Although at first glance this article may appear to be the result of some spur of the moment philosophical reflection, this author feels that it is safe to assume that the hypotheses presented by Nielson were based on sound theoretical structure and were the result of professional observation. To some extent Nielson's hypothesis regarding goal setting and establishment of priorities has been strengthened by other research.

---

[11] Ibid.

E. A. Wilkening and D. E. Johnson interviewed 139 Wisconsin dairy farmers in an attempt to (1) determine the relationship between types of decision and goals; (2) determine the effect of status and role on goal orientation, and (3) determine the importance of goal priority on practice adoption.[12] The major shortcoming of this research was in its failure to inventory more than a few pre-selected goals. However, the conclusion that profit as a goal is related to the type of decision and the priority assigned to the decision, itself seemed to overshadow the limitations of the number of goals inventoried. A most important result of this study was its implication of the insufficiency of the concept of an "economic man."[13]

Another study conducted in Wisconsin which seems more closely related to Nielson's hypotheses and the IMS model was one conducted by Rieck and Pulver.[14] Although the main objective of this study was to develop an empirical measure of decision-making ability, the study seemed to be more of a process study than an attempt to measure management. In this particular study a normative, rational decision-making model was developed and used as the yardstick to evaluate changes in decision-making ability among participators in an intensive management

---

[12] E. A. Wilkening and Donald E. Johnson, Goals in Farm Decision-Making as Related to Practice Adoption, Agricultural Experiment Station Research Bulletin No. 225, University of Wisconsin, Madison, Wisconsin, 1961, p. 4.

[13] Ibid., p. 6.

[14] Robert E. Rieck and Glen C. Pulver, An Empirical Measure of Decision-Making, Agricultural Experiment Station Research Bulletin, No. 238, University of Wisconsin, Madison, Wisconsin, June, 1962.

education program. The assumption was that the closer an individual approached the normative model the better decision-maker he was likely to be. The rational processes of management defined in the normative model were orientation, observation, analysis and evaluation, and implementation.[15] These processes of course are very similar to those of the IMS. Although the study did result in a crude index to measure managerial ability, the significance of the study was that it showed that management processes could be evaluated through the analysis of observable human behavior. It also indicated that the management process is itself subject to improvement through intensive educational activities.

Moving out of the area of research designed to study the management process itself, it seemed necessary to survey some of the more significant projects designed to discover why differences in the process exist among individual decision-makers. Mac Eachern, Thomas, and Eisgruber conducted a study which appeared to fall into this area.[16] The objectives of this study were to discover abilities which influenced the management process and to analyze the importance of these abilities. The major contribution of this study was methodological in nature. The implications regarding the management process become unclear when it is

---

[15] Ibid., p. 9.

[16] Gordon A. Mac Eachern, D. Woods Thomas, and Ludweig M. Eisgruber, Analysis of Human Attributes and Their Relationship to Performance Level of Farm Tenants, Agricultural Experiment Station Research Bulletin No. 751, Purdue University, Lafayette, Indiana, November, 1962.

realized that the study was concerned with tenant farmers, all of whom were under the guidance of a professional farm management service. The methodological procedure was unique and consisted of gathering a large amount of biographical data from the respondents, reducing the data to that which would discriminate between "good" and "poor" tenants, and then subjecting these data to factor analysis in order to discover basic abilities explaining variations in tenant ability.[17] The usefulness of these factors for explaining variations in decision-making ability may be suspect due to the sharing of the decision function by tenants and their advisors. However, the study did suggest the usefulness of factor analysis as a means of reducing large amounts of data about farm operators down to understandable proportions.

The final study to be reviewed in this section is one which was conducted by Huffman.[18] Although the study dealt primarily with classifying farm managers according to goal orientation, Huffman did explore the use of factor analysis as a means of selecting variables related to managerial performance. Huffman isolated nine factors from a list of twenty-five variables. Further analysis of these factors indicated that the following four factors were of significant importance to economic performance: (1) economic orientation; (2) independence; (3) personality; and (4) general knowledge.[19] These factors, although general in content,

---

[17] Ibid., p. 7.

[18] Donald C. Huffman, "A Technique for Classifying Farm Managers According to Managerial Ability" (unpublished Doctor's dissertation, The Ohio State University, Columbus, 1963).

[19] Ibid., p. 77.

seemed to be consistent with existing hypotheses concerning factors influencing the managerial process. Huffman did not attempt to develop refined measures of these factors but suggested that such measures may ultimately provide means of empirically measuring and predicting managerial performance and ability.

A summary of the literature regarding the management process suggests that the model of management which views management as a process of problem recognition, observation, analysis, decision-making, action-taking, and responsibility bearing, provides a meaningful framework for research aimed at discovering the essence of management. This is not to say that the model has reached perfection. There still remains the need to continuously subject the model to empirical verification and to improve its capacity to conceptualize the management process. Nevertheless, the model is a creation of farm management economics, and its purpose, from the beginning, has been the removal of the unknowns regarding the management resources in agriculture. The model therefore constituted the framework around which the present study was designed.

II. RESEARCH RELATED TO THE MEASUREMENT AND PREDICTION OF MANAGERIAL PERFORMANCE

Research aimed at measuring and predicting managerial performance and/or ability pre-dates the type of research reviewed in the last section by several years. Generally speaking, all such research has been based on the assumption that management performance as measured by some pre-selected criterion could be related to some observable attributes

of farm managers. The methodology for this type of research has consisted of developing a list of descriptive items hypothesized to indicate the presence or absence of managerial aptitude and selecting from this list those items which discriminated between "good" and "poor" managers. The importance of studies of this type is realized when one notices the great deal of similarity in the results. Furthermore, studies of this type can be viewed as the initial attempt to analyze the human factor in agriculture.

One of the first studies concerning an analysis of the human factor in agriculture, was conducted by Wilcox, Boss, and Pond, in Minnesota, in 1932.[20] Relating labor earnings, as a criterion of success, to personal characteristics such as age, education, farm experience, agricultural knowledge, and use of farm practices, these researchers reported that interest, need, ambition, and judgment were "directly reflected in the earnings or business success of the farmer."[21] Today such conclusions would not likely warrant much attention, but at the time of this study variations in earnings among farmers were associated more with variations in the farms rather than the managers. In the same year, Wilcox and Lloyd conducted a nearly identical

---

[20]Walter W. Wilcox, Andrew Boss, and George A. Pond, Relation of Variations in the Human Factor to Financial Returns in Farming, Agricultural Experiment Station Bulletin No. 288, University of Minnesota, Saint Paul, Minnesota, June, 1932.

[21]Ibid., p. 39.

study in Indiana.[22] Their results were the same as those listed in the Minnesota study with the exception that they subjected their factors to multiple correlation analysis in an attempt to assign priorities to the factors related to financial earnings. This analysis led to the conclusion that ambition was the most important factor affecting earnings, followed by possession of agricultural information.[23]

Research oriented toward analyzing the human factor seemed to become almost non-existent immediately following the work in Minnesota and Indiana, but began to reappear in the early 1950's. In 1952 Reiss completed research concerning "individual differences in entrepreneurial and managerial ability among Illinois farm operators."[24] Hypothesizing that "there are consistent observable differences among farm operators and that measures of such differences should provide valid indications of difference in achievement,"[25] Reiss obtained 723 essays describing "good" and "poor" farmers. These essays were obtained from farmers and professional agricultural workers. After editing these essays, 257 different descriptive items remained. The items were concerned with such things as personal behavior, job proficiency, family relationships,

---

[22]Walter W. Wilcox and O. G. Lloyd, The Human Factor in the Management of Indiana Farms, Agricultural Experiment Station Bulletin No. 369, Purdue University, Lafayette, Indiana, August, 1932.

[23]Ibid., p. 1.

[24]Franklin Jacob Reiss, "Individual Differences in Entrepreneurial and Managerial Ability Among Illinois Farm Operators," (unpublished Ph.D. thesis, University of Illinois, Urbana, 1952).

[25]Ibid., p. 2.

health status, recreation, social participation, belief and attitudes, and practice use.[26] These descriptive items were reduced to eighty-five items having the greatest discriminatory power relative to "good" and "poor" farmers.[27] The criterion used to separate "good" and "poor" farmers was an average of returns to capital and management, operators labor and management, and net returns to management, over a three-year period. These items were then arranged in a forced-choice rating format, and given to neighbors of 236 farmers, who were asked to rate these farmers.[28] The forced-choice technique required the raters to rate those farmers on both favorable and unfavorable characteristics. The results of the research supported the hypothesis that there are consistent observable characteristics of farmers which are significantly correlated with success. Reiss concluded that a high degree of financial success in farming was related to strong economic motivation, good training and experience, and an adequate amount of agricultural knowledge.[29]

It is interesting to note that conclusions similar to those of Reiss are evident in many of the studies regarding the management resource in agriculture. A case in point is a study conducted by Hess and Miller

---

[26] Ibid., p. 204.

[27] Ibid., p. 210.

[28] Ibid., p. 209.

[29] Ibid., p. 210.

in 1954.[30] Their study, although not explicitly designed to measure management, did attempt to isolate personal, economic, and social factors related to success. The results of their study strongly indicated the importance of motivation, agricultural knowledge, and problem recognition. Implications concerning the general management resource in agriculture were limited, however, due to the limitation of the sample to dairy farmers, and to the predominant emphasis placed on actions and behavior specific to the milk production enterprise.

Following the work of Hess and Miller, research concerning the measurement of management ability and/or performance changed from an emphasis on isolating and describing characteristics related to success to an emphasis on developing actual measuring instruments. The fact that one of the more methodologically sound instruments developed was done so by a rural sociologist is an indication of the interdisciplinary nature of the study of the human resource in agriculture.

Straus developed measures for four variables which can be considered as values or goal orientations, and which act as a predispositional force on the decision process.[31] The variables measured were innovation proneness, rural life preference, primary group perference, and economic motivation. The procedure used to develop these measures,

---

[30] C. V. Hess and L. F. Miller, Some Personal, Economic, and Sociological Factors Influencing Dairyman's Actions and Success, Agricultural Experiment Station Bulletin No. 577, Pennsylvania State University, College Station, Pennsylvania, June, 1954.

[31] Murray A. Straus, A Technique for Measuring Values in Rural Life, Agricultural Experiment Station Technical Bulletin, No. 29, Washington State University, Pullman, Washington, August, 1959, p. 1.

although similar to development of measures of managerial performance by others, was unique from one standpoint. Straus hypothesized that these four variables were real, and then developed scales to measure them without relating the scales to any type of performance criterion. It was only after scales had been developed and refined that scores on the scale were related to performance. Results of these comparisons for a group of Columbia Basin settlers, indicated that high success is related to high economic motivation and innovation proneness, while low success is related to a high score on rural life preference.[32] Like Reiss, Strauss used a forced-choice format in the construction of his measuring device. Unlike most other measuring devices, Straus' instrument avoided the so-called "criterion problem" which implies that a measuring device based on some criterion is only as good as the criterion.

In the same year of Straus' work, McCormick, Blanchard, and Thomas developed a biographical questionnaire the purpose of which was to predict the probable level of farm tenant performance.[33] Using ratings by professional farm managers as the criterion of performance, and relating these ratings to a large amount of biographical data, thirty-six items were isolated which discriminated between "good" and "poor" performers. The relevance of this research to measuring managerial

---

[32] Ibid., p. 13.

[33] Ernest J. McCormick, Robert E. Blanchard, and D. Woods Thomas, An Objective Method of Selecting Farm Tenants, Agricultural Experiment Station Research Bulletin No. 678, Purdue University, Lafayette, Indiana, April, 1959.

performance or ability is suspect from at least two points of view. First, the biographical questionnaire was developed to predict probable performance level of farm tenants. This itself limits the applicability of the questionnaire but these limitations become even more specific when it is realized that the tenants used in the questionnaire development were all under the supervision of a professional farm manager. Secondly, the use of only biographical data disregards the influence of such variables as drives, motivation, values, attitudes, interests, capabilities, and feedback systems on managerial processes.[34]

The insufficiency of biographical items for separating managers on the basis of performance has been suggested by research conducted by Wirth.[35] Wirth used pattern analytic procedures to classify managers according to managerial ability as measured by production function residuals, and the ratio of net farm income to total farm capital. He found twenty-six items concerning drives, motivations, goals and values, and thirteen items concerning decision processes significantly separated managers on the basis of the criteria. Of equal importance he found twenty-one biographical items when used alone were insufficient, and

---

[34] See Figure 1, Chapter I, p. 12.

[35] M. E. Wirth, "Pattern-Analytics: A Method of Classifying Managerial Types," The Quarterly Bulletin, 47(2):166-198, November, 1964.

when combined with the items mentioned above added nothing to the classifying ability of his analysis.[36]

In concluding this section it is appropriate to review a few attempts to incorporate the management factor into production function analysis. To date, such attempts have been relatively unsucessful. This is in no small way due to the present inability to measure managerial ability or performance. Nevertheless such attempts are worthy of mention because of the encouragement they generate.

In 1960, Paris attempted to predict input levels for 1956 on the basis of 1952 parameters and 1956 prices and incomes.[37] His initial attempt to do this resulted in large deviations between predicted and observed input levels. In general terms, these deviations were attributed to failure to specify the right type of production function and failure to include relevant variables. One of the relevant variables not included was the management resource. Paris incorporated the management factor into his production function in the form of four observable characteristics--age, education, economic value score, and vocabulary score. The result was only a slight improvement in his predictive equation.[38] Even a slight improvement in a case where such a limited number of managerial variables were included is indeed encouraging.

---

[36] Ibid., p. 194.

[37] Donald Gordon Paris, "Predicting Farm Behavior from Estimates of Input Productivity for a Sample of Western Kentucky Farms" (unpublished Doctor's dissertation, University of Kentucky, Lexington, 1960), p. 87.

[38] Ibid., p. 88.

Finally, a fairly recent study by Pugh, Thomas, and Eisgruber attempted to incorporate the management factor into the production function in the form of an index of tenant ability.[39] The results indicated that both output and marginal value productivity of physical inputs increased with increases in tenant ability, but not significantly. When it becomes apparent that the index of tenant ability used was the one developed by McCormick, Blanchard, and Thomas, having as it did, inherent limitations relative to measuring management, such results are not surprising.[40] Even with these limitations, however, the quantification and use of the management factor in production function analysis was demonstrated.

III. IMPLICATIONS OF LITERATURE REVIEW

The review of literature concerning the analysis of the human resource in agriculture was meant to serve the purpose of providing direction to the current research. It indicated what has been done, what the current situation is, and what is in need of doing in this broad research area.

Regarding past contributions it appears that most of the work done has been of a pilot study nature. In a sense the past has been a period of exploring the potential of research directed toward

---

[39] C. R. Pugh, D. W. Thomas, and L. M. Eisgruber, Farm Tenant Ability, Output, and Resource Productivity, Agricultural Experiment Station Research Bulletin No. 793, Purdue University, Lafayette, Indiana, April, 1965.

[40] See last paragraph on page 29.

analyzing the management resource, rather than concentration of research resources around any specific problem. When these past contributions are viewed as a whole they appear to possess a common feature; namely, the lack of consensus regarding what it was that needed to be analyzed. In short, past research lacked a concrete, meaningful model of the management process.

Regarding the current situation, the literature review indicates that a model now exists which can be used as a framework for design of research aimed at understanding the management resource. This model conceives management as being, at least partially, a mental process consisting of problem recognition, observation, analysis, decision-making, action-taking, and responsibility bearing. Using this model, management ability can be defined as the ability to perform the functions in the process, and managerial performance can be viewed as the result of carrying out these functions. The validity of the model has been strengthened both by the fact that it is a creation of farm management economics and it has been empirically verified to a certain degree. The current status of the problem can be simply stated--there is now a model of management. The generality of the model cannot be denied but in an area where so little solidification of concepts and establishment of priorities has taken place, confinement to a highly specific model would not seem to be the appropriate order of the day.

Regarding future needs the literature review suggested the following: First, the model itself should be subjected to analysis

aimed at continuous refinement. Such refinement will likely be in the form of the addition of new functions to the process and/or alterations in existing functions. There is a definite need for investigation of external influences on the process, as well as the interrelationships among process functions. Secondly, there is a critical need for research designed to develop meaningful criteria of managerial performance. Measurement and prediction ultimately depend upon unbiased and efficient criteria. Finally, the literature review seems to indicate that satisfactory quantification of the management factor for explicit use in economic analysis may be a long-run accomplishment. A statement in a recent social science research text stated "that the development of measurement processes is dependent upon the constant interaction of both empirical procedures for measurement and theoretical concepts about what is being measured."[41] The problem of measuring management is presently at the threshold of this interaction.

With the problem stated and related literature reviewed, the content of the remainder of the report deals with the specific problems attacked by the present researcher. The reader should constantly keep in mind the broad nature of the management evaluation problem and its current stage of development. Otherwise, expectations concerning the remainder of the report may deviate considerably from actual accomplishments.

---

[41]Claire Selltiz, et al., Research Methods in Social Relations, revised edition (New York: Holt, Rinehart, and Winston, Inc., 1964), p. 197.

CHAPTER III

METHODOLOGY

Since the present study had as one of its major objectives the exploration of methodology useful for evaluation of managerial behavior, it is appropriate to describe in detail the methodological procedures used. They can be classified as (1) those used to collect the data regarding managerial behavior and (2) those used to analyze the data collected. Such a classification serves as the basic framework around which the following description was designed. In terms of this framework the description of data collection outlines the procedure used to develop a questionnaire designed to inventory relevant management behavior and describes the respondents who provided the information for the study. The description of data analysis attempts to present simply, but yet sufficiently, the methodology used to evaluate the raw data collected. The methodology used in both instances was relatively new in the area of farm management research, although not new in other disciplines concerned with human behavior. Such newness seemed to justify a more detailed description than might have been the case if the present study had been conducted within a social science discipline other than agricultural economics.

I. METHODOLOGY FOR DATA COLLECTION

The methodology used in collection of data for the present study can be described as a step-by-step process of (1) hypothesizing the existence of selected management behavior variables, (2) selection of a number of items hypothesized to be indicative of such behavior, (3) arrangement of the items into a descriptive questionnaire, and (4) an administration of the developed questionnaire to an appropriate sample of individual farm operators. This methodology was an adaptation of that used in studying leadership behavior.[1] Modifications of the procedure have been used in agricultural research by Reiss,[2] Straus,[3] and McCormick, et al.[4] The basic assumption underlying this type of methodology is that there are observable human actions which are indicative of the hypothesized behavior variables and hence the inventory of such items can serve as a basis for analyzing the hypothesized variables.

---

[1] Ralph M. Stogdill and Alvin E. Coons, editors, Leader Behavior: Its Description and Measurement, Research Monograph No. 88, The Bureau of Business Research, The Ohio State University, Columbus, 1957.

[2] Franklin Jacob Reiss, "Individual Difference in Entrepreneurial and Managerial Ability among Illinois Farm Operators" (unpublished Doctor's thesis, University of Illinois, Urbana, 1952).

[3] Murray A. Straus, A Technique for Measuring Values in Rural Life, Agricultural Experiment Station Technical Bulletin No. 29, Washington State University, Pullman, Washington, August, 1959.

[4] Ernest J. McCormick, et al., An Objective Method of Selecting Farm Tenants, Agricultural Experiment Station Research Bulletin No. 678, Purdue University, Lafayette, Indiana, April, 1959.

Specification of Processes

Before specifying the particular processes hypothesized in the present study, it is necessary to understand the nature of processes. A process is viewed to be "synonomous with activity and behavior," and can be defined as "the physiological (and psychological) activities involved, or believed to be involved, in a particular behavior."[5] Many of these processes have not been identified and are thus hypothetical in nature. A more appropriate term than process, for this research, is hypothetical process variable which has been defined by English and English as "a hypothetical construct referring to an actual, though presently unobservable, inferred activity or process."[6] Such is the nature of the variables hypothesized in the present report.

The variables hypothesized were given the following names: (1) organization; (2) planning; (3) environmental communication; (4) representation; (5) managerial professionalism; (6) observation; (7) analysis; and (8) initiating action. The specification of these hypothetical processes immediately called for some justification for specifying these particular processes. Selection of these particular variables was the result of two things.

First, the content of these processes has been implied in past research regarding the management resource in agriculture. Organization and

---

[5]Horace B. English and Ava Champney English, A Comprehensive Dictionary of Psychological and Psychoanalytical Terms (New York: David McKay Company, Inc., 1958), p. 410.

[6]Ibid.

planning are processes which were expressly implied in early farm management research. Representation and communication, on the other hand, have been implied as existing processes in numerous leadership and management studies. Managerial professionalism, which is defined as the existence of an orientation, toward management as a professional endeavor, has been implied in the observations of many professional agriculturalists. Finally, observation, analysis, and initiation of action are explicitly hypothesized to exist by the conventional management processes model.

Secondly, the particular processes specified were considered to be meaningful and relevant to the study of management behavior, by the author and other members of the author's research committee. In research of the type reported in the present study it becomes necessary to place some limitations on the types of behavior inventoried. Such limitations require a combination of knowledge of prior research findings and researcher's judgment. A consensus of opinion indicated that the hypothesized variables initially set forth in this study were the result of the application of this combination.

Item Selection

Once the hypothetical process variables had been specified the next logical step was to develop an item pool. Such a pool of items was collected and written with the following points emphasized: First, an item should be written in such a way as to describe behavior which was indicative of a specific hypothetical process variable. Secondly,

the item should be written in such a manner that it would be meaningful to all of the respondents. Thirdly, the item, although describing specific behavior, should be written so that it described behavior related to the processes hypothesized rather than to any particular type of farm organization, enterprise, or practice.

Since the inventory of actual behavior of farm operators was an important part of the present research it was decided that the content validity of the items would be improved if the items were submitted by persons working closely with farm operators. To accomplish this, ninety-five County Agricultural Extension Agents throughout Tennessee were asked to submit items descriptive of behavior of "good" and "poor" farm managers. Sixty-seven County Agents returned the completed forms. An editing of the items to eliminate similar descriptions resulted in 144 descriptive items of "good" farm managers (Appendix A), and 93 descriptive items of "poor" farm managers (Appendix B). Following the collection of a pool of descriptive items from Agricultural Extension Agents, supplemented by items from related research, each item was evaluated relative to its indicativeness of one of the hypothetical process variables. The following working definitions were used to relate individual items with specific hypothetical processes:

1. Organization: Items indicative of systematic ways of doing things, and of structure and methodical treatment or approaches to problem solving.

2. Planning: Items indicative of looking ahead, developing courses of action, and making preparations for future events.

3. Environmental Communication: Items indicative of communication with one's environment, flow of information from manager to off-farm environment, expression, person-to-person communication.

4. Managerial Professionalism: Items indicative of the presence of an orientation toward farming as an executive type profession, pride in management, and satisfaction with management demands.

5. Observation: Items indicative of gathering information, recognition of facts and occurrences, and awareness of affairs pertaining to the farm business.

6. Analysis: Items indicative of reasoning, analytical processes, and calculation.

7. Initiating Action: Items indicative of motivation toward change, origination of new practices, and ability to take action.

8. Representation: Items indicative of environmental participation, involvement in off-farm activities, and desire for off-farm representation.

An item by item evaluation resulted in a total of 122 items assumed to be indicative of either the presence or absence of the hypothetical processes. The items are listed in Table I, under those respective processes to which they were assigned. Those items describing behavior assumed to be indicative of the presence of the process are preceded by a plus (+) and those items describing behavior assumed to be indicative of the lack of the process are preceded by a minus (-). As shown in Table I, 20 items were constructed to indicate the organization process; 13 items the planning process; 15 items the environmental communications process; 19 items the managerial professionalism process; 14 items the observation process; 14 items the analysis process; 14 items the initiating action process; and 13 items the representation process.

TABLE I

DESCRIPTIVE ITEMS ASSUMED TO INDICATE PRESENCE OR ABSENCE OF SPECIFIED MANAGERIAL PROCESSES, BY PROCESSES

Scale Indicator[a]		Descriptive Item
		A. ORGANIZATION
+	1.	Usually complete work as scheduled
+	2.	Assign each farm worker and/or family member to certain tasks
-	3.	Do not include family members when planning farming operation
-	4.	Never seem to get work done as scheduled
+	5.	Usually develop a written farm plan
+	6.	Allow a certain amount of time for each routine farm job
-	7.	Farm without a written plan
+	8.	Use government programs only to the extent they fit own program
+	9.	Determine what the family wants, then set up farm operation to meet these requirements
-	10.	Never seem to have things needed at time they are needed
+	11.	Usually adjust size of crop and livestock enterprises when prices change
+	12.	Obtain opinion of family members concerning large farm expenditures
+	13.	Do routine chores about the same time each day
+	14.	Make written notes during the day of unusual situations noticed
+	15.	Schedule work in such a way as to have least amount of lost time and motion
+	16.	Write things down rather than depend on memory
+	17.	Use some type of published record book
+	18.	Have special times scheduled for record keeping
+	19.	Have standard operating procedures for doing my work
+	20.	Follow a set pattern in going about the farming operation.
		B. PLANNING
+	1.	Have everything needed before starting a job
+	2.	Determine total amounts of operating items (feed, fertilizer, etc.) needed well in advance

TABLE I (Continued)

Scale Indicator		Descriptive Item
+	3.	Establish certain dates as deadline for completion of jobs
-	4.	Do little long-run farm and home planning (for example, 5-year plan, 10-year plan)
+	5.	Usually develop a yearly plan to use as guide for operation of farm
+	6.	Plan production to meet favorable price periods
+	7.	Plan purchases so as to take advantage of seasonal discounts
-	8.	Carry out farm operations without a written farm plan
-	9.	Never seem to have time for leisure and recreation
-	10.	Often need something from town in order to complete a task
+	11.	Plan each day's activities beforehand
+	12.	Subscribe to outlook and projection type publications
+	13.	Check weather forecast at least twice daily
		C. ENVIRONMENTAL COMMUNICATIONS
+	1.	Read a wide variety of magazines, books, news articles, etc.
+	2.	Talk quite often with County Agent and other professional agricultural workers
-	3.	Seldom talk about my farming operation and its problems with people other than my family
+	4.	Discuss my own farming operation with neighbors and friends
-	5.	Contact professional agricultural workers only when have serious problems
+	6.	Frequently discuss national, international, political, social and economic problems with other farmers, businessmen, County Agent, etc.
+	7.	Often contact my political representatives when concerned with legislative changes
-	8.	Seldom pay much attention to state, national and international news
-	9.	Often feel uneasy when discussing farm business matters with people other than family members and close friends
+	10.	Don't hesitate to accept positions requiring leadership and public appearances
-	11.	Don't maintain particularly close speaking relationships with bankers, cooperative supervisors, and other non-farm businessmen

TABLE I (Continued)

Scale Indicator		Descriptive Item
+	12.	Keep those with business and scientific interests in my operation pretty well up to date on my present operation and future plans
-	13.	Have difficulty making myself understood
+	14.	Make a point of obtaining national and world news information daily
-	15.	Receive most information from family and very close friends
		D. MANAGERIAL PROFESSIONALISM
+	1.	Feel that farm operators need periodic management training courses
	2.	Feel that the use of credit is a required part of farm management
+	3.	Emphasize farming as a business rather than farming as a "way of life"
-	4.	Feel that success in farming is mostly a matter of hard physical work
-	5.	See little reason to be constantly changing methods of production and adopting new practices
+	6.	Get a great deal of personal satisfaction from attempting to solve the many problems farming presents
+	7.	Feel that the challenge offered by farming is a more important one than living in the country as a reason for farming
+	8.	Use the knowledge of agricultural specialists and businessmen to help solve unfamiliar problems
-	9.	Have difficulty understanding such concepts as budgeting, marginal analysis, alternative costs, capital, net worth, returns to resources
+	10.	Feel that farming success depends on keeping a detailed set of records
+	11.	Feel that keeping up with scientific research and developments is necessary for success
+	12.	Mostly make changes on basis of figuring out its effect on my own operation rather than on basis of recommendations from outside sources
+	13.	Believe that the farmer is more like a businessman than a skilled worker or technician
+	14.	Would rather be a farm manager than a skilled worker if the pay was the same

TABLE I (Continued)

Scale Indicator		Descriptive Item
+	15.	Feel farming would be more enjoyable if there weren't so many decisions to make
+	16.	See a lot in common between running a farm and operating a non-farm business
+	17.	Usually take some time off to enjoy myself after having solved a lengthy farming problem
+	18.	Usually ask myself if a problem is worth solving before doing anything about it
-	19.	Often wish I were a little more confident in my ability to manage my operation
		E. OBSERVATION
+	1.	Usually keep up with what other farmers are doing
+	2.	Keep pretty close watch on market conditions and prices
+	3.	Keep pretty well up to date on changes and new developments concerning farm programs
+	4.	Often watch, listen to, and read about national news and current problems
+	5.	Use research information a great deal in my farm operation
-	6.	Obtain most of my information from close friends and neighbors
-	7.	Seldom vary amounts and analyses of fertilizers and feeds I use
+	8.	Attend such things as field days, machinery demonstrations, adult farmer classes, etc., when at all possible
-	9.	Probably couldn't satisfactorily describe the kinds of soils I have and their characteristics if asked to do so right now
-	10.	Don't "shop around" when buying supplies and selling products
+	11.	Could tell someone the approximate yields and production of individual fields and animals on my farm without looking at records
+	12.	Keep pretty well up to date on new production intervals
+	13.	Look at my farm records at regular intervals
+	14.	Always listen to daily market reports

TABLE I (Continued)

Scale Indicator		Descriptive Item
		F. ANALYSIS
+	1.	Calculate total cost and returns for each enterprise in my farming operation
+	2.	Usually determine the acreage necessary to justify ownership before deciding to buy a new piece of machinery
+	3.	Adopt recommended practices only after determining affect of them on my own operation
+	4.	Determine the benefit of government programs before deciding extent of participation
+	5.	Use farm records to a large extent in making my decisions
-	6.	When purchasing feed, seed, fertilizer, machinery, etc., I give little emphasis to things other than price
-	7.	Often adopt a new practice or method because it seems to be working for others
+	8.	Consider entire farm operation before adopting a new production method
-	9.	When purchasing feed, seed, fertilizer, machinery, etc., I prefer to purchase only the top line
-	10.	When deciding to adopt a new farm practice added cost is the determining factor
-	11.	Seldom attempt to determine why certain enterprises vary in returns from year to year
+	12.	Calculate or have calculated such efficiency indicators as machinery cost per acre, pounds of gain per dollar of feed, labor cost per acre, percent of land in high value crops, etc.
+	13.	When considering expanding farm enterprises I usually find out both the additional costs and the returns
+	14.	Always keep a complete set of farm records for each enterprise
		G. INITIATING ACTION
+	1.	In my farming operation I am always looking for newer and better ways to farm
+	2.	Always among the first farmers to try out new ideas and methods of farming

TABLE I (Continued)

Scale Indicator		Descriptive Item
+	3.	Adjust to technology over a period of time, never all at once
-	4.	Adjust to technology only if I am forced to or as a last resort
-	5.	Usually wait to see if most others will adopt a new practice before adopting it myself
-	6.	See little reason to change methods and adjust to technology since it won't solve my problems
-	7.	Usually try to adopt all new practices that I know about
+	8.	Encourage other farmers in the community to accept new ideas and methods in farming
+	9.	Adopt new methods before they are approved by "experts" and other farmers
-	10.	Am satisfied with my farming operation as it is
-	11.	Adopt a new practice only after it has become acceptable to all the other farmers in the community
+	12.	Always emphasize to other farmers the importance of change in farming
+	13.	When solving problems I try to think of all the alternatives and approaches to the problem
+	14.	Continuously read, ask questions, and participate in activities that will teach me more about farming
		H. REPRESENTATION
+	1.	Participate regularly in farm organizations
+	2.	Quite often attend field days, adult farmer classes, machinery demonstrations, etc.
+	3.	Accept positions of community responsibility when asked
-	4.	Attend few off-farm activities
-	5.	Do not participate regularly in community activities
+	6.	I am fairly active in community affairs
+	7.	Emphasize farm and home beautification as one of the more important farm-family goals
-	8.	Let other farm members represent our farm and family at off-farm activities, rather than attending myself
-	9.	Am not concerned about what the community thinks of me

TABLE I (Continued)

Scale Indicator		Descriptive Item
-	10.	Am not an active participant in political activities
-	11.	Have little interest in off-farm activities
+	12.	Emphasize to my family the importance of participating in off-farm activities
+	13.	Volunteer the use of farm and family resources to assist in community activities, field days, etc.

[a]The scale indicator indicates the relationship assumed between the behavior described in the item and the process. Plus (+) indicates that the behavior described contributes positively to the ability to perform the process. Negative (-) indicates that the behavior described contributes negatively to the ability to perform the process.

In the context of managerial ability the items assigned to each process can be viewed as an indication of the ability or lack of ability to carry out the process. Ability is defined as "the actual power to perform an act, physical or mental, whether or not attained by training and education. It implies that the task can be performed now, if the necessary external circumstances are present; no further training is needed."[7] It is this now terminology that the items indicated in Table I were stated. The items attempted to describe the farm operator relative to his performance of each process in terms of his present behavior.

Questionnaire Development

Following the selection of items to sample behavior indicative of the hypothetical processes, the next problem became one of organizing these items into a questionnaire for collecting the data. Due to a limitation of time, field personnel, and funds, a self-fillout questionnaire was decided upon as the means of data collection. This decision immediately raised the question regarding the most appropriate format to use in presenting the items to the respondents.

Two alternative formats were evaluated--a forced-choice format and a self-rating ordinal scale. The forced-choice format has been used extensively in descriptive questionnaires attempting to sample effective non-cognitive behavior such as attitudes and values.[8] Briefly,

---

[7] Ibid., p. 1.

[8] Straus, op. cit., pp. 5-6.

this method arranges a pool of items into small groups, usually four items, containing items describing both socially acceptable and socially unacceptable behavior. The respondent is asked to select from each group an item "most like" and an item "most unlike" himself. The items are arranged into enough combinations that sooner or later the respondent describes himself in terms of both acceptable and unacceptable bahvior. A major advantage of the forced-choice technique is that it prevents the respondent from describing himself in completely favorable terms. However, this format is disadvantageous for presentation of a large number of descriptive items, and similarly it loses its major advantage if the behavior to be described is not noticeably related to social values. Such seemed to be the case in the present study and thus a self-rating ordinal scale was used.

The self-rating ordinal scale adopted consisted of a multiple choice format with five alternative responses. The alternatives were: (1) very much like me; (2) like me; (3) uncertain; (4) unlike me; and (5) very much unlike me. The use of a five-point scale was adopted on the basis that a lesser number of choices would limit the descriptiveness of the questionnaire and a larger number would be more apt to create respondent resistance due to the length of the questionnaire.

Although the behavior described by the 122 items selected was assumed to be unaffected by social values, a review of the items suggested that some of the items contained a high value tone. This was probably the result of constructing the items from descriptions of "good" and "poor" farmers by County Agricultural Extension Agents,

and the supplementing of these items by descriptions of farm managers, according to some criterion of performance, found in past management studies. In order to reduce the affect of high value tone on the responses to the items two procedures were employed. First, each question was reviewed by four individual researchers and questions having a high value connotation were rephrased to eliminate such connotation. Secondly, since the names given to the hypothetical processes might be affected by social values these names were dropped from the questionnaire and the items were randomized by use of a random number table before constructing the questionnaire.

Questionnaire Administration

Although many studies dealing with the management factor in agriculture have used judgment samples the present study used a random sample. There were two reasons for using a random sample: (1) This study was primarily concerned with obtaining a representative sample of the specified behavior exhibited by farm operators. A random sample seemed most likely to assure such representation. (2) The present study was a part of a broader research project aimed at studying the managerial resources in the Elk River Watershed of Tennessee. Collection of data regarding behavior was thus coincident with collection of other data regarding the commercial farm operator in the Elk River Watershed, from which inferrences concerning the total population could be made.

Even though collection of data regarding behavior of farm operators was restricted to a small geographical area the limitation of the applicability of the findings of the present study to the area does not necessarily follow. This is so, first, because the processes hypothesized are not specific to the area in which the sample was drawn. Secondly, the items constructed to indicate these processes were constructed to sample general management behavior, rather than management behavior specific to any particular type of farm organization, enterprise, or practice. Nevertheless, a description of the area from which the sample was taken was expected to increase the meaningfulness of the present study.

The Area: The data collected for the present study were obtained from commercial farm operators, having $2500 or more gross farm sales. These operators were located in the Elk River drainage area of Franklin, Lincoln, Giles, and Moore Counties in South Central Tennessee. The area is located about midway between Nashville, Tennessee, and Birmingham, Alabama, from North to South, and about one-third the way from Chattanooga to Memphis, from East to West.[9] The area is dominantly an agricultural area containing a large number of small farms. Topographically, the land is moderately rolling with a small proportion of level land located along the Elk River and in some parts of the Highland Rim Plateau. Although commercial farms with gross farm sales of $2500 or

---

[9] Elk River Watershed: Summary of Resources with Documentary Supplements (Knoxville: Tennessee Valley Authority, August, 1962), p. 10.

more constitute only about one-third of all farms, they are responsible for approximately two-thirds of all farm sales, control about 61 percent of all farm land, and 65 percent of all cropland.[10] There is no predominant type of farm in evidence. However, recent statistics indicate a shift from crop oriented organization to a livestock oriented organization.

The Sample: The sample for the present study consisted of 123 commercial farm operators, located in randomly selected two-mile square blocks in Giles, Lincoln, Franklin, and Moore Counties of the Elk River Watershed. The sample was divided among the counties approximately proportional to the percent of commercial farmers that the county contained relative to the total number of commercial farmers in the area. Of the 123 farmers completing the questionnaire, 27 came from Franklin County, 36 came from Giles County, 48 from Lincoln County, and 12 from Moore County.

The following procedure was used to collect the data: The randomly selected blocks for each county were sampled consecutively until the desired number of farm operators had been obtained. Each farm operator in the block who satisfied the following criteria was asked to complete the questionnaire: (1) he must have had gross farm sales of $2500 or more in 1967; (2) his place of residence must have been in the block; (3) he must have been the major decision-maker

---

[10] Ibid., pp. A4-A5.

regarding control, organization, and allocation of resources; and (4) he must have been in the role of decision-maker for at least one year.

The questionnaires were then collected from the farm operators during a period ranging from one day after delivery to ten days after delivery. Because the use of a questionnaire, as contrasted to an interview, was somewhat unique for the present type of study, an evaluation of its effectiveness in obtaining the desired data can be viewed as a contribution to data collection methodology.

The questionnaire was eleven pages long with a supplemental page for those operators unable to furnish the answer to a question regarding net farm income. It was estimated that the entire questionnaire could be completed from one-half hour to an hour and fifteen minutes. In terms of returns, 178 questionnaires were delivered in order to obtain the 123 completed questionnaires, for a return of 69 percent. It was noticed by the field workers that a higher proportion of delivered questionnaires were completed when the pick-up period was reduced. An analysis indicated that for the first deliver-pick-up period, which allowed a lapse of seven to ten days, 66 percent of the questionnaires were returned completed. During the second delivery-pick-up period, which allowed a lapse of one to two days, 80 percent of the questionnaires were completed. As a whole the field workers found the respondents very receptive to the self-rating questionnaire used, and the results indicated that such a procedure possessed some advantages over the mail-out questionnaire technique relative to

expected returns, and over the conventional interview technique relative to time requirements for data collection.

The distribution of selected characteristics of the farm operators in the sample is shown in Table II. This table indicates that the highest proportion of the operators were between 40 and 49 years of age. The average age for the sample was 48.5 years. Nearly 63 percent of the operators had completed ten or more years of school, while the average educational level of the sample was 10.4 years.

In terms of size of farm operation, a little over two-thirds of the operators farmed less than 200 acres of combined crop and pastureland. The average size of operation, in terms of combined crop and pastureland, was 189 acres. Although the sample was restricted to commercial farmers with gross sales of $2500 or more, nearly half of the operators reported net farm incomes less than $2000. The average net farm income was $3538.37. Table II further shows that beef and hog enterprises were predominant in the sample.

II. METHODOLOGY FOR DATA ANALYSIS

The present study had as its major objectives the identification of managerial processes inherent in observable managerial behavior and the relationship of such processes to managerial performance. For purposes of satisfying the first objective factor analysis seemed to provide the most appropriate method, and for the second objective regression analysis was chosen.

TABLE II

DISTRIBUTION OF SAMPLE BY SELECTED CHARACTERISTICS, NUMBER OF FARM OPERATORS, AND PERCENT OF OPERATORS IN EACH CLASS, ELK RIVER WATERSHED, TENNESSEE, 1968

Characteristic		Number of operators	Percent of operators
Age (years)			
29 or less		6	4.9
30-39		18	14.6
40-49		41	33.4
50-59		33	26.8
60 and over		25	20.3
	Total	123	100.0
Education (years)			
6 or less		7	5.7
7-9		39	31.7
10-12		66	53.7
over 12		11	8.9
	Total	123	100.0
Size of Operation (acres of crop & pastureland)			
less than 100		39	33.6
100-199		40	34.5
200-299		18	15.5
300 and over		19	16.4
	Total	116	100.0
Net Farm Income			
less than $1000		33	28.5
$1000-$1999		19	16.4
$2000-$3999		34	29.3
$4000-$6999		15	12.9
$7000 and over		15	12.9
	Total	116	100.0
Type of Farming[a]			
Cash crop		22	17.9
Grade A Dairy		17	13.8
Grade B Dairy		16	13.0
Beef		37	30.1
Beef and Hog		31	25.2
	Total	123	100.0

[a]Type of farming based upon major source of income.

Factor analysis seemed most appropriate for the analysis of the collected data for two reasons. First, the method has as one of its objectives the explanation of a large amount of observable phenomena in terms of a smaller number of unobservable variables or "common factors." Secondly, this method of analysis was originally developed in the field of psychology for purposes of isolating basic mental processes inherent in observable human behavior. The method is more mathematical than statistical in that "quantitative data are treated mathematically to uncover the smallest number of basic variables to which crude observations can be reduced and to throw light upon the relationships among these variables."[11] Furthermore, the method appears to be particularly adapted to exploratory research. As Cattell has stated, "one need have no more definite idea than Columbus had of America in regard to what may be found. It is sufficient to hypothesize that some structure lies there."[12] At the present stage of research regarding human behavior and farm management, there is a great and demanding need for the isolation of basic human processes relevant to the decision-making aspects of managing a farm business. This need requires the use of research methods not requiring rigid specification of relevant variables and hypothesized relationships. Factor analysis fits the description of such methods since it

---

[11] T. G. Andrews, editor, Methods of Psychology (New York: John Wiley and Sons, 1948), p. 556.

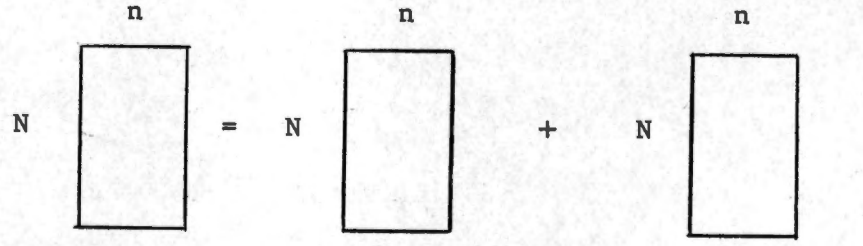
[12] Raymond B. Cattell, Factor Analysis: An Introduction and Manual for the Psychologist and Social Scientist (New York: Harper and Brothers, 1952), p. 14.

is probably as much a method of "variable synthesis"[13] as it is factor analysis, "for although it analyzes out the distinct factors at work among the variables, it also groups the variables together in ways which permit one to synthesize new entities."[14]

A better understanding of factor analysis can be facilitated by a more mathematically oriented specification of the model. The following specification of the factor model is presented only to the extent of providing the reader with a knowledge of the method sufficient for understanding the remainder of this report.

The Classical Factor Analysis Model

The classical factor analysis model can be diagrammatically specified as follows:[15]



Which says that any (N x n) data matrix, where N is the number of observations and n is the number of items, is the sum of an (N x n) matrix of true measures and an (N x n) matrix of error

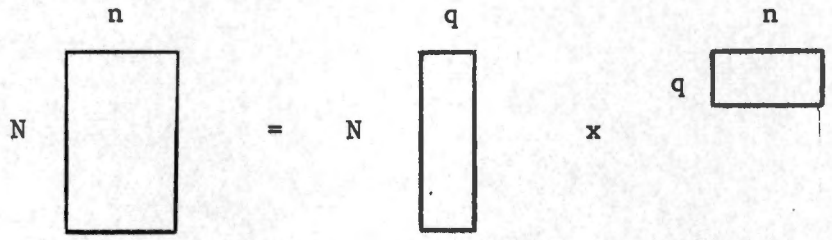
---

[13] Ibid., p. 15.

[14] Ibid.

[15] Paul Horst, Factor Analysis of Data Matrices (New York: Holt, Rinehart, and Winston, Inc., 1965), p. 95.

measures. Factor analysis has as one of its major computational objectives the factoring of the matrix of true measures into two product matrices as follows:[16]



True Measures Matrix | Factor Score Matrix | Factor Loading Matrix

The factor score matrix expresses the degree to which each of the N individuals responding to n items possesses each of q common factors. The factor loading matrix describes each of the n items linearly in terms of the q common factors. Although all the various methods of factor analysis imply the presence of the factor score matrix, only a few explicitly determine this matrix computationally, but rather most methods have as their end result the determination of the factor loading matrix. However, once the factor loading matrix has been determined it is then possible to determine the factor score matrix through the use of simple matrix operations. Such was the procedure in the present research.

Mathematically, then, the classical factor analysis model can be specified as:[17]

---

[16] R. C. Durfee, "Multiple Factor Analysis," University of Tennessee Computing Center, The University of Tennessee, Knoxville, Tennessee, August 11, 1966, p. 2.

[17] Harry H. Harman, Modern Factor Analysis, second edition, revised (Chicago: The University of Chicago Press, 1967), pp. 15-16.

$$z_j = a_{j1}F_1 + a_{j2}F_2 + \ldots + a_{jq}F_q + d_jU_j \quad (j = 1, 2, \ldots, n)$$

where z_j = item j

$a_{j1} \ldots a_{jq}$ = common factor coefficients

$F_1 \ldots F_q$ = common factors

U_j = unique factor

d_j = unique factor coefficient

assuming: (1) the common factors and unique factors have zero means and unit variances.

(2) the unique factors are uncorrelated with each other and uncorrelated with the common factors.

(3) the total variance in the data matrix is composed of that due to common factors (communality) and that due to a specific factor in each item and to error in measurements (uniqueness).

Assumptions (1) and (3) can be stated mathematically as:

$$S_j^2 = 1 = h_j^2 + d_j^2$$

$$= a_{j1}^2 + a_{j2}^2 + \ldots + a_j^2q + d_j^2$$

where S_j^2 = total variance of item j

h_j^2 = communality or variance of variable j attributable to the common factors

d_j^2 = unique variance or variance of variable j attributable to unique factors

Assumption (2) can be expressed mathematically as:[18]

$$a_{j1}\,a_{k1} + a_{j2}\,a_{k2} + \ldots + a_{jq}\,a_{kq} = r_{jk}$$

Where $a_{j1} \ldots a_{jq}$ = common factor coefficients for item j.

$a_{k1} \ldots a_{kq}$ = common factor coefficients for item k.

r_{jk} = correlation coefficient for item j and k.

---

[18] Gordon A. Mac Eachern, D. Woods Thomas, and Ludwig M. Eisgruber, Analysis of Human Attributes and Their Relationship to Performance Level of Farm Tenants, Agricultural Experiment Station Research Bulletin No. 751, Purdue University, Lafayette, Indiana, November, 1962, p. 7.

Assumption (2) indicates that any correlation between the items must be accounted for by q common factors.[19] The mathematical problem to be solved then becomes the determination of a matrix of common factor coefficients which will yield a reproduced correlation matrix most closely approximating the observed correlations in the data matrix.

Solving the Factor Analysis Problem

The factor analysis problem usually consists of two sub-problems. The first sub-problem is that of determining the initial factor loading matrix. The second sub-problem is that of rotation of the initial factor loading matrix into meaningfulness.

In the present research the principal axis or principal factor method of analysis was used to solve the first sub-problem. Horst classifies this method as a basic structure solution which "yields the best least square approximation to the data matrix,"[20] and which possesses the following characteristics: (1) the effect of a given factor is removed from the correlation matrix before the next factor is obtained; (2) for each factor computed the residual matrix, resulting from subtracting a correlation matrix reproduced from the factor loading vector from the observed correlation matrix, has a minimum sum of squared elements; (3) maximum variance is accounted for by the first factor, maximum remaining variance by the next factor, and so on;

---

[19] Harman, loc. cit.

[20] Horst, op. cit., p. 103.

(4) the solution is iterative with the rank of the original matrix being reduced at each iteration; and (5) the solution yields factors which are independent or uncorrelated (referred to as orthogonal factors).[21] The output from this first problem is a principal-axis factor loading matrix of the form:

	F_1	F_2	. . . .	F_q
Z_1	a_{11}	a_{12}	. . . .	a_{1q}
Z_2	a_{21}	a_{22}	. . . .	a_{2q}
.	.	.	. . . .	.
.	.	.	. . . .	.
Z_n	a_{n1}	a_{n2}		a_{nq}

where $Z_1 \ldots Z_n$ = items

$F_1 \ldots F_q$ = common factors

$a_{11} \ldots a_{nq}$ = common factor coefficients or "loadings"

The q number of factors retained in this final matrix is the number of factors necessary to explain the total common factor variance or communality.[22]

Given the solution to the first sub-problem there is the need for interpretation of the factor loading matrix. Usually the initial selection is not in the most simple terms and therefore is in need of rotating to meaningfulness. Harman has stated that "once the initial factor matrix has been determined an infinite number of

---

[21] Ibid., p. 157.

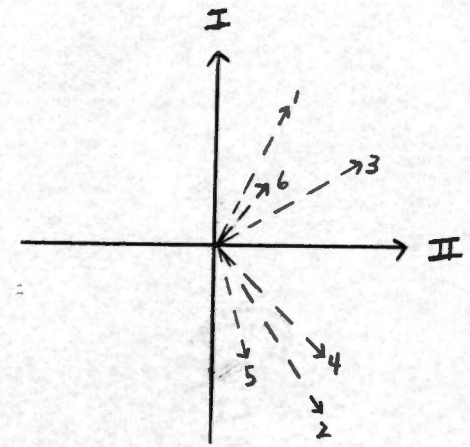
[22] Harman, op. cit., p. 143.

rotations is possible from one coordinate system to another without any effect on the adequacy of the solution."[23] The rotational problem can be described then as a means of describing the n items in a factor analysis problem in reference to the q common factors isolated in the initial factor matrix.

The rotational procedure and its effect is shown in Figure 2, for a hypothetical problem where two factors have been isolated from six items. The initial factor matrix (b.) is represented geometrically by (a.), where I and II are uncorrelated (orthogonal) reference vectors in the common-factor space with each item vector having two coordinates (common-factor coefficients of the initial factor matrix). The objective is to identify the nature of factor I and II, but since they are not observable entities they must be identified through the items from which they were derived. This objective is met by rotating the reference vectors I and II, maintaining their orthogonality, until their relationship with the item vectors is such that they can be identified by evaluating the items most closely oriented to them. Such a rotation is shown graphically in part (c.) of Figure 2, and the effect of the rotation on the initial common factor coefficients is shown in part (d.) of Figure 2. The rotated factor matrix (d.) shows much more clearly than does the initial factor matrix (b.) that factor I can be identified through items 1, 3, and 6 and factor II through items 2, 4, and 5.

---

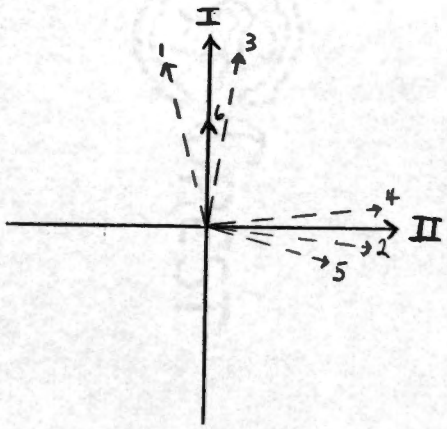
[23] Ibid., p. 249.



(a)

Initial Factor Matrix		
Item	I	II
1	.70	.50
2	-.70	.50
3	.60	.80
4	-.50	.70
5	-.60	.30
6	.40	.40

(b)



(c)

Rotated Factor Matrix		
Item	I	II
1	.85	-.14
2	-.14	.85
3	.98	.12
4	.14	.84
5	-.20	.62
6	.57	.00

(d)

Figure 2. Geometric Representation of the Orthogonal Rotation of the Initial Factor Matrix to the Rotated Factor Matrix.

The rotation problem in the present study was accomplished by the varimax rotation method. The method possesses two characteristics which are highly desired in any factorial solution. First, the method satisfies the criterion of simple structure which states that: (1) each row of the factor matrix should have at least one zero; (2) each column in the factor matrix should have at least as many coefficients approaching zero as there are common factors; (3) for every pair of columns there should be a large number of items having small coefficients in both columns, with several items with large coefficients in one column and small coefficients in the other.[24] Secondly, and perhaps most importantly, the method yields a factorially invariant solution which can be defined as a solution which "allows generalization about the factors to an infinite domain."[25] In the area of farm management where diversity in type and size of farming is often the case, this characteristic seems particularly relevant.

With regard to the model just discussed, it should be noted that even though the principal-factor method of obtaining the initial factor matrix and the varimax method of obtaining an orthogonal simple structure matrix provides an objective and mathematically precise way of analyzing a data matrix, subjectivity still enters into the final analysis of identifying or naming the factors. Recognizing this shortcoming of factor analysis and having presented the

---

[24] Ibid., p. 98.

[25] Ibid., p. 312.

model, it was then appropriate to apply the model to the present research problem.

Briefly reviewing what is to follow, the principal-axis factor method is used in Chapter IV to determine the initial factor matrix and the varimax method is used to rotate the factors into meaningfulness. Using the results of these analyses the factors are then identified and assigned names. An analysis of the relationship of the identified factors to several management performance criteria, using factor scores computed from the rotated factor matrix of Chapter IV as the independent variables, is reported in Chapter V.

It seems important to mention at this point that the methods used in the present study to analyze the data required a tremendous amount of computational work. Nearly all of the computations required were accomplished through the use of the IBM 7040 Computer in operation at The University of Tennessee Computing Center. Without the use of the computer programs which provided the solutions to the initial factor matrix and the rotated matrix it is likely that the present study would not have been feasible.[26] Although The University of Tennessee Computing Center had no program written specifically for the computation of a principal axis factor score matrix, the Center provided an invaluable service by writing such a program. In the regression analysis, used in Chapter V, a standard taped program was used to relate identified factors to managerial performance criteria.[27]

---

[26] Durfee, op. cit., pp. 1-28.

[27] The University of Tennessee Computing Center, "BMD02R Stepwise Regression," The University of Tennessee, Knoxville, Tennessee, 1968.

CHAPTER IV

A FACTORIAL ANALYSIS OF MANAGERIAL BEHAVIOR

As previously indicated in Chapter III, the conventional factor analysis problem consists of two phases: (1) the initial problem of factoring the data matrix (or correlation matrix); and (2) the rotation of the initial matrix to meaningfulness relative to a reference system composed of the orthogonal factor vectors isolated in the initial factoring phase. The first phase of the problem is mathematical; the second phase, although conforming to the criteria of a simple structure expressed as mathematical functions, is subjective since in the final analysis it is necessary for the researcher to assign names to the factors. The present chapter was conveniently divided in terms of solving the initial factoring problem, the rotation of the initial factor matrix, and the identification of the rotated factors.

I. THE INITIAL FACTOR MATRIX

The initial factoring problem consisted of subjecting 100 items, designed to inventory the presence of eight hypothetical managerial processes, to a principal axis factor analysis. Although there were initially 122 items used in collecting the data, the limitations of the computer program made it necessary to eliminate 22 items in the factor analysis. This elimination was the result of an item analysis based on the correlation of each item with the total raw score of the

hypothetical process to which the item was assigned. The 22 items having the lowest correlations were eliminated by this procedure. The 100 items retained in the factor analysis are shown in Appendix C. Of the 123 questionnaires obtained only 114 of these were fully completed relative to the 100 managerial process items. The resulting data matrix analyzed was then of the order 114 x 100.

The initial factoring problem consisted of computing a principal axis factor matrix which would explain the total variance due to common factors (communality). Because the total communality cannot be known until a factor matrix is computed it was first necessary to estimate the communality of each variable. Squared multiple correlations have been shown to provide a good first approximation of the communalities. Using squared multiple correlations as estimates of the communalities, twenty-one factors were arbitrarily extracted in the first approximation of the factor matrix. This matrix showed that the first eleven factors explained 96.4 percent of the variance to be explained by common factors (communality). Using actual communalities computed from the first eleven factors, a second and final approximation of the factor matrix was computed. This matrix revealed that the eleven factors actually explained 99.8 percent of the variance to be explained by common factors. Table III shows the percent of the total common factor variance explained by each of the eleven factors, as well as the comulative variance explained by each additional factor.

The final principal axis factor matrix is shown in Table IV. That this was the matrix desired was supported by the fact that the

TABLE III

PERCENT OF TOTAL COMMON FACTOR VARIANCE EXPLAINED, AND PERCENT OF COMULATIVE COMMON FACTOR VARIANCE EXPLAINED, BY ELEVEN UNROTATED COMMON FACTORS

Factor	Common Factor Variance Explained	Cumulative Common Factor Variance Explained
	(%)	(%)
I	26.29	26.29
II	12.02	38.31
III	11.85	50.16
IV	8.97	59.13
V	7.31	66.44
VI	6.56	73.00
VII	6.13	79.13
VIII	5.45	84.58
IX	5.44	90.02
X	5.00	95.02
XI	4.79	99.81

TABLE IV

UNROTATED PRINCIPAL AXIS FACTOR MATRIX

Item	Factors										
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
1	.243	.284	.251	-.043	.179	.239	-.080	-.208	-.291	-.008	.268
2	.110	.248	.102	.297	.159	.071	-.084	-.256	-.083	-.006	.170
3	.604	-.145	.106	-.201	-.184	-.023	-.048	.087	.172	-.020	.019
4	.414	-.359	.092	-.313	-.059	-.176	.081	-.121	-.039	-.236	-.054
5	.194	-.144	-.143	-.146	.329	-.053	-.102	-.115	.079	.148	-.089
6	.535	-.067	-.111	.036	-.108	.116	-.074	-.035	.084	.163	-.108
7	.134	-.094	-.225	.100	-.170	-.007	.138	-.304	.101	.100	.090
8	.354	-.272	.148	-.239	-.196	-.097	.067	-.066	.053	-.290	.022
9	.407	-.108	.012	-.046	-.163	.252	-.142	-.026	.022	.205	-.241
10	.235	-.348	-.356	.162	.014	.141	-.014	.021	-.132	-.030	-.026
11	.215	-.208	-.448	.318	.077	.064	-.141	-.087	-.017	-.220	.019
12	.324	-.034	-.166	-.212	-.181	.089	.244	-.061	-.215	.241	.135
13	.333	-.472	-.001	-.014	-.045	.046	-.053	.186	-.021	.002	-.041
14	.021	-.319	-.359	-.016	.296	-.051	.212	.056	.159	.075	.023
15	.059	-.161	-.472	.068	-.146	-.058	-.161	.008	-.002	-.070	.122
16	.045	.134	-.217	-.155	-.038	.125	-.159	.123	.153	-.198	-.106
17	.181	-.153	.156	.326	.302	.172	-.036	.067	-.002	-.125	.133
18	.185	.220	.149	-.091	-.162	.051	-.108	.150	.113	.280	-.179
19	.242	.055	-.317	-.248	-.037	-.055	-.229	-.006	.104	-.027	.107
20	.096	.060	.246	.183	-.185	.076	-.093	-.168	.217	.099	.178
21	.598	-.278	.296	-.114	-.084	-.111	.020	.036	.261	.017	.156
22	.491	-.099	.133	.032	-.030	.326	-.204	.034	.180	-.156	.145
23	.253	-.387	.105	.342	-.212	-.026	-.093	-.040	.223	-.010	.125
24	.263	-.220	-.200	.230	.218	.144	-.183	-.103	-.207	-.012	.118
25	.220	-.409	.194	.188	.076	.046	.028	-.176	-.069	-.108	-.051
26	.235	.362	.301	.240	.046	.079	.117	.057	.143	.036	.049
27	.134	.017	-.131	-.286	.323	.067	.092	-.139	.013	.099	-.140
28	.406	-.009	.025	-.025	-.144	.247	-.189	.006	.142	.063	.005
29	.096	.237	.033	-.050	-.132	-.036	.111	-.109	.119	.004	-.102
30	.411	-.205	.087	.052	.434	-.069	-.244	-.083	-.057	.118	-.052
31	.338	.080	.041	.032	.143	.114	-.210	-.329	.188	-.208	-.185
32	.264	.120	.145	.058	.397	.061	.129	.252	.034	.245	.203
33	.456	.051	-.287	.101	-.210	-.069	-.168	-.111	.003	-.087	-.040
34	.146	.115	.188	.061	.310	-.300	.082	.116	.190	.119	-.032
35	.174	.255	.021	.427	.078	-.232	.077	.069	.199	-.106	-.037
36	.057	-.039	-.169	-.048	-.033	.144	-.034	.224	.019	.134	-.388
37	.495	-.093	.080	.213	.465	-.053	-.123	.136	-.048	.093	.112
38	.367	.081	-.487	.161	-.163	-.210	-.019	-.006	-.221	-.139	.051
39	.468	.357	-.448	-.083	-.143	-.019	-.111	.095	.003	.004	.110

TABLE IV (Continued)

Item	Factors										
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
40	.342	-.170	-.389	.317	.049	-.125	.010	-.033	-.101	.089	-.139
41	.258	-.309	.058	.149	-.054	.406	.089	-.088	-.172	-.025	-.188
42	.419	-.105	-.319	.129	-.050	-.036	.246	.107	.080	.000	.089
43	.348	.119	-.258	-.157	.078	.123	.127	-.099	-.030	.079	-.249
44	.251	-.155	.216	-.170	-.088	-.104	-.019	.015	-.124	-.154	-.062
45	.344	-.304	.196	-.315	.049	-.177	.057	.090	-.147	-.185	-.090
46	.348	.190	-.010	.071	.267	-.057	.175	.020	.049	-.170	-.033
47	.452	.222	-.106	-.025	-.040	-.169	-.122	.248	-.164	-.093	-.313
48	.199	.227	.121	-.126	.184	-.248	-.217	.045	.180	-.157	-.308
49	.387	.061	.286	.121	-.253	.043	-.199	-.062	-.202	-.183	.026
50	.249	.078	-.144	.086	.152	-.017	-.028	.108	.293	-.338	-.009
51	.107	.154	.285	-.198	.307	.183	-.199	-.244	-.084	-.215	.104
52	.496	.172	-.052	-.123	-.132	.150	.273	-.068	.276	-.051	.155
53	.207	-.286	.165	.083	-.297	-.133	-.117	.022	-.015	-.004	-.153
54	.443	-.063	-.345	-.186	-.089	-.136	-.105	.189	-.071	.013	.089
55	.082	-.067	.140	-.177	-.086	.080	.269	-.062	.186	-.085	.023
56	.414	.314	.300	.074	-.110	-.096	-.153	-.036	-.280	-.011	.031
57	.355	.030	.170	.040	.141	.083	-.433	-.062	.145	.214	-.044
58	.229	-.158	-.132	-.106	.242	.015	.162	-.125	.041	.349	.127
59	.297	-.473	-.040	.040	-.043	.131	.143	-.365	-.034	.091	.089
60	.392	.089	.183	-.073	-.121	.056	.185	.025	-.263	.301	-.116
61	.143	.159	-.069	.425	-.092	-.003	.048	-.276	-.105	.122	-.211
62	.366	-.037	.274	.050	-.067	.056	-.119	.123	-.148	.034	.314
63	.154	-.218	.304	.093	-.060	-.325	-.134	-.118	.087	.290	-.047
64	.253	.090	-.155	.461	-.203	-.150	.110	-.181	.011	.058	.014
65	.463	.047	-.175	.134	-.005	-.109	.031	.066	-.029	.226	-.127
66	.327	-.110	.131	-.276	-.049	.248	.065	-.081	.145	-.003	-.076
67	.175	.226	-.223	-.014	.268	.232	.055	-.204	.041	-.109	-.223
68	.177	.129	-.190	.029	.334	-.214	-.009	-.222	-.057	-.067	.199
69	.340	.260	.503	.097	-.028	-.288	-.179	.078	-.127	.056	-.012
70	.499	-.335	.203	-.174	-.052	-.287	.177	.036	-.032	-.080	.108
71	.272	-.130	-.111	.010	.195	-.225	.047	.129	.067	-.102	-.004
72	.097	.126	.233	.121	-.143	.023	.245	-.047	-.092	.127	-.200
73	.481	-.339	.187	-.044	.142	-.148	.095	.125	-.096	-.100	.163
74	.388	.071	-.071	-.390	.236	-.024	-.127	-.080	-.144	.227	-.025
75	.410	.279	-.158	-.259	-.062	.217	.193	-.143	.214	-.117	.103
76	.265	.204	-.074	-.255	.040	-.310	-.001	-.155	-.157	.096	.125
77	.136	-.029	.235	.183	.031	.199	-.002	.118	.037	-.144	-.140
78	.356	-.193	.206	-.088	.103	.182	.168	.307	-.406	-.070	-.077
79	.262	.095	-.280	.355	.111	.022	.091	.272	.019	.058	-.098

TABLE IV (Continued)

	Factors										
Item	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
80	.399	.247	-.073	.033	-.152	.086	.228	.233	-.136	-.157	.163
81	.303	.021	.248	.112	.040	.090	.097	.094	.318	-.035	-.189
82	.303	.255	-.111	-.051	-.196	.047	-.170	.148	-.007	.045	.070
83	.316	.386	-.131	-.132	-.133	-.100	-.066	.047	.158	.055	.226
84	.295	-.179	.094	.009	-.001	.027	.312	.145	.004	-.000	-.092
85	.393	.200	.171	.008	.033	-.236	.177	-.255	.146	-.031	-.169
86	.045	.137	.281	.071	-.091	.040	.220	.085	-.067	-.091	.176
87	.328	.184	.167	.114	.072	.041	.206	-.079	-.175	-.017	-.056
88	.086	-.331	.082	.214	.092	.301	-.021	.067	.050	.078	-.119
89	.300	-.164	.036	.114	.010	-.375	-.045	-.225	.059	-.011	.077
90	.294	.325	.190	-.278	.072	.080	-.058	-.111	-.116	-.022	-.128
91	.095	.201	-.077	.148	.155	.111	.203	.224	-.140	-.340	-.008
92	.459	.312	-.077	.048	.081	-.055	-.005	.237	-.020	-.031	.015
93	.356	.249	-.337	-.050	.040	-.008	.021	-.113	-.189	-.065	-.121
94	.171	.367	.020	-.007	.187	.063	.243	.019	-.125	-.066	.066
95	.109	.099	.114	.082	.007	-.126	.327	-.070	.256	.166	.053
96	.314	.159	.040	-.079	.036	.288	-.084	.035	.164	.014	.162
97	.492	.066	-.114	-.056	.058	.137	-.145	.214	-.006	.178	-.084
98	.304	.207	-.030	.272	.047	.163	.046	.185	.079	.062	.004
99	.146	.057	.270	.460	.151	-.074	.161	-.001	-.065	-.030	-.018
100	.240	-.106	-.206	-.214	.017	.049	.281	.048	.031	.027	-.120

total communality computed from this matrix was nearly identical with the total communality estimated from the eleven factor portion of the twenty-one factor first approximation factor matrix.

The results of the initial factoring problem indicated the presence of 11 common factors among the 100 items, rather than 8 common factors or management processes, as initially hypothesized. The coefficients of the factor matrix shown in Table IV are the a_{jq}'s of the classical factor analysis model expressed in Chapter III.[1] These coefficients can be viewed as linear regression coefficients when regressing the variable z_j on eleven factors, where $j = 1, 2 \ldots, 100$. It is customary in literature regarding factor analysis to call these coefficients factor loadings and to refer to a matrix of these coefficients as a factor loading matrix. Such terminology has been employed in the remainder of the report.

The solution of the initial factoring problem suggested an eleven-dimensional common-factor space within which each of the eleven factors constituted a reference vector, each reference vector being at a 90° angle with all other reference vectors. Also located within this space were 100 item vectors each having eleven coordinates (factor relating them to the reference vectors.[2] A review of these coordinates indicated that there was a need for rotation of the common factor reference vectors in order to identify the factors isolated.

---

[1] See last paragraph, p. 58.

[2] R. C. Durfee, "Multiple Factor Analysis," The University of Tennessee Computing Center, The University of Tennessee, Knoxville, Tennessee, August 11, 1966, pp. 24-25.

II. ROTATION OF THE INITIAL FACTOR LOADING MATRIX

The factor loading matrix shown in Table IV, page 69, was rotated to its simplest form by use of the varimax rotation method.[3] The resulting matrix is shown in Table V. A comparison of Table V with Table IV shows that a few factor loadings on each factor have been substantially increased while a large number of loadings have been forced to approach zero.

Given a rotated varimax factor loading matrix, the usual procedure employed by factor analysts is to use the items having "high" loadings to identify or name the factors. For factor analysts skilled in the interpretation of the rotated matrix, the number of items selected to identify a factor is somewhat an art. The present researcher, not possessing such skill, decided that such a selection of items should be based upon a more objective criterion than visual observation. Since the factor loadings can be assumed to be linear regression coefficients their statistical significance was tested by the t-test as follows:[4]

$$t_{.05} = \frac{|a|}{\hat{Q}a}$$

$t_{.05}$ = t value at 95 percent level of significance with 114-11=103 d.f.

where $|a|$ = absolute value of factor loading

$\hat{Q}a$ = estimated standard error of factor loading

---

[3] Ibid.

[4] Dick A. Leabo, Basic Statistics, 3rd edition (Homewood, Illinois: Richard D. Irwin, Inc., 1968), p. 397.

TABLE V

ROTATED VARIMAX FACTOR MATRIX[a]

Item	Factors										
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
1	.107		.159		.647*					.108	-.117
2		-.196	.114	.144	.450*			.161			
3	.426	.503*				.211				-.134	
4		.676*				.121	.143				.113
5			-.131				.449*	.125		-.120	
6	.412	.163	.114	.255		.131	.170		.196	-.143	
7				.341		.285		-.112		-.175	
8		.590*				.204		-.110			
9	.400	.132	.164				.180	-.128	.316	-.163	
10		.125		.456*			.136		.277		-.133
11			-.253	.600*					.197		
12	.216	.181	.249	.158		.174	.229	-.175			-.339
13	.129	.426		.145	-.123				.318		-.125
14	-.186		-.225	.218	-.290		.334	.179			-.156
15	.117		-.283	.427	-.124			-.141			
16	.263		-.256							.185	.183
17				.100	.267			.321	.363		
18	.416		.209	-.210						-.149	
19	.314		-.286	.157			.164		.194		
20					.192	.224	-.226			.330	
21	.244	.591*				.271		.238	.119	-.299	
22	.358	.249	-.167		.291	.218			.363		
23		.233		.272		.112	-.266	.104	.303	-.376	
24			-.111	.405	.276	-.146	.163		.238		-.124
25	-.210	.328		.179	.146				.341	-.135	
26	.174	-.103	.263	-.117	.206	.214	-.176	.364			
27							.505*				
28	.424	.110			.126	.155			.232	-.130	
29	.119	.168				.216		-.125			.167
30		.240		.137	.279	-.193	.366	.311	.179	-.186	
31	.132			.131	.304	.192	.145		.158		.442*
32	.131			-.136	.144		.193	.515*			-.276
33	.371	.128		.459							.150
34				-.120				.513*	-.118		
35		-.106	.107	.206			-.238	.469*			.216
36	.196		-.204								.440*
37	.141	.204		.175	.281	-.148	.217	.545*	.187		
38	.253	.102		.620*					-.222	.179	
39	.603*			.341		.129			-.258	.173	

TABLE V (Continued)

Item	Factors I	II	III	IV	V	VI	VII	VIII	IX	X	XI
40				.594*	-.114	-.107	.157	.146	.101		
41		.173	.201	.173				-.170	.534*		
42	.188	.175		.412	-.172	.223		.193		.105	-.161
43	.253		.155	.173		.152	.391			.171	.126
44		.440*									
45		.647*					.136				
46		.111		.115	.128	.164	.106	.358		.240	.149
47	.462*	.205	.167	.161		-.213		.149		.218	.266
48	.196	.116		-.134				.245	-.134		.501*
49	.259	.287	.194		.362		-.280				.114
50	.141		-.272	.152		.188		.282		.181	.235
51			-.108	-.203	.561*						.163
52	.331	.167				.583*		.103			
53		.334	.119	.103	-.104	-.109	-.175		.146	-.256	
54	.421	.290	-.133	.289			.148		-.153		-.127
55	-.106	.173		-.167		.321	.103				
56	.320	.180	.344		.413	-.104	-.149	.100	-.127		
57	.351				.286		.163	.177	.183	-.345	.136
58				.111		.147	.443*	.144		-.148	-.261
59	-.147	.300		.323		.231	.215	-.156	.261	-.235	-.165
60	.268	.193	.520*				.154				-.132
61		-.219	.383	.365							.181
62	.239	.282			.325		-.158	.129			-.259
63		.222	.174			.111		.154		-.537*	
64			.265	.498*		.136	-.187	.135		-.132	
65	.328		.225	.313			.171	.219			
66	.202	.270		-.133		.290	.196	-.104	.208		
67		-.175		.143	.142	.181	.325			.257	.270
68	-.102		-.100	.281	.243		.207	.263	-.342		
69	.241	.234	.328	-.162	.307	-.182	-.204	.310	-.146	-.173	.155
70		.703*				.110		.156		-.101	
71		.260	-.113	.178			.111	.293			
72			.467*								
73		.601*			.115			.267	.101		-.158
74	.299	.190			.192		.522*		-.152		
75	.340				.120	.550*	.164			.198	
76	.152	.170	.107		.161		.216		-.455*		
77							-.143	.124	.344		.126
78	.112	.439	.242			-.187			.287	.331	-.195
79	.220	-.130		.335	-.150			.349	.153	.187	

TABLE V (Continued)

Item	Factors I	II	III	IV	V	VI	VII	VIII	IX	X	XI
80	.165	.113	.236	.272	.279	.353			-.121	.204	
81	.159	.127	.114	-.105		.229		.292	.279		.212
82	.491*										
83	.451*					.231		.124	-.330		
84		.309	.202		-.149	.132		.154	.190	.102	
85		.194	.297			.282		.231	-.149		.333
86			.198	-.147	.128	.139	-.257	.101		.126	-.131
87	.114	.124	.401		.184	.127				.121	
88									.522*		
89		.295		.289				.178	-.145	-.294	.101
90	.271	.110	.196	-.197	.298		.196		-.105	.120	.204
91							-.120	.195		.519*	
92	.479*		.130	.137				.239	-.103	.178	
93	.295		.138	.342			.186		-.163	.238	.131
94			.199		.200	.149		.202	-.125	.337	
95			.211		-.106	.331		.267			
96	.369				.208	.259			.125		
97	.553*	.116		.108			.157		.135		
98	.295	-.117	.127	.125				.301	.184	.110	
99			.371	.143			-.359	.215	.132		
100		.195			-.223	.191	.279			.169	

[a]Factor loadings < .100 are omitted and assumed to be zero for purposes of clarity in observing the table.

*Loadings significant at the t.05 level.

Harman presents a table for estimating the standard error of a factor loading coefficient, given the average correlation between items.[5] Solving the above equation for "a" required a factor loading equal to or greater than .440 to be significantly different from zero at the 95 percent level of significance. Of the 100 items subjected to the factor analysis 43 separate items were found to be significantly loaded on one of the 11 common factors. No item was significantly loaded on more than one factor.

III. THE IDENTIFICATION OF FACTORS

In many factor analytic studies it is often difficult to identify all of the factors isolated in the initial factor loading matrix. The reason for this difficulty is the computational procedure whereby the maximum variance in the data is extracted by the first factor, the maximum remaining variance is extracted by the second factor and so on, so that the later factors often explain only a small proportion of the total variance to be explained. This is clearly shown by Table III, page 68. However the varimax rotation method partially solves this problem by weighting the items or variables in such a way that the total variance to be explained is more equally distributed among the factors necessary to explain the variance.[6] The result of this weighting can be seen in Table VI which shows the percent of total common factor

---

[5] Harry Harman, Modern Factor Analysis, second edition, revised (Chicago: The University of Chicago Press, 1967), p. 435.

[6] Ibid., p. 306.

TABLE VI

PERCENT OF TOTAL COMMON FACTOR VARIANCE EXPLAINED, AND PERCENT OF CUMULATIVE COMMON FACTOR VARIANCE EXPLAINED, BY ELEVEN ROTATED COMMON FACTORS

Factor	Common Factor Variance Explained	Cumulative Common Factor Variance Explained
	(%)	(%)
I	13.76	13.76
II	13.69	27.45
III	7.70	35.15
IV	11.89	47.04
V	8.03	55.07
VI	6.95	62.02
VII	8.19	70.21
VIII	8.79	79.00
IX	8,34	87.34
X	6.67	94.01
XI	5.79	99.80

variance explained by the eleven rotated factors. It is evident that the percent of total common factor variance explained by both the unrotated and rotated matrix is identical. Even though this weighting procedure did enhance the identification of the less evident factors it did not resolve the problem of subjectively naming the factors. This problem was at least partially solved by having three researchers name the factors independently, without knowledge of the names assigned by the other researchers. The three researchers then compared the names and attempted to name the factors on the basis of a consensus of opinion regarding their content. The final names of the factors were the result of such a procedure, and are assumed to be less subjective than might have been the case if the author had assigned the names to the factors only on the basis of his own interpretation.

Preliminary attempts to identify the eleven factors isolated in the present study indicated that items loaded significantly on Factors I, II, IV, and VIII were relatively homogeneous in their content, therefore making these factors more easily identified than the others. Items loaded on Factors III, V, VI, IX, and XI could be described as possessing a moderate degree of homogeneity in content, while those loaded on Factors VII and X appeared to possess the least amount of homogeneity of content, making these factors the most difficult to identify. At one point in time the consideration was made that only those factors which could be least subjectively identified on the basis of statistically significant factor loadings would be reported in the study. This consideration was rejected and replaced by an attempt to

identify all of the eleven factors isolated. The lack of knowledge existing in farm management research regarding the behavior of farm operators seemed to justify such an attempt, realizing of course the subjectivity involved.

The subgroups of the significantly loaded items for the eleven factors isolated in the present study did not in any case explain more than 54.9 percent of the factor's total variance, as is shown in Table VII. Releasing the restriction of statistically significant factor loadings permitted a larger number of items to be used in factor naming. However, at the same time it confused the situation by permitting a greater heterogeneity of content among the items used to identify any given factor. Nevertheless, it was necessary in some cases to review several of the highest non-significant items in order to gain enough insight into the content of the factor to be able to tentatively give it a name. The use of the statistical significance criterion seemed to provide items that were more "pure" measures of the factor on which they were loaded, as evidenced by the fact that none of the items were significantly loaded on more than one factor. With these limitations on naming of factors in mind the eleven rotated factors were interpreted as follows:

Factor I

The items loaded significantly on Factor I are shown in Table VIII, along with the hypothetical process to which each item was initially assigned. These items together explained 29.6 percent of the

TABLE VII

FACTOR VARIANCE, FACTOR VARIANCE OF SIGNIFICANTLY LOADED ITEMS, AND PERCENT OF FACTOR'S VARIANCE EXPLAINED BY SIGNIFICANTLY LOADED ITEMS, FOR ELEVEN ROTATED FACTORS

Factor	Factor Variance[a]	Factor Variance of Significantly Loaded Items[b]	Factor Variance Explained
			(%)
I	5.266079	1.556785	29.6
II	5.237708	2.876166	54.9
III	2.947614	.488489	16.6
IV	4.549439	1.763857	38.8
V	3.072306	.935830	30.5
VI	2.661473	.642389	24.1
VII	3.136256	.925359	29.5
VIII	3.364602	1.04538	31.1
IX	3.191981	.764665	24.0
X	2.552853	.557730	21.8
XI	2.217655	.639965	28.9

[a]Sum of squared factor loadings for all items in factor column of rotated factor matrix.

[b]Sum of squared factor loadings for all items with coefficient larger than $\pm$ .440 in factor column of rotated factor matrix.

TABLE VIII

ITEMS USED TO IDENTIFY FACTOR I,[a] FACTOR LOADINGS OF ITEMS, HYPOTHETICAL PROCESSES TO WHICH ITEMS WERE INITIALLY ASSIGNED, AND ITEM CONTENT

Item	Factor Loading	Hypothetical Process	Item Content
39	.063	analysis	Always consider both the additional costs and returns when deciding about expanding farm enterprises.
97	.553	observation	Keep pretty well up to date on new production methods.
82	.491	managerial professionalism	Feel that the challenge offered by farming is a more important one than living in the country as a reason for farming.
92	.479	analysis	Consider entire farm operation before adopting a new production method.
47	.462	observation	Could tell someone the approximate yields and production of individual fields and animals on my farm without looking at records.
83	.451	analysis	Always determine the benefit of government programs to me before deciding extent of participation.

[a]Factor I was named Perceptive Analysis.

factor's total variance (Table VII). These items seemed to be indicative of the presence of a process of observing and analyzing the farm business. The fact that factor analysis combined items initially assigned to the hypothetical analysis and observation processes lends support to the hypothesis that some management functions may be interdependent and overlapping. This hypothesis would appear to be particularly applicable to analytical and observational processes, for it seems hard to imagine any analysis taking place without the observation of some type of information beforehand and intermittantly during the process. On this basis, Factor I was identified as Perceptive Analysis. The presence of this factor in the factor matrix supported the initial hypothesis of the presence of analytical and observational processes in the behavior of farm operators.

Factor II

The items loaded significantly on Factor II are shown in Table IX. The items on this factor contained the highest over-all loadings of any of the eleven factors as well as the most homogeneity of content. It is apparent that a large number of the items are indicative of participation in off-farm activities. The fact that six out of the eight items were initially assigned to the hypothetical representation process as well as the fact that the eight items explained 54.9 percent of the factor's total variance (Table VII, page 81) suggested that these items were measuring a process similar to the one hypothesized. This similarity lead the researcher to name this factor Activity Participation,

TABLE IX

ITEMS USED TO IDENTIFY FACTOR II,[a] FACTOR LOADINGS OF ITEMS, HYPOTHETICAL PROCESSES TO WHICH ITEMS WERE INITIALLY ASSIGNED, AND ITEM CONTENT

Item	Factor Loading	Hypothetical Process	Item Content
70	.703	representation	Participate regularly in farm organizations.
4	.676	representation	Am fairly active in community affairs.
45	.647	representation	Let other family members represent our farm and family at activities in the community, rather than attending myself.
73	.601	environmental communication	Talk quite often with county agent and other professional agricultural workers.
21	.591	representation	Quite often attend field days, adult farm classes, machinery demonstrations, etc.
8	.590	representation	Emphasize to my family the importance of participating in activities in the community.
3	.503	observation	Attend such things as field days, machinery demonstrations, adult farmer classes, etc., when at all possible
44	.440	representation	Do not participate regularly in community activities.

[a]Factor II was named Activity Participation.

implying an active involvement in off-farm activities, both on a social and a business basis.

Factor III

Factor III did not present the ease of identification so apparent in the previous factor. Table X shows that only two items were significantly loaded on this factor. These two items together explained 16.6 percent of the factor's total variance (Table VII, page 81), which was the least amount of a factor's total variance explained by any of the other ten sub-groups of items. The items loaded significantly on the factor appeared to have little homogeneity of content relative to the processes to which they were initially assigned. A review of the two items suggested that the items were measuring some type of motivational factor. Supplementing the items shown in Table X with the five highest non-significantly loaded items (see items 87, 61, 99, 56, and 59 in Appendix C) on the factor seemed to support the presence of a motivational factor specifically dealing with the presence or lack of self-induced initiative to make changes. On the basis of this supplemental information Factor III was identified as Self-induced Action. The ability to take action on one's own decisions and accept the consequences seemed implied in this factor.

Factor IV

The items significantly loaded on Factor IV are shown in Table XI. As was the case with Factor II, the items loaded significantly show a

TABLE X

ITEMS USED TO IDENTIFY FACTOR III,[a] FACTOR LOADINGS OF ITEMS, HYPOTHETICAL PROCESSES TO WHICH ITEMS WERE INITIALLY ASSIGNED, AND ITEM CONTENT

Item	Factor Loading	Hypothetical Process	Item Content
60	.520	representation	Attend few off-farm activities.
72	.467	planning	Do little long-run farm and home planning (for example, 5-year plan, 10-year plan).

[a]Factor III was named Self-induced Action.

TABLE XI

ITEMS USED TO IDENTIFY FACTOR IV,[a] FACTOR LOADINGS OF ITEMS, HYPOTHETICAL PROCESSES TO WHICH ITEMS WERE INITIALLY ASSIGNED, AND ITEM CONTENT

Item	Factor Loading	Hypothetical Process	Item Content
38	.620	organization	Have standard operating procedures for doing my work.
11	.600	organization	Usually complete work as scheduled.
40	.594	planning	Always have everything needed before starting a job.
64	.498	organization	Never seem to get work done as scheduled.
33	.459	organization	Schedule work in such a way as to have least amount of lost time and motion.
10	.456	organization	Usually allow a certain amount of time for each routine farm job.

[a]Factor IV was named Systematic Organization.

considerable degree of homogeneity of content, with five out of the six items having been initially assigned to the hypothetical process called organization. The six items together explained 38.8 percent of the factor's total variance (Table VII, page 81). A review of the items suggested that these items were indicative of an ability to systematically organize and schedule work to be done. The items appeared to support the presence of two of the initially hypothesized processes, organization and planning, which were both greatly emphasized in early farm management research and literature. These processes combined seemed to constitute an ability to coordinate and methodically plan all of the various day to day activities involved in the operation of a commercial farming unit. It seemed that such a factor could be appropriately identified as Systematic Organization.

Factor V

The items which together explained 30.5 percent of the total variance of Factor V (Table VII) are shown in Table XII. Although the interpretation of Factor V presented some difficulty with regard to a meaningful name, the significantly loaded items seemed to be indicative of a value orientation or attitude. The content of these items seemed to possess the common characteristic of measuring some type of "feeling" or affective[7] characteristic of farm operator's behavior. Assuming that these items were measuring an attitude or value, it appeared that the

---

[7] H. J. Klausmeier, Learning and Human Abilities: Educational Psychology (New York: Harper Brothers, 1961), pp. 5-8.

TABLE XII

ITEMS USED TO IDENTIFY FACTOR V,[a] FACTOR LOADINGS OF ITEMS, HYPOTHETICAL PROCESSES TO WHICH ITEMS WERE INITIALLY ASSIGNED, AND ITEM CONTENT

Item	Factor Loading	Hypothetical Process	Item Content
1	.647	managerial professionalism	Strongly feel that success in farming is mostly a matter of hard physical work.
51	.561	initiating action	Am satisfied with my farming operation as it is.
2	.450	managerial professionalism	Feel farming would be more enjoyable if there weren't so many decisions to make.

[a]Factor V was named Physical Work Orientation.

attitude or value was relative to the physical versus mental work involved in farming. Implicit in these items seemed to be a factor indicative of a high value placed on physical labor as contrasted with a depreciation of the value of physical labor. Consequently, this factor was named Physical Work Orientation.

Factor VI

Only two items were significantly loaded on Factor VI as shown in Table XIII. Both of the items had considerably higher loadings than the remainder of the items, with a definite break in the magnitude of the loadings being in evidence. The two items loaded significantly explained 24.1 percent of the factor's total variance (Table VII, page 81). Although the two items were initially assigned to different hypothetical processes, factor analysis indicated that the two items were measuring the same process or factor. A review of the content of the items substantiated this indication. Although at first glance these items appeared to be indicative of the observation of or collection of knowledge regarding the off-farm environment, a review of items 80, 95, and 55 (the three highest non-significant items) suggested that the factor was in some way related to a process of communicating and maintaining an awareness of the off-farm environment, both at the local level and the global level. The items seemed to imply both involvement and communication with ones total environment. Factor VI was identified as Total Environment Communication.

TABLE XIII

ITEMS USED TO IDENTIFY FACTOR VI,[a] FACTOR LOADINGS OF ITEMS, HYPOTHETICAL PROCESSES TO WHICH ITEMS WERE INITIALLY ASSIGNED, AND ITEM CONTENT

Item	Factor Loading	Hypothetical Process	Item Content
52	.583	environmental communication	Make a point of obtaining national and world news information daily.
75	.550	observation	Often watch, listen to, and read about national news and current problems.

[a]Factor VI was named Total Environment Communication.

Factor VII

Unlike Factor VI, there was no apparent break in the magnitude of the factor loadings on Factor VII. Adding to the difficulty of interpretation was an over-all lack of homogeneity of content among the significantly loaded items, as can be observed in Table XIV. Four items explained 29.5 percent of the factor's variance (Table VII, page 81). Since it was necessary to review several of the highest non-significant loadings in an attempt to interpret this factor, its meaning was highly subjective. The review of items 14 and 43 (Appendix C) combined with the significantly loaded items 5 and 58 seemed to indicate that the factor was indicative of the gathering of market information for purposes of making operational adjustments. Factor VII was therefore tentatively identified as Market Information Adjustment. This factor seemed to indicate a high degree of price consciousness and a high value placed on market changes as a criterion of adjustment.

Factor VIII

Factor VIII was among the group of factors most easily identified. The four items loaded significantly on Factor VIII are shown in Table XV. These four items explained 31.1 percent of the factor's total variance (Table VII). With the exception of item 37 the remaining significantly loaded items appeared to be indicative of the ability to verbally communicate with other persons. Although item 37 did not explicitly refer to verbal communication, this type of communication seemed to be implied in the encouragement of others to take certain actions. Factor VIII was

TABLE XIV

ITEMS USED TO IDENTIFY FACTOR VII,[a] FACTOR LOADINGS OF ITEMS, HYPOTHETICAL PROCESSES TO WHICH ITEMS WERE INITIALLY ASSIGNED, AND ITEM CONTENT

Item	Factor Loading	Hypothetical Process	Item Content
74	.522	managerial professionalism	Emphasize farming as a business rather than farming as "just a good way of living."
27	.505	environmental communication	Frequently discuss my own farming operation with neighbors and friends.
5	.449	planning	Plan production to meet favorable price periods.
58	.443	planning	Plan purchases so as to take advantage of seasonal discounts

[a]Factor VII was named Market Information Adjustment.

TABLE XV

ITEMS USED TO IDENTIFY FACTOR VIII,[a] FACTOR LOADINGS OF ITEMS, HYPOTHETICAL PROCESSES TO WHICH ITEMS WERE INITIALLY ASSIGNED, AND ITEM CONTENT

Item	Factor Loading	Hypothetical Process	Item Content
37	.545	initiating action	Encourage other farmers in the community to accept new ideas and methods in farming.
32	.515	environmental communication	Often feel uneasy when discussing farm business matters with people other than family members and close friends.
34	.513	environmental communication	Seldom talk about my farming operation and its problems with people other than family.
35	.469	observation	Probably couldn't satisfactorily describe the kinds of soils I have and their characteristics if asked to do so right now.

[a]Factor VIII was named Person-to-Person Verbalization.

identified as Person-to-Person Verbalization. This factor resembled Factor VI from the standpoint that both factors indicated a type of communication. Factor analysis indicated however that communication, as a type of behavior relevant to farm operators, must be defined in terms of two different types of communication.

Factor IX

The items significantly loaded on Factor IX are shown in Table XVI. These items explained 24.0 percent of the factor's total variance (Table VII, page 81). Although there appeared to be little homogeneity of content in the items relative to the initial hypothetical processes to which they were assigned, interpretation was facilitated by the appearance of a definite change in the magnitude of the factor loadings. Both item 41 and 88 seemed indicative of a process concerned with the detailed collection and recording of information in the operation of the farm business. Item 76, at first glance, appeared to be unrelated in content to the other two items. On the other hand, the item may have sampled the type of process indicated by the other two items through the use of detailed information in a decision situation regarding adoption of new techniques. A look at non-significantly loaded items 22 and 17 (Appendix C) strengthened the case for concluding that this factor was concerned with the detail involved in collection and recording of information. This factor was tentatively identified as Detail Mindedness. Such a factor seems to imply two types of managers with regard to the collection and recording of information. On

TABLE XVI

ITEMS USED TO IDENTIFY FACTOR IX,[a] FACTOR LOADINGS OF ITEMS, HYPOTHETICAL PROCESSES TO WHICH ITEMS WERE INITIALLY ASSIGNED, AND ITEM CONTENT

Item	Factor Loading	Hypothetical Process	Item Content
41	.534	organization	Write things down rather than depend on memory.
88	.522	planning	Always carry out farm operations without a written farm plan.
76	-.455	analysis	Adopt recommended practices only after determining effect of them on my own operation.

[a]Factor IX was named Detail Mindedness.

the one end of a continum would be a manager who gathers and records information which is highly specific and detailed, while on the other end of the continum would be a manager who uses general principles and so-called "rules of thumb" in carrying out his operation.

Factor X

Factor X was one of the more difficult factors to interpret. The two items which were significantly loaded on this factor were initially assigned to different hypothetical processes as indicated in Table XVII. Nevertheless, factor analysis indicated that the two items, which explained 21.0 percent of the factor's total variance (Table VII, page 81), were measuring the same factor. This indication was supported by the definite reduction in the magnitude of the factor loadings between the significant and non-significant items. One of the shortcomings of factor analysis is the subjectivity necessary in identifying the factors isolated. Factor X exemplified this shortcoming, for although factor analysis grouped items 91 and 63 together, they appeared to have little in common regarding their content. Again, as with other less apparent factors, it was helpful to supplement items 91 and 63 with non-significant items 94 and 78 (Appendix C). All of these items taken together appeared to indicate the presence of a process of community influence on the activities and decisions within the farm firm and farm family organizations. On the basis of this interpretation of the items, Factor X was identified as Community Intra-farm Influence. Such a factor stresses the interdependence between the farm and the community.

TABLE XVII

ITEMS USED TO IDENTIFY FACTOR X,[a] FACTOR LOADINGS OF ITEMS, HYPOTHETICAL PROCESSES TO WHICH ITEMS WERE INITIALLY ASSIGNED, AND ITEM CONTENT

Item	Factor Loading	Hypothetical Process	Item Content
91	.519	observation	Don't "shop around" when buying supplies and selling products.
63	-.537	representation	Am not an active participant in political activities.

[a]Factor X was named Community Intra-farm Influence.

Factor XI

The items which together explained 28.9 percent of the variance (Table VII, page 81) of Factor XI are shown in Table XVIII. These items did appear to possess a considerable degree of content homogeneity as well as possessing factor loadings above what appeared to be a natural break in the magnitude of the factor loadings. The items taken as a whole described a farm operator who emphasizes the challenge of the management task over the physical labor involved in operating a farm. They further described a farm operator who places a great deal of value on maintaining an awareness of current technology. Finally they described a farm operator who is willing to accept positions of leadership and responsibility. The items appeared to be measuring or describing a value or orientation indicative of the concept of a farm operator as a businessman as contrasted to the farm operator as a laborer. From this standpoint factor analysis grouped items together which were similarly grouped under the hypothetical process referred to as managerial professionalism, and hence supported the presence of such an orientation among farm operators. This similarity seemed to suggest identifying Factor XI as Managerial Professionalism.

IV. FACTORS COMPARED TO HYPOTHETICAL PROCESSES

One of the major objectives of the present study was to investigate the presence of selected hypothetical processes in the behavior of farm operators. This objective made it important to compare the results

TABLE XVIII

ITEMS USED TO IDENTIFY FACTOR XI,[a] FACTOR LOADINGS OF ITEMS, HYPOTHETICAL PROCESSES TO WHICH ITEMS WERE INITIALLY ASSIGNED, AND ITEM CONTENT

Item	Factor Loading	Hypothetical Process	Item Content
48	.501	managerial professionalism	Would rather be a farm manager than a skilled farm worker, if the pay was the same.
31	.442	managerial professionalism	Feel that keeping up with scientific research and developments is necessary for success.
36	-.440	environmental communications	Rarely hesitate to accept positions requiring leadership and public appearances.

[a]Factor XI was named Managerial Professionalism.

of the factor analysis with the hypothetical processes. Such a comparison implies the hypothesis testing function of factor analysis. This function was recently expressed by Hobbs when he stated that factor analysis "should be viewed primarily as a means of verifying a conceptual clustering of variables rather than a substitute for conceptualization."[9]

Factor analysis was used to perform the function of hypothesis testing in the present study with regard to the validity of the initial grouping of items hypothesized to measure the hypothetical processes. The validity of the hypothetical processes should be positively related to the degree to which factor analysis grouped items similar to the way they were grouped to measure the hypothetical processes. In other words, if a group of items with similar content are loaded heavily on a given factor by factor analysis, and this group of items is similar in content to a group of items hypothesized to measure a given hypothetical process, then this constitutes empirical evidence that the factor being measured is similar to the hypothesized process. The results of comparing the hypothetical processes of the present study with the factors isolated by the factor analysis are shown in Table XIX.

Table XIX shows that eight of the eleven factors isolated in the factor analysis were similar in content to the eight hypothetical processes. In total all of the hypothetical processes were supported by the factor analysis. However, there was an apparent variation in the degree to which each of the hypothetical processes was supported.

---

[9]Daryl Hobbs, "Use of Factor Analysis in a Farm Management Study," paper presented at Symposium on Present Use and Potential of Linear Programming and Other Operations Research Techniques in Farm Management Extension, Columbia, Missouri, January, 1965, p. 20. (Mimeographed)

TABLE XIX

FACTORS SIMILAR IN CONTENT TO EIGHT HYPOTHETICAL PROCESSES, BY HYPOTHETICAL PROCESS

Hypothetical Process	Factors Similar in Content to Hypothetical Process
Organization	IV
Planning	IV
Environmental Communication	VI, VIII
Representation	II
Managerial Professionalism	V, XI
Observation	I
Analysis	I
Initiating Action	III

Factor analysis combined the hypothetical processes into a single factor in two instances, while it divided a single hypothetical process into two separate factors in two other instances. Table XIX indicates that although organization and planning were initially hypothesized as separate processes, factor analysis grouped items together into a single factor, Factor IV, which was identified as Systematic Organization. Similarly, Factor I, Perceptive Analysis, appeared to be a combination of the hypothetical processes observation and analysis. In both of these instances factor analysis appeared to support the presence of the initially hypothesized processes but not as separate and independent entities.

On the other hand, factor analysis indicated that the hypothetical process environmental communication could be explained as two different factors, Factor VI and VIII, identified as Total Environment Communication and Person-to-Person Verbalization, respectively. Both factors were shown to be separate and unrelated types of communication processes by factor analysis, and thus suggested that the hypothetical process was too broadly defined.

Similarly, the hypothetical process managerial professionalism was not supported by factor analysis as constituting a single process. Factor analysis indicated that two separate factors were being measured by items initially assigned to the hypothetical process. Both factors did seem to be value or orientation factors. Factor V, Physical Work Orientation, appeared to be indicative of the value placed on physical labor, while Factor XI appeared to be indicative of the value placed on farming as an occupation.

The hypothetical process representation was supported by factor analysis. As a matter of fact the similarity between the content of items hypothesized to measure the hypothetical process and the items grouped together by factor analysis on Factor II, was very evident. Factor II was named Activity Participation because this name seemed to be more indicative of the content of the factor than did representation.

The hypothetical process initiating action was to some degree related to Factor III. Both the hypothetical process and Factor III contained items indicative of motivation. However, factor analysis appeared to select items from a variety of subgroups intended to measure the hypothetical processes, and from these isolated a factor similar to the hypothetical process. Factor III though, appeared to be indicative of self-motivation or initiative as contrasted to other-motivated initiative, and was therefore identified as Self-induced Action.

In summary, the comparison of the hypothetical processes with the factors led the researcher to accept the hypothesis that such processes as were defined at the outset of the study are present in the behavior of farm operators. The factor analysis further indicated that much of the observable behavior of the farm operator is not random behavior but is generated by some unobservable mental process. If behavior is not random then it is subject to investigation and interpretation and in the final analysis to control and improvement. This final goal in the analysis of human behavior may be quite distant in the future. The

next chapter presents an analysis of the relationship of the factors isolated in the present chapter to selected managerial performance criteria, with the thought in mind that a knowledge of such relationships will in some way contribute to decreasing the distance to the ultimate goal of the quantification of managerial ability.

CHAPTER V

RELATIONSHIP OF IDENTIFIED FACTORS TO MANAGERIAL CRITERIA

The present chapter attempts to analyze the statistical relationship between the factors identified in Chapter IV and selected criteria of managerial performance. The general hypothesis tested was that some portion of the variation in a managerial performance criterion would be explained by variations in the factors. Such a general hypothesis was based on the assumption that the items from which the factors were derived were sampling behavior relevant to the mental processes involved in the management function. No specific hypotheses were stated regarding the relationship between factors and criterion for two reasons. First, the items from which the factors were derived were in no way related to their discriminatory powers relative to managerial criteria. Secondly, the present status of the "criterion problem"[1] in farm management research suggests that the lack of a highly significant statistical relationship between factors and criteria may be insufficient reason for discounting the importance of factors regarding their relevance to the management function. Given the limitations of the managerial performance criteria traditionally used in farm management research

---

[1] Willard T. Rushton and E. T. Shaudys, "A Systematic Conceptualization of Farm Management," Journal of Farm Economics, 49:53-63, February, 1967; and M. E. Wirth, "Pattern Analytics: A Method of Classifying Managerial Types," The Quarterly Bulletin, 47, No. 2 (East Lansing: Michigan State University Agricultural Experiment Station, November, 1964), pp. 166-197.

it is still useful to relate the factors to the criteria from the standpoint that such an analysis can be of considerable assistance in variable specification for future research.

The procedure used to analyze the relationship between factors and criterion were as follows: (1) factor scores were computed to indicate the degree to which 114 individual farm operators possessed each of the eleven factors; and (2) the computed factor scores were then treated as independent variables in a linear multiple regression, using three different criteria of managerial performance alternatively as the dependent variables.

I. DERIVATION OF FACTOR SCORES

The classical factor analysis model views a raw score matrix (data matrix) as being the sum of a matrix of true measures and a matrix of error measures.[2] The solution of the factor analysis problem involves the factoring of the true measures matrix into two product matrices, the factor score matrix and the factor loading matrix. Most factor analysis methods provide only the solution of the factor loading matrix, thereby requiring additional matrix calculations to determine the factor score matrix. The method used to calculate the factor score matrix in the present study was presented by Horst as follows:[3]

---

[2] See Chapter III, p. 57.

[3] Paul Horst, Factor Analysis of Data Matrices (New York: Holt, Rinehart and Winston, Inc., 1965), p. 477.

$$B = aQ^{-1}$$

$$Y = ZB$$

where a = principal axis factor loading matrix
Q = basic diagonal matrix of characteristic roots
Y = principal axis factor score matrix
Z = data matrix

Although Horst did not indicate the application of this method to the rotated factors, such an application was presented by Harman.[4]

It seemed appropriate to mention at this point that the usefulness of factor scores to measure factors is presently a controversial subject among factor analysts. The controversy centers around the idea that factor scores are derived from an estimated correlation matrix which itself is an estimate of the original correlation matrix computed from the data matrix. Both Horst and Harman, whose works constituted the major reference sources for the factor analytic procedures used in the present study, support the usefulness of factor scores. Horst explicitly states that factor scores estimated from the reduced correlation matrix are as reliable as those obtained by applying traditional regression techniques to the data matrix.[5] As a matter of fact, the method used in the present study to derive the factor score matrix yields a solution equivalent to that obtained by use of least squares regression.[6]

The method used to obtain factor scores solved the factor score problem mathematically in the sense that each of the eleven factors was

---

[4]Harry Harman, Modern Factor Analysis, second edition, revised (Chicago: The University of Chicago Press, 1967), p. 348.

[5]Horst, op. cit., pp. 469-470.

[6]Ibid., p. 476.

described as a linear combination of all of the 100 items used in the factor analysis. There was therefore no statistical estimation involved in the procedure.[7] The solution was arrived at by first solving the following system of linear equations for the B coefficients:

$$F_1 = B_{11}z_{11} + B_{21}z_{21} + \ldots + B_{n1}z_{n1}$$
$$F_2 = B_{12}z_{12} + B_{22}z_{22} + \ldots + B_{n2}z_{n2}$$
$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$
$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$
$$F_m = B_{1m}z_{1m} + B_{2m}z_{2m} + \ldots + B_{nm}z_{nm}$$

where $m = 1, 2, \ldots, 11$

$n = 1, 2, \ldots, 100$

The solution of this system of equations provided a (100 x 11) matrix of B coefficients. The final factor score matrix, which provided a score for each of the N = 114 individuals on each of the m = 11 factors was then obtained by post multiplying the (114 x 100) data matrix by the (100 x 11) matrix of B coefficients. The solution provided was the result of solving the following system of equations for the factor scores of each individual on each factor:

$$S_{11} = B_{11}z_{11} + B_{21}z_{12} + \ldots + B_{n1}z_{1n}$$
$$S_{12} = B_{12}z_{11} + B_{22}z_{12} + \ldots + B_{n2}z_{1n}$$
$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$
$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots$$
$$S_{Nm} = B_{1m}z_{N1} + B_{2m}z_{N2} + \ldots + B_{nm}z_{Nn}$$

---

[7] Harman, op. cit., p. 348.

where m = 1, 2, . . . , 11
n = 1, 2, . . . , 100
N = 1, 2, . . . , 114

The set of factor scores solved for above constituted a set of eleven independent variables hypothesized to explain some portion of the variation in managerial performance criteria. Prior to subjecting the eleven hypothetical factors to regression analysis it appeared that some insights into the nature of the factors might be gained through a correlation analysis of the factor scores with selected characteristics of the farm operators.

II. RELATIONSHIP OF FACTOR SCORES TO EDUCATION, AGE, AND YEARS OF MANAGEMENT EXPERIENCE

The biographical characteristics selected for a correlation analysis with the eleven hypothetical factors were education, age, and years of farming experience as an owner-operator. All of these variables were measured in years and they have been hypothesized as important variables influencing the management function in numerous studies.

The results of the correlation analysis are shown in Table XX. The significance of the coefficients was tested at both the 95 percent and 99 percent levels of confidence.[8] Of the three biographical characteristics it was apparent that education showed a higher over-all relationship with the eleven factors than did either age or years of experience as an owner-operator.

---

[8]Dick A. Leabo, Basic Statistics, third edition (Homewood, Illinois: Richard D. Irwin, Inc., 1968), p. 537.

TABLE XX

RESULTS OF CORRELATION ANALYSIS BETWEEN FACTOR SCORES ON ELEVEN FACTORS AND THREE BIOGRAPHICAL CHARACTERISTICS, 110 FARM OPERATORS, ELK RIVER WATERSHED, TENNESSEE, 1968

Factor	Coefficient Biographical Characteristic		
	education	age	experience as owner-operator
	(years)	(years)	(years)
Perceptive Analysis	.316[a]	-.091	-.011
Activity Participation	.134	.004	.055
Self-induced Action	.389[a]	.053	.088
Systematic Organization	.081	.087	-.019
Physical Work Orientation	.392[a]	-.200[b]	-.098
Total Environment Communication	.337[a]	.076	.079
Market Information Adjustment	-.109	.110	.021
Person-to-Person Verbalization	.291[a]	-.038	.062
Detail Mindedness	.080	-.124	-.216[b]
Community Intra-farm Influence	.105	.126	.199[b]
Managerial Professionalism	.247[b]	-.251[b]	-.128

[a]Significantly different from zero at 99 percent confidence level.

[b]Significantly different from zero at 95 percent confidence level.

Education was highly correlated with Perceptive Analysis, Self-induced Action, Physical Work Orientation, Total Environment Communications, and Person-to-Person Verbalization; and was correlated to a lesser degree with Managerial Professionalism. All of the relationships were positive. The high over-all relationship between education and the eleven hypothetical factors is suggestive of the mental nature of the factors, with implications that such factors may be highly responsive to change through educational activities or programs.

Neither age nor years of experience as an owner-operator showed the over-all relationship with the eleven factors which was so evident regarding education. Age was significantly and negatively related to both Physical Work Orientation and Managerial Professionalism. Both of these factors appeared to be measuring an orientation toward a "headwork" approach to farming as contrasted to the "hardwork" approach. Such an orientation toward farming appears to be more prevalent among younger farm operators.

Years of experience as an owner-operator was significantly but negatively related to Detail Mindedness. Since this factor was indicative of the indiscriminate use of information, such a relationship might be interpreted as the result of learning to sort out relevant and irrelevant information for decision purposes as experience increases. Years of experience as an owner-operator was significantly and positively correlated with Community Intra-farm Influence, a factor indicative of the degree to which decisions within the farm systems are

influenced by community approval. The direction of this relationship suggests an increasing interdependence between the farm system and the community through time.

The over-all results of the correlation analysis were considered to be of significant value to the area of farm management research from a broad theoretical standpoint. The relationships exhibited were consistent with and lended support to the model of managerial performance shown in Figure 1, page 12. The relationships found between the biographical characteristics, especially education, and the eleven hypothetical factors added support to the validity of the hypothetical factors as non-random mental processes inherent in the behavior of farm operators.

Correlation analysis however did not provide any direct evidence of the importance or relevance of the hypothetical factors to managerial performance. Answers to these questions are implied in the extent to which the factors explain the outcome or result of managerial effort, the indices of which are commonly referred to as managerial performance criteria.

III. SPECIFICATION OF TYPE OF ANALYSIS

The model used in the present study to evaluate the relationship between the hypothetical factors and the managerial performance criteria was the Stepwise Regression model.[9] The output of this model is a series

---

[9]The University of Tennessee Computing Center, "BMD02R Stepwise Regression," The University of Tennessee, Knoxville, Tennessee, 1968.

of multiple linear regression equations, computed at each n step on the basis of adding to the n-1 step the independent variable which makes the greatest reduction in the error term of the model. The model can be expressed in the following form:[10]

$$Y_j = B_0 + B_1F_1 + \ldots + B_mF_m + e$$

where Y_j = managerial performance criterion j

$B_1 \ldots B_m$ = partial regression coefficient of y_j regressed on m common factors

$F_1 \ldots F_m$ = common factors

e = error

The model assumes that managerial performance is a linear function of the hypothetical factors. Such a model also provided a means of specifying the degree of confidence, at each step in the stepwise procedure, with which it could be stated that a relationship actually existed between the criteria and the factors.

IV. MANAGERIAL CRITERIA SELECTED

In analyzing the relationship of the hypothetical factors identified in the present study to the management resource the following three criterion variables were selected: (1) returns to management; (2) net farm income; and (3) size of operation. Of these only returns to management was selected prior to the collection of data. The selection

---

[10] Gordon A. MacEachern, et al., Analysis of Human Attributes and Their Relationship to Performance Level of Farm Tenants, Agricultural Experiment Station Research Bulletin No. 751, Purdue University, Lafayette, Indiana, 1965, p. 8.

of the other criteria was the result of their immediate availability and the opinion of the researcher that relating the hypothetical factors to several different criteria would provide additional insights into the relevancy of the factors as management variables.

Returns to management is the earnings of the management resource after earnings to the land, labor, and capital resources have been determined. As such, this index of management performance is a residual measure. The measure does clearly indicate what the manager received for his efforts, but does not necessarily indicate what the manager contributed in terms of productivity. In other words, the measure fails to recognize the earnings of the other resources which may be attributable to the management resource. This measure may also vary from one locality to another due to variations in the values used to determine land, labor, and capital earnings. Since the present study was confined to a small area this effect was assumed to be negligible and the values used were the same for each farm operator.

Returns to management was determined for each farm operator as follows:

> Returns to management = (net farm income + value of farm products used in the home) - (.05 x land investment + .05 x capital investment + 1.25 x hours of unpaid family and operators labor)

Net farm income was selected as a criterion on the basis that it should reflect the outcome of the management process more completely than returns to management, assuming that the earnings of land, labor, and capital resources are some partial function of the management process.

This measure, since it reflects the net earnings of all of the resources owned by the operator, does not require the specification of any arbitrary values for determining the earnings attributable to land, labor, capital, and management resources separately. From a policy standpoint increases in net farm income have become firmly entrenched as a goal to be achieved. This fact alone would seem to provide sufficient reason for attempting to identify variables which explain variations in this measure of performance.

Size of operation was selected as a criterion variable because of the implications it seemed to have regarding the management resource. These implications arise from the observation of constantly increasing average size of farm and constantly decreasing numbers of farms. This situation is the result of farm consolidation and fewer farm operators controlling the production resources in agriculture. On the assumption that increases in size of operation require increases in the input of the management resource then size of operation should be useful as an index of the management input. Viewed in this manner, size of operation provides a different type of criterion than either of the two previously mentioned criterion, for while they serve as indicators of the outcome of the managerial process, size of operation serves as an indicator of the input of the managerial resource.

The hypothesis which led to the selection of size of operation as a criterion variable was as follows: Size of operation constitutes an observable index of the input of the management resource; therefore,

some part of the variations in this index should be explained by variations in the hypothetical factors identified in the present study.

V. REGRESSION OF CRITERIA ON THE IDENTIFIED HYPOTHETICAL FACTORS

Regression analysis often has as a major objective the development of equations to predict changes in a dependent variable associated with unit changes in the independent variable. In the present study the major objective of the regression analysis was to determine the degree and nature of the relationship between the dependent variable and the independent variables. Meaningful predictions of management performance on the basis of inputs of the managerial processes are somewhat premature at this stage of farm management research. Although the regression analysis does provide estimates of the effect of a unit change in the processes on the dependent variable, additional research is required to indicate how to effect such changes in the processes.

The approach used in the present study was to retain all of the hypothetical factors in the regression equation rather than retaining only those whose regression coefficients were significant at a specified level of confidence. Statistical significance was not disregarded but rather was allowed more flexibility than is often the case.

The statistical significance of each individual regression coefficient and each regression equation was determined and reported in order to allow a scientific interpretation of the findings. The statistical criterion used to determine the degree of confidence with

which it could be stated that a regression coefficient was significantly different from zero was the t value. This value was computed as follows:[11]

$$t = b/Q_b$$

where b = net regression coefficient
Q_b = standard error of b

The statistical significance of the regression equation was provided by testing the significance of R^2, the multiple coefficient of determination. R^2 indicates the percent of the variation in the dependent variable which is explained by the regression equation. The appropriate statistical criterion used to determine the degree of confidence with which it could be stated that R^2 was significantly greater than zero was the F value. This value was provided by the computer program used to obtain the regression equations.

The regression analysis consisted of alternatively regressing returns to management, net farm income, and size of operation on the factor scores of the following hypothetical factors:

X_1 = Perceptive Analysis

X_2 = Activity Participation

X_3 = Self-induced Action

X_4 = Systematic Organization

X_5 = Physical Work Orientation

X_6 = Total Environment Communication

X_7 = Market Information Adjustment

X_8 = Person-to-Person Verbalization

---

[11] Leabo, op. cit., p. 397.

X_9 = Detail Mindedness

X_{10} = Community Intra-farm Influence

X_{11} = Managerial Professionalism

Returns to Management Regressed on Hypothetical Factors

The regression of returns to management on the eleven hypothetical factors resulted in the following regression equation, where the factors are arranged in the order in which they entered into the equation:

$$\hat{Y}_1 = 2009.90 - 420.15\ X_3 + 283.14\ X_9 - 391.97\ X_8 + 672.05\ X_2 - 954.15\ X_1 + 427.93\ X_4 + 235.07\ X_5 - 160.69\ X_{11} - 219.04\ X_6 + 127.03\ X_7 + 97.99\ X_{10}$$

where $\hat{Y}_1$ = estimated returns to management.

The level of confidence which can be associated with each of the above regression coefficients is shown in Table XXI. R^2 for the above equation was .119 indicating that nearly 12 percent of the variation in returns to management was explained by the equation. This R^2 value was significant at the 85 percent level of confidence.

The confidence level could have been increased to 90 percent by retaining only the first six variables to enter the equation. These variables were X_3 (Self-induced Action), X_9 (Detail Mindedness), X_8 (Person-to-Person Verbalization), X_2 (Activity Participation), X_1 (Perceptive Analysis), and X_4 (Systematic Organization). These six variables explained 93.1 percent of the total variation explained by eleven variables. Table XXI indicates that these six variables, with

TABLE XXI

REGRESSION COEFFICIENTS, t-VALUES, AND LEVEL OF CONFIDENCE FOR REGRESSION OF RETURNS TO MANAGEMENT ON ELEVEN HYPOTHETICAL FACTORS, 110 FARM OPERATORS, ELK RIVER WATERSHED, TENNESSEE, 1968

Factor	Regression Coefficient	t-Value	Level of Confidence
			(%)
Perceptive Analysis	-954.15	1.3971	80
Activity Participation	672.05	1.2887	70
Self-induced Action	-420.15	.9242	60
Systematic Organization	427.93	.9244	60
Physical Work Orientation	235.07	.5459	40
Total Environment Communication	-219.04	.5072	30
Market Information Adjustment	127.03	.2941	20
Person-to-Person Verbalization	-391.97	.9121	60
Detail Mindedness	283.14	.6628	40
Community Intra-farm Influence	97.99	.2414	10
Managerial Professionalism	-160.69	.4125	30

the exception of X_9, had regression coefficients with a relatively higher degree of significance than the other variables, although none of the regression coefficients in the eleven variable regression seemed to be associated with a level of confidence sufficient for interpreting the direction of relationship between the factor and the criterion.

The results of regressing returns to management on the eleven hypothetical factors suggested that the factors are related to the criterion, but only at a moderate level of confidence. In terms of the individual factors it appeared that Factors I, II, III, IV, and VIII were of the most importance in affecting variations in the criterion variable.

Net Farm Income Regressed on Hypothetical Factors

The regression of net farm income on the eleven hypothetical factors resulted in the following regression equation, where the factors are arranged in the order in which they entered into the equation:

$$\hat{Y}_2 = -10269.00 + 1558.90\,X_1 - 675.58\,X_{10} + 639.31\,X_8 - 480.36\,X_6 - 353.38\,X_4 + 361.75\,X_9 - 261.66\,X_5 + 129.15\,X_3 + 122.42\,X_{11} - 77.11\,X_7 - 79.03\,X_2$$

where $\hat{Y}_2$ = estimated net farm income.

Table XXII shows the level of confidence associated with the regression coefficients of each of the eleven factors. The R^2 value for the above equation was .168 and was significant at the 90 percent level of confidence. The first four variables in the equation

TABLE XXII

REGRESSION COEFFICIENTS, t-VALUES, AND LEVEL OF CONFIDENCE FOR REGRESSION OF NET FARM INCOME ON ELEVEN HYPOTHETICAL FACTORS, 110 FARM OPERATORS, ELK RIVER WATERSHED, TENNESSEE, 1968

Factor	Regression Coefficient	t-Value	Level of Confidence (%)
Perceptive Analysis	1558.90	2.0649	95
Activity Participation	- 79.03	.1371	10
Self-induced Action	129.15	.2569	20
Systematic Organization	- 353.38	.6905	50
Physical Work Orientation	- 261.66	.5497	40
Total Environment Communication	- 480.36	1.0064	60
Market Information Adjustment	- 77.11	.1615	10
Person-to-Person Verbalization	639.31	1.3457	80
Detail Mindedness	361.75	.7661	50
Community Intra-farm Influence	- 675.58	1.5069	80
Managerial Professionalism	122.42	.2842	20

explained 93.6 percent of the variation explained by eleven variables. These four variables were Factor I (Perceptive Analysis), Factor X (Community Intra-farm Influence), Factor VIII (Person-to-Person Verbalization), and Factor VI (Total Environment Communication). Retaining only these four variables in the equation increased the level of confidence to 99 percent. Table XXII shows that the level of confidence associated with the regression coefficients of the first four variables to enter the equation was considerably higher than that of the other seven variables.

The regression of net farm income on the eleven hypothetical factors exhibited a higher over-all degree of statistical significance than did the regression of returns to management on the same factors. Also, a greater degree of confidence could be placed on the explanatory value of the factors as well as on the significance of the individual regression coefficients.

Size of Operation Regressed on Hypothetical Factors

The regression of size of operation on the eleven hypothetical factors resulted in the following regression equation, where the factors are arranged in the order in which they entered the equation:

$$\hat{Y}_3 = - 698.90 + 86.05\ X_1 + 24.48\ X_{11} + 40.17\ X_8 - 55.89\ X_2 - 26.81\ X_{10} + 21.91\ X_6 - 22.64\ X_4 - 21.75\ X_5 + 16.30\ X_3 + 7.77\ X_9 + 3.44\ X_7$$

where $\hat{Y}_3$ = estimated size of operation, measured in acres of open land operated.

Table XXIII shows the confidence level associated with the regression coefficients of each of the eleven factors in the equation. The R^2 value for the equation was .422, indicating a much higher degree of relationship between the eleven factors and size of operation than resulted in the two previous regressions. This R^2 was significant at the 99.5 percent level.

Of the 42.2 percent of variation in size of operation explained by the regression equation, the first six variables in the equation explained 93.9 percent. The first six factors to enter the equation were Factor I (Perceptive Analysis), Factor XI (Managerial Professionalism), Factor VIII (Person-to-Person Verbalization), Factor II (Activity Participation), Factor X (Community Intra-farm Influence), and Factor VI (Total Environment Communication). Table XXIII shows that the confidence levels of the regression coefficients for these factors were considerably higher than the coefficients exhibited by the remainder of the factors. Table XXIII also shows that the over-all level of confidence associated with the regression coefficients of the regression of size of operation on the eleven factors was higher than the over-all confidence levels of the coefficients on the two previous regressions.

Results of the regression of size of operation on the eleven hypothetical factors supported the hypothesis that size of operation might be useful as a criterion or index of the input of the management resource, assuming that the factors are relevant management variables. In terms of the degree of confidence which could be placed in the

TABLE XXIII

REGRESSION COEFFICIENTS, t-VALUES, AND LEVEL OF CONFIDENCE FOR REGRESSION OF SIZE OF OPERATION ON ELEVEN HYPOTHETICAL FACTORS, 110 FARM OPERATORS, ELK RIVER WATERSHED, TENNESSEE, 1968

Factor	Regression Coefficient	t-Value	Level of Confidence (%)
Perceptive Analysis	86.05	3.6742	99.5
Activity Participation	-55.89	3.1258	99
Self-induced Action	16.30	1.0454	70
Systematic Organization	-22.64	1.4265	80
Physical Work Orientation	-21.75	1.4730	80
Total Environment Communication	21.91	1.4798	80
Market Information Adjustment	3.44	.2323	10
Person-to-Person Verbalization	40.17	2.7261	99
Detail Mindedness	7.77	.5306	40
Community Intra-farm Influence	-26.81	1.9279	90
Managerial Professionalism	24.48	1.8330	90

results of the regression equations, this confidence continually increased as the regressions progressed from the returns to management regression, to the net farm income regression, and then to the size of operation regression.

VI. RELATIVE IMPORTANCE OF THE HYPOTHETICAL FACTORS

Interpretation of the importance of the hypothetical factors was based on the relative position of the factor in the regression equations and on a comparison of the confidence level of the regression coefficients for the factors on all three regression equations obtained. The latter comparison is shown in Table XXIV.

Factor I, Perceptive Analysis, appeared to be one of the most important factors related to management as measured by the three criterion variables. Factor I was among the group of factors, in each regression equation, which accounted for over 90 percent of the total explained variation. The regression coefficients of the factor on the net farm income and size of operation regressions indicated that increases in such a factor would be associated with increases in the criterion variables. Although the regression coefficient of the factor on the returns to management regression suggested an opposite relationship, the confidence level of the coefficient did not seem to justify such an interpretation.

Factor VIII, Person-to-Person Verbalization, appeared to be another of the more important management variables. This factor was also among the group of factors, in each regression equation, which

TABLE XXIV

SUMMARY OF CONFIDENCE LEVEL OF REGRESSION COEFFICIENTS RESULTING FROM REGRESSION OF RETURNS TO MANAGEMENT, NET FARM INCOME, AND SIZE OF OPERATION ON ELEVEN HYPOTHETICAL FACTORS, 110 FARM OPERATORS, ELK RIVER WATERSHED, TENNESSEE, 1968

Factor	Confidence Level		
	Returns to Management	Net Farm Income	Size of Operation
	(%)	(%)	(%)
Perceptive Analysis	80	95	99.5
Activity Participation	70	10	99
Self-induced Action	60	20	70
Systematic Organization	60	50	80
Physical Work Orientation	40	40	80
Total Environment Communication	30	60	80
Market Information Adjustment	20	10	10
Person-to-Person Verbalization	60	80	99
Detail Mindedness	40	50	40
Community Intra-farm Influence	10	80	90
Managerial Professionalism	30	20	90

accounted for over 90 percent of the total explained variation. Table XXIV shows that the regression coefficients of this factor were among the more highly significant coefficients in all three regressions. Again, as with Factor I, the regression coefficients of Factor VIII on the net farm income and size of operation regressions were indicative of a positive relationship between this factor and the criterion variables.

The last of what have been referred to as the more important factors affecting management was Factor X, Community Intra-farm Influence. Factor X was among the group of factors which accounted for over 90 percent of the total variation explained by the net farm income and size of operation regressions. The regression coefficients of Factor X in the net farm income and size of operation regressions indicated a negative relationship between community influence on actions within the farm firm and the criterion variables.

In terms of the confidence level of the regression coefficients and relative position in the regression equations, Factor II, Activity Participation, appeared to be of considerable importance as a management related factor. This factor was among the group of factors explaining over 90 percent of the total explained variation on the returns to management and the size of operation regressions. The regression coefficient of the factor in the latter regression indicated a negative relationship between the factor and the criterion variable.

Factor VI, Total Environment Communication, was among the group of factors explaining over 90 percent of the total explained variation on the net farm income and size of operation regressions. However, the confidence level of the regression coefficients on both regressions was considered insufficient for estimating the nature of the relationship between the factor and the criterion variables.

Of the remaining factors, Factor III (Self-induced Action), Factor IV (Systematic Organization), Factor IX (Detail Mindedness), and Factor XI (Managerial Professionalism) appeared in the group of factors which explained over 90 percent of the total explained variation in one of the three regressions. Factor XI, Managerial Professionalism, was the only one of the factors which possessed a regression coefficient with a degree of confidence justifying interpretation. This factor appeared to be significantly related to the size of operation criterion variable with a positive relationship being indicated. Within this group of factors Factor IX, Detail Mindedness, was associated with regression coefficients having very low confidence levels.

Factor V, Physical Work Orientation, and Factor VII, Market Information Adjustment, were not included on any of the three regressions, among the group of factors explaining over 90 percent of the total variation explained by the regressions. Both of these factors had regression coefficients with confidence levels which were considered prohibitive regarding any interpretation of the nature of the relationship between the factors and the criterion variables.

In summary, the regression of the three criterion variables on the eleven hypothetical factors supported the hypothesis that the factors identified by a factor analysis of selected managerial behavior data would explain some portion of the variation in managerial performance criterion variables. Although a considerable amount of the variation in the criterion variables was unexplained, that which was explained was associated with confidence levels sufficient to allow the acceptance of the eleven factors identified as relevant to the managerial performance model specified at the outset of the study. On this basis it is the conclusion of the present researcher that the factors identified in the present study constitute an addition to the total set of managerial processes, the identification and measurement of which will ultimately provide for the improvement and efficient allocation of the management resource in commercial agriculture.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The resources combined to generate the physical output of the agricultural production plant can be conceptually separated into land, labor, capital, and management. Both labor and management can be classified as the human resources used in producing the agricultural output. Continual improvement in the technical and economic efficiency with which these resources are combined requires a knowledge of both their quality and quantity. Since the resources are substitutes for one another, then the limiting factor in effecting the most efficient resource combinations is a greater lack of knowledge concerning the characteristics of one resource relative to the other resources. In agricultural production this limitation is imposed by a lack of knowledge concerning the nature of the management resource.

The problem facing production researchers is to identify the aspects of human behavior relevant to agricultural production and to specify the characteristics of such behavior. In terms of actual research, solving this problem will require at least three separate, but interrelated, areas of study: (1) The first area of study should be of the most basic nature and should be directed toward the development and validation of concepts which will serve to delineate or define the management function; (2) Following the development of a definition

of this function it should then become possible to discover the relationships existing between variations in management and variations in the other resources, as well as variations in the output of the production process; (3) The ultimate research objective is the quantification of the management resource and should be the basis of the third area of study. Given a quantified measurement of the management input it then becomes possible to effect more efficient resource combinations.

The present study was designed to contribute to the first two areas of study described above. The specific objectives of the study were specified as follows: (1) to empirically investigate the presence of selected hypothetical management processes in the everyday behavior of farm managers and/or to develop new processes; (2) to explore the usefulness of factor analysis as a method for isolating basic management processes from observed behavior of farm operators; and (3) to evaluate the relationship between the processes isolated by factor analysis and selected criteria of managerial performance.

A review of the literature and research pertinent to the study of the management resource in agriculture revealed that a definite change in the concept of management occurred in the early 1950's. Prior to this time management had been viewed as the "art" of organizing the farm business and operating it on the basis of a number of "principles" of farm management. The new concept of management, which was developed to explain variations in the management resource, was one viewing management as the "science" of decision-making. This new

concept of management defines management as consisting of some group of mental processes which determine managerial outcome.

The present research had as its starting point the definition of eight mental processes hypothesized to be relevant to the operation of the farm business. These processes were as follows: (1) organization: a process involving the development of systematic and methodical treatment of problems, and use of standard operating procedures; (2) planning: a process involving development of foresight, goal selection, setting priorities and forward projection; (3) environmental communication: a process of information flow from farm operator to the off-farm environment, person-to-person communication, and verbal expression; (4) representation: a process of social participation, and projection of farm and farm family into off-farm social system; (5) managerial professionalism: a process leading to the development of an orientation toward farming as an executive profession, and a satisfying and challenging occupation; (6) observation: a process of gathering information, recognition of relevant facts and occurrences, and awareness of affairs pertaining to the farm business; (7) analysis: a process of reasoning, analytical approaches to problem solving, and calculation; and (8) initiating action: a process involving motivation toward change, action taking ability, and origination of new approaches.

The general hypotheses tested were: (1) that these eight processes do exist and that they can be empirically validated through analyzing observable behavior which is indicative of such processes;

(2) that these processes will explain some portion of the variation in managerial outcome.

Following the definition of the hypothetical processes, a questionnaire was developed to inventory observable behavior which was assumed to be indicative of the various processes. The questionnaire contained 122 descriptive items which were selected from an item pool. The item pool was composed of descriptions of "good" and "poor" farm managers submitted by sixty-seven County Agricultural Extension Agents in Tennessee and of items used in other studies. A five response ordinal scale was used to ascertain the degree to which the respondent exhibited the behavior described by the items.

The questionnaire was delivered to a random sample of commercial farm operators located in the Elk River Watershed of Franklin, Moore, Lincoln, and Giles Counties, Tennessee. The sample consisted of 123 farm operators having gross farm sales of $2500 or more. These operators were the major decision makers regarding control, organization, and allocation of the farm resources and had functioned in such a capacity for at least a year. Of the 123 questionnaires obtained from the farm operators only 114 were completed relative to the 122 items designed to inventory behavior.

Factor analysis was used to analyze the items describing the farm operator's behavior. The factor analysis model was chosen for two reasons: (1) one of the model's major objectives was the explanation of a large amount of observable phenomena in terms of a smaller number of unobservable variables; (2) the model was originally developed

in the area of psychology for purposes of isolating basic mental processes inherent in observable human behavior. The model is especially useful in the exploratory phase of research. The present research was of such a nature.

Factor analysis is a mathematical model rather than a statistical model. Conceptually, factor analysis factors a data matrix into two product matrices.[1] These two matrices are the factor score matrix and the factor loading matrix. The factor loading matrix describes the n items of the data matrix as a linear combination of a number of "common" factors, usually less than n. The factor score matrix describes the degree to which each of the N individuals of the data matrix possesses the common factors.

The output of the principal axis factor analysis method which was used in the present study, is the factor loading matrix. The matrix is of the order (n x q), where n is the number of items and q is the number of common factors necessary to explain the variation in the data. The row coefficients of the n items can be viewed as linear regression coefficients of the items regressed on the q factors. Geometrically, the matrix defines a q common factor space within which there are q orthogonal (uncorrelated) factor vectors and n item vectors whose coordinates are the factor loading coefficients. Since the factors are themselves unobservable entities, it is necessary to

---

[1]Paul Horst, Factor Analysis of Data Matrices (New York: Holt, Rinehart, and Winson, Inc., 1965), pp. 95-96.

identify them on the basis of the items with which they are most closely associated in the factor space. It is only by chance that the items will be related to the factors in such a way that the factors can be identified. This problem is solved by rotating the factor vectors within the factor space until the most meaningful relationship is exhibited. The rotational method used in the present study to achieve the most meaningful structure was the varimax method.

The data matrix subjected to factor analysis in the present study was of the order (N x n) where N = 114 respondents, and n = 100 descriptive items. The results of this analysis yielded an (n x q) factor loading matrix, where n = 100 items and q = 11 factors. The eleven factors isolated explained 99.8 percent of the common factor variance. Difficulty in interpretation of the factors on the basis of the unrotated matrix suggested the need for rotation of the factors. Identification of the eleven factors was based on an interpretation of the content possessed in common by the items having significant factor loading coefficients on the factor being identified,[2] supplemented in some cases by the content of several of the highest loaded non-significant items.

A major criticism of factor analysis is the necessity of subjectively identifying the factors on the basis of the observable behavior described. In the present study an attempt was made to reduce this subjectivity by two procedures. First, only items with a relatively

---

[2]Significantly different from zero at the 95 percent level of confidence.

high degree of statistical significance were used to identify the factors. Secondly, the processes indicated by the items were independently identified by three researchers. That this substantially reduced the subjectivity involved was supported in the first instance by the fact that none of the items were loaded significantly on more than one factor, suggesting that the items were relatively "pure" measures of the factor on which they were significantly loaded. Secondly, a comparison of the three independent identifications of the factors revealed a high degree of consensus regarding what the items implied.

Factor I, Perceptive Analysis, appeared to be a process indicative of an ability to observe and analyze problems associated with operating the farm business. In terms of the hypothetical processes initially defined, Factor I supported the hypothesis of both observation and analysis processes but suggested that they are interdependent in nature.

Factor II, Activity Participation, appeared to be indicative of the degree to which the farm operator and family take part in off-farm activities, both from the standpoint of social activities and business activities. Factor II supported the presence of the initial hypothetical process defined as representation.

Factor III, Self-induced Action, was indicative of an ability to take action on the basis of ones' own decision, as contrasted to the inability to do so without a considerable degree of encouragement

by others. The identification of Factor III was believed to support the presence of the hypothetical process initiating action.

Factor IV, Systematic Organization, was indicative of a process of methodical arrangement, creation of rigid order, and establishment of patterns for accomplishing tasks. The factor supported the presence of the hypothetical processes planning and organization, but suggested that they are inseparable. Implied in such a factor is a considerable degree of rigidity relative to changes in organizational structure.

Factor V, Physical Work Orientation, appeared to be indicative of the value an individual places on physical work, as well as the satisfactions derived from physical labor. The factor was implicative of an attitude rather than a mental process. This factor had not been initially hypothesized as a separate factor but had been included under the hypothetical orientation referred to as managerial professionalism.

Factor VI, Total Environment Communication, was identified as being indicative of the process of communicating or maintaining contact with the total off-farm environment. This factor supported the hypothesis of the initial hypothetical process environmental communication.

Factor VII, Market Information Adjustment, appeared to be indicative of a process of continuously obtaining market information and making operational adjustments on their basis. This factor was not initially hypothesized, and its identification was considered only tentative due to the difficulty involved in its interpretation.

Factor VIII, Person-to-Person Verbalization, was indicative of the ability to effect face-to-face communication, expression of ideas verbally, etc. Although this type of ability was initially assigned to the hypothetical process environmental communication, factor analysis indicated that it is a separate and independent process.

Factor IX, Detail Mindedness, seemed to be indicative of a tendency to collect and use highly specific and detailed information in carrying out the management function, as contrasted to the use of more general principles and "rules of thumb." This factor was one of the more difficult to identify.

Factor X, Community Intra-farm Influence, was indicative of a process determining the degree to which actions within the farm organization are conditioned by community approval or disapproval. This factor was not implied in any of the initially hypothesized processes.

Factor XI, Managerial Professionalism, seemed to be indicative of an attitude regarding farming as an occupation. The attitude implied was one of viewing farming as a professional management occupation rather than a skilled or unskilled labor occupation. This factor was consistent with the initially hypothesized process referred to as managerial professionalism.

Following the identification of the eleven factors isolated in the factor analysis it was assumed that these factors constituted some subset of the managerial processes affecting managerial outcome, and thus should explain some part of the variation in this outcome. A measure of the degree to which each operator exhibited or possessed

each of the eleven factors was provided by the calculation of the factor score matrix. These scores became independent variables in regression analysis where selected managerial performance criteria were used as dependent variables.

Additional insights into the nature of the eleven factors was provided by a correlation analysis of the factor scores with age, education, and years of experience of the farm operators. This analysis revealed that Factor I (Perceptive Analysis), Factor III (Self-induced Action), Factor V (Physical Work Orientation), Factor VI (Total Environment Communication), and Factor VIII (Person-to-Person Verbalization) were related to education at a highly significant (99 percent) level of confidence, with Factor XI (Managerial Professionalism) being related at a significant (95 percent) level of confidence. The direction of the relationship was positive for all of these factors. The over-all relationship between education and these factors suggests that the factors are of a mental process nature and may be susceptible to change through educational methods.

Age was correlated significantly and negatively with Factor V (Physical Work Orientation), and Factor XI (Managerial Professionalism), while experience as an owner-operator was significantly related to Factor IX (Detail Mindedness) negatively, and to Factor X (Community Intra-farm Influence) positively.

The relationship between the eleven factors and managerial outcome was analyzed by regressing three different management criteria on the eleven factors. The three criteria used were: (1) returns to

management; (2) net farm income; and (3) size of operation. Criteria (1) and (2) were used as indicators of the output resulting from the input of the management resource. Criterion (3) on the other hand was used as a criterion or index of the input of the management resource, assuming that increases in the size of farm operation require increases in the input of the management resource.

The regression of returns to management on the eleven factors resulted in an R^2 of .12, indicating that 12 percent of the variation in this criterion was explained by variations in the factor scores. This R^2 value was significant at the 85 percent confidence level. The first six factors to enter the equation were Factor III (Self-induced Action), Factor IX (Detail Mindedness), Factor VIII (Person-to-Person Verbalization), Factor II (Activity Participation), Factor I (Perceptive Analysis), and Factor IV (Systematic Organization). These six factors actually explained 93 percent of the total variation explained by eleven factors at a 90 percent level of confidence.

The regression of net farm income on the eleven factors resulted in an R^2 of .17, with a 90 percent level of confidence. The first four factors to enter the equation were Factor I (Perceptive Analysis), Factor X (Community Intra-farm Influence), Factor VIII (Person-to-Person Verbalization), and Factor VI (Total Environment Communication). These four factors accounted for 94 percent of the total variation in net farm income explained by eleven factors, at a 99 percent level of confidence.

The regression of size of operation on the eleven factors resulted in an R^2 of .42 with a 99.5 percent level of confidence. On the assumption that size of farm operation is an index of the input of the management resource, it appeared that the eleven factors isolated constitute a partial description of the processes which may be useful for defining the management function. The first six factors to enter this regression were Factor I (Perceptive Analysis), Factor XI (Managerial Professionalism), Factor VIII (Person-to-Person Verbalization), Factor II (Activity Participation), Factor X (Community Intra-farm Influence), and Factor VI (Total Environment Communication). These six factors accounted for 94 percent of the total variation in the criterion variable explained by all eleven factors.

The relative importance of the eleven factors in constituting relevant managerial concepts was assessed on the basis of the relative position of the factor within the three different regression equations, and the level of confidence which could be assigned to the regression coefficients of the factors. On the basis of this evaluation Factor I (Perceptive Analysis), Factor VIII (Person-to-Person Verbalization), and Factor X (Community Intra-farm Influence) appeared to have the highest over-all relationship to the management criteria. Factors I and VIII appeared to be positively related to the managerial criteria, while Factor X indicated a negative relationship to the criteria.

Factor II (Activity Participation) and Factor VI (Total Environment Communication) exhibited a high over-all relationship to the

managerial criteria, followed by Factors III (Self-induced Action), IV (Systematic Organization), and XI (Managerial Professionalism), which all appeared to be moderately related to management criteria as a whole. A negative relationship was indicated between Factor II and size of operation, while a positive relationship was exhibited between Factor XI and the same criterion.

Factor IX (Detail Mindedness), Factor V (Physical Work Orientation), and Factor VII (Market Information Adjustment) exhibited the least degree of over-all relationship to the management criteria. The level of confidence of the regression coefficients for these factors was prohibitively low regarding any interpretation of the nature of their relationships to managerial criteria.

The results of the present study supported the following hypotheses: (1) the observed behavior of farm operators can be analyzed by factor analysis as a means of identifying basic mental processes and/or abilities which will explain variations in the observed behavior; and (2) when the behavior observed is hypothesized to be relevant to the management function of the farm operator, on the basis of a sound theoretical framework, then the factors identified will explain variations in management performance criteria.

The present research led to the following conclusions and implications regarding additional research: (1) the present study appeared to indicate that the traditional criteria used to measure managerial performance may not be accounting for the total performance given by management. It may well be that personnel evaluation type criteria or

some other type of personal evaluation by persons familiar with the management function may actually provide a more realistic appraisal of the management performance than do some of the more objective indicators presently used. There seems to be a definite need for research aimed at criterion development. (2) The factors identified in the present study are considered to be a contribution to some subset of total human mental processes, which will ultimately define the dimensions of the managerial processes portion of the model shown in Figure 1.[4] Nevertheless, the present study was considered exploratory in nature, therefore requiring additional empirical validation of the processes isolated, as well as the hypothetical formulation and testing of the presence of other managerial process variables. (3) The ultimate objective in management research is the ability to effect desirable changes in the management resource, therefore indicating a need to determine educational methods needed to effect changes in the types of processes isolated in the present study.

In the final analysis the present research findings are highly tentative. Much of the variation in managerial outcome criteria was left unexplained. Nevertheless, what was explained was done so with a relatively high degree of confidence and should be of scientific interest and value to farm management researchers. In addition, the present research should provide some indication of the usefulness of psychometric models for analyzing the human resource in commercial

---

[4]See Figure 1, p. 12.

agriculture. It is hopeful that the results of the study will generate the degree of scientific patience and interest which will certainly be required of those continuing research in an area where explaining the behavior of man is the ultimate goal.

BIBLIOGRAPHY

BIBLIOGRAPHY

A. BOOKS

Andrews, T. G., editor. Methods of Psychology. New York: John Wiley and Sons, Inc., 1948.

Boss, Andrew, and George A. Pond. Modern Farm Management. Saint Paul: The Webb Publishing Company, 1947.

Bradford, Lawrence A., and Glenn L. Johnson. Farm Management Analysis. New York: John Wiley and Sons, Inc., 1953.

Case, H. C. M., and Paul E. Johnston. Principles of Farm Management. New York: J. B. Lippincott Company, 1953.

Case, H. C. M., and D. B. Williams. Fifty Years of Farm Management. Urbana: University of Illinois Press, 1957.

Cattell, Raymond B. Factor Analysis: An Introduction and Manual for the Psychological and Social Scientist. New York: Harper and Brothers, 1952.

English, Horace B., and Ava Champney English. A Comprehensive Dictionary of Psychological and Psychoanalytical Terms. New York: David McKay Company, Inc., 1958.

Forster, G. W. Farm Organization and Management. New York: Prentice-Hall, Inc., 1938.

Harman, Harry H. Modern Factor Analysis, second edition, revised. Chicago: The University of Chicago Press, 1967.

Horst, Paul. Factor Analysis of Data Matrices. New York: Holt, Rinehart, and Winston, Inc., 1965.

Hudelson, Robert R. Farm Management. New York: The Macmillan Company, 1939.

Johnson, Glenn L., et al., editors. A Study of Managerial Processes of Midwestern Farmers. Ames: The Iowa State University Press, 1961.

Klausmeier, Herbert J. Learning and Human Abilities: Educational Psychology. New York: Harper and Brothers, 1961.

Leabo, Dick A. Basic Statistics, third edition. Homewood: Richard D. Irwin, Inc., 1968.

Selltiz, Claire, et al. Research Methods in Social Relations, revised edition. New York: Holt, Rinehart, and Winston, Inc., 1964.

Thurstone, L. L. Multiple-Factor Analysis. Chicago: The University of Chicago Press, 1947.

B. AGRICULTURAL EXPERIMENT STATION PUBLICATIONS

Hess, C. V., and L. F. Miller. Some Personal, Economic, and Sociological Factors Influencing Dairymen's Actions and Success. Agricultural Experiment Station Bulletin No. 577, Pennsylvania State University, College Station, Pennsylvania, June, 1954.

Johnson, Glenn L., and Cecil B. Haver. Decision-Making Principles in Farm Management. Agricultural Experiment Station Bulletin No. 593, The University of Kentucky, Lexington, Kentucky, January, 1953.

Johnson, Glenn L. Managerial Concepts for Agriculturalists. Agricultural Experiment Station Bulletin No. 619, The University of Kentucky, Lexington, Kentucky, July, 1954.

Lee, John E., Jr., and E. D. Chastain. Problem Recognition in Agriculture. Agricultural Experiment Station Bulletin No. 319, Auburn University, Auburn, Alabama, 1959.

Mac Eachern, Gordon A., D. Woods Thomas, and Ludwig M. Eisgruber. Analysis of Human Attributes and Their Relationships to Performance Level of Farm Tenants. Agricultural Experiment Station Research Bulletin No. 751, Purdue University, Lafayette, Indiana, November, 1962.

McCormick, Ernest J., Robert E. Boanchard, and D. Woods Thomas. An Objective Method of Selecting Farm Tenants. Agricultural Experiment Station Research Bulletin No. 678, Purdue University, Lafayette, Indiana, April, 1959.

Nielson, James. The Michigan Township Extension Experiment; The Farm Families . . . Their Attitudes, Goals, and Goal Achievement. Agricultural Experiment Station Technical Bulletin No. 287, University of Michigan, East Lansing, Michigan, 1962.

Pugh, C. R., D. Woods Thomas, and L. M. Eisgruber. Farm Tenant Ability, Output and Resource Productivity. Agricultural Experiment Station Research Bulletin No. 793, Purdue University, Lafayette, Indiana, April, 1965.

Rieck, Robert E., and Glenn C. Pulver. An Empirical Measure of Decision-Making. Agricultural Experiment Station Research Bulletin No. 238, University of Wisconsin, Madison, Wisconsin, June, 1962.

Straus, Murray A. A Technique for Measuring Values in Rural Life. Agricultural Experiment Station Technical Bulletin No. 29, Washington State University, Pullman, Washington, August, 1959.

Straus, Murray A. Direct, Indirect and Disguised Measurement in Rural Sociology. Agricultural Experiment Station Technical Bulletin No. 26, Washington State University, Pullman, Washington, 1957.

Straus, Murray A., and Barnard D. Parrish, The Columbia Basin Settler. Agricultural Experiment Station Bulletin No. 566, Washington State University, Pullman, Washington, 1956.

Wilcox, Walter W., Andrew Boss, and George A. Pond. Relation of Variations in the Human Factor to Financial Returns in Farming. Agricultural Experiment Station Bulletin No. 288, University of Minnesota, Saint Paul, Minnesota, June, 1932.

Wilcox, Walter W., and O. G. Lloyd. The Human Factor in the Management of Indiana Farms. Agricultural Experiment Station Bulletin No. 369, Purdue University, Lafayette, Indiana, August, 1932.

Wilkening, E. A., and Donald E. Johnson. Goals in Farm Decision-Making as Related to Practice Adoption. Agricultural Experiment Station Research Bulletin No. 225, University of Wisconsin, Madison, Wisconsin, 1961.

C. JOURNAL ARTICLES

Kelso, M. M. "A Critical Appraisal of Agricultural Economics in the Mid-Sixties," Journal of Farm Economics, 47:1-16, December, 1965.

Lee, John E., Jr., and E. D. Chastain. "The Role of Problem Recognition in Managerial Adjustments," Journal of Farm Economics, 42:650-659, August, 1960.

Nelson, A. G. "The Management Factor in Commercial Agriculture: How Can It Be Improved?," Journal of Farm Economics, 47:1446-1448, December, 1965.

Nielson, James. "Improved Managerial Processes for Farmers," Journal of Farm Economics, 43:1250-1261, December, 1961.

Pond, G. A., and W. W. Wilcox. "A Study of the Human Factor in Farm Management," Journal of Farm Economics, 14:470-479, July, 1932.

Reiss, R. J. "Measuring the Management Factor," Journal of Farm Economics, 31:1065-1072, November, 1949.

Rushton, Willard T., and E. T. Shaudys. "A Systematic Conceptualization of Farm Management," Journal of Farm Economics, 49:53-63, February, 1967.

Straus, Murray A. "Managerial Selectivity of Intensive Extension Work," Rural Sociology, 24:150-161, June, 1959.

Wirth, M. E. "Pattern-Analytics: A Method of Classifying Managerial Types," The Quarterly Bulletin, 47(2):166-198, November, 1964.

D. UNPUBLISHED MATERIALS

Blanchard, Robert E. "The Development and Validation of Instruments for Selecting Farm Operators for Farm Management Services," Unpublished Ph.D. thesis, Purdue University, Lafayette, 1956.

Chastain, E. D. "An Empirical Study of the Decision-Making Process in Farm Management." Unpublished Ph.D. thesis, Purdue University, Lafayette, 1956.

Durfee, R. C. "Multiple Factor Analysis." University of Tennessee Computing Center, The University of Tennessee, Knoxville, Tennessee, August 11, 1966.

Harrington, Harvey P. "Measuring the Managerial Ability of Farmers." Unpublished Master's thesis, The University of Missouri, Columbia, 1964.

Hobbs, Daryl. "Use of Factor Analysis in a Farm Management Study." A paper presented at Symposium on Present Use and Potential of Linear Programming and Other Operations Research Techniques in Farm Management Extension. Columbia, Missouri, January, 1965.

Huffman, Donald C. "A Technique for Classifying Farm Managers According to Managerial Ability." Unpublished Doctor's dissertation, The Ohio State University, Columbus, 1963.

Paris, Donald Gordon. "Predicting Farm Behavior from Estimates of Input Productivity for a Sample of Western Kentucky Farms." Unpublished Doctor's dissertation, University of Kentucky, Lexington, 1960.

Reiss, Franklin Jacob. "Individual Differences in Entrepreneurial and Managerial Ability Among Illinois Farm Operators." Unpublished Ph.D. thesis, University of Illinois, Urbana, 1952.

E. OTHER SOURCES

Elk River Watershed: Summary of Resources with Documentary Supplements. Knoxville: Tennessee Valley Authority, August, 1962.

Farm Management in the West, Report No. 4. Conference Proceedings, Farm Management Research Committee of the Western Agricultural Economics Research Council. Denver, Colorado, October 24-26, 1962.

Measuring Managerial Ability of Farmers. Symposium Proceedings, North Central Research Committee on the Management Resource in Farming (NC-59). Chicago: The Farm Foundation, December, 1962.

Stogdill, Ralph M., and Alvin E. Coons, editors. Leader Behavior: Its Description and Measurement, Research Monograph 88. Columbus: The Bureau of Business Research, The Ohio State University, 1957.

The University of Tennessee Computing Center. "BMD02R Stepwise Regression," The University of Tennessee, Knoxville, Tennessee, 1968.

APPENDIXES

APPENDIX A

SUMMARY OF BEHAVIOR OF "GOOD" FARM MANAGERS DESCRIBED BY 67 COUNTY AGENTS IN TENNESSEE

1. He establishes priorities for jobs.
2. He does work on time.
3. He accepts recommended crop production practices if proven.
4. He accepts recommended livestock production practices if they are applicable to his situation.
5. He maintains machinery and keeps it serviceable.
6. He stresses quality in his crops and livestock.
7. He emphasizes efficiency in production.
8. He emphasizes maximum production.
9. He keeps ahead of schedule.
10. He has knowledge of plant and animal growth and needs.
11. He obtains production information from reliable sources before undertaking production.
12. He constructs farm plan and operates on the basis of it.
13. He uses most current production equipment.
14. He formulates set of well-defined goals.
15. He develops farm plan to accomplish established goals.
16. He is an early adopter of improved production practices.
17. He maintains store of information on latest technological changes.
18. He emphasizes keeping accurate and complete records.
19. He consults successful producers regarding production decisions.
20. He is constantly striving to improve his production "know-how."
21. He experiments with new methods to test their applicability to own situation.
22. He constantly is searching for cost cutting and profit increasing production methods.
23. He is aware of capabilities of his resources.
24. He organizes crop and livestock enterprises on basis of land resource.
25. He consults professional agricultural workers.
26. He attends meetings dealing with production.
27. He reads widely concerning production.
28. He emphasizes mechanization of all phases of farm operation.
29. He emphasizes economics of production.
30. He considers a new practice with regard to its effect on total operation.
31. He observes practices used by successful farmers.
32. He keeps records concerning cost/per unit of production.
33. He looks to professional agricultural research agencies for leadership.

34. He loves his work.
35. He is proud of his yields and production.
36. He emphasizes quantity of output.
37. He constantly evaluates new practices.
38. He realizes adverse effects of overproduction.
39. He spends less time with outside groups, etc.
40. He is concerned about detail of operation.
41. He reads and studies a great deal.
42. He is usually ahead on his work.
43. He attempts to purchase in quantity.
44. He anticipates inputs well in advance.
45. He is not an "in" and "outer" but stays in and adjusts operation to current situation.
46. He concentrates on input prices rather than market prices.
47. He is aware of his cost of production.
48. He is among the first to adjust to price changes.
49. He is willing to borrow money to buy supplies when it is profitable to do so.
50. He keeps up with market trends and prices.
51. He considers all possible marketing alternatives.
52. He makes extensive use of price information sources.
53. He checks prices daily.
54. He is aware of current supply and demand situation.
55. He organizes production according to market needs.
56. He considers quality of inputs he purchases as well as price.
57. He attempts to buy and sell through outlets where his bargaining power is maximized.
58. He bases production on long range price forecasts.
59. He shops around when buying and selling.
60. He markets products through a cooperative if possible.
61. He plans production to match favorable price periods.
62. He markets quality products.
63. He is willing to borrow money to pay cash for supplies.
64. He contributes a great deal of time to marketing.
65. He reads market reports and outlook statements.
66. He is aware of marketing and purchasing methods.
67. He emphasizes volume of sales.
68. He is active in marketing and purchasing activities.
69. He is satisfied with prices paid and received.
70. He is disturbed about his buying and selling power.
71. He uses storage of non-perishable products as means of increasing sales revenue.
72. He considers possibility of marketing crops through livestock.
73. He is aware of "cost-price" squeeze.
74. He demands price stability in government policy.
75. He emphasizes marketing high quality products.
76. He uses outlook and market data in planning his buying and selling activities.
77. He accepts proven technological advances.

78. He evaluates new idea before adopting it.
79. He is an early adopter.
80. He keeps up with new information concerning technological change.
81. He considers new technology relative to his own situation.
82. He is "open-minded" regarding new ideas.
83. He is cautious in his approach to change.
84. He adjusts as rapidly as possible.
85. He constantly strives to develop the necessary skills to apply new technology.
86. He has knowledge of fundamental concepts.
87. He accepts the research evidence published by professional researchers.
88. He consults with successful farmers concerning technological changes.
89. He adapts new changes to his own situation.
90. He investigates technology change fully before adoption.
91. He consults his wife concerning adoption of a change.
92. He makes adjustments cautiously, only after study.
93. He is moderate in his adjustment to change in technology.
94. He is in constant contact with sources of information.
95. He is receptive to new ideas.
96. He consults wife and other family members regarding decision-making.
97. He consults professional agricultural workers.
98. He has sound working arrangements with credit institutions and business firms.
99. He delegates responsibilities to family members.
100. He participates in community activities.
101. He is concerned with welfare of others.
102. He emphasizes own ideas but respects others.
103. He shares his knowledge with others.
104. He is active in farm organizations.
105. He emphasizes educational achievement.
106. He demonstrates a willingness to cooperate.
107. He involves himself in family affairs.
108. He emphasizes neatness and order around the farmstead.
109. He emphasizes high standard of living for his family.
110. He includes family in planning farm operation and establishing goals.
111. He sees farming as business operation.
112. He looks to professional agricultural workers for leadership and answers to problems.
113. He commands the respect of his neighbors, etc.
114. He participates in leisure activities with family.
115. He considers family needs in his planning.
116. He emphasizes success and community status.
117. He is generally more interested in own business but will accept community responsibilities.

118. He is sympathetic to free markets in agriculture.
119. He uses government programs to his advantage.
120. He is aware of current social problems.
121. He has knowledge of current government programs and policies.
122. He fits government programs into farm plan, not vice versa.
123. He pictures himself as part of larger community.
124. He is sympathetic to farm bargaining organizations.
125. He feels that there is too much government control in agriculture.
126. He takes government programs as given and farms within these conditions.
127. He is against the welfare state.
128. He feels that farmer is not getting fair shake.
129. He participates in political activities.
130. He votes for the man and not the party.
131. He has well conceived ideas concerning his political, social, economic philosophy.
132. He shows little interest in international problems and political philosophy.
133. He wants less government interference in everything.
134. He maintains contact with legislative representatives.
135. He indicates deep concern with present social, economic, and political problems.
136. He is active in policy discussions at community, county, and state levels.
137. He is optimistic with regard to the future.
138. He feels a certain amount of government control is necessary.
139. He emphasizes need for price and production stability.
140. He will not participate in farm programs if income adversely effected.
141. He professes a belief in more work and less handouts.
142. He stresses that citizenship should be taught in schools.
143. He bases participation in government programs on its effect on total business.

APPENDIX B

SUMMARY OF BEHAVIOR OF "POOR" FARM MANAGERS DESCRIBED BY 67 COUNTY AGENTS IN TENNESSEE

1. He does little reading concerning production.
2. He never attends educational meetings.
3. He disregards pioneer practices.
4. He resists change.
5. He is satisfied with mediocre yields and products.
6. He emphasizes "status quo."
7. He does little planning ahead.
8. He is certain his way is best.
9. He fails to see his operation as a total unit.
10. He obtains most information from his neighbors.
11. He has no farm plan.
12. He is a slow adopter.
13. He is haphazard in carrying out his operation.
14. He is always a half-day late.
15. He is bull-headed about own ideas.
16. He is a "habit" farm producer.
17. He feels no need for keeping records.
18. He fails to obtain adequate information.
19. He emphasizes being independent.
20. He is not interested in learning new techniques.
21. He is conservative in credit use.
22. He does little planning.
23. He goes overboard on new methods.
24. He is apathetic regarding his production.
25. He minimizes cash outlays.
26. He seldom seeks help from his peer groups.
27. He is careless in carrying out production.
28. He blames crop failures on "bad luck."
29. He doesn't attempt to study price movements.
30. He greatly emphasizes low farm product prices and high input prices.
31. He doesn't attempt to market products cooperatively.
32. He feels that all agricultural products should have a support price.
33. He limits his output because of national surpluses.
34. He considers only product prices in making decisions.
35. He expends little effort toward comparison of alternative buying and selling channels.
36. He markets all products at harvest regardless of price.
37. He feels government should guarantee income.
38. He shows little concern over quality of product.

39. He purchases cheapest inputs regardless of quality.
40. He shifts blame for marketing mistakes on others.
41. He is unaware of current market prices.
42. He gives little consideration to timeliness in buying and selling.
43. He accepts low prices as given data in making decisions.
44. He is highly responsive to "high pressure salesmanship."
45. He feels that he is a "price" taker in all situations.
46. He buys and sells on basis of personalities rather than economics.
47. He is highly critical of prices.
48. He buys and sells on impulse.
49. He restricts inputs as means of adjusting to unfavorable prices.
50. He doesn't understand the market system.
51. He is resistant to change in methods.
52. He fails to attend demonstrations or educational meetings to learn about new technology.
53. He is satisfied with his antiquated methods.
54. He is unaware of technological change.
55. He is a slow or late adopter.
56. He feels "book learning" is a hindrance.
57. He closes his eyes to change.
58. He jumps into technological changes with little or no evaluation.
59. He makes minor changes but not major changes involving large capital outlays.
60. He has no desire to improve standard of living or level of income.
61. He either tries nothing or everything.
62. He thinks of technology only in terms of its costs--not its returns.
63. He is uninterested in community improvement work.
64. He sees little value in higher education.
65. He expects professional agricultural workers to be able to make his decisions.
66. He doesn't participate in community activities.
67. He doesn't cooperate with professional agricultural workers.
68. He lacks pride in the community.
69. He does not involve family in planning.
70. He emphasizes independence and self-sufficiency.
71. He is slow to accept others advice.
72. He will accept rewards without responsibility.
73. He has a defeatist attitude.
74. He feels everyone out of step but himself.
75. He stresses incompetence in others.
76. He does not participate with family in community affairs.
77. He participates in community activities on a sporadic basis.
78. He refuses to accept community responsibility.
79. He doesn't consider farm as a business firm.
80. He is the "doubting Thomas" of the community.
81. He often makes irrational purchases to keep up with the neighbors.
82. He is "too busy" for community affairs.
83. He is down on everything.

84. He has no interest in social, economic, or political problems.
85. He is critical of government intervention in all areas.
86. He wants more help from government.
87. He is extremely critical of politicians.
88. He is unfamiliar with government agricultural programs.
89. He expresses an attitude of intolerance.
90. He is critical of larger, more successful farmers.
91. He is more dependent on government programs than "good" managers.
92. He is concerned only with short run effect of government programs.
93. He stresses obtaining as much from government as possible without giving anything in return.

APPENDIX C

LIST OF ITEMS SUBJECTED TO FACTOR ANALYSIS

Item No.	Item Content
1.	Strongly feel that success in farming is mostly a matter of hard physical work.
2.	Feel farming would be more enjoyable if there weren't so many decisions to make.
3.	Attend such things as field days, machinery demonstrations, adult farmer classes, etc., when at all possible.
4.	Am fairly active in community affairs.
5.	Plan production to meet favorable price periods.
6.	Keep pretty well up to date on changes and new developments concerning farm progress.
7.	Emphasize farm and home beautification as one of the more important farm-family goals.
8.	Emphasize to my family the importance of participating in activities in the community.
9.	In my farming operation, I am always looking for newer and better ways to farm.
10.	Usually allow a certain amount of time for each routine farm job.
11.	Usually complete work as scheduled.
12.	Usually check weather forecasts at least twice daily.
13.	Usually will accept positions of community responsibility when asked.
14.	Usually adjust size of crop and livestock enterprises when prices change.
15.	Follow a set pattern in going about my farming.
16.	Never seem to have time for leisure and recreation.
17.	Always farm without a written plan.
18.	Feel that the use of credit is a required part of farm management.
19.	Usually determine the acreage necessary to justify ownership before deciding to buy a new piece of machinery.
20.	Usually adopt new methods before they are proven by researchers and other farmers.
21.	Quite often attend field days, adult farmer classes, machinery demonstrations, etc.
22.	Spend considerable amount of time reading, asking questions, and participating in activities that will teach me more about farming.
23.	Always develops a written farm plan.

24. Regularly calculate or have calculated such efficiency indicators as machinery cost per acre, pounds of gain per dollar of feed, labor cost per acre, percent of land in high value crops, etc.
25. Make written notes during the day of unusual situations noticed.
26. Buy or use new practices and methods only if it becomes necessary to stay in farming.
27. Frequently discuss my own farming operation with neighbors and friends.
28. Get a great deal of personal satisfaction from attempting to solve the many problems farming presents.
29. When purchasing feed, seed, fertilizer, machinery, etc., I make my money go farther by buying the cheapest available.
30. Always emphasize to other farmers the importance of change in farming.
31. Feel that keeping up with scientific research and developments is necessary for success.
32. Often feel uneasy when discussing farm business matters with people other than family members and close friends.
33. Schedule work in such a way as to have least amount of lost time and motion.
34. Seldom talk about my farming operation and its problems with people other than family.
35. Probably couldn't satisfactorily describe the kinds of soils I have and their characteristics if asked to do so right now.
36. Rarely hesitate to accept positions requiring leadership and public appearances.
37. Encourage other farmers in the community to accept new ideas and methods in farming.
38. Have standard operating procedures for doing my work.
39. Always consider both the additional costs and returns when deciding about expanding farm enterprises.
40. Always have everything needed before starting a job.
41. Write things down rather than depend on memory.
42. Assign certain tasks (chores) to each farm worker and/or family member.
43. Keep pretty close watch on market conditions and prices.
44. Do not participate regularly in community activities.
45. Let other farm members represent our farm and family at activities in the community, rather than attending myself.
46. Don't maintain particularly close speaking relationship with bankers, cooperative supervisors, and other non-farm businessmen.
47. Could tell someone the approximate yields and production of individual fields and animals on my farm without looking at records.

48. Would rather be a farm manager than a skilled farm worker, if the pay was the same.
49. Obtain most of my information from close friends and neighbors.
50. Seldom have a family discussion when planning farm operations.
51. Am satisfied with my farming operation as it is.
52. Make a point of obtaining national and world news information daily.
53. Use some type of printed record book.
54. Do routine chores about the same time each day.
55. Am not concerned about what the community thinks of me.
56. Adopt a new practice only after it has become acceptable to all the other farmers in the community.
57. Always among the first farmers to try out new ideas and methods of farming.
58. Plan purchases so as to take advantage of seasonal discounts.
59. Have special time scheduled for record keeping.
60. Attend few off-farm activities.
61. Often need something from town in order to complete a task.
62. Receive most information on matters of interest to me from family and very close friends.
63. Am not an active participant in political activities.
64. Never seem to get work done as scheduled.
65. Always determine total amounts of operating items (feed, fertilizer, etc.) needed well in advance.
66. Feel that farm operators need periodic management training courses,
67. Usually keep up with what other farmers are doing.
68. Often calculate total cost and returns for each enterprise in my farming operation.
69. Usually wait to see if most other farmers will adopt a new practice before adopting it myself.
70. Participate regularly in farm organizations.
71. Determine what the family wants, then set up farm operation to meet these requirements.
72. Do little long-run farm and home planning (for example, five-year plan, ten-year plan).
73. Talk quite often with county agent and other professional agricultural workers.
74. Emphasize farming as a business rather than farming as "just a good way of living."
75. Often watch, listen to, and read about national news and current problems.
76. Adopt recommended practices only after determining affect of them on my own operation.
77. See little reason to change methods and buy or use new practices and methods in farming because they won't solve my problems.

78. Have little interest in activities in the community.
79. Never seem to have things needed at time they are needed.
80. Always develop a yearly plan to use as guide for operation of farm.
81. Contact professional agricultural workers only when have serious problems.
82. Feel that the challenge offered by farming is a more important one than living in the country as a reason for farming.
83. Always determine the benefit of government programs to me before deciding extent of participation.
84. Volunteer use of farm and family resources to assist in community activities, field days, etc.
85. Frequently discuss national, international, political, social and economic problems with other farmers, businessmen, county agent, etc.
86. Always have difficulty understanding words such as budgeting, marginal analysis, alternative costs, capital, net worth, return to resources.
87. Seldom vary amounts and analyses of fertilizers and feeds I use.
88. Always carry out farm operations without a written farm plan.
89. Often contact my political representatives when concerned with legislative changes.
90. Believe that the farmer is more like a businessman than a skilled worker or technician.
91. Don't "shop around" when buying supplies and selling products.
92. Consider entire farm operation before adopting a new production method.
93. Always plan each day's activities beforehand.
94. Seldom pay much attention to state, national, and international news.
95. Often have difficulty making myself understood.
96. See a lot in common between running a farm and operating a non-farm business.
97. Keep pretty well up to date on new production methods.
98. Seldom attempt to determine why certain enterprises vary in returns from year to year.
99. Often wish I were a little more confident in my ability to manage my operation.
100. Listen to daily market reports nearly every day.

VITA

William Ruthvan Morrow was born December 7, 1938, in Burlington, West Virginia, the son of Mr. and Mrs. Ruthvan W. Morrow, Jr. He was graduated from Mountaineer High School in Thomas, West Virginia, in 1956. In that same year he entered Potomac State College, located in Keyser, West Virginia, where he pursued an agricultural education curriculum.

Upon completion of his freshman year he entered the U. S. Navy. After serving four years and attaining the rank of Second Class Petty Officer, he was honorably discharged August 25, 1961. After attending Potomac State College his sophomore year, he transferred to West Virginia University where he was graduated with a B. S. degree in Agriculture, June 1964. While attending West Virginia University he was the recipient of the Ralston Purina Scholarship and was initiated into Gama Sigma Delta. He was graduated with High Honors.

In September 1964 he entered the Graduate School of The University of Tennessee where he was a National Defense Education Act Fellow in the Agricultural Economics Department. He received his M. S. degree in Agricultural Economics from The University of Tennessee in August 1966. In June 1967 he became a candidate for the Ph. D. degree in Agricultural Economics and is presently engaged in fulfilling the necessary requirements for this degree. His major area of concentration was in Production Economics and Farm Management, with minor

concentrations of interest in General Agricultural Economics and Economic Thought.

William Ruthvan Morrow was married in June 1959, and he and his wife are the parents of four children. Upon completion of the requirements for the Ph. D. degree, he will join the faculty of Eastern Kentucky University as an Assistant Professor in the Economics Department.