AN EVALUATION OF THE INTERSTATE MANAGERIAL STUDY CLASSIFICATION OF KNOWLEDGE SITUATIONS

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AN EVALUATION OF THE INTERSTATE MANAGERIAL STUDY CLASSIFICATION OF KNOWLEDGE SITUATIONS

By

Curtis Franklin Lard

AN ABSTRACT

Submitted to the College of Advanced Graduate Studies of Michigan
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ABSTRACT

The main purpose of this study is to evaluate the relevance of the "knowledge situation" concepts used in the Interstate Managerial Study. The hypotheses tested by this investigation are: (1) farm managers encounter and can recognize the knowledge situations in their own experiences; and (2) farmers' ability to recognize and give verified examples of the knowledge situations is related to their characteristics.

The classification of knowledge situations under consideration is the one defined by G. L. Johnson and C. B. Haver. It is an extension of an earlier classification of Frank Knight's.

The Interstate Managerial Survey provided the data for testing the hypotheses of this Study. A set of questions defining each of the knowledge situations--positive and negative risk action, learning, inaction, positive forced action and subjective certainty-- and calling for corresponding examples of the situation was asked 1075 farmers in seven midwestern states. The questions were so constructed that the farmers responded with examples from their own managerial activities. In order for the answers to be considered complete, the farmers were asked to explain what was done and what was involved in doing it.

The complete or verified examples of the knowledge situations which farmers gave were used to test the hypotheses. The characteristics of these farmers were then related to their ability to recognize and give verified examples of the knowledge situations. The most important variables found to be related to ability to recognize and give verified examples of the knowledge situations were (in order): (1) education,

(2) thinking method used (induction and/or deduction), (3) attendance at agricultural meetings, (4) average gross farm income, (5) total debts, and (6) years farming experience.

In general, farmers' ability to understand and give verified examples of the knowledge situations increases with; (a) higher education, (b) increases in the use of deductive reasoning, (c) increases in the number of agricultural meetings attended, (d) higher farm incomes, (e) increases in debts and (f) increases in years of farming experience.

It was concluded that the classification of knowledge situations, as followed in the Interstate Managerial Survey, corresponds, to an important degree, with farm manager behavior. However, the classification was found to be incomplete. To further complete the classification, a new knowledge situation--involuntary learning--is added. Involuntary learning is defined as a situation wherein the manager does not voluntarily learn more since the cost of additional information equals or exceeds its value to him but, in which, some outside force makes it necessary to learn or for some learning to occur regardless of the will of the manager.

The definition of a new development (new technology) as followed in the IMS led to confusion of the knowledge situations. To help eliminate this confusion a new definition is presented. The definition of new technology, as advanced herein, is stated as follows: a technology will be considered "new" to an individual farmer until he makes either a positive or negative risk action decision toward adoption of the technology, after which, it is an old technology to him.

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Any errors remaining herein are the sole responsibility of the author.

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CHAPTER I

INTRODUCTION

This study is an integral part of a group of investigations, known as the Interstate Managerial Study (hereafter referred to as IMS), concerning the managerial concepts and principles employed by farm managers in operating their businesses. The specific objectives of this inquiry are (1) to test the general hypothesis that farm managers recognize the different degrees of knowledge when they are explained to them, (2) to see if the managers can give verified examples of having encountered these knowledge situations, (3) to make and test certain hypotheses about the attributes of the farmers who recognize and give verified examples of the knowledge situations and the types of information involved, and (4) to state the general implications of the study. The degrees of knowledge under consideration are those defined by two midwestern agricultural economists[1] who have extended an earlier classification of Frank Knight's.[2]

The study addresses itself both to formulating concepts about "states of knowledge" and to empirical tests of hypotheses involving these concepts. This part of the IMS tests the validity of these concepts and attempts the resultant necessary reformulations.

Knowledge is the end product of learning which is a necessary task

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[1]G. L. Johnson and C. B. Haver, Decision Making Principles, in Farm Management, Kentucky Bulletin 593 (Lexington: University of Kentucky, 1953).

[2]Frank H. Knight, Risk, Uncertainty and Profit, Houghton-Mifflin, New York, 1921.

of most people operating a going concern, such as a farm. The knowledge a manager possesses at any given time may vary from none to perfect and his behavior is very likely to vary with the amount or degree of knowledge possessed.

It is a part of this study to offer explanations and describe the characteristics and behavior of farm managers possessing different specified amounts or degrees of knowledge. Both the cost of obtaining and the value of possessing knowledge are subjective. Therefore, in studying the knowledge a manager possesses, we must use subjective measurements. As the questions used in this study from the IMS, were most frequently stated so that a manager told or responded about his own personal experiences,[3] the data are often behavioristic.

The question is frequently asked by economists, "What use can be made of information on the degrees of knowledge held by farm managers?" This study should provide a better understanding of how farm managers think when managing their farms. It is believed that such information would help direct or improve a) research in farm management, b) the type of information made available to farm managers, c) the extension aid offered to farmers, d) the education of the farm management student and e) policy recommendations for agriculture.

The farm firm is both a decision-making producer and a decision-making consumer. The IMS takes the interdependency of the farm firm and the household into consideration.

The Order of Presentation

The basic plan of this study may be described as follows.

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[3]The list of questions concerning the knowledge situations, as studied in the IMS, is present in the Appendix.

In Chapter II, the theoretical setting and background for the states of knowledge are developed. Included in this chapter are (1) the role of the learning function and knowledge in the managerial processes, (2) a theory of knowledge, (3) the theoretical development of the states of knowledge over the period from the classical economists to present and (4) definitions of the "states of knowledge."[4]

The origin and objectives of IMS will be given in Chapter III. Attention will be directed toward the survey, the sample, the interviewing and the coding procedures. While the general overall characteristics of the IMS will be described, major attention will be given to that part concerning knowledge situations.

In Chapter IV, the primary purpose is to set the stage for this investigation. A summary is presented of the findings of a pilot study in Kentucky.[5] This pilot study was a forerunner to the IMS wherein certain questions and concepts concerning the managerial function were tested for appropriateness and relevance. Also in Chapter IV, the knowledge concepts are defined and described as they have been studied in IMS.[6] In the last section of this chapter, the independent variables are described and discussed.

The three chapters that follow (V, VI, and VII) present the empirical evidence and relations tested in this study. Chapter V is concerned with presenting the evidence of the recognition of knowledge

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[4] Johnson, op. cit. p. 11f.

[5] G. L. Johnson, Managerial Concepts for Agriculturalists, Kentucky Agricultural Experiment Station, Bulletin 619, 1954, p. 36f.

[6] Great Plains Council. Proceedings of Research Conference on Risk and Uncertainty. Great Plains Council Publication no. 11. Fargo, North Dakota: North Dakota Agricultural College, 1953.

situations and the testing of the general hypothesis that farmers encounter and can recognize the different degrees of knowledge. In this chapter, knowledge situations confused and possible explanations for such confusions are presented. Also, the importance of each knowledge situation is stressed.

In Chapter VI, the types of information used in solving management problems are presented, along with, the types of information involved when managers confuse knowledge situations.

In Chapter VII, which is the real core of this analysis, there are stated other ex ante and ex poste hypotheses which have been verified or rejected with the empirical evidence from IMS. Also, some possible means are offered for eliminating the confusion of knowledge situations. Among these possible means the following are presented: (1) a new definition of new technology, and (2) a distinction between the game theoretic and the probablistic approach to decision making.

The general conclusions and implications made from this study are given in Chapter VIII. Some possible implications will be given for further research, farm management teaching, extension work, farm managers, and public policy formulation. These implications are based on observations and insights gained in this study.

CHAPTER II

THE THEORETICAL SETTING AND BACKGROUND

In developing the theoretical setting for the analysis, it is necessary to examine the learning process to see why it is necessary in management. This examination will be made by reviewing the past work on the degrees of knowledge. Therefore, such examination will make obvious the importance of an empirical investigation of the knowledge situations.

The Role of Learning Process and Knowledge in the Managerial Process

The management process is divided into five distinct steps.[7] Assuming the manager has defined the problem and determined what should be observed, the five tasks of management are as follows:

(1) Observation

(2) Analysis

(3) Decision making

(4) Action

(5) Acceptance of responsibility

Of the five steps, the first three involve learning. Knowledge is important in the managerial process.

The role of learning in the managerial process is the acquisition of information and knowledge. The learning process is one means whereby the manager improves his decisions.

The need for learning exists because of the gap between predictions

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[7]Johnson and Haver, op. cit. page 8.

and realizations. The more correctly the manager can predict the future, the better manager he is and the higher rewards (profits) he will receive. T. W. Schultz defines the entrepreneur as one who must make two interrelated decisions, what to do and how to do it.[8] In the same article, Schultz states, "Little has been done to reduce the divergence between expectations and realizations. The gap between expectations and realizations is a positive measure of what is probably the most important source of inefficiency and waste in present day (1939) farming. ..... mistakes are usually traceable to the fact that expectations were faulty." If such statements are accepted, then the learning process and the degrees of knowledge become the basis for improving the efficiency of managers and reducing economic waste.

Because knowledge is so often imperfect, it is necessary that we investigate the theory of knowledge to develop a fuller understanding of the subject matter, herein presented. In this study, no attempt is made to give a complete description of the theory of knowledge (which is not well developed anyway). Enough should be described, however, to indicate the general nature of the learning process as it is related to managerial decision making. It should also stress the degrees or correctness of knowledge in the process of developing a fact or "true" knowledge.

In a dynamic economy -- where factors affecting the firm are changing continuously -- a manager finds that his knowledge is often imperfect and incomplete. This makes it necessary for the manager to learn. Since learning requires time, effort, and money, the manager attaches a

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[8]Schultz, T. W., "Theory of the Firm and Farm Management Research," Journal of Farm Economics, Vol. XXI (1939).

disutility to the process of acquiring additional information. If we assume the law of diminishing returns applies to the learning process, then it would yield an increasing marginal cost curve and a diminishing marginal utility curve for knowledge as the product of the learning process. Then the marginal disutility of getting information can be equated with the marginal utility (or worth) of such knowledge to maximize income or total satisfaction.

A Theory of Knowledge

Science can be regarded as storehouse of organized, consistant knowledge and the scientific method as a process whereby we find truth or knowledge. Whitney says, in the Elements of Research, "..... after every pause for analysis, integration, and deductive verification, a leap more or less in the dark must be made, if any conclusion at all, however tentative, is to be reached." Thus, knowledge may not be exact but as Dewey says "science is simply the most authentic knowledge of nature, man, and society that is possible at any given time by means of the methods and techniques then and there available."[9] As knowledge is ordinarily only tentative and imperfect, a manager in an ever-changing dynamic economy must continually employ himself in the learning process.

A manager may have imperfect knowledge which can be overcome to a certain extent by learning. People can employ two methods of learning -- inductive and deductive. Deductive learning (or reasoning) is conceived to be concerned with the conditions under which particular or instanial propositions are inferable from universal premises. Inductive reasoning, on the other hand is conceived as dealing with those inferences which

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[9]A quote from Elements of Research by Whitney.

enable us to derive universal conclusions from particular or instantial premises. Deduction, as contrasted with induction, is distinguished by the fact that the conclusion is certain and necessary if the premises are. In general, conclusions reached by induction are probable only. Deduction proceeds from general principles to other general principles or to particulars; induction seeks to establish general principles or laws by examination of particular cases. Deduction is analytic; induction, synthetic. A set of more general definitions may be stated as follows: (1) deductive learning - a method of scientific reasoning by which from general principles concrete applications or consequences are deduced and (2) inductive learning - act or process of reasoning from a part to a whole.[10]

Knowledge as acquired by scientists is based upon rigorous demonstration and consistency, while the knowledge which an individual qua layman considers adequate may be less rigorous and of a personal subjective nature. Knight says,

> "The ordinary decisions of life are made on the basis of 'estimates' of a crude and superficial character. In general the future situation in relation to which we act depends upon the behavior of an indefinitely large number of objects, and is influenced by so many factors that no real effort is made to take account of them all, much less estimate and summate their separate significance. ....Prophecy seems to be a good deal like memory itself, on which it is based. So when we try to decide what to expect in a certain situation, and how to behave ourselves accordingly, we are likely to do a lot of irrelevant mental rambling, and the first thing we know we find that we made up our minds, that our course of action is settled."[11]

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[10] Cohen, M. R., and Nagel, E. An Introduction to Logic and Scientific Method. New York: Harcourt, Brace and Co., 1934.

[11] Knight, op. cit.

Marshall[12] has remarked that the business manager's decisions are guided by "trained instinct" rather than knowledge.

Whitney[13] remarked that the normal human mind often acts in terms of problem situations without thought, i.e. tradition or habit are substituted. Once a person has experienced an event, he may need very little extra information to decide when he is faced with the similar problem again. Often times it may be advantageous to act according to custom or habit, since cost of acquiring the extra information may exceed its value.

It is evident from the brief discussion of the nature of knowledge above, that knowledge may be of varying degrees. A classification of degrees of knowledge for use in studying management will be more useful if it considers the personal, subjective value and costs of knowledge as well as the more objective measures.

Theoretical Development of the States of Knowledge

It is now appropriate to classify the different degrees of knowledge. Knight distinguished three different degrees of knowledge. They are perfect knowledge or certainty, risk and uncertainty. He defined perfect knowledge or certainty as a situation in which a manager has no risk-bearing and learning task to perform. This degree of knowledge is essentially that assumed by the classical static economic theorists. Knight defined risk as where probabilities of making errors of perception and inference are known, thus permitting the risk-bearing function to be carried out. However, since the probabilities of errors are known, the costs of bearing the risks can be computed and incorporated into an

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[12] Marshall, A. Principles of Economics. London: Macmillian Co., Ltd., 1936.

[13] Whitney, op. cit.

insurance scheme, thereby eliminating this type of risk bearing as a necessary managerial task. Uncertainty is not susceptible to measurement and cannot be eliminated. It is this uncertainty which gives rise to the management function and profits. Hart pointed out that Knight's distinction between risk and uncertainty was somewhat incomplete.

Albert G. Hart[14] recognized the lack of clarity in the distinction between Knight's risk and uncertainty. Hart defined risk to denote the holding of anticipations which are not "single valued" but constitute a probability distribution having known parameters. He defined uncertainty to denote the holding of anticipations under which the parameters of the probability distribution are themselves not single valued. He argued that if known probabilities exist and the entreprenuer has the possibility of deferring decisions (with or without special costs) the manager can still be in an uncertainty situation -- because he is willing to forego decision to learn more or collect more evidence to improve the accuracy of his prediction. This is to say, the manager may know the probabilities of error and be able to compute risk-bearing costs but feel that the passage of time will permit him to learn more about the event at less cost than the value of such knowledge. Thus, he may act as if the situation were an uncertainty situation.

The important contribution of Hart's analysis was that he anticipated the close correspondence between the process of improving estimates with the passage of time and the principles of sequential analysis. Hart said,

"Unless the event in question is imminent, the future must be

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[14] A. G. Hart, "Risk, Uncertainty, and the Unprofitability of Compounding Probabilities," Reprinted in Studies in Mathematical Economics and Econometrics, 1942, Pages 110-118.

> expected to bring in more relevant evidence. Possibly new evidence will change our outlook and give our estimates a radically different expectation value. More probable new evidence will confirm our impressions and leave the expection value substantially unchanged."[15]

This is to say, the manager tries to preserve flexibility or continue learning in his planning process and in his firm, depending upon the cost of the new evidence and of delay in reaching a decision.

Abram Wald,[16] a statistician, re-examined the formal theory of statistical decision-making in the late thirties and early forties. In single sample analysis, statisticans set up certain standards of accuracy and compute the sample size necessary to reach such accuracy, after which, they make the observations and make their terminal decision. Wald devised a system of statistical decision making whereby a standard of accuracy is set up first and evidence is then gathered and analyzed simultaneously. This is called sequential decision ---- a series of decisions or a chain. The word sequential deals with the situation in which evidence is collected in little units (observations) one at a time and the information at each stage is used to make the choice among three decisions: (1) enough information is available to accept one alternative, (2) enough information is on hand to accept the other alternative or (3) a decision to take still another observation. If the decision is to take on additional observation, the learning process continues. (This formulation made Hart specific.)

A person using the sequential process needs the capacity to sort out the incoming information (which theory specifies) to determine what

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[15] Ibid., pp. 110-118.

[16] Abram Wald, Statistical Decision Functions, John Wiley and Sons, New York, 1950.

is incomplete, unreliable, biased or irrelevant. The accuracy of data is important since the decision is only as good as the data used to fuel the statistical decision-making system.

In decision making, the decision maker relies on both objective and subjective measurements. Subjectivity is involved because the accuracy of information is often based on the personal evaluation of the decision maker. The development of sequential statistical analysis provided the basis for dividing imperfect knowledge into subjective risk situations and three sub-categories of subjective uncertainty. The distinction between subjective risk and subjective uncertainty depends upon the standard of accuracy required by the manager or person desiring the decision. The three subjective uncertainty situations are (1) the situation wherein learning is continued, (2) the situation where learning is discontinued because its cost exceeds its value to the analyst or no action is taken because not enough information is available for a decision, and (3) the situation in which a manager (or person desiring the decision) is forced to act by outside circumstances even though more learning would be worthwhile if time permitted.[17]

G. L. Johnson[18] viewed Knight's thinking as being incomplete as follows,

> "First, he distinguished between risk and uncertainty on the unrealistic and objective basis of whether or not it was possible to compute probabilities of errors rather than on the subjective, but more realistic basis, of whether or not the amount of information on hand was considered adequate for action. Second, he did not break his uncertainty category down into sub-categories distinquishing between situations in which managers try to learn, do not try to learn, and are prevented from learning."

In the late forties, G. L. Johnson[19] defined four degrees of knowledge

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[17]These situations are more clearly and distinctly defined on page 24.

[18]Johnson, Kentucky Bulletin 619, op. cit.

[19]Johnson, G. L., unpublished doctoral thesis, "Allocative Efficiency of Agricultural Prices," University of Chicago, 1949.

possessed by managers while in the decision making process. These four knowledge situations were (1) certainty where the manager knows the future with certainty and has no risk-bearing function, (2) risk wherein a manager knows that a future event will fall within a known probability distribution, (3) uncertainty wherein a manager may know a future event will fall within a series of probability distributions to each of which is attached a likelihood, and (4) non-certainty wherein the manager may know nothing about a future event.

Since Johnson wrote his doctoral dissertation, he has reformulated and reclassified the knowledge situation held by managers. For a redefining and reformulating of the degrees of knowledge see the discussion below.[20]

Defining the States of Knowledge

The degrees of knowledge were more clearly and distinctly formulated by Johnson,[21] when he was a member of the Agricultural Economics staff at the University of Kentucky, in 1950. He did some reformulating of the knowledge situations as they were presented in his Ph.D. dissertation, along with, added information which he gathered by doing some case studies. These few case studies in two Kentucky counties were based on responses to probing, open-ended type questions used when he interviewed a few farmers to see how near these concepts coincided with their behavior. As a result of the extra information received from the case studies and other research work in collaboration with L. A. Bradford (on some occasions) and C. B. Haver (on other occasions), Johnson presented and defined five knowledge situations. These five knowledge situations

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[20]Also see Kentucky Bulletin 593 and North Dakota Bulletin 400.

[21]L. A. Bradford and Glenn L. Johnson, Farm Management Analysis, John Wiley and Sons, New York, 1953.

in which farm managers find themselves are as follows: (1) subjective certainty, and (2) subjective uncertainty including (a) risk (b) learning (c) inaction and (d) forced action. These were defined as follows: (1) subjective risk is where information, though known to be imperfect, is considered to be adequate for decision and the cost of more information equals its value, (2) learning is where the manager incurs additional cost to get additional information because the knowledge present is considered inadequate for decision and the value of additional information exceeds the cost of acquiring it, (3) inaction is where present knowledge is inadequate for decision and the manager has no ability or desire to learn more since the cost of information is higher than the value, (4) forced action is a situation wherein a time element is involved and some outside element forces the decision before the manager is able, willing and ready to bear the consequences. The manager regards present knowledge as inadequate for decision but the "time element" prevents further learning. Subjective certainty is defined as a situation where a manager regards present information as perfect or so nearly perfect that he can make the decision and ignore probabilities of errors.

After the case-study, mentioned above, a more detailed pilot study was conducted in Kentucky. From this pilot study, the knowledge situations were redefined by Johnson and Haver[22] as presented in Chapter IV. Also in Chapter IV, a graphic representation and the definitions of the knowledge situations will be given as they have been used in carrying out this study.

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[22]Johnson and Haver, op. cit. p. 11 ff.

CHAPTER III

SOURCE OF DATA

Interstate Managerial Survey

The Interstate Managerial Study, hereafter referred to as IMS, is based upon the ideas, principles, and concepts of management as they were stated in the bulletin, Decision Making Principles in Farm Management by Johnson and Haver.[23]

The main contribution of the bulletin, mentioned above, is a functional-situational framework within which farm management may be viewed. Assuming the problem has been defined, the five functions or tasks that management performs are: (1) observation, (2) analysis, (3) decision making, (4) action, and (5) acceptance of responsibility. In carrying out these tasks (especially the first three), the managers encounter different degrees of knowledge which are (1) subjective uncertainty, (2) subjective certainty. These different degrees of knowledge were believed to be possessed with reference to the knowledge which the manager had about a type of information. The types of information used by farmers in decision making were classified as (1) price, (2) production methods, (3) new development, (4) human, (5) institutional, and (6) home technology. This bulletin formed the basis for the IMS.

In August 1953, a Risk and Uncertainty Conference was held by midwestern agricultural economists at Bozeman, Montana. At this conference,

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[23]Johnson and Haver, op. cit.

an interstate survey was decided upon as a means of obtaining data to test the concepts and principles set forth in Johnson's and Haver's bulletin.

The Survey[24]

Cooperative relationships were established which included agricultural economics personnel interested in the development of managerial concepts and principles from the Agricultural Experiment Stations of: (1) Ohio State University, (2) University of Kentucky, (3) Purdue University, (4) Michigan State University, (5) North Dakota State Agricultural College, (6) Iowa State College, and (7) Kansas State College. The services of the Farm Foundation and of the Risk and Uncertainty Sub-committee of the North Central Farm Management Research Committee were utilized in establishing these cooperative relationships. These institutions cooperated in setting up and running the survey.

The survey was conducted in seven states during the summer of 1954. A total of 1075 schedules were completed on farmers in the following states: (1) Kentucky, (2) Indiana, (3) North Dakota, (4) Iowa, (5) Kansas, (6) Ohio, and (7) Michigan. Michigan State University, as originator and a primary sponsor of the survey, arranged for and contributed the services of a survey expert for use (a) in constructing and pre-testing the survey schedule and (b) in training interviewers.

The Sample

The area and units to be sampled were delineated by the North Central

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[24] For a more detailed description of the survey, see the Journal of Farm Economics Proceedings No. 5, (December, 1955), pages 1097-1109

Regional Committee. The area consisted of eight geographical regions containing contiguous groups of whole or part counties located within the seven states (mentioned above).

The units interviewed consisted of non-urban commercial farms (census definition) with gross farm income of $2500 or more and which were managed by a single household unit. Commercial farms characterized by livestock share leases, father-son arrangements where both had a separate family and household, and regular business partnerships between two unrelated individuals were not eligible for interview. The survey was conducted by trained interviewers who were instructed to complete a specified number of schedules in each of the eight areas by the members of the Committee.

It was decided that a stratified random sample using area sampling units would be the appropriate design. Each of the eight areas was a stratum and each stratum was subdivided into area sampling units which contained on the average two eligible farms (in the case of Kentucky it was decided to use area sampling units which contained on the average three eligible farms). The decision to use the above sampling unit sizes in terms of eligible number of farms was based on considerations of cost and ease of field operation. The actual sample drawing was completed using the 1950 Census of Agriculture and the 1947 Revised Master Sample Materials.

It was first necessary to determine the numbers of eligible farms present in each whole or part county. This number was obtained for each county by taking the 1950 number of commercial farms with gross incomes of $2500 or more; subtracting from this the 1950 number of livestock share leases and finally reducing this number by 20 percent in order to adjust for partnerships, father-son arrangements, and changes in the number of farms since 1950. The 20 percent reduction factor was arrived at through the experience of the staff of the Sample Survey Group of the Statistical Laboratory at Iowa State College. After having determined the total number of eligible farms in each county, the total number of area sample units within that county was determined, and then the Master Sample Materials were used in subdividing the county into area sampling units of the desired size.

A simple random sample of the desired number of area segments was drawn from each stratum (with the exception of stratum 8) and these were numbered and indicated on $\frac{1}{2}$ inch scale county highway maps. The area segments within each stratum were numbered serially in the order with which they were drawn and the number assigned to segments on the maps consists of the stratum number followed by the area segment number. In the case of stratum 8 (Kansas), the number of interviews to be obtained was allocated to the individual counties by the Kansas representative on the North Central Regional Committee. A simple random sample of the desired number of area segments was drawn from each county in the stratum and these were indicated on county highway maps in the same manner as the other strata. The characteristics of the sample of the eight strata are presented in Table 1.

Interviewing

In June 1954, an interviewer's school was held at the Purdue University for one week. The school was instructed by Joel Smith of the Sociology Department of Michigan State University. G. L. Johnson and A. N. Halter assisted in instructing the interviewers. The interviewers attending

TABLE 1

CHARACTERISTICS OF THE SAMPLE OF EIGHT STRATA FOR THE INTERSTATE MANAGERIAL SURVEY

State	Estimated Number of Eligible Farms	Estimated Eligible Farms per Sampling Unit	Expected Number of Interviews	Actual Number of Interviews Taken
Kentucky	1,790	3	150	124
Ohio	23,599	2	200	137
Indiana	15,769	2	200	189
Michigan	37,545	2	224	199
Michigan	394	2	30	30
North Dakota	9,301	2	150	129
Iowa	23,649	2	140	120
Kansas	6,985	2	206	147

represented each of the states involved in the study. The purposes of the school were (1) to acquaint the interviewers with the study, the survey and the schedule; (2) to instruct the interviewers in the proper techniques to use in interviewing; and (3) to supervise some practical exercises in interviewing under field conditions.

The interviewing was done in the summer and fall of 1954. A total of twenty-three interviewers in the seven states contacted the eligible farms. The interviewers were given specific instruction of how to locate each prospective interviewee or farm. He was also given instructions of how to use each of the six schedules. These six schedules were rotated in sequence and each one contained the questions to test the specific hypotheses of the study but not every schedule contained the same listing of questions.[25]

When 10 to 20 interviews were completed by an interviewer, the completed schedules were sent to Joel Smith for review. He examined the completed schedules for uniformity in interviewing and completeness.

Coding Procedures

The personnel at Michigan State University constructed a code which made it possible to transfer the data from the schedules to IBM punch cards. The process of coding consisted of four stages: (1) the construction of a preliminary code, (2) the revision and testing of the code, (3) the actual coding, and (4) the checking.

The preliminary code was constructed by Joel Smith, G. L. Johnson, and A. N. Halter. They took a large number of responses to a specific question and defined categories into which each answer would fit. The answers were then assigned numbers.

After the preliminary code was completed, it was presented to the Risk and Uncertainty Sub-Committee. Then the code was revised in accordance with what the sub-committee recommended. The revision was tested for reliability. This test was done as follows: (1) two persons would code 15 or 20 actual questionnaires randomly selected from the seven states; (2) the code numbers assigned by the testers for each item were compared for agreement; (3) when the code numbers did not agree, appropriate adjustments were made until the coding became consistent.

In the third stage, the actual coding of the schedules carried out by clerks under the supervision of Joel Smith and A. N. Halter. The

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[25]The questions concerning knowledge situations were on every schedule.

clerks carried out the coding by the use of the code sheet. The coding was then checked by a second person.

After all the answers had been assigned numbers by use of the code sheet, the tabulating department of Michigan State University punched the code numbers into IBM cards. The data on each schedule required a total of 480 columns on six IBM cards. The punched cards were again checked for interrelated punches between the columns for each question. After initial marginal tabulations were run these checks were repeated on punch and column totals.

CHAPTER IV

A REPORT OF A PILOT STUDY AND THE STATES OF KNOWLEDGE AS STUDIED IN IMS

As has been discussed in Chapter II, the knowledge situation possessed by a manager depends upon his personal subjective evaluation. The previous discussion has provided a basis for sub-categorizing the uncertainty or imperfect knowledge situation into more meaningful, realistic terms. In the succeeding sections of this chapter, a review of the results of an empirical test of the knowledge concepts is presented. Also, the definitions of the different degrees of knowledge (as studied in IMS) which the manager possesses are given in more detail.

A Pilot Study in Kentucky[26]

A pilot study, concerning the management concepts and principles, was conducted in Montgomery County, Kentucky in 1951. Thirty-one farmers were asked questions concerning the management problems which they faced; the information they used in solving problems; the importance of knowledge situations (risk, learning, inaction and forced action); the relative importance of inductive and deductive thought processes; whether or not they employ the flexibility principle; and the importance of strategic operations in their managerial activities.

The primary objectives of this study were (1) the sorting of existing managerial theory and principles for relevance, (2) the studying and understanding of managerial activity. The study was designed to serve as a basis for formulating subsequent more adequate surveys, in

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[26]Johnson, "Managerial Concepts for Agriculturists," op. cit. p. 36f.

particular the IMS.

Most of the farms surveyed were over 60 acres in size, and were located on soils of mixed limestone and shale origins. The farms had fairly large burley tobacco bases and the farmers experienced moderate incomes. In general, the area was well served with roads, schools, markets, electricity, and telephones. Since this study was of an exploratory nature, it was deemed unwise to attempt a greater geographic survey. However, despite its geographic limitations, the survey was surprisingly conclusive in some instances and highly suggestive in other instances.

From the pilot study, the following conclusions were reached: (1) the learning situation was empirically important; (2) farmers do take steps to prolong the learning situation, i.e., to keep the business flexible in order to gain from what can be learned; (3) farmers have clearcut ideas about the nature and extent of the costs and values of flexibility; and (4) farmers weigh the costs of learning against the value or usefulness of what can be learned.

In summary, the pilot study gave the following results: (1) the farmers indicated about a fifty-fifty split on the use of the inductive and deductive thought processes; (2) all five types of information (price, production, innovations, human, and institutional) proved to be important but the listing appeared incomplete; (3) subjective uncertainty situations were important including risk and forced action, though forced negative actions were confused with negative risk actions and with inaction due to lack of knowledge while the learning situation appeared to be particularly important, (4) all farmers indicated that they employed inductive reasoning and all farmers indicated that they employed deductive reasoning, and (5) all farmers indicated they employed personal strategies.

While the above study was being completed, G. L. Johnson and C. B. Haver[27] collaborated and came up with the following classification of knowledge situations; positive risk action, negative risk action, learning situation, inaction situation, certainty and positive forced action. These are defined as follows: (1) positive risk action - where a manager is not completely sure (he has a probability distribution of the outcomes) of the outcome, but is willing to take the consequences of acting and being wrong; (2) negative risk action - wherein a manager decides not to act even though he runs a risk of being wrong in not acting, he is willing to take the consequences of being wrong, by not acting; (3) learning situation - wherein a manager postpones a decision to act or not to act until he can get additional information; (4) inaction - a situation wherein the manager does not have enough information to act but the value of additional information is not worth the cost and effort of learning it; (5) certainty - a situation wherein the farmer acts as if he were certain of the outcome and does not worry about being wrong; and (6) positive forced action - a situation wherein the manager is forced by circumstances to make a decision when he regards the information he has as inadequate for decision. He is forced to act before he is ready, willing and able to bear the consequences.

The sub-dividing of risk action into positive and negative becomes necessary because of the different consequences associated with the different actions. In deciding to act either positively or negatively, the manager faces the possibility of making two types of errors,[28] when choosing between two alternatives. The Type-I error is made when a hypothesis is

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[27]G. L. Johnson and C. B. Haver, Decision Making Principles, in Farm Management, Ky. Bull. 593, 1953.

[28]J. Neyman and E. Pearson's work on this subject is summarized by P. Hoel, Introduction to Mathematical Statistics, John Wiley and Sons, New York, 1947, pp. 202-206.

rejected when, in fact, it was true or best. The Type-II error is made when the alternative hypothesis is accepted when, in fact, it was false or worst. In decision making the manager specifies the accuracy desired and the probability of making each of the errors. The different consequences involved, if either error is made, help determine whether the action taken will be positive or negative.

The knowledge situations, as defined by Johnson and Haver, are essentially the classification studied in IMS and used in this thesis. The questions used to study the different knowledge situations are presented in the Appendix. Knowledge situations, as studied in IMS, are more vividly explained and described in the discussion which immediately follows.

Definitions and Explanations of the Knowledge Concepts as Studied in IMS[29]

In defining and explaining the knowledge situations held by managers, marginal analysis is used. Since a role of management is to narrow the gap between business expectations and realizations and this gap exists because of imperfect knowledge, we can explain the nature of returns to managers in terms of their capacity to form correct judgments. Managers learn to improve knowledge and reduce risk at a cost. This cost involves money, time and effort.

From the above discussion and the results of the "Pilot Study," the manager can be regarded as placing a marginal value on additional information and incurring a marginal cost on the cost of acquiring such information. Since the value placed on additional information is subjective and the costs involve something other than money cost, we can replace marginal value with marginal utility and marginal cost with marginal

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[29]G. L. Johnson, "Learning Processes, the Individual Approach," in the Procedings of Research Conference on Risk and Uncertainty in Agriculture, North Dakota Agricultural Experiment Station, Bulletin 400, 1955.

disutility. We can assume the law of diminishing returns applies to learning, because statistical formulas show diminishing returns (in terms of accuracy) to size of sample and general experiences seem to indicate that there are diminishing returns in deductive thinking. In the process of acquiring information, there is the possibility that the cost of information increases at an increasing rate since as more and more learning is acquired it becomes more difficult (in terms of effort, time and money) to get an extra unit of information. It follows then that the cost of acquiring additional information yields an increasing marginal cost (or disutility) curve. The law of diminishing utility yields a diminishing marginal utility curve for knowledge, the product of the learning process. These two curves, marginal utility and marginal cost, can be placed on the same diagram as shown in Figure 1. The value of additional information (MU curve) decreases at an increasing rate and the cost (MC curve) of additional information increases at an increasing rate.

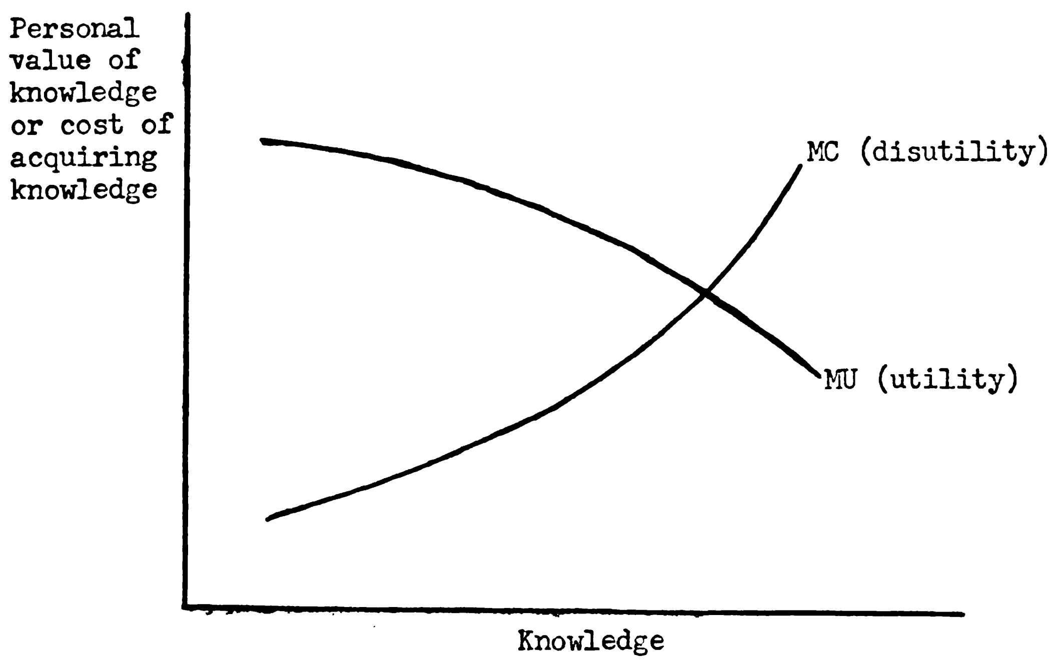

Figure 1. Cost and Value Functions for Knowledge.

The risk action situation is defined to exist where present knowledge, though known to be imperfect, is regarded as adequate for decision and the cost of additional knowledge (or information) equals its value. The risk situation is diagramed in Figure 2.

The learning situation is defined as a case where present knowledge is inadequate for action in the sense that the manager is subjectively unwilling to decide and more knowledge can be acquired at a personal subjective cost lower than its value. Thus, he engages in further learning before deciding. This situation is diagramed in Figure 3. Here the flexibility principle is involved, i.e. the firm delays decision and keeps its business flexible so it can do more learning. It is often possible for a manager to move from this situation to a risk action situation.

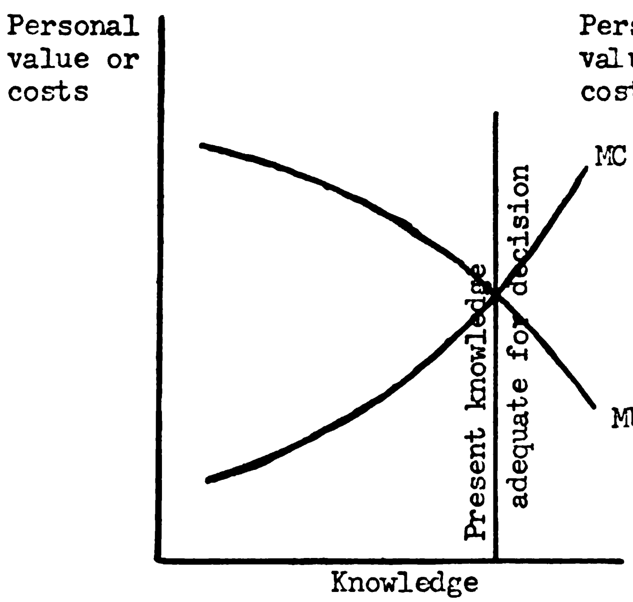

Figure 2. The Risk Action Situation.

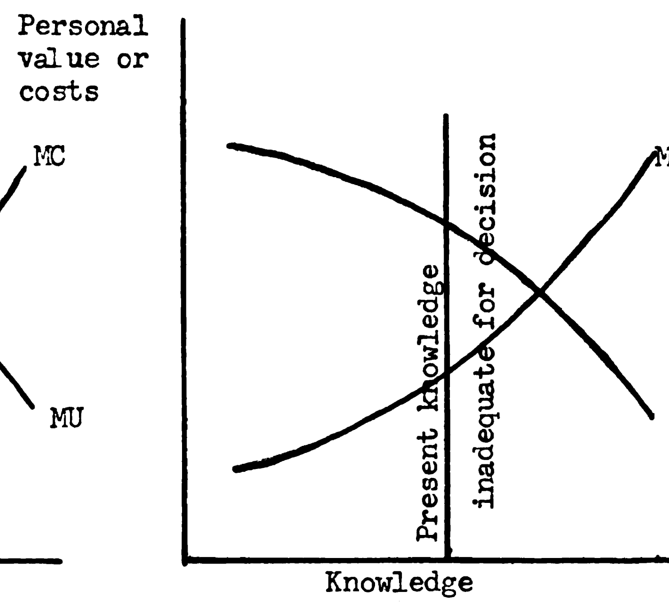

Figure 3. The Learning Situation.

The inaction situation is defined as a case where present knowledge is inadequate for action (which confirms the decision not to take positive action) and the cost of more knowledge exceeds its value -- hence, there is no action and no learning. This situation is diagramed in Figure 4.

The <u>forced action situation</u> is defined as a situation wherein present knowledge is inadequate for action but some outside force makes a decision (positive or negative action) necessary before more learning can take place. Decision and action are forced before the manager is ready, willing and able to act. This situation is diagramed in Figure 5.

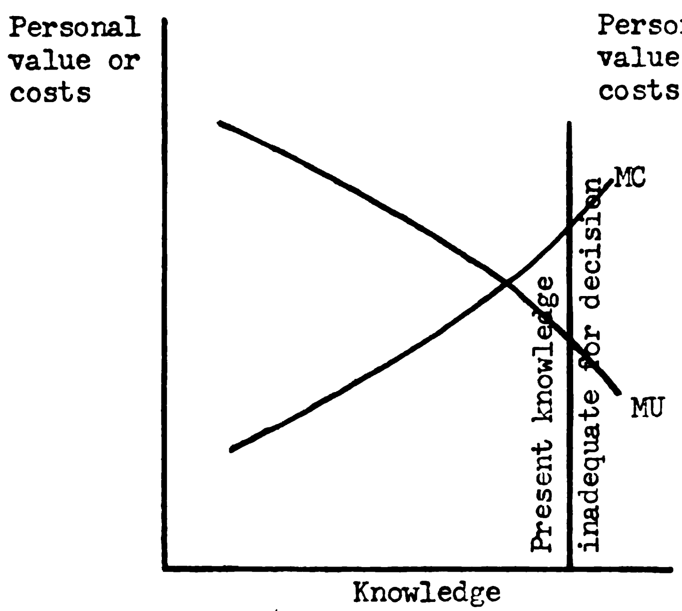

Figure 4. The Inaction Situation.

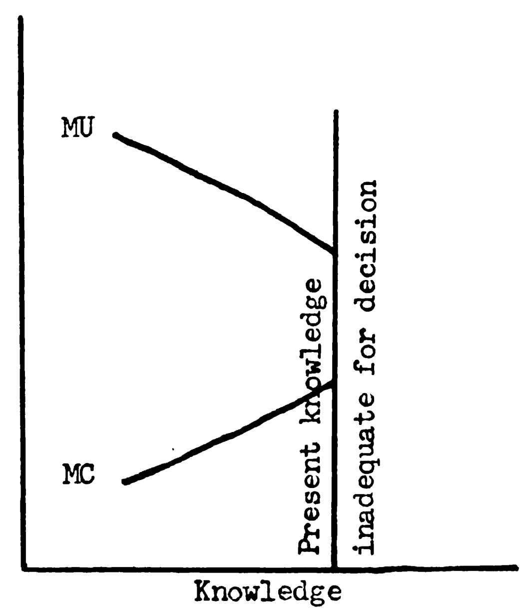

Figure 5. The Forced Action Situation.

The <u>certainty situation</u> is defined as a case where present knowledge is adequate for decision, and the value of additional information is zero. The manager regards it as perfect or so nearly perfect that he can ignore probabilities of errors. No attempt has been made to diagram this knowledge situation.

Because of the importance of negative risk action, it has been separated from positive risk action in this study. Negative risk action and the five situations described above are the ones which have been examined empirically in the IMS.

The Control Variables

In testing the knowledge concepts empirically, certain variables were held constant or controlled. The "control" variables included: (1) education, (2) additional training, (3) past participation in 4-H and FFA, (4) years farming experience, (5) age, (6) average gross income, (7) net worth, (8) total assets, (9) total debts, (10) acres in cropland and rotation pasture, (11) thinking method used in arriving at conclusions, (12) most natural thinking process used by the farmer, and (13) the respondent's attendance at organizational meetings. In setting up the study of the knowledge concepts, these variables were conceived to have certain relationships with the ability of farmers to recognize and give verified examples of the different degrees of knowledge they had encountered in their own experience.

It was hypothesized that farmers with more formal education would be more able to recognize and give verified examples of the different knowledge situations. The breakdown of the farmers by grades of formal education completed was as follows: (1) 1 to 7 grades -- 130 farmers; (2) 8 grades -- 355; (3) 9 to 11 grades -- 197 farmers; (4) 12 grades -- 286; and (5) 13 grades and over -- 102 farmers.

It was hypothesized that farmers with more additional training could more easily recognize and give verified examples of the different knowledge situations. The additional training included such things as (1) G. I. or veteran's training, (2) adult vocational agriculture, short courses or regular meetings, (3) mechanical training relatable to agriculture (e.g., welding, carpentry, engine repairing), and (4) other specified training. Of the 1068 farmers responding to this question (additional training), 827 had had additional training and 241 had not.

Past membership in 4-H and FFA was hypothesized to be positively related to farmers' ability to recognize and give verified examples of the knowledge situations. Of the 1028 farmers responding to this question (membership in 4-H and FFA), 33 had participated in both the 4-H and FFA, 150 had participated in either one or the other, and 845 had not been members of either.

The farmers with more years of farming experience in operating their own farms were believed more able to recognize and give verified examples of the different knowledge situations. Of the 1063 farmers responding to the question concerning years farming experience (1) 315 farmers had 10 years or less, (2) 145 had 11 to 15 years, (3) 265 had 16 to 25 years, (4) 196 had 26 to 35 years, and (5) 146 farmers had 36 or more years farming experience.

It was hypothesized that younger farmers could recognize and give verified examples of the knowledge situations more often than older farmers. The breakdown of the farmers by age groups is as follows: (1) less than 30 years old --71 farmers; (2) 30 to 34.9 years -- 107 farmers; (3) 35 to 44.9 years -- 297; (4) 45 to 54.9 years -- 261; (5) 55 to 64.9 years -- 234; and (6) 65 and over -- 95 farmers.

As either average gross income, net worth, total assets or total debts increase, it was postulated that the farmers would be more able to recognize and give verified examples of the different knowledge situations. Since average gross income is a "fairly" good measure of net worth and total assets, only average (average of the last 3 years) gross income and total debts were tested for relationships.

The ability to recognize and give verified examples of the different knowledge situations was postulated to be positively correlated with acres in cropland and rotation pasture. However, the size of farms varied so widely by state and by type of farming, that it was considered impractical to measure the relationships of this variable to knowledge situations. It would have involved the use of index numbers which was not considered worth-while since income should also reflect this variable.

In arriving at conclusions, farmers use deduction, induction, and a combination of inductive and deductive thought processes.[30] Of the 541 farmers asked which method they used, 61 indicated they used mainly deduction, 127 used mainly induction and 336 indicated that they used both induction and deduction. It was hypothesized that farmers who used mainly the deductive thinking method would be more able to recognize and give verified examples of the abstract knowledge concepts. The same hypothesis was made concerning the natural thinking method of the farmer.

It was hypothesized that farmers attending organizational meetings could recognize and give verified examples of the different knowledge situations more often than farmers who did not attend. The organizational meeting referred to includes attending county agent and extension specialist meetings and non-governmental farm organization meetings. Among the 1075 farmers interviewed, participation was as follows: (1) attendance at both kinds of meetings -- 319 farmers; (2) attendance at only county agent and extension specialist meetings -- 151 farmers; (3) attendance at only non-governmental farm organization meetings -- 192 farmers; and 410 farmers did not attend either. Answers concerning this question were not ascertained from three farmers.

The relationships between these independent variables and the farmers' recognition and verification of knowledge situations are tested and presented in Chapter VII.

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[30]The questions concerning the deductive and inductive thought processes were on only 541 of the 1075 schedules taken.

CHAPTER V

THE RECOGNITION OF KNOWLEDGE SITUATIONS

The general hypothesis concerning the knowledge situations in the IMS can be stated as follows: Farm managers can recognize the five knowledge situations in their own experience. The respondents were asked, for example, "could you please give me some examples of things which you or your family did last year, when you were not completely sure of the outcome, but willing to take the consequences of acting and being wrong?" The farm manager responded in whatever way he saw fit. No choices or examples were given for him to choose from. This type of question was asked concerning each knowledge situation.

The answers or examples given by the respondents were recorded more or less word for word by the interviewer. Afterwards the examples were examined for relevance and consistency. Sometimes situations were confused but more often the respondents gave clear, unconfused examples of each knowledge situation as they had encountered in their own experiences. The answers of the respondents were sorted into the following groups: (1) yes answers (farmers who said that they had been in the situation) supported with verified unconfused examples to verify their having encountered the knowledge situation; (2) those which indicated that the farmer had not encountered the situation; (3) yes answers supported with unverified examples;[31] (4) those which confused one knowledge situation

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[31] A verified example includes what was done and what was involved in doing it. For example, a verified example of the risk action situation would indicate what was done and that there was a risk involved in doing it.

with another; (5) other answers which could not be classified as examples; (6) those giving no examples but indicated that the situation was not confused; and (7) those having no answer. The distribution by answer category is shown in Table 2.

Since it is very difficult to secure data and research information on the different degrees of knowledge held by managers, it is very possible that biases may be introduced. However, in setting up the study much care and effort were taken to minimize these biases by the careful formulation of questions, pretestings and training of interviewers.[32] Also, caution was exercised against biases in analyzing the data. The process of securing such data and information on knowledge situations is one requiring a general knowledge of farming, a very high degree of confidence on the part of the interviewee in the interviewer (as is usually the case in getting unbiased data), a close knowledge of the particular problem on the part of the interviewer and, most of all, a knowledge of the processes of management on the part of the interviewer.

In total there were 1075 farmers interviewed. The breakdown by states in the IMS is given in Table 1, Chapter III.

The number and percentage of farmers recognizing each of the knowledge situations are given in Table 2.

From Table 2, it can be seen that the positive risk action, learning and the certainty situations are the ones for which the most examples were given and which were verified most often while the inaction and positive forced action situations were the ones for which the least examples and verifications were given. It is quite conclusive that all knowledge situations were important but that they varied as to frequency reported.

It is interesting to note that the negative risk action situation was among the ones which were encountered most. However, only 35 percent of

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[32]See page 18 for a detailed description of the interviewer training, etc.

TABLE 2

FARMERS' RESPONSES TO QUESTIONS INVOLVING UNDERSTANDING OF AND ENCOUNTERS WITH DIFFERENT KNOWLEDGE SITUATIONS

Knowledge Situation	Answer Categories								
	Situations encountered and kind of example					No examples of encountering			
	Total	Verified[a]	Unverified	Confused	Other Example	Total	Did Not Encounter	No Examples	No Answer
Positive risk action	891	479	381	7	24	184	83	33	68
Negative risk action	695	245	400	43	7	380	236	10	134
Learning	716	480	202	22	12	359	251	16	92
Inaction	322	170	124	13	15	753	522	32	199
Certainty	729	475	184	11	59	346	224	15	107
Positive forced action	412	161	210	33	8	663	633	12	18
	Percentage Distribution								
Positive risk action	100	53	43	1	3	100	45	18	37
Negative risk action	100	35	58	6	1	100	62	3	35
Learning	100	67	28	3	2	100	70	4	26
Inaction	100	53	39	4	4	100	69	4	27
Certainty	100	65	25	2	8	100	65	4	31
Positive forced action	100	39	51	8	2	100	95	2	3

a/ A verified example indicates what was done and what was involved in doing it. For example, a verified example of the learning situation indicates what decision was postponed and that the farmer was going to learn more about the decision problem.

the farmers claiming to have experienced the situation could give verified examples of having actually encountered it. Also, the negative risk action situation was the one confused most by the farmers. It would appear that the definition is not clear but as shall be evident later, the confusion does not necessarily arise from the definition of the situation.

Confusion of Knowledge Situations

The negative risk action, the positive forced action, and the learning situations were confused more often than the other knowledge situations. These confusions could arise from a number of sources including inadequate explanations on the part of the interviewers, misunderstanding on the part of the interviewee, and poor or inappropriate definitions of the knowledge situation. However, it is held by the writer that these are among the minor causes for the confusion of knowledge situations.

The total confusions and the situations confused are given in Table 3. It is evident that the two situations most frequently confused were usually confused with only two other knowledge situations. The negative risk action was confused most often with the inaction situation, while the positive forced action was confused most often with the positive risk action situation. The possible reasons and explanations for the confusion of knowledge situations will be discussed in Chapter VII.

The Importance of Each Knowledge Situation

Each of the knowledge situations calls for different action and the use of different principles and strategies to combat risk and uncertainty upon the part of the farm manager. The importance of the knowledge situation is related to the type of action associated with it.

In subjective risk situations, the principles of formal and informal insurance can be employed, of course, the amount of insurance needed depends upon the type and seriousness of the risk and the ability of the

TABLE 3

NUMBER FARMERS[a] CONFUSING EACH KNOWLEDGE SITUATION WITH THE OTHER KNOWLEDGE SITUATIONS

Knowledge Situation Confused	Knowledge Situation With Which Confused								
	Positive Risk Action	Negative Risk Action	Learning	Inaction		Certainty		Positive Forced Action	Total
				Vol.	Invol.	Pos.	Neg.		
Positive Risk Action	X	-	2	-	-	4	-	1	7
Negative Risk Action	-	X	9	23	1	-	10	-	43
Learning	-	9	X	7	4	-	2	-	22
Inaction	-	3	7	X	2	-	1	-	13
Certainty	7	-	2	-	-	X	X	2	11
Positive Forced Action	21	-	2	-	2	8	-	X	33
Total	28	12	22	30	9	12	13	3	129

a/ There was a total of 109 farmers who confused knowledge situations. However, one farmer may confuse more than a single situation (which 20 farmers did).

\- Indicates no observations.

X Indicates that situation can not be confused with itself.

manager to sustain losses. Informal insurance includes arrangements, generally within the business, to protect against loss. These include (1) discounting returns; (2) liquidity; (3) education; (4) "excess" horsepower; (5) "excess" feed supply; (6) diversification; (7) maintaining cash reserves and (8) having some unused credit. Formal insurance includes (1) fire insurance, (2) life insurance, and (3) crop insurance.

The learning situation involves the principles of inductive and deductive learning processes. Budgeting, economic principles, continuous function analysis, linear programming, etc. are helpful to farmers in the learning situation. The learning process also requires that the business be flexible or be able to employ the flexibility principle.

For the inaction situation, few principles are applicable. Those which do apply deal mainly with determination of the chances which a manager is willing to run in taking action. Here society can employ services which are helpful to the farmers in making decisions. Anything which can be done to reduce the cost of information or increase the value of information will tend to help the manager make a better decision.

In the inaction situation, farmers can employ strategy principles. The manager may pick the minimax (the best of the worst outcomes) and try to minimize the maximum loss by choosing the appropriate course of action. However, other people may want to strive for the maximax, wherein, the manager wants to maximize the maximum possible. The manager could select actions such as taking out insurance which would minimize the possible losses that might be incurred.

In the subjective certainty situation, the principles of static economics and the principles of budgeting are particularly applicable. In this situation, knowledge is considered so good that the manager can take action

without taking the precaution of protecting himself in case he should be wrong.

Summary

This chapter has been primarily concerned with presenting the gross results from the survey (IMS) on the recognition of the knowledge situations by the farmers and their ability to give verified examples of each situation.

The incomplete answer groups were not investigated in this study, however, they seem to substantiate the general hypothesis, but were not consistent and explicit enough to be classified in the verified group. Also, these incomplete answer groups (unverified examples) provide a basis to determine the knowledge situations which are most difficult to understand (ex poste).

From this chapter the following conclusions are apparent: (1) in general, the ability of farmers to understand the classification of degrees of knowledge has been confirmed, (2) all the knowledge situations are relevant, (3) the learning, risk action and certainty situations are particularly important, (4) the negative risk action situation is the most difficult for farm managers to understand and easiest to confuse, (5) possibly some other knowledge situations need to be defined. The conclusions reached in this study confirm the results, concerning knowledge concepts, of the Kentucky Pilot Study which was conducted by G. L. Johnson in 1951.

This analysis has not taken into account every situation a manager encountered. Since a manager could encounter the same situation many times, the order of importance of the situations can not be given.

Chapter VI

INFORMATION AND CONFUSIONS CONCERNING THE KNOWLEDGE SITUATIONS

The types of information needed by a farm manager in solving his management problems depend, among other things, upon the characteristics of the business which he operates. Thus, the manager may find himself in the position of collecting many types of information simultaneously. In the IMS, types of information are grouped in the following categories: (1) price information, (2) production information, (3) information concerning new developments, (4) human information, (5) institutional information, and (6) information concerning home technology.

In solving a single problem, a manager may find himself drawing on as many as three or four or even all six types of information. Thus, it becomes difficult to call a particular problem a price problem, or a production problem or etc. The IMS has furnished some data on the relevance of these different types of information. These are shown in Table 4.

In Table 4, information concerning production methods was the predominat type of information which farmers indicated they would use in organizing and operating farms for profits. About fifty percent of the time they mentioned production methods (old technology). Another significant feature was that farmers indicated the need for information on new production technology more often when considering the operation of farms for profit than when considering farm organization. When considering operating the farm for family satisfaction, institutional information was the one predominantly mentioned.

Table 4 Number of Times Components[a] of Each of the Six Major Types of Information Were Mentioned by Selected Groups of Midwestern Farmers in 1954

Type of Information	In Connection With					
	Organizing Farms		Operating Farms for Profit		Operating Farms for Family Satisfaction	
	Number	Percent	Number	Percent	Number	Percent
Price	46	1.6	919	26.0	89	5.6
Production Method	1565	53.0	1562	44.1	230	14.4
New Production Technology	4	.1	642	18.1	103	6.4
Human	455	15.4	50	1.4	255	16.0
Institutional	871	29.5	322	9.1	804	50.3
Home Technology	11	.4	45	1.3	117	7.3
Total	2952	100	3540	100	1598	100
Number of Farmers Interviewed	534	---	903	---	903	---

a/ Excludes mentions of the six broad types—only mentions of component category are tabulated. Chi-Square=3269 with 18.3 required at the one percent level.

TABLE 5

Number of Examples Farmers Gave by Type of Information in Each Knowledge Situation

Knowledge Situation	Price	Prod.	New Develop.	Human	Insti- tutional	Home Tech.	No of farmers giving examples
Positive Risk Action	79	749	19	123	116	12	891
Negative Risk Action	52	580	9	116	77	27	695
Learning	90	602	61	88	77	35	716
Inaction	15	256	40	39	54	1	322
Certainty	95	555	8	90	155	11	729
Positive Forced Action	35	318	4	112	81	8	412
			Percentage Distribution				
Positive Risk Action	7	68	2	11	11	1	100
Negative Risk Action	6	67	1	14	9	3	100
Learning	9.5	63	6.5	9	8	4	100
Inaction	4	63	10	10	13	--	100
Certainty	10	61	1	10	17	1	100
Positive Forced Action	6	57	1	20	15	1	100
			Percentage Distribution				
Needed in Connection with:							
Organizing	1.6	53.0	.1	15.4	29.5	.4	100
Operating: For profits	7.0	44.1	18.1	1.4	9.1	1.3	100
Operating: For family	5.6	14.4	6.4	16.0	50.3	7.3	100

Types of Information by Knowledge Situation

The data in Table 5 indicate that production information was mentioned more often than other types of information when farmers were asked to give examples of each knowledge situation. More farmers, however, were able to give examples within the risk action situation, the learning and the certainty knowledge situations than for the other knowledge situations.

When the data on each type of information are broken down by knowledge situations, the picture does not differ from that secured with the gross tabulations. From Table 6 below, farmers gave more examples in the price category when considering the learning and certainty situations than when considering other knowledge situations. More production information examples were mentioned for positive risk action than for any other knowledge situation.

TABLE 6

PERCENTAGES OF FARMERS' EXAMPLES GIVEN BY KNOWLEDGE SITUATIONS WITHIN EACH INFORMATION CATEGORY

Knowledge Situation	Types of Information					
	Price	Prod.	New Develop.	Human	Institution	Home Tech.
Positive risk action	21.5	25.0	14.0	22.0	21.0	13.0
Negative risk action	14.0	19.0	6.0	20.0	13.5	29.0
Learning	25.0	20.0	43.0	15.0	13.5	37.0
Inaction	4.0	8.0	28.0	7.0	10.0	1.0
Certainty	26.0	18.0	6.0	16.0	28.0	12.0
Positive forced action	9.5	10.0	3.0	20.0	14.0	8.0
Total	100.0	100.0	100.0	100.0	100.0	100.0

In the case of new production methods (new developments) more examples were given by farmers illustrating the learning and inaction situations than were given for the other four situations combined. Forty-three percent of the farmers giving examples involving new technology were in the learning situation.

Human information examples occurred more often in giving risk action and positive forced action examples, than in giving examples of the other knowledge situations.

Farmers giving examples for the certainty and the positive risk action situation mentioned institutional information more often than when giving other examples.

Home technology was mentioned more often for the learning situation than for any other knowledge situation.

Confusion of Knowledge Situations by Type of Information Involved

Chapter V discussed the confusion of knowledge situations in a preliminary way. Attention is now directed to types of information involved when confusions occurred. The knowledge situations most frequently confused with other knowledge situations were negative risk action and positive forced action. The negative risk action was confused more often with inaction while positive forced action was confused more often with positive risk action.

The confusions of knowledge situations by type of information are given in Table 7. The negative risk action accounted for 39 percent of the total confusion. As indicated in Table 7, fifty-three percent of all the confusions involved information on new development (new technology). Of the two situations confused most, negative risk action and positive forced action, new development information was involved forty-nine and fifty-three percent of the time, respectively.

TABLE 7

THE CONFUSED EXAMPLES OF KNOWLEDGE SITUATIONS BY TYPE OF INFORMATION INVOLVED

Knowledge Situation Confused	Type of Information Involved						
	Price	Prod.	New Develop.	Human	Institutional	Home Tech.	Not Ascert.
Positive risk action	-	3	7	-	-	-	-
Negative risk action	7	10	34	2	11	5	1
Learning	1	6	16	-	1	2	1
Inaction	2	1	7	1	3	3	-
Certainty	2	1	10	1	1	1	-
Positive forced action	7	-	21	-	7	4	1
	Percentage Distribution						
Confusion by Total:							
Examples given	5.2	.7	67.4	1.0	4.1	16.0	1.7
Examples confused	10.5	11.6	53.0	2.2	12.7	8.3	1.7

The above analysis seems to centralize the confusion problem within new technology (new development). The small percentages of confusions involving other types of information, leads to the conclusion that the main cause of confusion may be found in the definition of new technology rather than in the definition of the knowledge situations. A further discussion of the confusion of knowledge situations, with particular attention to new technology, is presented in Chapter VII.

Summary

Since the schedule only called for respondents to give at least one example of each knowledge situation, we are unable to classify knowledge situations by their relative importance with reference to the ones which farmers encounter most. However, the total number of farmers encountering the different knowledge situations, does give us some idea

of which situations are most common among farmers. (See Table 5) Also, we did not order the decisions which the farmers had to make in terms of their importance. Thus, we cannot say, for example, that the positive risk action and the production information were the most important, but they were the ones indicated by more farmers.

In this chapter we are able to make the following conclusions: (1) all six categories of information used in solving management problems are important,[33] (2) production information was mentioned more often than other types of information when farmers were asked to give examples of each knowledge situation, (3) production information was most important in organizing and operating the farm for profits,[33] (4) institutional information is the predominant type needed when considering operating the farm for family satisfaction,[33] (5) the risk action, learning and certainty situations were the knowledge situations farmers could give more verified examples of by type of information, (6) and new development was the most frequent type of information involved in the confused examples.

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[33]Part of these conclusions were not direct results of this analysis, but have only been further expressed. Conclusions 1, 3 and 4 (above) were given in G.L. Johnson's article, "New Knowledge and Decision Making Processes," presented in the Journal of Farm Economics Vol. 41, (Dec. 1958)

CHAPTER VII

ATTRIBUTES OF FARMERS IN DIFFERENT KNOWLEDGE SITUATIONS, SOURCES OF CONFUSION AND REFORMULATIONS

In this chapter, the characteristics of farmers able to give verified examples of each particular knowledge situation are compared. However, the analysis is not subject to generalization in some instances because the variables involved are interrelated and caution must be exercised in estimating the degree of association with any single variable or characteristic. The variables involved often change in the same or opposite directions, thus, enforcing or off-setting each other. After certain hypotheses and relations are tested, some possible ways of clearing up the tendency of farmers to confuse certain knowledge situations are discussed.

While a general _ex ante_ hypothesis was made concerning the ability of farmers to recognize and give verified examples of the knowledge situations, the majority of the hypothesizing consisted of less important _ex ante_ and _ex poste_ hypotheses. _Ex poste_ hypotheses are those formulated after the data have been collected and inspected in a preliminary way. From such preliminary inspection, certain hypotheses (_ex poste_) are set forth and then tested by much more detailed analyses of the data. The obvious disadvantages of using _ex poste_ hypotheses are: (1) the evidence may not be conclusive and complete since the study was not designed to test such hypotheses and (2) the hypotheses are more or less designed to agree with the data collected instead of the data being collected to test the hypotheses. Offsetting these disadvantages are the following advantages of _ex poste_ hypotheses: (1) they allow for more complete analysis of the evidence, (2) they help make explicit certain indicated relationships, (3) often times, if made and tested, they may save time and money in collecting and analyzing new evidence, (4) they help substantiate other hypotheses made and conclusions reached, and (5) provide explanations for certain relations and indicate possible areas for further research.

Statement of Other Ex Ante and Ex Poste Hypotheses

The characteristics of farmers which were related to degree of knowledge encountered include the following: (1) grade of school completed, (2) farming experience, (3) age of farmer, (4) gross farm income, (5) natural thinking process, (6) organizational associations in which farmers participated, (7) additional training (veteran's training, adult vocation agriculture, etc.), (8) past-membership in 4-H and FFA, (9) total debts, and (10) thinking method used.

A. The ex ante sub-hypotheses[34] concerning the degrees of knowledge are stated as follows: The encountering of the degrees of knowledge and the ability to give verified examples are

(1) positively dependent on the grade of school completed

(2) positively related to years of farming experience

(3) negatively related to the age of the farmer

(4) positively related to gross farm income

(5) related to the natural thought process, i.e. whether it is most natural for the farmer to reason inductively, deductively, or a combination of both

(6) positively related to the number of organizational affiliations

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[34]For a more detailed discussion of these hypotheses see pages 29 to 31 of this thesis.

(7) positively related to the additional training received

(8) positively related to membership in the 4-H and FFA

(9) positively related to total debts

(10) positively related to the thinking method used (in the following order; induction, both, and deduction).

The characteristics of farmers encountering one degree of knowledge are not necessarily the same as those encountering another degree of knowledge.

The chi-square test for independence was employed to test these variables for independence with regard to the ability of farmers to recognize and give verified examples of actually encountering the knowledge situations. The test of the hypotheses under (A) above by each knowledge situation yielded the following list of variables as having dependent (at the 10 percent level) relationships with ability to recognize and give verified examples of actually encountering the indicated knowledge situations (where f stands for the phrase "a function of" and - stands for a relationship with sign other than stated in the hypotheses above):

1. positive risk action = f (education, years farming experience, natural thinking process, association with organizations, total debts, and thinking method used).
2. negative risk action = f (education, age, association with organizations, additional training, total debts, and thinking method used).
3. learning situation = f (education, - years farming experience, age, gross income, association with organizations, additional training, membership in FFA and 4-H, and thinking method used).
4. inaction = f (education and thinking method used).
5. certainty = f (education, years farming experience, gross income,

additional training, membership in FFA and 4-H, and total debts).

6. positive forced action = f (education, years farming experience, gross income, association with organizations, additional training, total debts and thinking method used).

B. The characteristics of those farmers who did not encounter the knowledge situations were essentially the inverse of those who did encounter and give verified examples, i.e. where the relationships above are positive, these would be negative, etc.

C. Ex poste, it was hypothesized that the type of information given under each knowledge situation is independent of education, years farming experience, age, gross income, etc. This hypothesis is derived from a more fundamental proposition that the type of information needed is determined by the problem, not the characteristics of the farmers. Thirty-six chi-square tests for independence were computed in comparing the characteristics of farmers with the type of information given, only one of which yielded a significant difference or dependence (at the 5 percent level). This variable was gross farm income and the knowledge situation involved was negative risk action. However, it is still concluded that the type of information given is independent of the characteristics of farmers under consideration. This is possible because over twenty percent of the components or expected values in the one table (which yielded statistical significance) tested were less than five. Thus, we can conclude that this particular test is unreliable.[35]

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[35] If any of the expected values in the computation is one or over 25 percent of the expected values are less than 5, the chi-square test is unreliable. For further explanation, see W. J. Dixon and K. J. Massey, Jr., Introduction to Statistical Analysis, second edition, McGraw-Hill Co., New York, 1957, p. 222. Also, see pages 106-7 in Statistical Inference by H. M. Walker and J. Lev, Henry Holt and Co., New York, 1953.

D. Ex poste, it was hypothesized that the inability of a farmer to recognize one knowledge situation was independent of his inability to recognize another. Also, it was hypothesized that the ability of a farmer to give a verified example of one knowledge situation was independent of the ability to give a verified example of another situation. The tables for six of the ten independent variables were tested. The summarized results of these tests are given below in Table 8 both for farmers who did not indicate that they had encountered the knowledge situations and for farmers giving verified examples. Twelve chi-square tests were computed for independence, of which, there was not a case of dependence, (at the 5 percent level). Thus, the above hypotheses are accepted as confirmed.

Characteristics of the Farmers Confusing Knowledge Situations

The characteristics of those farmers confusing the negative risk action and the positive forced action, the two most commonly confused situations, have been investigated with respect to the ten independent variables. The results of such investigations are summarized in Table 9.

It can be concluded that the characteristics of farmers who confused a knowledge situation are not practically different from those who gave unconfused verified examples though they are significantly different from a statistical standpoint in the case of age and past membership in 4-H and FFA for the positive forced action knowledge situation.

It must be remembered that it is difficult to attribute cause of a particular incident to any one variable. The age of those farmers confusing the positive forced action knowledge situation were statistically significantly different from those farmers giving unconfused verified examples. The age of a farmer is closely correlated with education and years farming experience; thus the variable may be, in effect, a composite variable

TABLE 8

A COMPARISON OF THE ATTRIBUTES OF FARMERS' ABILITY AND INABILITY TO RECOGNIZE AND GIVE VERIFIED EXAMPLES OF ONE KNOWLEDGE SITUATION AND THAT OF OTHER SITUATIONS

Independent Variables	Degrees of Freedom	Farmers Indicating That They Did Not Recognize	Farmers Recognizing and Giving Verified Examples	
		Computed X^2 Value	Computed X^2 Value	X^2 Required to be Significant at 5 Percent Level
Education	20	17.5	18.2	31.41
Farming Experience	25	30.9	27.2	37.65
Age	25	16.9	18.6	37.65
Income	15	16.4	12.9	25.00
Thinking Method	10	6.0	5.9	18.31
Organizational Meetings	15	24.2	16.2	25.00

TABLE 9

A COMPARISON OF THE CHARACTERISTICS OF THE FARMERS CONFUSING KNOWLEDGE SITUATION WITH THOSE WHO GAVE UNCONFUSED VERIFIED EXAMPLES

Characteristic or Variable	Degrees of Freedom	Negative Risk Action Computed X^2 Value	Positive Forced Action Computed X^2 Value	Required[a] X^2 Value
Education	4	6.69	1.10	9.49
Farming Experience	5	2.94	6.18	11.07
Age	5	1.95	11.16*	11.07
Income	3	1.10	.44	7.81
Natural Thinking Method	2	3.00	1.86	5.99
Organ. Participation	3	5.58	3.61	7.81
Additional Training	1	.36	.78	3.84
Membership in 4-H and FFA	2	2.60	6.05*	5.99
Total debts	4	4.80	3.99	9.49
Thinking Method Used	2	2.04	2.39	5.99

a/At the 5 percent level of significance

* These variables were statistically significant

measuring the effects of several variables which, when taken together, are statistically significant. As the observations were so few that twenty-five percent of expected the values were less than five,[36] regrouping was carried out. The resultant test revealed significance. It is concluded that age is probably a composite variable and the significance is of little practical importance (as mentioned above).

Some explanations of the confusion of knowledge situations are discussed below.

Possible Explanations and Means of Eliminating Confusion of Knowledge Situations

The knowledge situations confused most often were the negative risk action and the positive forced action situations. The negative risk action was confused with the inaction, negative certainty, and the learning situations, while the positive forced action was confused primarily with the positive risk action and the positive certainty situations. In all cases of confusion, the new development information was the dominant type involved.

Having ascertained the two major knowledge situations confused (accounting for 61 percent of all confusion) and the type of information involved, new development (accounting for 53 percent of the information which was involved in all confused examples), two lines of investigation were open. One would concentrate on definitions of the knowledge situations while the other would concentrate on the definition of new technology. A third, but less promising, approach involved making a more clear-cut distinction between game theoretic and the probabilistic approaches to decision making.

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[36]Dixon and Massey, op. cit. page 222.

The Definitions of the Knowledge Situations Involved

The negative risk action is defined as a situation wherein a manager decides not to take positive action even though he runs a risk of being wrong in not acting, i.e. he is willing to take the consequences of being wrong, by not acting. The manager regards present knowledge as adequate for decision and the cost of more knowledge equals its value, both in personal subjective terms. Thus, a decision is made to take negative action and the voluntary learning process is dis-continued. The knowledge situations with which it was confused most often were the inaction, negative certainty, and the learning situations. In all these cases no positive action is involved in carrying out the decision.

Since the manager was questioned ex poste, it was probably easy to confuse the negative risk action situation with other negative actions (or no decision to act). The reasons for this indication are: (1) from the time the farmer made the decision (not to act) until he was interviewed other information could have been acquired that made what was originally considered a negative risk action a negative certainty situation by "hind sight" or (2) by "hind sight," the information which was considered adequate for a negative risk action decision could appear inadequate for such a decision at the time of interview or (3) with the passage of time, other information could have been involuntarily collected which converted the risk action situation into a learning situation.

Ex ante, the negative risk action situation does not seem confusing; (695 farmers said they understood it when explained to them) however, ex poste it does. It is concluded that the definition is fairly accurate and that the confusions arose primarily from (1) the ex poste nature of the question or (2) the definition of the type of information involved.

The positive forced action situation has been defined as a situation wherein the manager is forced by outside circumstances to make a decision when he feels the information he has is inadequate (in terms of what he feels is required to be ready, willing and able to act) and in which he may or may not be willing to spend more time, money and effort for information. The knowledge situations, with which it was often confused, were positive risk action and positive certainty. All three of the situations confused called for a decision followed by a positive action. Since subjective accuracy is involved in either case, the manager at the time the decision was made could have felt that the information he had was accurate enough to take a positive risk action or a certainty action only to find after the decision was made and the action taken, that what materialized fell short of his expectation. Managers referring to such examples in the survey, may have rationalized their decision, i.e. they could have ratioalized that they were forced to act in order to avoid confessing that an earlier risk action and/or certainty decision was incorrect.

Because many farmers (see Table 2) could recognize and give verified examples of the two most often confused knowledge situations, it is concluded (1) that the definitions of the knowledge situations are fairly adequate and (2) that farmers can understand the knowledge concepts but when recalling a decision made earlier the various negative decisions are difficult for them to understand. To help clear up this difficulty another knowledge situation--involuntary learning--is added to the existing list of knowledge concepts. Also, it is concluded that the principal source of confusion of knowledge situations arises from the inadequate definition of new developments (new technology).

The Definition of a New Knowledge Situation

The new knowledge situation, involuntary learning, is defined as a situation where the manager is subjectively unwilling to learn more since the cost of additional information equals or exceeds its value to him but, in which, some outside force makes it necessary to learn or for some learning to occur regardless of the will of the manager.

This new knowledge situation should explain why farmers who gave examples of the inaction and the negative risk action situations confused them with the learning situation from an ex poste position. Also, the new situation serves as a means for moving a farmer from an inaction situation to a learning situation.

The Definition of a New Development (New Technology)

A new development was defined vaguely in the IMS as one which did not exist before (to the knowledge of the farmer). A new development becomes an old development after it has been known or introduced to a farmer or a farming area.

The definition of new development (new technology) used in IMS worked quite well, even though vague with respect to degree of awareness, until the degrees of knowledge were investigated. The importance of new development information was evident by the number of farmers indicating that they needed this type of information in organizing and operating their farms for profits.[37]

Some of the information on new developments or changes in farm practices and items used in production involved the following examples: (1) supplemental irrigation, (2) antibiotics, (3) anhydrous ammonia, (4) chemical weed killers, (5) meat-type hogs, (6) new feed supplements, (7) self

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[37] G. L. Johnson, "New Knowledge and Decision Making Processes," Journal of Farm Economics, Vol. 41 (December 1958).

feeding silos and (8) krilium. These were considered as new developments to the farmers interviewed at the time the survey was conducted, in 1954. Some of these inputs or items may have been known to farmers within a particular area, but a particular farmer may have known nothing at all about the items. It is possible for certain farmers to be using an input which has not been made known to certain other farmers within the same geographic area. This could happen because of the inadequate sources of information available to farmers, inability for farmers to learn of a new idea or input, poor communication and transportation, etc. Therefore, within a given area the knowledge among farmers with respect to a recent development may vary from none to complete, i.e., farmers within a given area are very likely to hold varying degrees of knowledge about a given input or technology. Thus, within one given area a single technology may be unknown, new and/or old.

If we refer to a new development as a newly discovered input and until its existence is known to farmers, then it becomes necessary to distinguish between the degree of awareness required for a new and for an old technology.

If we say, for example, that a farmer read about a new development in a magazine or saw a picture of it, does this mean that it becomes an old development (an old technology)? Not necessarily so, because such information may not be enough for the farmer to understand what it is. This is not to say that he must know enough about the new development to make use of it. It is merely stressing the point that just a small bit of information is not enough for the new technology to become old. This small amount of information contrasts with the amount of information required for the farmer to construct a probability distribution of the outcomes of a decision made concerning a particular new input. Understanding involves knowing the meaning and the implications of a thing. The ideas just mentioned seem to lead to a consideration of the degrees of knowledge involved.

Willard Cochrane[38] has indirectly referred to the degree of knowledge which a farmer must have about a new technology before it becomes old. He views the adoption of a known technology by farmers as being a technological advance whereas Johnson would say, for the most part, that this would be an economic adjustment. Also, K. Bachman of U.S.D.A., while in a seminar at Washington, D. C. approached Johnson with a question which involved how much a farmer must know about a new technology before it becomes old. These comments seem to call for further development of the new technology definition.

A farmer may hear over the radio or read in a paper about a new development. For the time being, he may "shove the information aside in his mind" but within a while he may come in contact with the same development through conversation or observation. This time he gives it more thought. He may even go see the new development or he could even try it (a trial sample).[39] The input may appear profitable or non-profitable for his business. But, if the input is applicable for his type of operation, the farmer is faced with making a decision. The farmer will make one of the following decisions (with reference to the input): (1) decide to acquire,

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[38] W. W. Cochrane, "Some Additional Views of Demand and Supply," in Agricultural Adjustment Problems in a Growing Economy, Iowa State College Press, Ames, Iowa 1958.

[39] This is consistant with Beal and Bohlen's adoption process up until the farmer makes the decision to adopt, but here we are concerned with both positive and negative decisions toward adopting a new technology. For their decription of the adoption process see Beal and Bohlen, How Farm People Accept New Ideas, Special Report No. 15, Agricultural Extension Service, Iowa State College, Ames, Iowa (November, 1955).

(2) decide not to acquire, (3) "wait and see" or learn more, or (4) he may decide the input is of no further interest to him.

When the farmer had just heard of the new development, and "pushed it aside in his mind," it would be difficult to say the new development was known to him. The knowledge situation was voluntary inaction for a short time. But the next time he came in contact with the new development, he began experiencing the learning situation (involuntary). When the farmer spent time, effort and/or money to go see the input or tried it, he began encountering the learning situation (voluntary). This situation would be involved until he made a decision. The decision made for the instance involved, would be determined by the information present. At this point his knowledge of the development was adequate for a positive or negative risk action. If the manager chooses either of the two actions, he is taking a risk action. There is another situation where a given technology can remain new. If the farmer encounters the negative forced action situation, the technology can still remain a new technology to the farmer. When the farm manager reaches this position (where he automatically or voluntarily decides), the new development becomes an old development (old technology) to that particular farmer. This does not say that the new technology becomes an old technology to farmers who have not gone through a similar process. Once a farmer has reached the position where he makes a positive or negative risk action decision, the technology becomes old to him. If later the input (development) is adopted by the farmer, it is an economic adjustment and not a technological advance.

The advantages of defining new technology in terms of the degrees of knowledge, as given above, are: (1) it covers situations where farmers learn involuntarily about a technology; (2) it continues to distinguish between technological advance and economic adjustments; (3) it would prevent a farmer from being in the learning situation or inaction situation for an indefinite time, provided the technology was applicable for his business; and (4) the subjectivity of the situation implies that effect of the objective economic conditions surrounding the situation is subjectively determined. Thus, the economic conditions may not be reflected in the market place.

There are many factors which could influence the conversion of a new technology to an old technology. These include the demand for the inputs involved and the product produced, whether it is an instrumental technology or not, the social and economic forces involved, the size and complicatedness of the technology, and the seasonality of the production process involved. Communicability will influence the required time.

If the new definition of new technology had been followed, much of the confusion of the knowledge situations would have been eliminated.

The Distinction Between Alternative Approaches to Decision Making Under Uncertainty

A manager involved in a decision problem under uncertainty can be conceived to be facing sets of events, alternative actions, strategies (ways of reacting to events), and consequences of the actions taken and the events surrounding the decision. There is at least one other part to a decision problem. This part is a means of ordering the consequences. Hildreth[40] defines the concepts event, action, consequence and strategy as follows: (1) event - the observations or evidence involved in a decision such as prices, weather phenomena, etc.; (2) action - is the positive behavior of the managers, such as, signing a SCS contract, selecting a certain input combination or selling 1,000 bushels of corn from storage; (3) consequence - is a meaningful result of actions and

[40] Hildreth, Clifford, "Problems of Uncertainty in Farm Planning," Journal of Farm Economics, Vol. 39, 1957.

events, such as, net revenue realized from a choice of inputs and the actual weather; and (4) a strategy is a way in which the manager reacts to the events in his environment.

There are two theories or approaches to decision making under conditions of uncertainty. The parts of a decision problem (mentioned above) are common to both approaches. These approaches are the probabilistic and the game theoretic (which are discussed below). Although we classify them as two approaches, there are probabilities involved within both approaches. In the probabilistic approach, the decision maker tries to maximize the average or expected gain,[41] whereas, in the game theoretic approach, he may minimize the maximum loss which can occur (i.e. choosing the action with the smallest possibility of being wrong), maximize the maximum gain or employ some other strategy.

The Probabilistic Approach - Under the probabilistic approach to decision making, the decision maker acts as though he has a subjective probability distribution defined over the set of possible events (prices, weather phenomena, etc.) The probability distribution may be either computed or assumed from the manager's own evaluation. He has a consequence assigned to each combination of action and event. Any strategy will involve a probability distribution of consequences. The strategy which maximizes expected utility is optimal.

This approach has been the one primarily used in the IMS. Probability distributions were involved in both of the subjective risk action situations and the subjective certainty situations. In the learning situation, a probability distribution is partially present or is being constructed as more information is acquired. The other subjective risk situations could involve probability distributions. If so, the manager's knowledge of the

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[41]Some persons would consider this a strategy of the game theoretic approach.

probability distribution is inadequate for a decision.

The Game Theoretic Approach[42] - The game theoretic approach is characterized by the supposition that while certain events can be recognized as possible, probabilities and probability distributions cannot always be applied to describe meaningfully these events. This is not to say that probabilities and probability distribution are not involved. The events are randomized and unpredictable, i.e. they do not necessarily follow a given pattern or behave rationally (if individuals are involved). In such models, the decision maker chooses a strategy (a way of reacting) which is associated with the possible consequences. To each set of consequences, the decision maker assigns a subjective value (utility), such that, he is able to decide which outcome is preferable. He may employ both a single strategy or a mixed strategy depending upon which will be optimal.

The strategy may be viewed as a set of rules stating how to act in a variety of circumstances. If the decision maker violates the rules of the game, he will lose to his opponent or fail to reach the optima.

The development of the statistical decision function by Wald[43] is closely related to the game theoretic approach. The circumstances of the decision may make it essential that the strategy chosen minimizes the the maximum loss. The formulation of the statistical decision function has provided a basis for choosing the appropriate strategy and defining loss. The loss involved is defined as the difference between the

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[42]Hildreth, Clifford, op. cit.; Earl R. Swanson, "A suggested Application of Game Theory to a Decision Problem in Agriculture" and "Selection of Crop Varieties: An Illustration of Game Theoretic Techniques" mimeographed releases from Dept. of Agricultural Economics, University of Illinois; John von Neumann and Oskar Morgenstern, Theory of Games and Economic Behavior (second edition), Princeton University Press, Princeton, 1947; Earl O. Heady, "Application of Game Theory in Agricultural Economics," Canadian Journal of Agricultural Economics, 1958, page 1ff; for other references to the game theoretic approach see the bibliography on page 77.

[43]Wald, op. cit. pages 8-12.

subjective value of the realized consequences of the strategy chosen (and the events) and that value which could have been realized if the outcome (and the events involved) had been correctly predicted.[44]

As was discussed earlier (pages 55-56) the inaction situation and the positive forced action situation did not involve positive voluntary action on the part of the manager. Thus, it was indicated the manager could employ a strategy, called minimax. Also the learning situation is subject to the use of strategic operations. The manager may employ certain strategies to obtain additional information or he may use it as a "bluff." It is possible to use a strategy with any of the knowledge situations.

There are two types of strategies which the manager may have the occasion to use. These are impersonal and personal strategies. The impersonal strategy is defined as a course of action against the nature or an opponent which cannot respond to the actions of the player. The personal strategy is defined as a course of action against an opponent who can react (thus you would choose a minimax for yourself and a maximin for him).

At times, the individual may feel forced to employ a strategy because he desires more information or wants to make a better decision. The decision made to employ such a strategy could be considered a positive forced action situation, a learning situation or possibly a positive risk action situation. It could be considered a forced action situation because the manager thought he had to do this act before he was "ready, willing and able." When looked at from the standpoint of a means to get more information, it would be called a learning situation. Also, when the manager made the decision it could have been made on the basis of positive risk action but <u>ex poste</u> the manager could indicate another person employed a strategy and forced him to act.

These ideas have not been tested in the analysis and only serve as

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[44]This strategy and definition of loss is similar to the minimax

indicators. These particular attempts (concerning game theoretic approach) to explain the confusion of knowledge are quite incomplete since the evidence was not conclusive nor was the basis completely sound. It may be concluded that possibly confusions in knowledge situations arise because of impersonal and personal strategies and counter-strategies, since the manager may be forced to learn or feel he is forced to act. But this source of confusion is believed to be only minor as compared to the inadequately defined new development type information.

Summary

From the analysis in this chapter, the following conclusions are made: (1) in general, the recognition and the ability to give verified examples of knowledge situations are related to the ten independent variables; (2) the characteristics of farmers who failed to recognize and give verified examples of knowledge situations are essentially the inverse of those who could; (3) types of information given under each knowledge situation are independent of such variables as education, age, etc.; (4) the failure to recognize one knowledge situation is independent of the failure to recognize another knowledge situation; (5) the ability of a farmer to give a verified example of one knowledge situation is independent of his ability to give verified examples of another; (6) the characteristics of farmers confusing a knowledge situation are not significantly different from those who give verified unconfused examples of that knowledge situation; (7) the definitions of the knowledge situations are fairly adequate; (8) the definition of new development employed in the IMS was not clear; (9) the definition of new development employed in the IMS led to the major confusion of knowledge situations; (10) the use of impersonal and personal strategies may lead to some confusion of the knowledge situations; (11) a new knowledge situation--involuntary learning--has been added to the knowledge concepts. Involuntary learning can be defined as a situation wherein the manager does not voluntarily learn more since the costs of additional information equals or exceeds its value to him but, in which, some outside force makes it necessary to learn or for some learning to occur regardless of the will of the manager; and (12) a new development or new technology has been redefined to include the degree of knowledge involved to convert a new to an old technology. The new definition is as follows: a technology will be considered "new" to an individual farmer until he makes either a positive or negative risk action decision concerning the input after which the input is an old technology to him.

Chapter VIII

SUMMARY, CONCLUSIONS AND IMPLICATIONS

This chapter will present a general review of the study, the conclusions reached and the general implications of such conclusions. Implications for further research, farm management teaching, extension work, farm managers and policy formulation will be presented.

Summary

This is an integral part of an empirical investigation of decision-making concepts and principles in farm management known as the Inter-state Managerial Study. It was believed that the land-grant system, particularly farm management researchers and both resident and extension teaching of management, have long neglected the process of management. The situations which managers find themselves in with respect to (1) knowledge and (2) the cost of acquiring and value of knowledge were believed to be one of the phases of management most seriously negelected. The general ex ante hypothesis of this study was: Farmers encounter and can recognize the states of knowledge in their own experiences. Other ex ante hypotheses involved were: (1) the ability of farmers to recognize and give verified examples of the knowledge situations is related to the 10 characteristics of farmers considered in this study, and (2) the characteristics of the farmers who could not recognize and give verified examples of the knowledge situation would be the inverse of those who could. Ex poste hypotheses were that: (1) the types of information given when discussing examples of the knowledge situations are independent of 10 characteristics of farmers; (2) the ability of a farmer to recognize one knowledge situation is independent of his ability to recognize another; (3) the ability of a farmer to give a verified example of one knowledge situation is independent of his ability to give a verified example of another situation; and (4) the characteristics of farmers confusing knowledge situations are not significantly different from those who gave verified unconfused examples.

In chapter II, the theoretical setting and background for the states of knowledge were given. In that chapter the nature of knowledge and the role of learning in the managerial process were discussed. The management function was defined to exist because of imperfect knowledge. This chapter presented Knight's classification of degrees of knowledge - certainty, risk, and uncertainty. The contributions of Hart, Wald, and Schultz were reviewed along with the development of the knowledge situations as they were presented by Johnson in his Ph.D. dissertation. These knowledge situations were (1) certainty, (2) risk, (3) uncertainty, and (4) non-certainty. Also, the knowledge situations, as they were classisied by Johnson from his collaborations with Haver and Bradford, were presented in Chapter II. The source of data and a description of the IMS were presented in Chapter III.

In Chapter IV, a report of a pilot study and the knowledge situations were presented. The knowledge situations were also described as they have been studied in the IMS. The knowledge situations as classified in this study were given as follows: (1) subjective certainty and (2) subjective uncertainty which was subdivided into (a) positive risk action, (b) negative risk action, (c) learning situation, (d) inaction and (e) positive forced action.

In Chapter V, the general hypothesis was tested by the use of the data collected on knowledge situations in the IMS. In the IMS survey, the knowledge situations were explained to the farmer as follows (for example): "Could you please give me some examples of things which you or your family did last year, when you were not completely sure of the outcome, but willing to take the consequence of acting and being wrong?" The situation just described is the positive risk action.

The next step of the analysis involved investigation of the types of information used by farm managers to solve management problems. These types of information (price, production, new developments, human, institutional and home technology) used were then related to the knowledge situations and the data on the extent to which farmers confused the knowledge situations. This part of the analysis is presented in Chapter VI. The procedure followed was to tabulate the type of information involved in the examples given, develop percentage distributions (by knowledge situations) and compute chi-squares. This demonstrated which types of information were important to farmers and which types of information were involved in the different knowledge situations.

The next step in the analysis attempted to establish the relationships between the ten independent variables (these were treated as independent, however, many of them may be interrelated) and the recognition and verification of knowledge situations.

Chapter VII presents tests of the relationships between the ability of farmers to recognize and give verified examples of the knowledge situations and the ten characteristics of farmers. The variables are (1) education, (2) years of farming experience, (3) age, (4) gross farm income, (5) natural thinking process (induction, deduction or a combination of both), (6) organizational associations in which farmers participated, (7) additional training (veteran's training, adult vocation agriculture, etc.), (8) past membership in 4-H and FFA, (9) total debts, and (10) thinking method used (induction, deduction or both). The method used to test the *ex ante* hypotheses concerning these variables was the chi-square test for independence.

This study, summarized above leads to the following conclusions concerning the degrees of knowledge which managers possessed in the decision making process.

The General Conclusions

Some of the conclusions reached in the analysis are general while combinations of others lead to general conclusions. The general conclusions are listed and summarized as follows:

1. All of the knowledge situations are relevant in studying farm manager thinking. Also, the definitions and formulations of the different degrees of knowledge appear fairly adequate. However, the negative risk action, and the positive forced action appear difficult to understand *ex poste*. Also, it seems appropriate to distinguish between *voluntary* and *involuntary* learning. Thus, a new knowledge situation -- *involuntary learning* -- has been added to the existing list of knowledge situations. The new knowledge situation -- *involuntary learning* -- can be defined as a situation wherein a manager is unwilling to learn more since the subjective costs of additional information equals or exceeds its value to him but, in which, some outside circumstances (or force) make it necessary to learn or for some learning to occur regardless of the will of the manager.

2. The learning, positive risk action and the subjective certainty situations are easily understood and/or commonly encountered by the farmers.

3. All six types of information used in problem solving by managers are important. Information on production methods was mentioned most often. This type of information is particularily important with regards to organizing and operating the farm for profits.

4. The definition of the new development (new technology) type of

information is inadequate, i.e. the degree of awareness, on the part of a farmer, which converts a new to an old technology is not specified. This conclusion was reached since 95 out of the 141 examples of knowledge situations given which involved new developments were confused with other knowledge situations. Also, of the 180 confusions of knowledge situations 53 percent involved new developments.

A revised definition is proposed for new technology which involves the degree of knowledge held with respect to the new input. This definition can be stated as follows: a development remains "new" until such time that the farmer takes either a <u>negative</u> or <u>positive risk action</u> toward acquisition or adoption. This is to say, after the farm manager has once experienced either the <u>positive</u> or <u>negative risk action</u> knowledge situations he may go from one knowledge situation to another but the input remains an old technology to him.

5. The confusion of knowledge situations is not attributed to inadequate definitions of the degrees of knowledge but primarily to the definition (as followed in IMS) of the new development (new technology) type information involved.

6. The farmer's ability to recognize and give verified examples of the different knowledge situations is related to the ten variables such as, age, farming experience, etc. In general, farmers' ability to understand and give verified examples of the knowledge situations increases with; (a) higher education, (b) increases in the use of deductive reasoning, (c) increases in the number of agricultural meetings attended, (d) higher farm incomes, (e) increases in debts and (f) increases in years of farming experience.

Some Possible Implications

At the onset of the Interstate Managerial Study, a part of the problem statement was given as follows: the land-grant system, particularily farm management researchers and both resident and extension teachers of farm management, probably neglects the process of management. The knowledge situations which farmers encounter were believed to be a part which was neglected. The conclusions reached in this study have implications for farm management researchers, farm management teaching, extension workers, farmers and the development of agricultural policy.

Implications for Farm Management Research

The importance of the learning process and the large numbers of farmers experiencing the learning situation seem to indicate that future research on farm management should investigate possible means of improving the decision making skill of managers. More attention should probably be given to the characteristics surrounding the knowledge situations and the actions called for in each situation. If learning leads to more accurate decisions and less economic waste, then the different learning techniques should probably be studied to find possible means of reducing the cost of learning so that more accurate decisions can be made and less economic waste will result. Also, researchers should probably investigate the path of transition from one knowledge situation to another. This could furnish a basis for more profitable and efficient results from extension workers in understanding farmers' problem situations and in recommending solutions.

The large number of confusions of knowledge situations in the new development type information indicates that further use of the definition of new technology advanced herein may be advisable. This would facilitate the determination of which knowledge situation the farmers are in with

respect to new technologies.

Implications for Farm Management Teaching

The implications of the concepts of knowledge and the above conclusions for farm management teaching are very similar to those indicated for researchers. The role of learning in the management process should be clearly depicted and explained to students. It should be stressed that the learning process is an integral part of a series of tasks which the manager must perform. The s tudents need to understand the full meaning of the types of errors (type I and II) which managers are subject to making and the consequences involved with each error. Also, the conclusion seems to indicate that the student should be made aware of the characteristics of the farm managers who encounter each of the knowledge situations. If the student becomes familiar with the behavior of farmers in a particular knowledge situation, he will be better able to determine the degree of knowledge involved and what measures should be taken. The importance of strategies and their applications should be presented in farm management teaching, since this may be the only means available to farmers in certain knowledge situations. Further, the value and cost of learning should be stressed, i.e. the s tudent needs to understand and determine the importance of information, the cost of acquiring information, and the flexibility required for learning.

Implications for Extension Workers

The above conclusions indicate certain implications for agricultural extension workers. Apparently the extension s ervice has been successful in furnishing farmers with information on old production methods but farmers were unable to get adequate information on new production methods from this source.[45]

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[45]G. L. Johnson, "New Knowledge and Decision Making Processes," Journal of Farm Economics, Vol. 41 (December 1958).

This s tudy indicates extension workers could help farmers understand new methods and improve their learning techniques concerning such information. The farmers giving examples of technology (both production and home) were predominately in the learning situation. This implies that extension workers could help farmers by adopting teaching techniques which reduce the cost of learning and improve the farmers' skill in learning. Also, the study indicates t hat extension workers could offer more help to f armers, if they ascertained what knowledge situation the farmer was in and adapt their extension help to the knowledge situation.

If the improvement of knowledge for the farmer comes through his learning processes, there is reason to believe that the farmer can become a better manager by viewing his problems in a knowledge situational model. This is especially true if we assume that inefficiency and economic wastes resulting from mismanagement come about because of t he gap between expectations and realizations.

If we accept the knowledge situational model as being a desired method to view managers' problems, then this s tudy leads to certain implications for Test Demonstration, Farm and Home Development, and 4-H Club work.

There are ways to move managers from inaction to another situation (possibly learning or risk) by both legitimate and illegitimate means. The legitimate means would include reducing the cost of information or increasing the value of information. The illegitimate would include such things as falsifying the value or falsifying the cost. These means could be carried out by the above mentioned organizations (if so desired). Also, involuntary learning can be used to move farmers from an inaction situation to a learning situation. This type of learning can be employed so long as the ends or r esults more than "justify" the means.

Implications for Farm Managers

The degrees of knowledge and the results of this study have some implications for farm managers. The managerial process involves the use of observations, economic and other analyses, and decision making which are necessary tasks for management. Of these, learning becomes important in all. Thus, farmers must become skilled in this task in order to improve their function as managers.

The managers could make use of the knowledge situational framework not only to improve their decisions, but they could make more efficient use of time, effort, and money expended for information. It could form a systematic way whereby farmers can attack their management problems. It could allow some farmers to rely more upon their ability rather than being a follower of others and/or late adopters of superior technologies.

Implications for Agricultural Policy Formulation

The concepts, the conclusions above and the results of this study seem to have certain implications for agriculture policy formulation, but these are not as explicit as the others. If farmers are in the inaction knowledge situation with respect to a certain event, then for any policy to stimulate these farmers there must be some means of increasing the value of extra information or reducing the cost of acquiring needed information for decision. For a policy to be most effective, the general characteristics of the farmers must be studied in order to determine the predominant degrees of knowledge held by farmers in this particular area of interest. There is another indication that types of information needed by farmers would help determine what a program, to aid farmers in making decision in the face of risk and uncertainty, should include for greater applicability and accomplishments.

The distinction made between technological and economic adjustments made possible by the revised definition of new technology, herein presented, should help to determine the source of the agricultural problems, i.e. whether it is an economic or a technological source.

APPENDIX

Questions Used in I.M.S. Concerning Knowledge Situations

44. Could you please give me some examples of things which you or your family did last year, when you were not completely sure of the outcome, but willing to take the consequences of acting and being wrong?

____

____

45. Now we'd like examples of things which you or your family decided not to do last year even though you ran a risk of being wrong in not acting. We want cases in which you were willing to take the consequences of being wrong and not cases where you postponed decisions until you could learn more.

____

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46. Please give me some examples of situations during the last year in which you postponed a decision to act or not to act until you could learn more.

____

____

47. Please give me some examples of situations that occurred last year in which you did not have enough information for taking action and in which you felt that what you could learn would not be worth the cost and effort of learning it.

____

____

48. Now I'd like you to give me some examples of situations occurring last year in which you were certain of the outcome, that is, situations in which you could act without worrying about being wrong.

____

____

49. Were there any occasions last year when circumstances forced you to make decisions and act without information you would have been willing to spend time and effort to get--if you had not been forced to act?

_____ No
_____ Yes   Could you please tell me what they were? ____________

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HUMANITIES I