



Management characteristics of interdisciplinary research : a case study of the Gallatin Canyon study  
by Henry Folke Shovic

A thesis submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of  
MASTER OF SCIENCE in Industrial and Management Engineering  
Montana State University  
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**Abstract:**

Traditionally, university research has been theory oriented, Problem solutions, or the applying of the results of theory to real world situations, have not been part of the university's tasks. With the growing complexity and immediacy of problems facing society though, the university has become more and more involved in this form of activity. This necessitates an Interdisciplinary outlook, as problems rarely fit neatly into disciplinary bounds.

At Montana State University a study is in progress to evaluate the environmental impacts of a recreation development in a formerly primitive area. This is a large project, with many specialties represented. Since this is a new form of research, the author undertook the study of investigating the emerging structure of project management, via a problem identification method. The technique used was an interview/ questionnaire one, used to identify problems perceived by the project members and problems made evident through the author's analysis of independent data. The questionnaire was orally administered to the twenty-eight members or related personnel affiliated with the project at the time. This was assumed to comprise the total population under investigation, eliminating sampling error.

Preceding the analysis, chi square tests were performed to detect inconsistencies in response. The technique of parallel collection was also used to reduce the chance of any one source being excessively overemphasized in the conclusions reached. Analysis was done in three areas., each attempting to identify problems from a different viewpoint.

Conclusions reached were that the problems found to exist were in the organization of the project operation and in the funding agency. The project was organized in a very broad, democratic fashion with all investigators reporting to the entire group. This did not, in this case, provide enough concrete direction for the operation of this type of research. The funding agency was the source of some confusion to the study members, as project goals were changed during the course of the operation, and funding levels were reduced well below optimum amounts.

Recommendations were of two types. The first was a suggested management system change to effectively break up the larger group into smaller "task oriented" groups that could function more efficiently in the time remaining to the study. The second type involved the suggestions that Interdisciplinary Research should be organized in a less theory oriented manner than the majority of the projects are now, and should be much more concrete in goal definition and organization.

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MANAGEMENT CHARACTERISTICS OF INTERDISCIPLINARY RESEARCH:

A CASE STUDY OF THE GALLATIN CANYON STUDY

by

HENRY FOLKE SHOVIC

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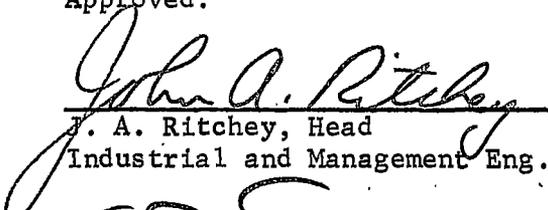
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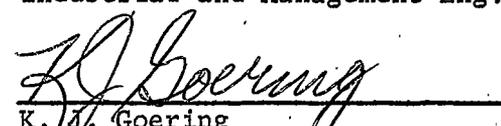
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Industrial and Management Engineering

Approved:

  
J. A. Ritchey, Head  
Industrial and Management Eng.

  
C. R. Emerson, Chairman  
Examining Committee  
Industrial and Management Eng.

  
K. J. Goering  
Dean of Graduate Studies

MONTANA STATE UNIVERSITY  
Bozeman, Montana

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## CHAPTER I

### ABSTRACT

Traditionally, university research has been theory oriented. Problem solutions, or the applying of the results of theory to real world situations, have not been part of the university's tasks. With the growing complexity and immediacy of problems facing society though, the university has become more and more involved in this form of activity. This necessitates an Interdisciplinary outlook, as problems rarely fit neatly into disciplinary bounds.

At Montana State University a study is in progress to evaluate the environmental impacts of a recreation development in a formerly primitive area. This is a large project, with many specialties represented. Since this is a new form of research, the author undertook the study of investigating the emerging structure of project management, via a problem identification method. The technique used was an interview/questionnaire one, used to identify problems perceived by the project members and problems made evident through the author's analysis of independent data. The questionnaire was orally administered to the twenty-eight members or related personnel affiliated with the project at the time. This was assumed to comprise the total population under investigation, eliminating sampling error.

Preceding the analysis, chi square tests were performed to detect inconsistencies in response. The technique of parallel collection was also used to reduce the chance of any one source being excessively over-emphasized in the conclusions reached. Analysis was done in three areas, each attempting to identify problems from a different viewpoint.

Conclusions reached were that the problems found to exist were in the organization of the project operation and in the funding agency. The project was organized in a very broad, democratic fashion with all investigators reporting to the entire group. This did not, in this case, provide enough concrete direction for the operation of this type of research. The funding agency was the source of some confusion to the study members, as project goals were changed during the course of the operation, and funding levels were reduced well below optimum amounts.

Recommendations were of two types. The first was a suggested management system change to effectively break up the larger group into smaller "task oriented" groups that could function more efficiently in the time remaining to the study. The second type involved the suggestions that Interdisciplinary Research should be organized in a less theory oriented manner than the majority of the projects are now, and should be much more concrete in goal definition and organization.

## CHAPTER II

### INTRODUCTION

#### A. The Need for Interdisciplinary Research

Traditionally, university research has been theory oriented. The university has been regarded as an institution where "science is advanced" and "the state of the art" is originated. Problem solutions, or applying the results of theory to real world situations, have been seen as the engineers' and the planners' domains; but, with the growing complexity and immediacy of the problems facing society, this is no longer the case. The university has been becoming more involved in the 'solving' of complex problems necessitating a "stepping out of" the bounds of the traditional academic disciplines into interdisciplinary areas. This seems to be the only way to solve complex problems, as they rarely fit neatly into an established discipline's realm. There are many prominent and knowledgeable authors and researchers advocating this concept. A number of these are mentioned here. In this and all other places where reference is made to an established work, the number following the reference is keyed to the bibliography in Appendix B.

An article by Pierre de Bie, entitled "Problem Focused Research" (26) is concerned with the discussion of a problem, or action research orientation. Mr. de Bie defines characteristics of this form of research, and acknowledges the probability that this type of activity

could be cross-disciplinary in nature. Implicitly an interdisciplinary approach is recommended, for Dr. de Bie states that methods and theories from varied specialties are needed to give a comprehensive view of social and physical reality. As the basis for interdisciplinary work is concerned with this type of cross specialty focus, the problem focused approach has much in common with it.

Dr. L. K. Caldwell, in his book, Environment: A Challenge to Modern Society, (6) develops a persuasive argument pointing up the need for a meaningful workable public policy. The relationship of man to man is seen as being fully as important as man's relationship to his environment. The only way to perceive these relationships and to use them coherently is to make use of information from the social sciences, along with the technical, biological and physical sciences. As seen by Dr. Caldwell, the many working concepts needed by an administrator or researcher to adequately manage an investigation of environmental situations almost necessitates an Interdisciplinary approach.

Dr. D. H. Henning, in his article, "Comments on an Interdisciplinary Social Science Approach for Conservation Administration" (12), perceives a need for an integrated, problem solving approach to problems of "resource management" or "conservation administration," here used synonymously. Administrators must make decisions based on values with respect to limiting human behavior, even more so than decisions relating

to actual use of the physical environment. Presently, Dr. Hennings feels, "professionalism" and specialization have limited the scope of the information available to decision makers, and also their willingness to use that information. Problems, and research on the solutions to them, are consequently defined in a technological manner, largely ignoring the social implications of their existence.

To broaden the base on which decisions of resource allocation and management are made, Dr. Henning suggests one of two approaches. The first is to create an Interdisciplinary study team able to integrate and work together for "combined conclusions." The second is delegating an individual to carry out the research. This individual would have a multidisciplinary orientation, or a "finger in many pies." He would also be able to synthesize and formulate cross-disciplinary conclusions.

Henning feels that the latter is the most realistic, a basic social science orientation using concepts from political science, sociology, psychology, anthropology, geography, and other related areas to make viable, Interdisciplinary decisions.

Though his approach is not from a team standpoint, Dr. Henning illustrates the potential of, and the need for the concept of an Interdisciplinary investigation of policy questions. He gives an example of a controversy in Colorado about the proposed selective disposition of elk and deer herds. The interrelations of the social, biological,

and ecological aspects of the problem made it difficult to view from an accurate perspective. On the other hand, the use of information from various sciences provided a more "systematic," i.e. comprehensive, outlook on the problem. This indicated that this method of investigation could be advantageous when applied to complex situations.

The most important advocates of Interdisciplinary Research, however, are the funding agencies such as National Science Foundation, the Rockefeller Foundation, the Department of Agriculture, etc., which are generating millions of dollars a year for this type of research.

Thus it is seen that there is, at present, a critical need for Interdisciplinary Research in many areas, all dealing with problems that are insoluble by other means.

This leads to the definition of Interdisciplinary Research used for this study. The general consensus among researchers and authors seems to be that Interdisciplinary Research must have an integrated, problem-focused orientation to be meaningful. The very reason for the existence of an Interdisciplinary Research format is to enable the investigation of complex phenomena, too complex for normal modes of unidisciplinary investigation.

These phenomena are usually funded in terms of problems to be solved. Thus, for this study the assumption is made that this approach is problem oriented, rather than pure research. Of course, an obviously concomitant characteristic is that the research is probably performed by representatives of different specialities, here restricted in scope to university personnel.

B. The Need for Research on Interdisciplinary Projects

Interdisciplinary Research is difficult to define, difficult to carry out, and difficult to make successful, both from the viewpoint of internally coordinating such research, and from the viewpoint of directing the research toward objectives or ends. One has only to look at the literature to determine this. (See Chapter IV-A-3-b, Literature Review for the Restricted Problem Area Search.) Another fact one can glean from a close look at the present literature is how little material there is. An extensive review by the author brought to light fewer than twenty separate pieces of information dealing with the subject of actually "running" Interdisciplinary Research projects.

The Gallatin Canyon Study had problems similar to this one. There were few examples of practical experiences and recommendations which the researchers and managers could rely upon to guide the project in productive directions. Therefore the project had to be guided largely on a "play it by ear" basis, with the attendant dangers of

miscalculation. Because of this it was apparent that there was a need for documentation and analysis of the problems faced, as well as solutions developed, and this project was undertaken by the author. To this author's knowledge, no case study of this type has been attempted before. This study would examine, in a scientific manner, the problems involved with the operation of this Interdisciplinary project. It is hoped that this preliminary study may be productive source material for other analytical case studies. Perhaps the form of measurement employed in this study will be helpful and understandable to those employed in a management capacity in the research field.

#### C. The Development of this Project

The Gallatin Canyon Study has been in existence approximately three years, funded as a one year pilot study by the National Science Foundation IRRPOS Program (Interdisciplinary Research Relevant to Problems of Our Society) and, following that, two years additional funding under the NSF RANN Program (Research Applied to National Needs). The title of these projects is "The Impact of A Large Recreational Development Upon a Semi Primitive Environment: A Case Study," grant numbers GI-38 and GI-29908X. (31, 32) The project has had several changes of management, several changes of goals (some inspired by the funding agency), and frequent changes in personnel makeup mostly due to sub-project completion. A history of the study is included in Appendix A for reference and perspective. This history

covers the period of July, 1970 to January 19, 1973, at which time interviews were conducted with representatives of the project team. Since that time, there have been minor changes in staffing. A new proposal (for July 1, 1973 - June 30, 1976) was written and submitted. The funding was approved for this period, but at a markedly reduced level, and with the stipulation of a final conclusion to be reached within this period. As of September 6, 1973, the work continues on the project with reduced funds, but with a more Interdisciplinary outlook, a result of the years of experience gained by the team.

Following is a statement of the purpose and objectives of this thesis.

## CHAPTER III

### PURPOSE AND HYPOTHESES STATEMENT

In general, this study is to provide management and other interests with relevant information about the operation of the Gallatin Canyon project. (as the university study will be called hereafter). Further, it is to develop a management tool for use in other studies.

The particular hypotheses to be tested are as follows:

- 1) "The Gallatin Canyon has had significant problems and identifiable conflicts in the course of the study."
- 2) "It is valuable to management to determine the forms and character of the above problems, both in general for future studies and for the Gallatin Canyon Study itself."

As further clarification, university Interdisciplinary Research is defined here as that research, Interdisciplinary in nature, administered, managed and staffed by university personnel. Large scale Interdisciplinary Research is to mean research having a team numbering more than five members. This minimum number was reached by a consultation with the works of various authors in the group dynamics and

operations field. (40, 41, 42, 43, 44, 45) Groups having less than this number are assumed to be able to function without formal management. This research work deals only with large scale University Interdisciplinary Research, and therefore conclusions can be properly applied only to that form of activity.

Finally, for purposes of this study, the terms "team," "project personnel," and "project investigators" refer to the Total Set, which includes all those interviewed. For a description of this set, see Chapter IV-C-1 and 2.

Following is a discussion of the investigative procedure employed in this study.

## CHAPTER IV

### EXPERIMENTAL PROCEDURE

#### A. Objectives of the Procedure

##### 1. Introduction

The objective of the data collection method was to provide parallel information sources, each having its own particular, unique data, but also acting upon the other as an internal check for consistency and reliability of the measuring device. The emphasis of the first source was on "researcher perceived" problems, i.e., the responses of the interviewees to indirect, exploratory questions being used as bases for the author's conclusions. Opinions, perceptions, and attitudes were the basis for analysis in this section. This is entitled "the Abstract Problem Search".

The second source was a restricted, guided search for problems found in other Interdisciplinary Research projects, that have been perceived to exist in the Gallatin Canyon study. The respondents had freedom in selecting which problems were most real, but the range of choices was limited. This source was a "respondent perceived" one, and was entitled "the Restricted Problem Area Search".

The advantage of the first source was a deep, imaginative set of responses, unrestricted by too many guidelines. This also allowed

a researcher analysis of the responses, thus eliminating the mistake of being too "direct" in questioning and receiving biased answers. The major disadvantage was that, out of long diatribes on perceived problems, little knowledge may be gained, and very "local" data may be obtained. This disadvantage was overcome by using the alternate source to balance the above responses. Though the boundaries were set rigidly, the amount of area covered is large due to the range of problems observed.

## 2. Abstract Problem Search Development

It was decided that the presence of problems could best be measured in this study by the following forms of inquiry: statistical information (age, experience, involvement, commitment); opinion information (about success, career impact, university propriety, importance); perceived facts (goals, purposes, definitions); and direct questions about problems and suggestions for improvements. All the above were applied to the Gallatin Canyon study and were duplicated in referring to large scale university Interdisciplinary Research in general, when possible.

With these inquiries made, it was felt a very satisfactory analysis could be performed to determine indirectly the problems in the study. The abstract questions were analyzed in logical groups. Those are discussed in Chapter IV-D-2, Sectional Analysis. The results

of that analysis are also presented here.

### 3. Restricted Problem Area Search Development

#### a. Introduction

The problem area search was developed from a thorough search of relevant literature commenting, analyzing, or even complaining about Interdisciplinary Research in academic circles. The sources were journals, books, manuscripts, interviews, and letters, all authored by individuals who had had some contact with university Interdisciplinary Research. For a bibliography of the literature review involved with this Problem Area Search and an author bibliography, please see Appendices B and C. The next subsection entitled, "Literature Review for the Restricted Problem Area Search" contains the actual literature review.

#### b. Literature Review for the Restricted Problem Area Search

This review was finished in February of 1973. The literature was notably scanty on the subject of university Interdisciplinary Research with most articles consisting of opinions of personal experiences and theorizing about possible directions for further steps. Inquiries were sent to many major institutions and libraries, but little appeared to have been done on the subject. A letter to the National Science Foundation (specifically the R.A.N.N. program, which was the sponsor of the Gallatin Canyon study), brought a response

stating that no research on Interdisciplinary Research was currently being done under their auspices, but they would be interested in the results. Current thoughts, opinions, and theories on the problems in Interdisciplinary Research follow.

Kenneth Roose theorizes on practical problems of Interdisciplinary projects in his work, "Observations on Interdisciplinary Work in the Social Sciences" (40). He comments about the kinds of people interested or instrumental in beginning Interdisciplinary programs in universities. The majority of the proponents of this approach are those who have the insight and creativity to see the relevance of problem focused sciences to society today, rather than relaxing in theoretical, strictly disciplinary specialties. Awareness of the complexity of social problems is seen as a central factor in this viewpoint.

It is stated that "the problems faced in administering Interdisciplinary programs are heavily influenced by the conflicts associated with their position (in the university)". The academic organization is not based on interdisciplinary lines, and strain is induced when there appears a desire for this cross-disciplinary association. Insecurity, lack of reward systems, and lack of confidence are seen by Mr. Roose as the primary sources of resistance and reluctance in the furthering of Interdisciplinary programs in the social sciences.

A similar opinion is held by Dr. D. T. Campbell. In his essay, "Ethnocentrism of Disciplines and the Fish Scale Model of Omniscience" (40), Campbell feels that not only is the academic system inadequate for an Interdisciplinary orientation, but is actually pulling farther from it by each discipline's "ethnocentrism," or tendency to move and organize around common "safe" terminology, departments, and individualized conceptual frameworks. Dr. Campbell suggests as a remedy a "fish scale" or evenly distributed range of disciplines, each covering a measured and slightly overlapping area to provide more communication and relevance to reality. This would be a true Interdisciplinary system with all the disciplines arranged and pursued in a functional manner. Examples of this are such cross-disciplinary specialties as political sociology, environmental psychology, or sanitary engineering.

A second article by Dr. Henning, "Interdisciplinary Land Use Planning: Ecosystems and Social Sciences," (13) discusses and analyzes an Interdisciplinary treatment of land planning, an activity traditionally in the hands of technoscientific disciplines.

Well documented, the article references and pulls together opinions of the author and other researchers into a statement of the need for Interdisciplinary approaches and recommendations for its accomplishment, especially in environmental management and land use planning. Various references are cited to support his conclusions,

including the Environmental Protection Act of 1970, the Council on Environmental Quality, E. P. Odum, C. W. Churchman, and other prominent researchers.

According to Dr. Henning, implementation of long range goals requires analyses of the "complete system," possible only with some form of Interdisciplinary approach. "Tradition bound disciplines" are resistive of efforts toward a comprehensive, integrated approach, which is a preliminary requirement to a "total environmental viewpoint." Additional problems mentioned are disciplinary dogma, "empire builders" or those who place their own department's or group's goals far above the organization's, and specialization of research and decision making into unreasonably narrow channels of thought. Additionally, the use of "technique" alone without regard or awareness for larger issues is seen as a major reason for improper planning and also as a source of resistance to any Interdisciplinary approach.

Application of an "ecosystems" orientation appears to be a practical method to circumvent the narrow "technique" approach, in addition to making use of its techno-scientific data and methods. Social sciences are also seen as useful in placing the "humanistic" values into the planning process.

A team using an Interdisciplinary approach should have these above orientations represented. The team must solve the problems of

disciplinarians; those of jargon, traditions, territorial concerns (the protection of a scientist's professional territory), and narrow reward systems. An approach is recommended following Dr. Henning's previous article (reviewed above). An individual would be specially educated in an "interdiscipline" or Interdisciplinary orientation, and would be used for planning, taking advantage of his knowledge of different fields.

In the Gallatin Canyon Study itself, a questionnaire was circulated querying the investigators about their views on the problems of the research effort. Summarizing major results, it was found that the professional reward system was felt to be inadequate, a unidisciplinary emphasis was more important for the individual researchers than an Interdisciplinary one, independent budget control by investigators was desirable, and a framework more structured than the present one (as of Winter 1971) would be of use. These results and the questionnaire format are contained in the continuation report and proposal done in May of 1972 (31).

The Lake Tahoe Study of 1972 is an example of an Interdisciplinary project that did not fulfill the objectives of problem oriented, integrated research in a manner satisfactory to the investigators. Dr. J. McEvoy III, the project director, analyzed their problems in his article, "Multi- and Interdisciplinary Research--Problems of

Initiation, Control, Integration, and Reward" (29). The study was conceived of initially as an Interdisciplinary project. The study team consisted of social and biological scientists investigating the cultural and physical impacts of development around Lake Tahoe and in the Tahoe Basin.

Dr. McEvoy comments on problems in the four areas of initiation (the preliminary organization and interest generation), control (of the project directions), integration (the welding of the various researchers' interests into a unified research operation), and reward (the stimulus of good research and increased commitment). One can see more easily the implications of these four concepts if they are taken separately.

According to Dr. McEvoy, initiation of a project, in the university context, is an open-ended process. Academic researchers are not committed to a "lock step" control of their interests and directions. Research money or administrative guidelines may influence their interests, but they are not required to become involved in Interdisciplinary Research, and Dr. McEvoy feels there would be active resistance to any attempt to impose an arbitrary extra-disciplinary framework for directing the research progress. The research oriented faculty member is also involved in many pursuits, and therefore his time available may be variable. He may not have adequate time to devote to the particular

sub-project as desired by an outside framework.

These two considerations limit Interdisciplinary Research effectiveness, as there must be a guiding, problem solving, integrated structure within which this type of research can be done, or it will degenerate into multi- or even aggregate-disciplinary research. At Tahoe, the project development followed the path of "inductive" strategy. Each investigator submitted a separate proposal and they believed this would lead to a unified, eventually Interdisciplinary approach. This was not the case and the research followed varied lanes toward varied destinations.

To control a project in industry, one has various strong, legitimate sanctions to impose upon individuals deviating from a project schedule or from project goals. These schedules are set up using PERT, time budgeting, etc.. As seen by Dr. McEvoy, this is not the case in the university. Academic research, where there is a strong desire for autonomy and self-determinism among the investigators, may have inherent conflict with any structure limiting those desires. Though for any structured, useful project there must be some deadlines and an organization for holding to them, the university setting is not felt by Dr. McEvoy to be conducive to the extensive use of the applicable techniques.

The Tahoe study began with little in common between investigators as far as methods, metrics, terminology, and cross-discipline understanding were concerned. After much effort, the project team developed a systems model, which was part of an attempt to involve investigators and to direct them toward the goals of the project. Dr. McEvoy does not comment on the success or failure of the model, but he does say that it was a simplified representation and ignored important components.

Finally, reward of efforts, or more importantly, the system of reward is a vital motivation in the operation and initiation of an Interdisciplinary project. The professional disciplinary group is seen by Dr. McEvoy to be the primary determinant of the motivating structure within which academic researchers operate. He states that,

their reference group is found in their professional discipline and their status and power within that discipline and within their department is primarily a function of the quality and quantity of their published research on topics defined as falling within that discipline. (29, p. 206)

At research oriented institutions, the reward system does not favor Interdisciplinary work simply because there is no "Interdisciplinary department" to handle it. Though Dr. McEvoy feels there are structural changes possible, they are met with resistance from disciplines and departments. Also, the administrative load of an Interdisciplinary research project is immense, and the time is felt to be grudgingly given by department heads, who are more student and

budget request oriented than the research and professionally oriented faculty member.

To conclude, Dr. McEvoy includes politics as another undesirable facet of most Interdisciplinary Research, from the sources of the RANN program itself (a politically influenced organization), to the local interests who seek to change or terminate the research for politico-economic reasons.

Dr. W. Larson, of the Sociology department at Montana State University, was interviewed concerning his experiences in Interdisciplinary Research. He had been involved in three studies of this sort, and had knowledge of others. The subjects of these projects were varied, among them agricultural sociology at the University of Wisconsin, educational sociology at the University of Colorado, and weather modification at Montana State University.

From Dr. Larson's experiences and opinions there emerged some basic concepts that may relate to the success or failure of an Interdisciplinary project. The problem oriented approach is felt to be a successful (if not the only successful) approach used now. If a problem can be defined, then an interested group of researchers may gravitate around it, and finally some form of administration could be formalized to give it direction. The research projects mentioned by Dr. Larson had a leadership structure, but the researchers came into

contact on an interest basis only. An attempt to rigidly control the project directions and the investigators' behavior was resisted, reflecting the academic freedom expected and normally granted.

The personality of the manager or director then, is felt by Dr. Larson also to be important. A corporate director would probably not be a wise choice as a university Interdisciplinary head, as his command function would be ineffective in a university setting.

Dr. Larson also feels a common neutral language would make a better, more integrated investigation possible, with less time wasted in bickering over terminology.

A small group is felt to be preferable or even essential to success, as the direction of research is so related to the various members' ideas and orientations.

The final and probably most important problem in Interdisciplinary Research is felt to be the "professionalism" or "discipline ego" of the members of an Interdisciplinary group. The need to defend one's discipline, one's status within that discipline, and one's personal competence is a prominent factor in the friction, personality conflict, and lack of developed direction evident in many Interdisciplinary projects. The success of the first was attributed by Dr. Larson directly to the fact that the members were not primarily involved in this

"ego boost process," as they were well established, therefore being able to get down to the business of making the Interdisciplinary project work.

Correspondence with Dr. D. L. Veal indicated that the Interdisciplinary Research done at the University of Wyoming has had varied success. He stated that,

I feel quite strongly about the need for interdisciplinary research; however, I don't usually agree with how much of the interdisciplinary research has been organized. Many of the institutions seem to organize a group of people and then instruct them to find some common problem of interest and address it. I believe that the converse usually works much better, that is, having a group of people with a common interest rallying around a problem rather than a group of people searching for a problem. For example, here at the University our Department has developed a very successful interdisciplinary effort with Botany, Microbiology, and Chemistry. This came about as a result of a problem which was clearly of common interest to investigators in each of these departments.

The successful example was involved with investigation into the nature of ice nuclei in the atmosphere. The interest in the project was developed before the Interdisciplinary project was organized formally. Also, Dr. Veal felt that the programs organized around a problem, and then "peopled" with investigators had not been particularly successful, at least on the University of Wyoming campus.

Therefore, the author of this thesis concludes that two approaches have been less than successful at the University of Wyoming. One, the organization of a team which then looks for a problem, and two,

the organization of an administration to address a problem or an area of research before the interest of potential investigators has been aroused--in other words, Interdisciplinary Research does not work there except as spontaneously generated. Any attempt to direct or focus, unless after the fact, appears not to produce "good fruit."

A group of authors from Massachusetts Institute of Technology have carried out an Interdisciplinary modeling process in a university setting, and have made their results known in the book, Systems Simulation for Regional Analysis: An Application to River Basin Planning (11). The project theme was a computer simulation of a river valley in Pennsylvania in terms of economic, social, demographic, political, and physical characteristics. Though the problem was defined as a multidisciplinary study, the indicated approach made it seem more of an Interdisciplinary one. The experiences of the MIT group are summarized below.

It appeared that there is an implicit assumption within small Interdisciplinary studies (5 - 15 people) that a group of individually efficient persons will automatically perform with equal efficiency as an Interdisciplinary team. This is not generally true. Also, there is usually on the team a part-time researcher / project director who is expected to play both roles, when he is primarily oriented toward his own research, and less toward efficient management.

The MIT group also felt that this project director encounters some particular problems in the operation of the Interdisciplinary project. Some individuals try to keep informed in depth with all parts of a project, even to the point of dereliction of their own subtasks. Others will follow their own path with no input desired from any sort of total project framework. Either trend will not further project objectives.

Lack of communication and conversely, "idle curiosity" to the point of subtask suffering are both extremes that should be limited or curtailed. On the MIT project, the investigators did not experience the problem of "idle curiosity" about other subparts to any great extent.

The matters of directing the research toward user acceptability and internal awareness of how far and to what depth to carry individual work are both seen as existing ambiguities in project management.

A modeling approach on the part of project management is seen by the MIT group as a useful structure in alleviating the above and other problems. They consider it advantageous to have a universal, neutral "authority" (the model) preside over the selection of the necessary inputs to be made, and control the directions subprojects take with respect to the total project.

Unfortunately, with this approach more rigorous scheduling is required to complete the assigned tasks, and the changes in project direction and personnel almost certainly required are not always agreeable to a university research team composed of interest motivated personnel. The process of assigning priorities and time sequences to a research project is called "balanced modeling" and, though sound in principle, the "institutional environment," or the non-availability of flexible personnel, may preclude its use. Team morale, frozen funds, and lack of positive authority are vital factors in this problem.

The methods used in the MIT study was to conduct a small Interdisciplinary planning project to evaluate and determine the proper and productive directions toward which the research should aim, and then the project was expanded to full operational levels with a model and project goals already in sight. This was felt to be an adequate method of progression, and the undertaking was successful in the eyes of the investigators. There was enough institutional flexibility in this study to allow for the necessary personnel adjustments.

In addition to the model, the MIT group viewed a good accounting system as a tool in effectively controlling, or at least monitoring the Interdisciplinary project. In small efforts, these may be the only formal methods available to the project director.

A paper by V. L. Arnold entitled "The Green Bay Research Program: A Case Study in Interdisciplinary Research" (3) focuses on an apparently successful Interdisciplinary effort using a modeling approach. The overall theme of the project was to evaluate the multi-disciplinary impacts and consequences of multiple use of the coastal zone of Green Bay, a Wisconsin estuary of Lake Michigan.

Three basic observations can be made from this article. The first is that a modeling or systems analysis approach is useful in evaluating and making individual researchers amenable to an Interdisciplinary approach. The second is that the Interdisciplinary effort will profit in content and relevance with a framework of systematic organization. Finally, the progress and results of Interdisciplinary Research will be significant only if decision making groups and the research staffs cooperate in information and technology transferral. The Green Bay study appears to have all three.

The traditional interdisciplinary approach is considered to be only a starting point in the investigation of complex cross-disciplinary problems according to Dr. W. Alonso, in his article, "Beyond the Interdisciplinary Approach to Planning." (2) The ordinary method of Interdisciplinary work is, in his words, to "Take a physical planner, a sociologist, an economist; beat the mixture until it blends; pour and spread." Unfortunately, Dr. Alonso does not agree that it is actually

so simple or that it works like this at all. For example, the word "economist" may imply a variety of different specialties, very few of which may be applicable to the problem at hand. After this economist has begun the Interdisciplinary project, he will find the recognition or professional esteem he desires lacking. The proper reward system does not exist.

The personnel who tend to be involved in Interdisciplinary Research are also felt not to be always ideal. This sort of research often attracts the mediocre, the eccentric, or the distinguished senior, none of whom, Dr. Alonso feels, are really what the project needs most. Work inequalities also bring conflicts to the surface, because some team members may have a subproject that, while no more important to the result, will consume a much larger block of time, thus giving rise to friction and unmet deadlines.

Another set of problems are those in communications. Whenever disciplines mix there are differences in word usage, varying desires for collaboration, and self consciousness about misunderstandings.

Dr. Alonso sees the solution to these inherent problems as being in a meta- rather than inter- disciplinary approach. That is, a discipline based on the common techniques, language and interests of actual processes, such as urban or regional planning. The education of a planner or social systems analyst should be in no specific

disciplinary specialty, but should draw from many. In Dr. Alonso's theory all the members of a cross-disciplinary team would be meta-disciplinary. They would be called together because of their common ground in problem solving, rather than because of their representation of different, separate specialties.

A paper by Dr. J. E. Ross, "Interdisciplinary Studies on Environmental Studies at the University of Wisconsin-Madison," (37) discusses the organization and goal structure of a program on the University of Wisconsin campus at Madison, Wisconsin that was designed to centralize the administration of Interdisciplinary projects involved with environmental studies. This type of research is almost always cross-disciplinary in nature, and a concerned and involved group of faculty saw the need for a coordination and education center on campus.

Dr. Ross feels that the university has great potential strengths in this area, and that the formation of an Institute for Environmental Studies would be useful to enable the performance of the above named functions. The Institute was created in February of 1970. Curriculum programs have been set up and student interest has been keen.

Problems in the genesis and growth of the organization are many. Internal communication between involved disciplines is felt to be continuously demanding and a tedious task. The effects of the lack of a

reward system for the Interdisciplinary teaching and research effort are felt here as the state budget tightens, restricting such new, "marginal" developments as Interdisciplinary Research centers. Goal definitions are also difficult, as the varying interests of the involved faculty members sometimes creates conflict.

The understanding of pollution, the environment, and pollution abatement are seen as primary instructional and research emphases of the Institute, and Dr. Ross feels rigor is very difficult to build into the programs. Regarding rigor, Dr. Ross concludes, "It is relatively easy to converse about environmental problems, even relatively easy to define the problems. It is much more difficult to quantify environmental interrelationships. We feel we must work on this issue in our research and in our teaching." These interrelationships are definitely Interdisciplinary in nature, and this is where the problems lie, not with the technical expertise, but directly in the human element, the Interdisciplinary team.

A second article by Dr. Ross, "The Case for The Rigorous Generalist," (36) makes a convincing case for the Interdisciplinary's value to society and education today. Disciplines are, in Dr. Ross' eyes, two things; first, the result of a body of theory and knowledge, and second, professional identification with a body of learning and other scientists with similar learning, both of which generate a sense

of respectability. The second definition is possibly the most important, as it is here problems begin. In an Interdisciplinary effort, disciplinary lines must be crossed to enable the research to continue and grow, and traditional faculty groupings, existing because of and in perpetration of "disciplines," are obstacles in its progress. The success of many Interdisciplinary efforts is attributed to the charisma of the initiator or director, rather than any efficient organization transcending disciplinary boundaries.

Additionally, the university is seen as essentially non-action oriented. In fact, "on every campus there is a dead-weight of opinion that regards action-oriented programs as hostile to the academic life." Academic freedom may be responsible for some of this, for the societal problems visible in the world today may threaten academicians because it limits individualism and the freedom to choose one's own interests.

The "problem focused" approach is felt to be necessary to a successful Interdisciplinary orientation. Without this as a binding force, the group wanders aimlessly in as many directions as there are team members, thus feeding fuel to the fire of negative connotations associated with the word, "Interdisciplinary."

A possible method of circumventing these inherent problems appears to Dr. Ross to be the formation of a new discipline, the "rigorous generalist," or an Interdisciplinary, not compartmented

into using information from a few disciplines, but open to many. Ogres still appearing here are the difficult necessity of staffing flexibility, the soft vs hard money problem, and lack of security (departmental and professional) for the students entering that curriculum. These exist in all new and radical endeavors in the university, but the long range goal (that of creating a true Interdisciplinary, not just another discipline) seems to Dr. Ross to justify the expense.

In the article "United We Stand," (18) the advancement of science is seen by Mr. Jameson to be most efficient when organized, i.e., when there is some form of framework guiding progress.

This is seen as particularly important in large scale problem-oriented research. This scale of research is now possible for many reasons, some of which are: the techniques for understanding and formulating models of large real-world systems are now available; complex data handling and analysis have become possible because of advances in computer technology; and the public is now greatly concerned with this form of research.

A systems analysis approach is advocated using an "a priori" organization to develop the area to be studied, and an application of various skills to gather the appropriate data.

To coordinate this research three methods are offered:

(1) an approach of emphasizing the goals of subsystems of the project; (2) emphasizing the investigators; or (3) a combination of the two above methods; i.e., an iterative goal-producing process. Any of these have the advantage of creating a mission oriented atmosphere, a necessary step toward truly interdisciplinary research progress.

Mr. Jameson feels, in his article, "Systems Approach to Research Planning," (17) that a systematic view of research would be an aid to developing long term need satisfying research. The proposed procedure is to have an outside group (exclusive of the project personnel) determine and build, using math techniques or simulation, a model of the situation to be studied. This, then, will be used as a guide to select experimenters and to set up goals for the research. Forrester's Systems Dynamics, gaming, mathematical programming, and multivariate analysis are given as possible approaches to various problems.

The major management advice is that the investigators should not pick the area of research, since this process will only identify interests. The problem model building should be left to an independent group for true "problem oriented" research.

c. Problem Area Creation

The major problems made evident in the preceding subsection have been categorized and separated for ease of understanding and usage. The literature review was first examined closely and significant perceived problems were listed separately. Then, a similar close examination of the list and a logical breakdown was made, and the groups representing these various logical subsets of the problems separated.

Following is a description and justification of this disaggregation. The categories used for this purpose are as follows:

- A. Disciplinary Internal Problems
  - 1. Resultants of Professional Status
  - 2. Resultants of Personal and Group Characteristics
- B. Administrative Internal Problems
  - 1. Resultants of Administrative Setup
  - 2. Resultants of Administrative Orientation
- C. External Problems
  - 1. Resultants of the Influence of Funders
  - 2. Resultants of the Influence of Other Interests

A brief explanation of each partition follows.

The Internal and External divisions functioned as differentiators between internal problems caused by, or connected with the members of the Interdisciplinary team (whether they were cognizant of them or not),

the ones caused by the internal workings of administration, and the problems caused by or allied with the influences and forces brought to bear by external forces (funding agencies, private outside interests, etc.).

The Internal Divisions. Under the Disciplinary Internal division is the Professional Status category, which is composed of problems related to the characteristics of the academic disciplinarian. These are only those that occurred because of the profession in which the team members have been enveloped. The various characteristics of professions are not listed here, but, in general, problems are placed in this category because they appeared to be related to the traditions, boundaries, and modes of thinking associated with this specific profession.

Problems not in this area, but still related to the internal processes involved in Interdisciplinary Research were placed under the category of Personal and Group Characteristics. This includes personal characteristics of researchers, group orientation of the team, and results of ethics, values, and prejudices. A number of these may be related to the professional orientation of the affected personnel, but in most cases, these will be results, effects, and implications of it. The differences in categories may be made clearer in an analogy. The bricklayer may refuse an offer of an assistant on the grounds of perceived less than adequate competence on the part of that assistant, or

because he does not care for anyone assisting him in a status capacity he considers reserved for him alone. The first reason would be placed in the Professional category, while the second would be assigned to the Group Process one.

The second Internal division is the Administrative one. The problem areas placed here were so because of their relationship to the power and control structure within which the members of the research team normally operate. The university administration, notably the department, and upper administration, are the power centers of this structure. Also under this heading is the administration and management of the project itself, though the occurrence of perceived conflicts directly associated with this are scarce, and therefore were not given conspicuous treatment here. This internal division is broken into two categories to delineate problems originating in the administrative structure from those arising from the personal characteristics of this structure. Again, there may be cause-effect relationships between them, but they are separated as far as practicable, sometimes arbitrarily, for the sake of usability.

The External Division. Finally, there are those problems external to the interdisciplinary process. Two major sources were identified, that of influences by the controllers of funds (e.g., NSF), and of influences of other outside interests, such as political or economic

groups and resource managers interested in the results and the directions the research takes.

d. Problem Area Statement

Each problem area condensed from the literature search was examined and placed in a category; these categories are stated, in order, in Appendix E. Each was shortened and reworded to convey the essential information to the reader without being too long, involved, or emotionally biased. These shortened problem areas are in Table 1. (corresponding to the order in Appendix E, Problem Area Expansion).

For the data collection, each problem area was stated or read by the respondents and rated on scale G, Appendix D. This was to be applied to both the problem in the Gallatin Canyon study and also in general.

The list was randomly ordered for the interview, to aid in the elimination of systematic biases from statement arrangement, and to help randomize any other systematic error present in the problem areas. The number directly following the statement number in Table 1 is the number of its location in the Problem Area section of the Questionnaire, which is entitled the "Factor List" (Appendix J, Interview Schedule).

TABLE 1

## Modified Shortened Problem Areas

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- A-1-a (8) Customary, established ways of doing things inhibit change in personal orientation, evaluation of new methods, and influx of new ideas
- A-1-b (4) the tendency of the "absolute truths" of a discipline to inhibit necessary or beneficial changes in orientation or methods
- A-1-c (26) disciplinarians tend to find a corner of their field and explore it thoroughly, and unfortunately sometimes have difficulty operating in Interdisciplinary directions
- A-1-d (14) technical language becomes too much a part of the individual's vocabulary for persons outside of his discipline to understand and for him to explain
- A-1-e (15) the beginning of a project with no model or framework for integration, under the assumption that an adequate one will develop "naturally"
- A-1-f (29) large freedom of choice in interests and pursuits within the academic profession conflicts with externally set goals of Interdisciplinary projects
- A-1-g (24) units, methods of measurements, and relevant variables are different across disciplines, deterring efficient communication

TABLE 1 - Continued

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- A-1-h (16) teams must develop through interest, therefore they may not attract the proper specialties, or any specialties at all for a particular project
- A-2-a (11) insecurity and lack of confidence within and about the field of expertise is manifested in a reluctance to leave the security of "safe" disciplinary language and investigations
- A-2-b (18) the tendency of members of a discipline to think and research in "safe" disciplinary directions, because of the support available within the disciplinary group and because of the feeling that the group is the "best" discipline
- A-2-c (21) disciplinarians desire to maintain and increase their place in their profession, and some see Interdisciplinary Research and orientations as a threat and interference to their hold on their position
- A-2-d (7) technical, esoteric language used to befuddle the outsiders (of a discipline) and to reinforce the elitist attitude of the insiders
- A-2-e (27) the over-protection of a professional "area" of one's own discipline evidenced by jargon, entrance requirements, enforced orientations of members by the ruling members, etc.

















































































































































































































































































































































































