R E P O R T R E S U M E S

ED 019 068 JC 680 146

A NEW APPROACH TO THE PLANNING AND MANAGEMENT OF EDUCATIONAL RESEARCH.

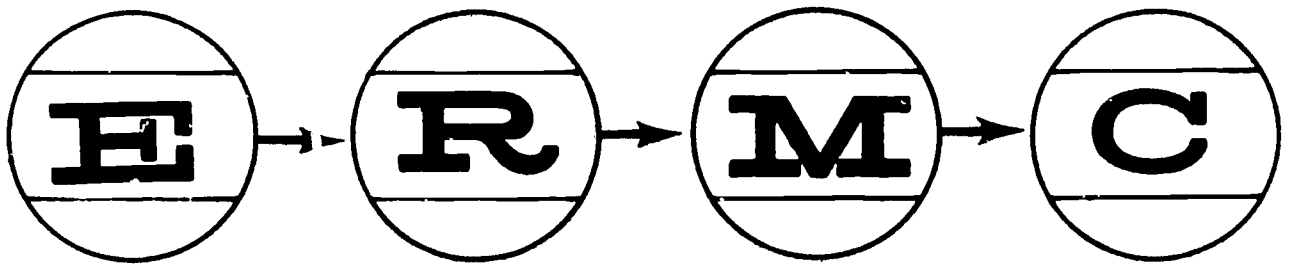
BY- COOK, DESMOND L.
OHIO STATE UNIV., COLUMBUS, SCHOOL OF EDUCATION

PUB DATE 27 OCT 64

EDRS PRICE MF-$0.25 HC-$0.84 19P.

DESCRIPTORS- *EDUCATIONAL RESEARCH, *RESEARCH PROJECTS, RESEARCH PROPOSALS, RESEARCHERS, RESEARCH DESIGN, RESEARCH METHODOLOGY, *PLANNING, *MANAGEMENT,

THE PROJECT METHOD OF FUNDING RESEARCH PLACES IMPORTANCE ON THE MANAGEMENT OF SUCH RESEARCH IN BOTH PLANNING AND OPERATIONAL STAGES. TYPICAL RESEARCH PROPOSALS DO NOT DEAL EFFECTIVELY WITH THE SCHEDULE TO BE MAINTAINED, THE COMPLEX OF INTERRELATED ACTIVITIES, THE NATURE OF THE TASKS TO BE PERFORMED, OR THE TIME AND RESOURCES NEEDED TO DO THE TASK. A SERIES OF 11 QUESTIONS CAN BE EFFECTIVELY APPLIED TO MANAGEMENT OF RESEARCH--(1) WHAT IS THE PRODUCT OR MAJOR OBJECTIVE OF THE PROJECT, (2) WHAT ARE THE SUBPROJECTS AT SUCCESSIVELY LOWER LEVELS WHICH MUST BE ACCOMPLISHED IN ORDER TO REACH THE MJAOR OBJECTIVE, (3) WHAT ARE THE TASKS OR ACTIVITIES TO BE ACCOMPLISHED, (4) AT WHAT LEVEL OF PERFORMANCE IS THE TASK TO BE ACCOMPLISHED, (5) WHAT IS THE ORDER OR PRECEDENCE OF THE TASKS, (6) WHO IS TO DO THE TASKS, (7) DO CERTAIN RESTRICTIONS OR CONSTRAINTS AFFECT PROJECT SCHEDULES, (8) HAS ADEQUATE CONSIDERATION BEEN GIVEN TO THE UNKNOWN NATURE OF MANY TASKS, (9) IS THE PROJECT PLAN FULLY UNDERSTOOD OR EASILY COMMUNICATED OUTSIDE OF THE PROJECT, (10) WHAT CRITICAL POINTS NEED ADDITIONAL RESOURCES, AND (11) WHAT ALTERNATIVE PLANS MAY BE DEVELOPED. THIS PAPER WAS PRESENTED AT THE ANNUAL COLLEGE OF EDUCATION FACULTY RESEARCH CONFERENCE (LAKE HOPE, OHIO, OCTOBER 1964). (WO)



A NEW APPROACH TO THE PLANNING AND MANAGEMENT OF EDUCATIONAL RESEARCH

by

Desmond L. Cook

October 27, 1964

Educational Research Management Center
School of Education
The Ohio State University

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Desmond L. Cook
College of Education
The Ohio State University

Present Situation

Traditionally, the researcher's position has been such that he could pretty much pursue topics of his own interest at his own rate and in his own way. The acceptance of a research project proposal today by a funding agency such as the Cooperative Research Branch, while giving recognition to effort, may at the same time present a new and unforeseen problem. One now suddenly finds thrust upon him not only the role of the researcher who is to carry out the proposed study but also imposed is the role of being a project director and/or manager, both of which occur under a new set of circumstances. The circumstances now facing the researcher have been well described in a discussion of a similar problem existing in the civilian aerospace industry (1).

> Invention and innovation must [now] in some sense be scheduled. Having set forth these plans, there is the necessity of controlling the [research] and development process so as to achieve these plans or to come as close to achieving the plans as possible. An important pressure for control is the watchful eye of Congress and Government Accounting Office which seeks to ensure that the taxpayer's money is spent with the greatest possible efficiency.

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[1]A paper presented at the Annual College of Education Faculty Research Conference, Lake Hope, Ohio, October 1964. The research reported herein was supported through the Cooperative Research Program of the Office of Education, U. S. Department of Health, Education and Welfare.

While it may well be that the researcher is competent and knowledgeable in his field, he may or may not be prepared to adequately handle the many and varied activities which are part of his role as a project director or manager, especially under the circumstances surrounding sponsored research. While the evidence to support such a contention is not readily available, the success of a project may depend upon this managerial role being performed well. Some evidence for this point might exist, however, in the observation that many sponsored researchers have to seek time extensions for their projects because they were not able to complete activities on schedule as originally planned for many reasons. It might also be seen to some degree in the observation that many final reports of completed research projects are not available until sometime after the official termination date of the project whereas the contract normally calls for the final report to be submitted on a certain date. The purpose of this paper is to present some thoughts and considerations that have come to me regarding this unaccustomed role of project director or manager which is thrust upon the researcher as a consequence of his successful efforts to secure support.

Definition of Terms

I would like to start by defining briefly several terms; specifically, the terms project, management, research management, and the management of research. The term project can be defined in terms of some characteristics set forth by Clark (2). The characteristics of a project as he sees them are (a) the end products are few in number, (b) each operation in the project is composed of a large number of

serial (or linear) and parallel jobs, (c) all of the jobs are directed toward a common objective or final event, (d) uncertainty exists as to the manner of accomplishment, length of time to be taken, and cost, and (e) different jobs are being done by different organizations having difficulty communicating with each other. While some of these characteristics may not be as applicable as others to the case of an educational research project, careful consideration will reveal that they do seem applicable to a great many education projects. The term management (when applied to a project) consists of continuous and intelligent direction so that the end objective is accomplished. The management process can be broken down into several substeps (3). Briefly, these steps consist of (a) the initial and most important step of establishing project objectives, (b) the development of a plan which shows the nature, sequence, and interrelationship existing partly among the subtask in order to accomplish the principal task, (c) the establishment of a schedule which serves as a bridge from planning to the implementation stage and serves to also translate plans to calendar times, (d) the evaluation of progress towards accomplishment of the main tasks and defining any problem areas, (e) making decisions with regard to the problem areas identified, and (f) recyling in view of the resultant decisions made and changes incorporated in the plan. Briefly, proper management of a project requires a plan of action which is essentially time-phased and which assures that reasonable resources will be made available to complete the project. Fouch (4) has utilized the term telesis, which means progress intelligently directed or the attainment of objectives by the application of

human intelligence to the available means, as a useful way of describing the management process. The term research management refers to a comprehensive analysis of the topics to be studied in the field of education (e.g., culturally deprived), relating these to present situations, and establishing priority for research projects (5). Such a function would be carried out by an agency such as the U. S. Office of Education. The management of research, on the other hand, is concerned with the efficient administration of specific projects aimed at reaching the goals set by research management. While a specific researcher might engage in both activities, it is my intention to focus at this time only on the management of research.

Up to this point, I have placed stress intentionally on the role of project manager after the project is funded. It is my deep belief that many of the considerations which have to be considered by the project director once the project starts can and should be anticipated in the planning stage of the project. I would, therefore, like to present my remarks in the context of both the project management and planning activities.

As a point of departure, I would assert that a large number of books, texts, and references dealing both with the preparation of research proposals and the conduct of research do not lead to an adequate definition of the resulting research or development project in a way such that it can be planned or managed efficiently. I would also state that such outlines to be used as guides for the preparation and the submission of proposals as published by the Cooperative Research Branch and similar agencies also are weak in doing these

tasks. It is true that such guides do request the purposes and objectives of the study, an outline of procedures, and a general time schedule. They tend, in my opinion, to deal with the project in a gross way resulting in a series of parts too often loosely combined into a whole. That is, there are brief sections on the research procedure to be employed, the subjects to be employed, the appropriate statistical analysis to be employed, each of which is presented without too much concern for the actual dependency existing between the parts. The time estimate tends to be rather gross in nature and may or may not be derived from careful study of exactly how long it takes to do such jobs as securing the subjects, developing the experimental conditions, and devising appropriate statistical treatments. In short, proposals prepared under these conditions do not adequately deal with three parameters of a research and development project with which one must eventually deal as project manager. They are (1) a schedule to be maintained, (2) a complex group of interrelated activities, and (3) a great uncertainty regarding the nature of the tasks to be performed and the time and resources needed to do the tasks. As a consequence of failing to recognize these parameters, important operational aspects often go ignored or unrecognized until a fire breaks out and then project manager hastens to call a fire engine (e.g., statistical consultant), to put it out. The failure to delineate <u>early</u> the relationships and dependencies existing among project tasks so that only the most important problems require the project director's time too often means the project director spends time on trivia.

Traditional proposal preparation and planning procedures also do not show a need for a system of continuous evaluation of progress in the project nor for a way of incorporating changes in the plan as the project moves along. Since the funding of a project usually brings with it a call for progress reports by the sponsor, it would appear that the project director should show some concern over a means of ascertaining exactly where he is at any time and where he tends to be in the near and distant future. The position I have set forth above does not come from a form of wishful thinking but derives from my direct experience on working with several funded research projects plus assisting several project directors in the management of their project during our current research on the applicability of the PERT technique to educational research.

New Approach

If my position has validity, then I am obligated to suggest a different scheme for the planning and management of research projects which overcomes the cited limitations of the traditional and current procedures. As seems so often with the case of Education, such a system or scheme comes to us from outside of our own energies and activities. Within recent years, the problems encountered in the conduct of research and development activities possessing the three characteristics noted above in areas other than educational research (namely military and industrial projects) have resulted in the development and elaboration of new planning and management systems. The generic term applied to these new systems is "network analysis" (6).

The differ enough from normal proposal preparation procedures as guides for the conduct of research to merit our attention.

The chief components of the network analysis system are (a) a graphic presentation showing the sequence and interdependence of all of the activities or tasks making up the project, (b) estimates regarding the time and resources needed to do each activity, (c) a determination of calendar dates when each activity can and must be started and completed if the final completion date for the project is to be met, and (d) the resulting management controls made possible by the use of the system. Time does not permit us to go into detail regarding the many variations of this general system which has been developed for project planning and management. The general nature of the technique, however, does result in a new and different set of questions which need to be asked both in the preparation of research proposals and actual conduct of the research and which the project director must answer if he is to both plan and manage a project to successful completion.

I would like to present some of these questions along with some observation and comment in response to regarding each. In order to provide a context for the questions, it is necessary that you accept the proposition that any research and development project consists of a series of activities or tasks which must be accomplished to successfully complete the project. These tasks vary in their specifity of detail. They are characterized by people using resources over time to accomplish a stated objective. Activities represent work and include such tasks as preparing, researching, building, deciding, testing,

computing, deleting, and similar actions. To complete any given activity in the project, we need to know who will do it at what skill level, in what quantity, on what facility, with what material, and where (7). Let us now turn our attention to some more specific questions.

Question 1. What is the final end product or major objective of the research or development project?

While we might approach our project with the idea that our results will ultimately result in changes in educational procedures, it is more realistic in the management of a project to recognize that the end product will have more visibility and concreteness. It will probably take the form of a final report, an organizational chart, a product of some kind, or some such end product. Once the final report is printed and distributed most Cooperative Research projects are terminated. The end product of such research projects for planning and management purposes thus becomes the final report.

Question 2. Assuming the major objective has been defined, what are the subprojects at successively lower levels which need to be accomplished in order to reach the principal objective?

The achievement of the major objective is going to be the result of the accomplishment of several lesser objectives. For example, a questionnaire will be the result of the lesser objectives of determining the format, arranging the tryout, mailing the final form, conducting follow-up procedures, and so on. In short, we need to break down the major tasks into smaller and smaller tasks. This

action results in a kind of "tree" which is built from top down. The lesser units in the tree can take the form of "hardware" items such as a questionnaire but can also consist of such items as functions to be performed, organizational structure, and funding procedures.

Question 3. What exactly are the tasks or activities to be accomplished?

The answer to this question consists of a careful delineation and definition of the major subproject tasks to a level of detail sufficient to describe the work to be done and which does not leave them in a rather vague condition. For example, to say that a "questionnaire is to be constructed" leaves the task undefined. We need to elaborate more on the specific tasks involved. Such tasks would include the more detailed activities of drafting questions, trying out the questionnaire, revising the questionnaire, developing a method of analysis, duplicating the questionnaire, and similar actions. To state in a proposal that "a workshop is to be conducted" leaves open the many subtasks which go into the successful conduction of a workshop which need to be explicated in order to plan and manage successfully for the workshop. Such subtasks would include the preparing and mailing of invitational letters, arranging room facilities, arranging for materials, arranging for speakers, and a host of related subtasks.

Question 4. To what level of performance or specification is the task to be done or accomplished?

Not only must we specify detail in each activity, we also must give consideration in the activity definition to desired performance.

standards. For example, one activity involved in test construction projects is the determination of the reliability coefficient. To secure high levels of desirable reliability, considerable time and effort must generally be put forth. One can, however, define the activity so that a lower level of reliability is acceptable and thus not as much as required in the way of time and personnel. Again, does one want personalized letters to go out to respondents in the questionnaire study or can a form letter serve the same purpose? In either case, the task must be specified in terms of the level of performance one is willing to accept in establishing the task. It makes quite a difference in defining an activity of "statistical analysis" whether one simply is going to calculate simple percentages for frequencies or whether one is going to go through the more rigorous process of employing many simple or complicated tests of statistical hypotheses.

Question 5. What is the order or precedence of the activities or tasks?

The answer to this question lies in the degree to which we can show the sequence, dependency, and the interrelationships of all the tasks to each other. Some tasks absolutely have to be done before others and so careful consideration has to be given to this problem of dependency and sequence. It is insufficient to simply state that statistical analysis will be done upon the completion of the experimental procedure. Instead, one must understand that in many cases experimental procedures should not begin until an appropriate statistical technique has been selected. The appropriate technique cannot be selected until one exactly knows what hypotheses are to be tested. Approaching it from the other side, once we know the hypotheses to

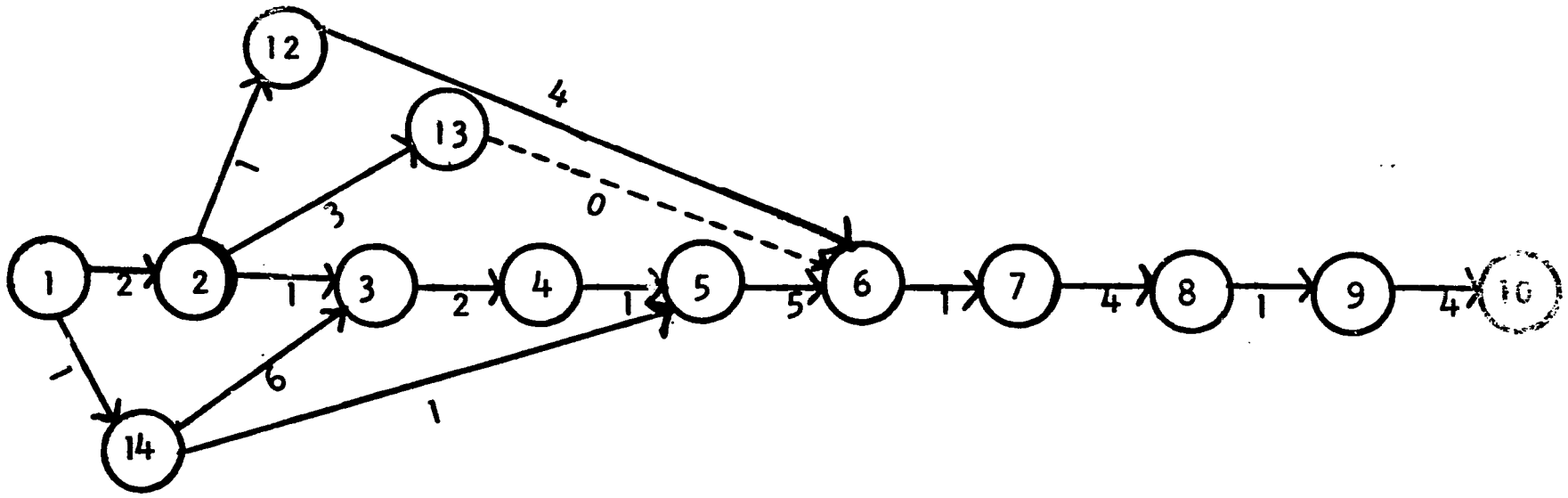
be tested, we can begin to look for a statistical procedure and fully understand and comprehend it before we begin the actual analysis of this data. We would thus avoid the too often occurring situation where the project director approaches the statistical specialists and says "What do I do with the data now?" Careful thought as to the order of tasks will reveal that most projects are not linear or serial in nature but consist of many parallel kinds of work which can be planned to go on concurrently. One can, for example, be arranging for statistical analysis while applying treatment conditions to experimental groups. The careful ordering of tasks will also reveal that there are certain key tasks whose specific accomplishment or nonaccomplishment will determine the movement forward or create delay in the project. By noting these critical points well in advance of conducting the actual project, the project director can effectively direct his attention to seeing that they are accomplished on time.

Question 6. Who is going to do the tasks?

As you visualize a project proposal in its planning stage, has it occurred to you exactly who is going to do each of the many tasks which have been specified? Generally, the practical answer to this question appears to take the form of making sure the project budget includes a couple of graduate assistants on the assumption that they will do most of the work. Assuming that the many tasks and subtasks have been carefully delineated, one needs to study the personnel requirements needed to accomplish the task along with an estimate of the time involved to do it, in order to arrive at a more realistic appraisal of personnel requirements. Careful delineation of tasks

will also point out how much of a specified level of competence is needed. For example, is a given activity such as key punching to be done by the secretary, the research assistant, or by a specialist in key punching? If the latter, how much time would he or she actually need to do the task to what level of error? Which of the many tasks of the project will be assigned to the research assistants and which ones will fall to the direct energies of the project director? Who is going to mail the questionnaires? Who is going to tally the responses? What kind of skill levels are needed for any of the activities? Careful delineation of the tasks can provide a more realistic personnel budget projection than might otherwise develop. An illustration of determining personnel requirements through the network analysis system is shown in Figure 1. The upper part of the figure shows a network for a small project involving the use of a questionnaire. The table below lists each activity using the event numbers (e.g., 01-02 design questionnaire) to identify the various activities on the project along with an estimate of the time required. Also shown are the estimated hours that the project specialist will contribute to each of the tasks. The hourly rates are also shown and these rates multiplied by the total hours committed gives a projected dollar total for the activity. The column totals show the amount of time to be contributed by the personnel plus the total amount of dollars.

Question 7. Is consideration given to certain restrictions or constraints which effect project schedules?



Event P - S	Activity Description	t_e Weeks	Estimated Hours				Hourly Rate				Dollar Total
			P.D.	R.A.	Sec.	K.P.	P.D.	R.A.	Sec.	K.P.	
01-02	Design Quest.	2.0	10		2		$10.00		$2.00		$104.00
02-03	Tryout Quest. Dupl.	1.0			4				2.00		8.00
03-04	Arr. Key Punch	1.0	1				10.00				10.00
04-05	Tryout Quest.	2.0		10				$5.00			50.00
05-06	Final Form Dupl.	1.0			8				2.00		16.00
05-06	Admin. Quest.	5.0		20				5.00			100.00
06-07	Key Punch	1.0				8				$2.50	20.00
07-08	Data Analysis	4.0	4	20			10.00	5.00			140.00
08-09	Summarize Data	1.0	4				10.00				40.00
09-10	Prep. Final Report	4.0	10	10	20		10.00	5.00	2.00		190.00
12-06	Hire Key Punch	0.4	1				10.00				10.00
02-13	Design Data Analysis	3.0	15				10.00				150.00
13-06	Dummy	0.0	-	-	-	-	-	-	-	-	-
01-14	Design Sample	1.0	4				10.00				40.00
14-03	Select Tryout Sample	0.6		5				5.00			25.00
14-05	Select Final Sample	1.0		10				5.00			50.00
	TOTAL		49	75	34	8					$953.00

Figure 1. Illustration of Determining Project Personnel and Requirements

The answer to this question centers around the degree to which the project director is able to foresee the fact that certain resources might not be available to him when desired. Reference is being made to the availability of students for research projects, the availability of computer facilities because of peak loads, and similar restrictions. For example, the PERT Project plan originally called for consultation with the participating project directors during the month of September. A casual conversation with one project director called our attention to the fact that September was a normal vacation period for university personnel. We therefore had to hastily change our plans to make initial contacts with the project directors during the mongh of August. This caused us to delay another aspect of the project which we were then working on in order to accomplish this task. Another example is encountered in the Hawthorne Effect Project where we assumed that the Computing Center had the kind of computer program suitable to our needs and which would be readily available. Careful checking, however, revealed that no such program existed and therefore the analysis of the first year's results are now behind schedule. One must plan and allow for what might be considered normal times for purchase orders to be processed and for the acquisition and making operational selected kinds of equipment.

Question 8. Has adequate consideration been given to the unknown nature of many tasks?

It may seem somewhat pointless to so state but the field of educational research and development does not have adequate records of past performance to adequately establish the time needed to complete certain

tasks. There is, consequently, much uncertainty with how long it takes to do many of the activities to be undertaken. For example, exactly how long does it take to process one thousand questionnaires of the type handled by the Research Register Project? Exactly how long does it take The Test Development Center to develop a national norm sample for one of its tests? Exactly how long does it take for the PERT Project to key punch and computer process the network for a project containing 500 events? Many of these activities are new and hence no experience is available. We can in many cases draw upon the experience of persons that are familiar with the technique to help us remove much of the unknown and whenever possible this should be done during the planning stage.

Question 9. Is the project plan fully understood and/or easily communicated to others inside and outside of the project?

While this may not seem to be an important element of proposal preparation right now, it becomes important when others try to understand exactly what it is that you are trying to accomplish. Complex verbal descriptions of procedures can become cumbersome and result in the reader becoming discouraged and perhaps reacting negatively to the proposal. A graphical presentation of the project using the network analysis system can readily convey to both superiors and subordinates the essential tasks to be accomplished, the order in which they are to be done, the time to be consumed, and the critical points in the project plan. Further, the network can provide for a visual system of evaluating progress on the project and thus informing others of the current status of work.

Question 10. What are the critical points needing additional resources?

Careful outlining of the tasks to be done will reveal that some are simply not as urgent in time of accomplishment as others. This condition can be referred to as positive slack for that task. Other tasks may have no slack or actually fall behind schedule and therefore have negative slack. Knowledge of where slack exists in the project is useful in that resources normally allocated to less crucial tasks can be transferred to those tasks showing negative slack or are behind schedule. Under careful management this "trade off" of resources can be anticipated to some degree in advance of the actual undertaking of the activity concerned.

Question 11. What alternative plans to the "best" plan is the researcher prepared to develop?

Any research proposal can be looked upon as representing the most desirable or best way to do the research. In this sense, it is an idealistic way of doing the study. It may be, however, that the limitations either of time and resources or both plus unexpected delays in the project may operate to invalidate the ideal approach. One must then be prepared to develop alternate ways of proceeding which may at the same time represent less desirable ways of doing the project. For example, ideally one might want to wait until all of the questionnaires are back before starting to do key punching. The increased time involved in following this procedure means that the project cannot be completed on schedule. To gain time, the key punching could be started before all questionnaires are returned. Such an action might result in problems developing that might not have occurred if the ideal plan

could have been followed. In such cases, the researcher must decide whether or not to delay the project and not meet the schedule or accept the increased risk associated with the change in plans. A researcher must be prepared therefore at any time in a project to develop alternative plans to his proposed plan because of the realities involved in project planning, scheduling, and operation.

Summary

There are perhaps many other questions which one might ask similar to the above but time certainly does not permit an exhaustive presentation of them. The above are presented to reflect the idea that a different approach to the planning and management of projects than has traditionally existed is needed. The basic technique I should like to suggest as a means not only of developing an operational chart for the effective planning of projects but also for managing projects after they are under way is that of network analysis.

The utilization of network analysis has several advantages which would appear to justify its use. These advantages are:

1. A graphical presentation of the total project showing the sequence and dependency existing between the many tasks in the project,

2. A more realistic projection of personnel requirements,

3. The method of determining potential trouble spots in the project at some time prior to the actual occurrence of the significant task,

4. Providing the project director with a way of allocating his energies so that the solution to the more significant problems can occupy his time rather than the trivial problems.

While not solving all of our problems, the judicious use of the technique permits us to see that all of the fires or trouble spots in the project once it is started are not of equal height but that some fires are larger than others and we know better at least where to throw the water.

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