COLUMN EDITOR: JAMES RATHS

PERT: A Technique for Education

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BECAUSE of the recent publicity given to the effectiveness of PERT, Program Evaluation and Review Technique, and because PERT charting is frequently either required or recommended as a part of proposals submitted for the purpose of obtaining federal funds, a great deal of interest and enthusiasm about PERT has recently been manifested among educators. The interest ranges from a simple inquiry into the essential characteristics of PERT on the one hand to a desire for a completely rigorous investigation in terms of minute detail of the PERT/COST system on the other.

Although originally designed for massive integrated research, development, or management programs in areas other than education, the system has certain characteristics that are applicable to educational research and to curriculum development projects.

The PERT System

PERT may be defined as a set of principles, methods, and techniques for planning programs in relation to objectives, interrelating and controlling variables of time and resources, scheduling events and activities, and replanning research or development programs (6:3). The technique provides a single network portrayal of the complete system. A uniform standard of communication is provided whereby all personnel associated with the project are presented with the same picture of progress, problems, and alternative remedies.

Proper utilization of the system enhances common understanding at all decision-making levels. Visibility and insight into problems that were never realized without the use of PERT emerge and become apparent. A basis on which the PERT system is established is that all organized activity must have as its motivating and guiding force the attainment of some predetermined objectives. The purposes and objectives are used as a yardstick against which all requirements and accomplishments are measured and evaluated. Although they are definitive at the outset, they may be altered as the process develops.

PERT provides clear, concise reports for those staff members supervising programs to:

1. Assess the plan of the program

2. Analyze and evaluate the status of completed work

3. Program the uncertainties of the objectives

4. Forecast or isolate potential problems

5. Arrive at reasonable decisions

6. Plan the best possible use of resources to achieve desired goals.

The benefits that accrue from PERT are commensurate with the amount of understanding and support applied to it.

It is emphasized that a device or technique, regardless of the degree of sophistication, is only a tool and can never be a substitute for effective and innovative curriculum supervision.

History and Application of PERT

Prior to the development of the PERT method, planning for large programs was usually conducted by a form of Taylor-Gantt charting introduced during the early part of this century, and by Fausch techniques involving numerous individual milestones. The task of assessing program status of large operations by continually updating and reviewing each milestone was laborious.

The PERT system is considered a "management breakthrough" for saving time and increasing efficiency of program operation. By 1961, the technique had found application in certain areas of the Air Force, Army, other agencies of the government, and private industry and business (3:2). NASA and the Department of Defense, introducing the cost variable, have more recently developed a uniform PERT/COST system, integrating costs and schedules into a common framework. Inclusion of PERT or similar management systems as part of contractual proposals is now required by a number of granting agencies.

At about the same time the Navy was developing PERT, the DuPont Company, concerned with the increasing costs and time required to bring new products from research to production, initiated a study which resulted in a similar technique known as the Critical Path Method (CPM). CPM, like PERT, is a dynamic system for planning, scheduling, reporting, and managing complex operations.

Examples of other variations of PERT procedures include: Program Evaluation Procedure (PEP) used by the Air Force, Preparing Educational Planners (also PEP) used by Litton Industries, Resource Allocation and Multi-Project Scheduling (RAMPS) used by CEIR, Inc., and Program Reliability Information System for Management (PRISM). At least 40 different code names or acronyms representing variations of new management controls have been reported (5:95).

Successful applications of PERT are many and varied and encompass virtually every field of human endeavor. Some examples of PERT that have saved time and money include: administrative planning, advertising campaigns, analysis of production cycles, weapon and space acquisitions, and others (1:45, 3:11, and 6:A.1).

Time and cost reductions have been demonstrated by the use of the PERT approach. Companies have shown 22 to 25 percent reduction in time, 15 percent

reduction in expending costs, and 37 percent reduction in downtime (6:A.1). The size of programs that have been analyzed by PERT networks ranges from a plan for a wedding to the Apollo program consisting of approximately 55,000 activities (3:10).

Developing a PERT Network

PERT is a statistical management control tool that assesses the reasonableness of plans and schedules and the feasibility of accomplishing tasks in detail by deadline times. The objective of the system is to provide necessary information to enable better planning and control of time and cost in developmental and operational projects, thereby obtaining a valid network which is meaningful to the person or persons who will actually execute the program. The PERT technique must be utilized concurrently and consistently with other aspects of curriculum planning and operational programs.

The accuracy and success of any system is dependent on the clarity and completeness of the purpose of the undertaking. In keeping with sound curriculum planning, the first step is to define the objectives. The system then requires that the objectives be divided into subdivisions, and then into the tasks to be performed.

A task is a unit of work required to complete a specific job such as a report, a test, a drawing, a lesson plan, or a service. Basic to the PERT system is that each task and the responsibility necessary to complete a given program must be visualized concisely to be displayed in a flow-chart type network.

A network is a graphic representation of a common framework for the accomplishment of all necessary tasks to be performed. It enables assignment of responsibility and resources, delineates objectives for monitoring progress, and provides a basis for planning and program visibility. Networks include only data that are significant, meaningful, and readily interpretable. Networks are composed of events and activities that have been previously identified.

Each station on the line is represented by an event. An event is a specific, definable accomplishment in a program network, which is recognizable at a particular instant in time. Events may be at the beginning or completion of one or more activities, and may be either physical or conceptual. Circles, squares, rectangles, or other geometric figures are used to represent events in the network (6:18), which are usually used for describing the activities that lie between them.

An activity is a clearly defined job to be done, characterized by persons using resources for some period of time to accomplish stated objectives. An activity might be preparing, researching, developing, analyzing, deciding, testing, or other similar actions. An activity is represented on a PERT network by an arrow which represents a connection or interdependency between two successive events. Networks are based on the assumption that an activity cannot be started until its preceding event has occurred, and that the event succeeding the activity cannot occur until all activities leading to the event are accomplished. Events and activities are defined with sufficient precision to communicate tasks to be performed, sequenced, positioned, and flow-chart-

ed according to a logical set of criteria displaying interdependencies. No subsequent event is completed until all of its predecessor events are completed. Tasks, activities, and events may have summary and charge numbers applied for the purpose of identification and determining costs.

From different combinations of sequences of activities emerge various paths from the beginning to the end of the project network. The time estimates of "optimistic," "most likely" and "pessimistic" are applied to the system and reduced to a single expected elapsed time. This expected elapsed time, together with standard deviation and probability data, provide the decision maker with a better opportunity to evaluate the degree of uncertainty involved in a schedule.

The times required by each path are determined by totaling the time for each activity along the path. The longest time through the network, the critical path, controls the schedule for the entire project. All other paths through the network are called slack paths. Some investigators feel that the critical path and slack time results are the most important calculations of PERT. The paths are ranked according to time from the longest to the shortest, and the activities on the critical path are analyzed to determine possible time reductions or whether activities can be performed concurrently. If the critical path is shortened to less than that of a slack path, that slack path then becomes critical, and its activities in turn are analyzed to determine how that path can be shortened. This process is continued until a plan is developed to complete the project by the desired date or the fastest time. If a network showing the critical path indicates that the program cannot meet the time required, it is then subjected to a decision-making process to determine appropriate adjustments. Network development and critical path analysis reveal interdependencies and problem areas which are neither obvious nor well-defined by conventional planning methods.

Model networks should be handled with a philosophy of flexibility to allow for the possibility of modifications which will match the realities of the program. After the network has been prepared and the schedule for the program has been established, cost estimates are made for each task by determining the materials and resources required to perform each task.

Although the technology of PERT has been developed to a relatively high degree, the success of a program depends on the amount of staff support. The expansion of the PERT approach to broader educational operations is a function of the acceptance of the system by educators. To the person not familiar with the approach, it may appear that it is too structured, too mechanical, and too definitive. It should be emphasized that the educator should never be bound to a particular system. Especially is this true if the system inflicts undesirable rigidity on the operation. However, clarification of objectives and thorough planning should not be construed to be synonymous with inflexibility. To the educator and particularly to the curriculum development specialist, the use of the PERT technique in planning educational activities and programs should be strong-

ly considered to enhance greater efficiency and thorough planning.

Although PERT has not been used extensively as a tool in curriculum development, Cook (1:49) has indicated that the steps involved in developing or revising a curriculum unit have been fairly well established. He emphasizes that two areas of curriculum development may apply the PERT approach. One is the development and preparation of instructional materials, and the other the process of disseminating information about these materials.

The PERT network is a logical graphic diagram or flow chart which identifies the relationships, interdependencies, and constraints in a program showing the sequential steps needed to reach a stated objective. The process of estimating expected elapsed time is separate from the process of scheduling.

Research and development projects can be supervised more effectively if staffs have the means to plan and control the schedules and costs of the work required for performance objectives.

Benefits to the educator in using PERT for curriculum development and educational research include:

1. A single network portrayal of the complete system

2. A basis for a unified standard of communication among staff members

3. A procedure that enhances common understanding at all decision-making levels

4. Reports that allow for thorough assessment of the sequence of activities, schedules, and costs

5. Reports that assist in analyzing and evaluating the status of completed work

6. Reports that assist in forecasting or isolating potential problems and decision making

7. Reports that assist in planning the best possible use of resources to achieve desired goals

8. A means whereby all tasks must be specifically defined

9. A means to determine where resources should be applied to best achieve the desired objectives

10. A means to assist in identifying those areas of potential delays.

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