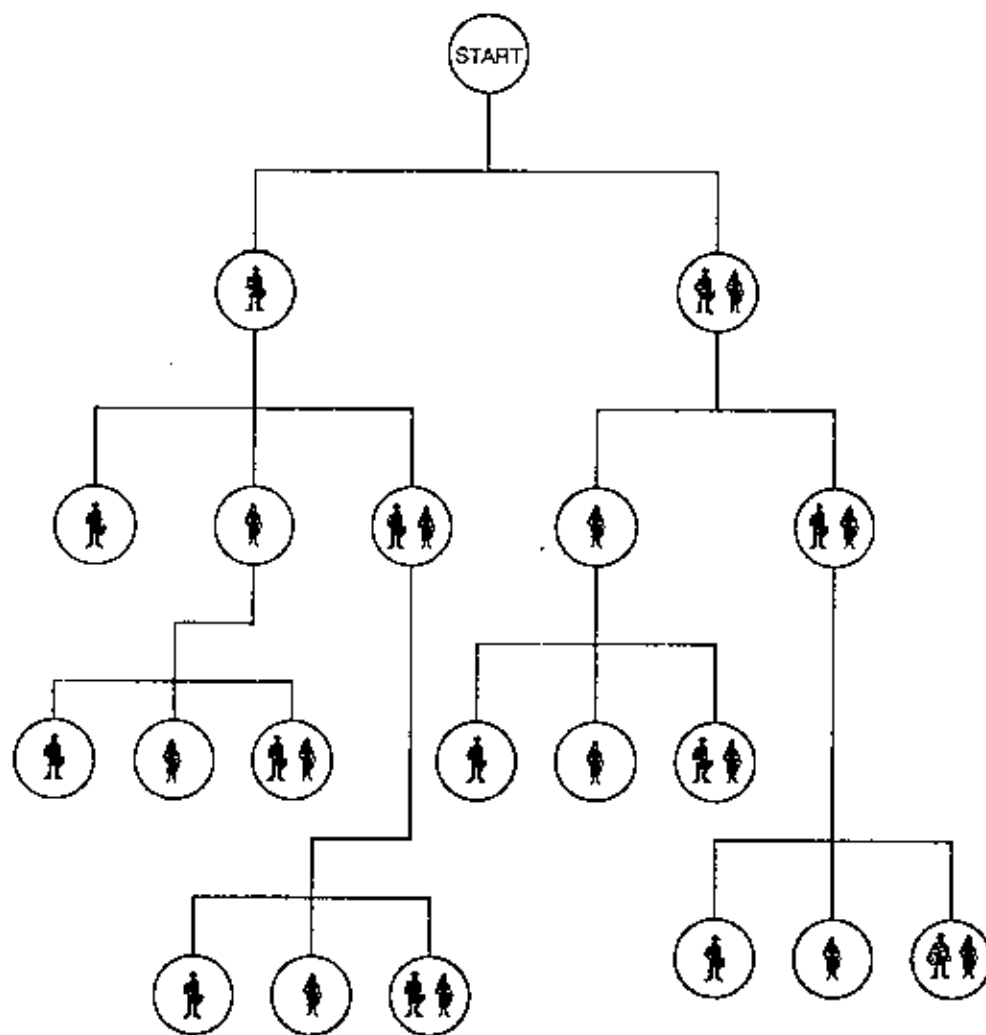


Budgeting Time and Money

Student Resource Book

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Table of Contents

	Page
I. INTRODUCTION	S-1
II. GENERAL BACKGROUND	S-1
A. Who Needs a Training Program?	S-1
B. What Is a Training Program?	S-2
C. Who Creates a Training Program?	S-3
III. SPECIFIC BACKGROUND	S-3
A. The Creative Communications Company	S-3
B. A Training Program Suitable for CCC	S-4
C. How Much Time Is Required to Develop This Training Program?	S-5
D. What Is the Cost of Production?	S-7
E. Organization	S-9
IV. THE GENERAL PROBLEM	S-11
V. THE SPECIFIC PROBLEM	S-11
A. Preliminary Problem	S-12
B. The Problem	S-12
C. Computer Problem	S-13



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I. Introduction

What does the name AT&T mean to you? Most of us think of a long-distance telephone company. In reality AT&T is much more than a telephone company. Persons at AT&T design, engineer, manufacture, install, and maintain a variety of products related to information movement and management. Some of these are for individual use. You may have seen them advertised on TV or for sale in AT&T stores. Many of them are much more complicated and are used in large-scale information systems.

In addition, AT&T provides its customers and its employees with high-quality *training* in the use and maintenance of its products. Our problem has to do with the development of training programs requested by the customers of AT&T.

There are four AT&T National Product Training Centers and fourteen regional centers. The main function of these centers is to "*develop and deliver training designed for customers and internal populations responsible for maintaining, operating, engineering, administering, or installing AT&T products and services.*" The setting of our problem is the AT&T National Product Training Center in Dublin, Ohio. The problem asks us to consider some budgeting options in the development of a training program requested by a company whose product uses AT&T equipment.

II. General Background

A. Who Needs a Training Program?

One product AT&T has designed and manufactured is an Electronic Switching System (ESS™). Suppose a company (we'll call it Creative Communications Company--CCC) buys this system for use in a product or service it is to provide to its own customers. Those who buy such a sophisticated product or service need to also know how to operate it; what to expect of it; and how to get rid of any "bugs" that may occur during shipping, handling, day-to-day operations, etc. Persons who use delicate and complicated systems need good instruction in how to use and care for this equipment. The company contracts with the AT&T training center to provide a training program that CCC can supply to buyers of its final product or service.

A training program can take a variety of forms and will probably have a number of components. It is important that it be *product specific*; that is, it must be designed directly and specifically for the particular product for which it is needed. It must be *performance-based*; that is, it must be closely related to maintaining and improving the operation of the product. It must be *comprehensive*; that is, it must prepare the customer for every question that may arise--ranging from instructions for turning it on and off to methods for dealing with any irregularity in the performance of even the smallest piece of it.

B. What Is a Training Program?

A very simple example of a training program is the instruction book that goes with your camera. My camera is the automatic kind. It advances the film for me, focuses for me, tells me what kind of film I am using, and tells me how many pictures there are left on the roll. Still it needs an instruction book to tell me how to load the film, what kind of batteries to use, where to install them, how the automatic flash lets me know it is ready, how to set the camera so that it will take a picture automatically, and how much time is allowed between the time it is set on automatic and the time it actually takes the picture. There are many pieces of equipment, large and small, that come with instruction books.

Training programs are much more than instruction books. They can involve many other approaches to training. For example, the Fast Break Swim Team is preparing its swimmers to compete in Olympic try-outs. They need a comprehensive training program. The *components* of this program might be--

1. a booklet entitled "Rules for Conditioning" that describes needed activities like running, lifting weights, stretching exercises.
2. a booklet entitled "Diet for Speed and Strength."
3. a video demonstrating the strokes with emphasis on arms, legs, and turns.
4. audio tapes to develop self-confidence, concentration, and visualization.
5. a chart describing detailed in-the-pool activities.

From time to time we include short questions to help you test how well you understand what you have read. Work these *Try Out Problems* (TOPs) and check your answers with your teacher.

TOP 1

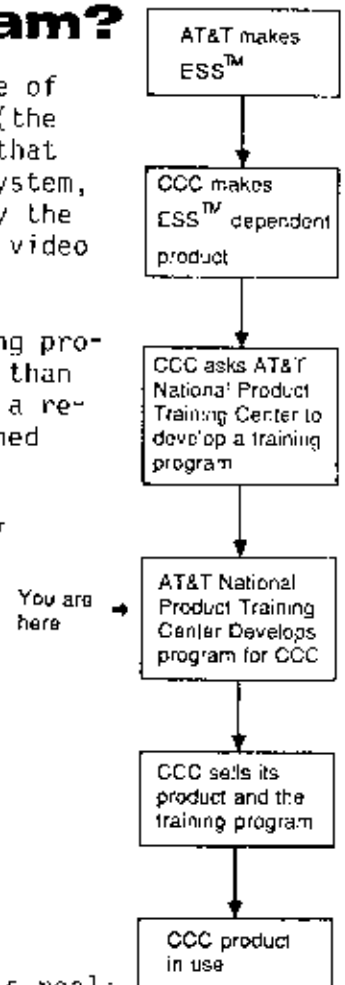
- a. Suggest some equipment for which there is a training program consisting of a single booklet.
- b. Plan a Driver Education program for your school. List study material and hands-on activities, assuming your school has all the needed equipment.

C. Who Creates a Training Program?

The answer to this question depends very much on the purpose of the program. In the case of my camera, the instruction booklet (the training program) is probably created by someone in the company that made the camera. However, for a very complicated video camera system, the training program would be much longer and might be created by the company that made some of the essential operational parts in the video equipment.

In the case of a swim team in a small community, the training program might be made by the coach and would likely be much simpler than the one suggested for the Fast Break team. That team might hire a retired Olympic coach to create a training program specially designed for its needs.

In our problem the training program is developed by the AT&T National Product Training Center, Dublin.



III. Specific Background

A. The Creative Communications Company

The AT&T National Product Training Center in Dublin, Ohio, is real; and it is providing the setting for our problem. The Creative Communications Company (CCC) is imaginary, but it is typical of many companies that use equipment developed by AT&T. Since it is an imaginary company, we can assume anything we wish about it. We assume that the communications system sold by CCC uses components created by AT&T. Thus it is logical to assume that CCC requests the AT&T Product Training organization to develop a training program that CCC can provide to companies or institutions that buy the CCC communications system.

B. A Training Program Suitable for CCC

In developing a training program, we must first decide what this program ought to include. Our projected training program consists of four main parts:

PART 1. OVERVIEW, OPERATION, ADMINISTRATION

- a. A course, *Overview*, introduces in general what the equipment is intended to do and describes special operational features, hardware, and terminology.
- b. A course, *Operation and Administration*, deals with the actual working of the equipment, trouble shooting, and debugging.

PART 2. INSTALLATION

A course, *Installation*, gives detailed instructions for setting up the equipment and provides related hands-on activities.

PART 3. MAINTENANCE

- a. A course, *General Maintenance*, teaches the regular procedures required to keep the equipment in good operating condition.
- b. A course, *Special Maintenance Procedures*, describes types of maintenance required periodically and includes hands-on activities.

PART 4. ENGINEERING

- a. *General Engineering Seminar* presents detailed basic engineering information related to the product.
- b. A course, *Advanced Engineering and Problem Solving*, includes information of a more advanced nature and examples of problems that may arise along with methods of handling them.

TOP 2

What part of the training program described above is similar to the instruction book for a camera?

Preparation and Testing

To produce each part of a good training program there is an important first step. Those involved in the preparation must be thoroughly

informed about the product, the company producing the product, and the potential buyers of the product. For this reason, field trips will be required. In this context a *field trip* means that the persons preparing the course materials travel to some location where first-hand information can be obtained. In our example the field trips will be made to CCC's production location.

Field trips are expensive, but they are also essential. A field trip will be required for the personnel involved in preparation of Part 1. A separate field trip will be required for the persons preparing Part 2. The third field trip can serve both those preparing Part 3 and those preparing Part 4.

TOP 3

In Section IIA it was stated that a good training program must be product specific, performance-based, and comprehensive. In your opinion, for which of these qualities are the field trips especially important?

Other trips will be needed besides these informational trips. At the end of each of the four parts, testing and evaluation is needed. This testing will best be done at either the location where the product is produced or at the location where it might be installed. These trips are called *field trials*. The field trials for Parts 1, 2, and 4 must be at a location away from Dublin. In order to reduce cost, the field trial for Part 3 can be held in-house, that is, at the AT&I National Product Training Center, Dublin.

C. How Much Time Is Required to Develop This Training Program?

Estimates of the time requirement for development of each part of the training program are listed in table I.

What Is an Hour?

We know the answer to that question of course! An hour is 60 minutes. In deciding how many hours a development takes, the word hour can be used in two ways. We can think of a *real-time* hour, that is, the length of time from 2 p.m. to 3 p.m. (Some real-time hours may seem longer than others, but they are all 60 minutes long.)



In developing a training program, more than one person may be working on the same project. Thus we have to think of a *work hour*. When one person works one real-time hour, one work hour is produced. If three people work from 2 p.m. to 3 p.m., three work hours are created. If a staff of 20 people work from 8 a.m. to 4 p.m., they have created $20 \times 8 = 160$ work hours.

In Table I the times listed are *work hours*.

TABLE I
ESTIMATE OF TIME REQUIRED FOR
DEVELOPMENT ACTIVITIES

PART OF TRAINING PROGRAM	ESTIMATE OF TIME
1. OVERVIEW, OPERATION, ADMINISTRATION	
Field Trip	2 days
Overview	240 hours
Operation and Administration	400 hours
Field Trial	5 days
2. INSTALLATION	
Field Trip	4 days
Installation	800 hours
Field Trial	5 days
3. MAINTENANCE	
*Field Trip	4 days
General Maintenance	240 hours
Special Maintenance	640 hours
**Field Trial	6 days
4. ENGINEERING	
Engineering Seminar	80 hours
Advanced Engineering & Problem Solving	240 hours
Field Trial	5 days

*Field Trip 3 must be taken by personnel developing Part 4.

**This field trial can be held in-house at the AT&T National Product Training Center, Dublin, if desired. In this case 6 days can be replaced by 48 hours.

TOP 4

- a. How many work hours does it take to prepare the Overview?
- b. If three persons are assigned to this preparation, how many real-time hours does it take?
- c. If three persons are assigned to this preparation, how many work hours does it take?

How Long Is a Day?

We may also want to talk about a *work day*. A real-time day is, of course, 24 hours; but it includes sleeping, eating, and playing, as well as working. A standard work day is considered to be 8 hours. Notice that in the table we said that a 6-day field trial would be changed to 48 hours of work. (6 work days = 6×8 hours.)

Also, it is assumed that in a week we work 5 days and that in a year we work 45 weeks. This assumption accommodates such things as vacations, sick days, and holidays. Thus a year of work is equivalent to $45 \times 5 \times 8 = 1800$ hours.



TOP 5

- a. How many real-time hours does it take one person to complete Part 1?
- b. If two persons work together on Part 1, does this change the real time required for a field trip?
- c. If two persons work together on Part 1, does this change the real time required for preparing the two courses?
- d. What is the total real time required for preparing Part 1 if two persons work together on this part?

D. What Is the Cost of Production?

Production cost includes many things: salary, supplies, overhead, depreciation of equipment, etc. It is estimated as \$25 per work hour. Figures here and elsewhere are arbitrarily chosen for convenience. In reality they might be much larger and would certainly change with changing economic conditions.



TOP 6

Ten persons (including everyone from office boy to office manager) work an eight-hour day five days a week in a small auto parts assembly factory. The office boy makes \$5 an hour. The manager makes \$20 an hour.

- a. What is the office boy's weekly pay?
- b. What is the manager's weekly pay?
- c. What is the estimated weekly production cost at the factory?

The cost estimate for the development of our Training Program is given in Table II.

TABLE I
COST OF PRODUCTION

Production Item	Cost
Field Trips	\$300 per day per person
Field Trials	\$500 per day per person
In-House Production	\$25 per work hour

TOP 7

- a. What is the difference in cost/hour between field trips and in-house production? (Assume an eight-hour day.)
- b. What do you think might make field trips and field trials more expensive than in-house production?

The AT&T National Product Training Center, Dublin, must consider how best to meet the requirements of a company that asks them to develop a training program. These requirements will usually take the form of keeping the cost down to a reasonable level and at the same time keeping the real time required for preparation short enough. You will need to consider how adding more persons affects the time and how it affects the cost.

TOP 8

- a. Suppose Part 1 is to be performed by one person. Fill in the following chart. Remember that although the real time required for the field trip is listed in hours, the calculation of cost is by number of days.

	<u>Real-Time Hours</u>	<u>Work Hours</u>	<u>Cost</u>
Field Trip	_____	_____	_____
Overview	_____	_____	_____
Operation & Administration	_____	_____	_____
Field Trial	_____	_____	_____
Total	_____	_____	_____

- b. Fill out the same chart assuming that two people are assigned to Part 1. Will the real-time hours for the field trip change? Will the real-time hours for the overview change?
- c. Will the real-time hours decrease or increase when two persons are assigned to Part 1? Will the cost of production increase or decrease?

E. Organization

One of the most important steps in considering a problem of this type is organizing your thoughts. You might begin by making a chart showing the *real time* involved in each part of the development plan for one, two, three, or more workers. A similar chart for the *cost* of developing each part would be useful also.

Next you will need to think of a way of analyzing the different ways of assigning workers to each part. There are many possible assignments, but you can discard some by giving some thought to the process. Sometimes choices can be eliminated by using conditions given in the problem.

One way of organizing the assignment of workers is to set up an array indicating parts in one direction (say horizontal) and workers in the other (vertical) and showing the assignment of a worker by a suitably placed "x."

For example, suppose two workers are to be assigned to Part 1 and Part 2. A possible plan is described in the following array:

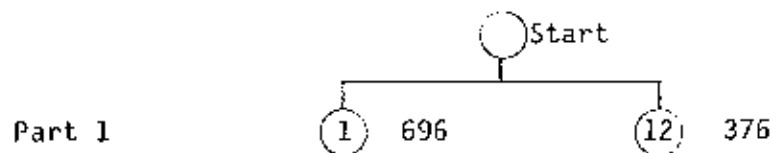
<u>Assignment</u>	<u>Part 1</u>	<u>Part 2</u>	<u>Real Time</u>
Worker 1	x	x	376 + 872
Worker 2	x		376

With this assignment it requires 376 hours to complete Part 1 and 872 hours to complete Part 2. Worker 1 (W1) will work a total of 1248 hours and W2 will work 376 hours. The entire project is completed in 1248 hours.

If the problem stipulates that the work must be completed in 900 hours, this plan would be immediately rejected. A condition like this one is called a *bound*.

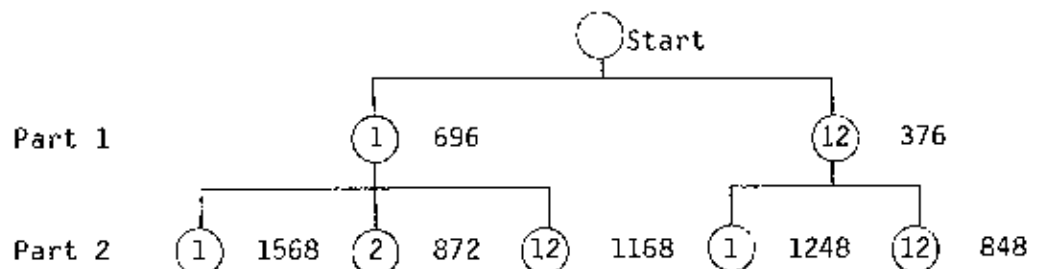
Another organizational technique is illustrated on the cover and title page of this book. The various lines going from one part to the next are called paths or *branches*.

Again, suppose two workers are to be assigned to Part 1 and Part 2. With this technique we would write the following:



There are two choices here for Part 1, W1 and both W1 and W2. The worker or workers assigned are shown by numbers in the circles. It might be helpful to write the real time beside each circle.

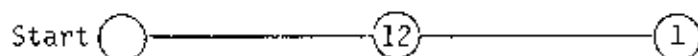
Now extend the path to include Part 2. This time there are more possible branches. Follow back up the branch to see who is working and what the total time will be.



TOP 9

- a. Why is ② not included in the chart at the Part 1 level?
- b. In the assignment for Part 2, why is it not necessary to include ② in the branches in the right-hand set, but it is necessary to include ② in the branches on the left?
- c. Why is it necessary to include 12 in both the left and the right branches?

Notice that the branch



gives the same assignment of workers as the array above.

IV. The General Problem

Analyze the development cost and time requirement for a comprehensive training program to be created by the AI&I National Product Training Center, Dublin. Discuss how to budget time and cost in order to meet the needs of a customer.

V. The Specific Problem

The Creative Components Company has asked the AI&I National Product Training Center, Dublin, to develop a training program for the communication system it is about to put on the market. The company would like to have a training program with the components described in Section III. (Again, costs are chosen for convenience.)

The following assumptions are made:

1. Each hour of in-house development costs \$25 per person.
2. Each field trip costs \$300 per person per day.
3. Each field trial costs \$500 per person per day.
4. Field trips must be taken away from the Dublin site. If at all possible, field trials should take place away from the Dublin site. The field trial for Part 3 will be in-house in order to reduce cost.
5. Field trip 3 must be taken by persons developing Part 4.

-
-
6. The four developmental parts can be carried on at the same time if enough persons are available.
 7. The four parts can be carried out in any order.
 8. The persons assigned to any part remain with that part until its completion and must be included in the field trip and also in the field trial.

A. Preliminary Problem

Discuss how to budget time and cost requirements for developing a training program satisfying the conditions listed. The AT&T National Product Training Center, Dublin, would like to have answers to the following questions:

1. What would the entire development (as outlined) cost if performed by a single person? How many real-time hours would it require?
2. What would the entire development cost if each part is performed by a single person, but a different person is assigned to each part? How many real-time hours would this require?
3. Suppose the entire development is performed by two persons, one assigned to Parts 1 and 2, the other assigned to Parts 3 and 4. What is the number of real-time hours required? What is the cost?
4. What is the shortest length of time needed to complete the entire development if no more than four persons are available to be assigned to it? How will the personnel be assigned to complete the development in the shortest time? What is the total cost in this case?
5. What is the least cost to develop the training program if five persons are available? How are the persons assigned? What is the corresponding time?

B. The Problem

The Creative Components Company expects to have its product on the market in four months. It requires a training program for the buyers of the product. The company would like answers to the following questions:

- a. What is the minimum cost to develop a training program in four months?
 - b. The company has set aside \$60,000 to have a training program developed. It is important that the program be of high
-
-

quality, as comprehensive as possible, and that Part 4 be included. Part 1 is essential. Discuss how you would develop such a program at a cost within \$1000 of the amount set aside. Include the number of persons used and how they will be assigned. Give reasons for the choices you make. If necessary, you may suggest changes in some of the assumptions listed, provided you give a justification of your suggested changes.

C. Computer Problem

Although one could design a computer program to do Problem B, Part a, such a program would require a long time to run on a microcomputer like the Apple IIe. Restrict the problem in any way you wish and write an appropriate program.

One suggested restriction is contained in the following statement: Find the least cost for developing a training program in four months, assuming that no more than eight workers are available, no more than two workers can be assigned to Part 1, and no more than two can be assigned to Part 2. Have the user input the desired time limit.

