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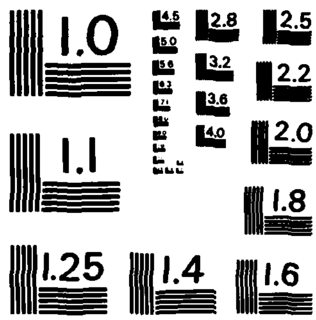


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# DEVELOPMENT OF A NETWORK ANALYSIS OF THE AIR FORCE PROVISIONING PROCESS FOR AN APPLIED COMPUTER SIMULATION EXERCISE

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Captain, USAF

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AFIT/GLM/LSM/84S-16





DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
**AIR FORCE INSTITUTE OF TECHNOLOGY**

Wright-Patterson Air Force Base, Ohio

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# DEVELOPMENT OF A NETWORK ANALYSIS OF THE AIR FORCE PROVISIONING PROCESS FOR AN APPLIED COMPUTER SIMULATION EXERCISE

THESIS

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the

Requirements for the Degree of

Master of Science in Logistics Management

Robert M. Douglas, B.S.    James E. Mulder, B.S., M.A.

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Finally and most importantly, we appreciate the support of our wives, Liz and Ann, who gave up many spring and summer family activities during 1984 so that we could complete this research. Hopefully, they feel the effort was worth their sacrifice.

Robert M. Douglas
James E. Mulder

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## Abstract

This research set out to produce a ready-to-use package for a computer-aided training exercise to teach a network analysis technique applied to the USAF provisioning process. The starting point for the application of the computer-aided instruction was the existing PROV-MAN-X exercise, but the newly developed exercise can serve either as a module for PROV-MAN-X or as a stand-alone product.

Information was gathered from interviews and prescribing government directives to construct a network model of the USAF provisioning process. Computer programs were designed to present a 64-question programmed text on network analysis and a computerized simulation of the provisioning process, both to be included in a training exercise primarily intended for use by provisioners attending courses at the Air Force Institute of Technology.

Summarizing the research objectives, the specific goals of the thesis were to (1) gather information to identify activities, relationships, and times for the USAF provisioning process, (2) design a computerized simulation model of the USAF provisioning process, and (3) develop "user friendly" computer programs to act as the instructional medium for the training exercise.

The remainder of the thesis was organized into the

following sections: literature review, model methodology, training exercise methodology, results, conclusions, and a comprehensive set of exercise instructions that includes appendices of: flowcharts, computer coding, exercise manuals, definitions, and the model of the provisioning process developed for the exercise.

Limitations of the research included: the deterministic branching of the provisioning network model, computer coding written specifically for the NOS 2.1 operating system on the CDC Cyber computer (with an available Graphical Evaluation and Review Technique with Queuing (Q-GERT) library), and the exercise has not yet been used in an actual classroom environment.

Exercise requirements include: one (1) to 99 computer terminals (visual-only, printer-only, or visual-printer), at least indirect access to a line printer, and a CDC Cyber computer with NOS 2.1 operating system and an available Q-GERT library.

# DEVELOPMENT OF A NETWORK ANALYSIS OF THE AIR FORCE PROVISIONING PROCESS FOR AN APPLIED COMPUTER SIMULATION EXERCISE

## I. Introduction

According to a 1980 study, games and simulations are defined as:

> An activity undertaken by a player or players whose actions are constrained by a set of explicit rules prior to tnat game and by a predetermined end point. . . . their elements comprise a more or less accurate representation or model of some external reality with which players interact in much the same way they would interact with the same actual reality (6:5).

A model can be defined as, "a constructed specific expression of a theory or one or more hypotheses (5:26)."

The United States Air Force (USAF) uses many computer simulations, mathematical models, and other exercises regarding everything from strategic force allocations to leadership role-playing; but there are only a few exercises in existence for management gaming. In the logistics management area, Bomb Management Exercise (BOMB-MAN-X), Logistics Management Exercise (LOG-MAN-X), Logistics Planning Exercise (LOG-PLAN-X), Supply Management Exercise (SUP-MAN-X), and Provisioning Management Exercise (PROV-MAN-X) are management games. They range from being fairly simple manual games (BOMB-MAN-X) to partially automated, comprehensive games (PROV-MAN-X).

## General Issue

PROV-MAN-X, a USAF logistics management exercise, was designed in 1963 by Professor B. J. May and Dr. Gilbert N. Calkins to provide logistics managers with an interactive learning experience of the overall provisioning process. The exercise includes six phases:

I - Time Phasing the Provisioning Process

II - Maintenance Concept

III - Provisioning Conference

IV - Policies, Budgets, Requirements, and Initial Contracts

V - Support of the Weapon System

VI - Student Critique

Phase V is the only automated phase. A computer program takes batch processed inputs consisting of inventory decisions for establishing requirements and the support of an operational weapons system. The game takes over 38 classroom hours, supervised by one to four instructors (22:1-5).

The objective of PROV-MAN-X is:

> . . . to provide students the opportunity of applying and testing their technical knowledge and management skills in the procedures and techniques of provisioning. By using this simulation technique it is possible to create a realistic environment in which decisions can be made, policies and concepts practiced, procedures implemented and months and years of experience compressed into a few hours of extensive training devoid of the risk or cost normally attached to provisioning decisions (22:1).

The two-fold objective of Phase I, Time-Phasing the Provisioning Process, is, "first, to increase understanding of the provisioning process, and secondly, to appreciate the use of PERT [Program Evaluation Review Technique] as a management tool [22:15]." Headquarters Air Force Logistics Command (HQ AFLC) and Headquarters Air Force Systems Command (HQ AFSC) clearly advocate the use of network analysis for the provisioning process; Chapter 42 of their pamphlet, AFLCP/AFSCP 800-34, states:

> Network analysis provides an effective integrated approach to managing the individual elements of logistics during the acquisition process. It enables the DPML/ILSM [Deputy Program Manager for Logistics/Integrated Logistics Support Manager] to integrate the various logistics elements as well as the total logistics support effort with the overall program planning and execution (11:para 42-1b).

To achieve the training objective, Professor May stated that it was essential that students not only build the provisioning network, but understand how that network reacts to what he described as "inherent, current or chaotic" problems (22:10).

## Problem Statement

Phase I of PROV-MAN-X is outdated and incomplete due to many recent changes in the USAF provisioning process and is limited in capability due to current time constraints on the manual play of this phase of the game (14, 9, 13, 18, 23, 28). The list of 46 events includes many which are decomposed single events (i.e. number 20, preparation of Reparable Item Breakdown (RIB); number 21, RIB completed; and number 22, RIB received by XYALC) and specific references are not cited to validate their accuracy or completeness (MMMM).

Due to technological, contractual, and policy changes over the years since PROV-MAN-X was last revised, the USAF provisioning process has steadily changed. For example, exercising the production option of a Full Scale Development (FSD) contract creates the need to provision earlier than ever before (28). A more realistic network model of the provisioning process should consider for inclusion many of the newly identified events/activities.

Phase I of PROV-MAN-X currently requires students to use Program Evaluation and Review Technique (PERT) to manually construct a network made up of the 46 events provided. The players then determine activity times for the events from prior knowledge or from research of government regulations and attempt to establish the "critical path" (22).

Upon observation made by the researchers of the students performing these tasks and interviews with the course directors, it appeared that the students had difficulty in the basic assembly of the network due to lack of feedback after making decisions on placement of events. Furthermore, there appeared to be no reasonable way for the instructors to test the knowledge of the groups during or after the play of the game (13; 37).

Based on research of literature and interviews with USAF provisioning policy makers, there were many important events absent from the list of 46 events used in the current version of PROV-MAN-X (13; 18; 23; 28).

Phase I of PROV-MAN-X should be updated with enough current and relevant events to insure an accurate simulation of the "real world" provisioning process and a method of dynamic analysis of that model in order to better achieve the desired training objective of the exercise.

<u>Problem Justification</u>

> The initial provisioning process has developed to the point that very few people know enough about the whole system to guide programs through it. Specialists responsible for the quality of their specific output, handle pieces of the process rather than concern themselves with the ultimate success of provisioning (35:12).

"The provisioning goal is to insure timely, adequate, and economic support of systems/equipment entering the Air Force inventory by need dates [12:Pt 1,Ch 1,para 1-2c]." Individuals participating in the provisioning process, often called "provisioners", normally control only one or two events out of the total process. In order for the goal of provisioning to be achieved, they must have a clear understanding of how their efforts fit into the total process. However, physical and economical considerations preclude giving these logisticans field experience in all of these activities. Therefore, placing them in a simulated, time-compressed, provisioning exercise provides the next best alternative. PROV-MAN-X, as a tool for that purpose, must remain an accurate and effective device to meet the training needs of Air Force provisioners.

## Research Objectives

Three main objectives should be achieved as a result of the research:

1. A current list of activities, relationships, and times for the USAF provisioning process must be identified and then narrowed down to a size manageable by an interactive computerized simulation model.

2. A computerized network model must be designed in such a way that it accurately simulates the USAF provisioning process and fulfills the interactive requirements of the training objective of Phase I of PROV-MAN-X.

3. A "user friendly" program should be developed which provides a training medium especially suited to the experience level of the students and which will encourage their enthusiastic participation in the exercise.

## Limitations and Scope

The training environment for the intended use of the simulation-game presented the following limiting factors:

1. The availability of automated data processing equipment (ADPE) terminals and capability of computer operating systems.

2. The ADPE experience level of students.

3. The network analysis experience level of students.

4. The amount of time allowed for students to

participate in the exercise.

Therefore, the following scope of research applied:

1. The simulation model was made simple enough to allow interaction by students with a low level of "hands on" computer experience.

2. The model was written in a computer language compatible with existing computer systems.

3. The complexity and size of both the programmed text and simulation-game were limited to a time constraint of not more than nine hours.

Data Availability

Data necessary to develop the model consisted of information regarding specific activities, activity relationships, and activity times for the USAF provisioning process. Information for this purpose was available through research of USAF, AFLC, and AFSC directives, and interviews at HQ AFLC and Air Force Acquisition Logistics Center (AFALC) offices of primary responsibility (OPRs).

Initial contacts with the AFALC Provisioning Guidance Branch (XRH), located at Wright-Patterson AFB, Ohio, provided a listing of 148 events/activities and relationships in the provisioning process (38).

The information for the programmed text on network analysis was takon from a handout currently used in the Air Force Institute of Technology (AFIT) Log 260 course.

Presentation changes were made when necessary to adjust the information in the handout to a multiple choice answer format (31).

# II. Literature Review

In Section I, the research objectives were defined, in general, as seeking to upgrade the content and instructional technique employed in PROV-MAN-X. For that purpose, information was needed on the current state of the USAF provisioning process and on the effectiveness of using a computerized simulation-game as the teaching medium. The scope of the literature review was defined by the purpose of the thesis--to develop and produce a ready-to-use computer simulation exercise. It was not intended to find empirical evidence of the exact nature of the provisioning process.

## The USAF Provisioning Process

Although now rescinded, Department of Defense Directive (DODD) 4140.40, formally included as Attachment 1 to Air Force Regulation (AFR) 65-2, Provisioning of End Items of Materiel (1980), included the best definition of provisioning found:

> The process of provisioning is an essential and critically timed series of actions required to assure initial support for end items entering the operating inventory of the Armed Forces. Planning for provisioning normally begins early in the life cycle of new end items of military design or prior to procurement of commercially designed end items. Planning for provisioning is required to assure that appropriate documents (i.e., standards and specifications) are cited in production (and pre-production) contracts. To be fully effective, provisioning must be a cooperative series of scheduled events between the customer (military user) and the contractor (industry supplier). To this end DOD components, under the Department of

> Defense policies and guidance . . . have developed and implemented a set of provisioning procedural documents (12:Atch 1).
>
> Furthermore:
>
> Provisioning is a process or series of actions extending over a wide range of functions, including design, maintenance planning, supply, requirements determination, item entry control, procurement, cataloging, and contract administration. . . . Provisioning culminates in the delivery of a minimum range and quantity of support items for initial outfitting/lay-in at user activities, bases or ships and for maintenance/supply activities for support during an initial period of service (12:Atch 1).

In addition, a series of definitions from the current edition of DODD 4140.40 is found in Appendix A.

Air Force Logistics Command Regulation (AFLCR) 65-5, Air Force Provisioning Policies and Procedures, is the provisioner's bible. In eleven parts, covering over 160 pages, it lays out many of the organizational responsibilities and documentation requirements for the USAF provisioning process. However, it does not and, for practical purposes, cannot provide a comprehensive flowchart of the entire system; nor does it specify regulatory completion times or mandatory requirements for more than a handful of activities. Nonetheless, AFLCR 65-5 was completely reviewed and a substantial amount of information withdrawn for use in constructing the model of the provisioning process (13).

The only other publication reviewed which helped shape the provisioning model or describe provisioning activities was AFLCP/AFSCP 800-34, Acquisition Logistics Management. Areas of particular interest were those chapters on the Integrated Logistics Support Plan (ILSP), contracting, supply support, and network analaysis (11).

All of the factual information taken from AFLCR 65-5, AFLCP/AFSCP 800-34, or interviews was either built into the model constructed in Appendix B or listed in the list of activities, also in Appendix B. The exceptions are the following quotations from AFLCP/AFSCP 800-34 on the use of network analysis in USAF acquisition management:

> Network analysis is a management technique used in planning and controlling various project elements or functions and their associated events and activities. It is a definitive process that organizes the variables into a network format that reflects interrelationships and interdependencies. It shows the project in a way that permits continual refinement and display of program goals and schedules. When the discipline of networking is maintained, program oversights and incompatibilities will be dramatically reduced (11:Chap 42, para 42-1a).

Also:

> Network analysis provides an effective integrated approach to managing the individual elements of logistics during the acquisition process. It enables the DPML/ILSM to integrate the various logistics elements as well as the total logistics support effort with the overall program planning and execution (11:Chap 42, para 42-1b).

The same chapter prescribes the beta distribution for determining expected elapsed times for activities within networks (11:Chap 42, para 42-2b).

Several other government publications were reviewed in search of information about the provisioning process, including references available through the Defense Technical Information Center (DTIC), but they did not specifically contribute data to the provisioning model.

## Effectiveness of Simulation-Games

Isak Assa, an internationally published educator and researcher, stated:

> A management simulation game is an experimental model that simulates certain situations in the process of managing the system, with taking an active role in the different stages of the decision-making process . . . they [simulation-games] are linked together through the game situation, where the scenarios, the roles, and the rules are described. Management games in this sense can be viewed as a communication tool for use by the decision-makers in a management laboratory environment, where they have the opportunity to use the achievements of other sciences such as mathematics, economics, and computers (3:388).

Theoretical Studies. Theoretical studies on why a given person learns a particular lesson, presented by a certain method, in one type environment, with a designated goal to be achieved, are widely published. Regarding why students may or may not learn effectively by using simulation-games, literature on the following issues were considered: motivation, structure, application, and learning objectives.

Motivation. Orbach listed 17 studies between 1966 and 1975 which indicated that simulation-games created considerable motivation in their participants--and some indicating that they do much better than other techniques of instruction, but there is very little in these studies to suggest why simulation-games possess this rather impressive capacity (25:4).

Orbach stated his hypothesis as:

> Simulation-games possess greater motivational power than other techniques of instruction, because they can better overcome the three sources of difficulties: they can create different needs in different students, they can induce the appearance of readiness to act in reduction of these needs, and they can PROVIDE AN ADEQUATE SETTING, as well as the means, for an immediate translation of this readiness into a very active behavior (25:8).

Student Types. Orbach also performed research on the effectiveness of learning using student types as the independent variable. By dividing students into categories called "achiever", "curious", "conscientious", and "sociable", he conducted research to better understand the level of learning achieved by each type of student on the same simulation-game. The findings appeared to support his claim that the type of student participating in a simulation-game had an effect on the learning outcomes achieved. He concluded that simulation-game designers and instructors should consider the types of students participating in the exercise when developing and conducting the exercise (25:14-29).

Structure. The Yefimov and Komarov study hypothesized that the structure and development of a game are the most important determinants of its future value as a training device. The structure includes the experimental situation, participants, and the material on the problem area. The experimental situation is subdivided into the scenario, setting, and regulations of the game. The scenario includes the description of roles, defining the activity of the whole team of players as members of the simulated organization, and introduces players into the conditions of the gaming activity, rendering initial conditions to them (36:148).

Application. Effectiveness of simulation-games may also be related to the type of instructor and the groups chosen to participate. Bredemeier and Greenblat stated that significant differences in attitude change occurred between groups of students who played the same simulation-game under different instructors (7:159).

Learning Objectives. Orbach divided learning objectives into three categories. The first was "acquisition and comprehension of knowledge." Here, he stated that simulation-games were probably too expensive and time consuming compared to other techniques (26:345-347). Bredemeier and Greenblat supported that claim saying, ". . . reviewing the claims and evidence suggests that games may be more effective teaching principles, procedures, and concepts than in teaching facts [7:164]."

Orbach's second learning objective was "application of knowledge", where players have already learned basic concepts. He referred to widespread agreement among theoreticians of learning that the best learning in this area occurs when applied under conditions as close to real life as possible--conditions available in a game, but normally not in a conventional classroom (26:347-349).

The third learning objective was "attitudinal change". Orbach stated that the greater emotional involvement brought about during role playing in simulation-games led to a more conducive environment for attitudinal change (26:353-355). Bredemeier and Greenblat reported that Shade and Paine (1975) found declines in political cynicism were produced more effectively through simulation than through conventional teaching methods (7:166).

Empirical Cases. After looking at the theoretical research of effectiveness of simulation-games, five empirical research studies and one meta-analysis were examined.

Case 1. Bredemeier et al. set out to test the effectiveness of a philosophy game called BA FA BA FA used to provide experiential referents for two abstract cultural concepts--"dogmatism" and "ethnocentrism". Game objectives were to acquire subject knowledge, broaden students' concept of education, and develop analytical skills (8:414-415).

To measure "dogmatism" and "ethnocentrism", Bredemeier et al. utilized the 40-item Rokeach Dogmatism Scale and a slightly modified version of the Adorno Ethnocentrism Scale. The results showed that the experimental group's positive change was significantly greater than the control group's change, at the .05 level of confidence or greater. Experimental group students seemed to become in conformity with the course and game objectives (8:418,427-428).

*Case 2*. Louscher and Van Steenburg performed a study on the effectiveness of a simulation-game called "Foreign Policy Decision-making: An Exercise" constructed by them. Identical questionaires, consisting of 21 questions, were completed before and after the exercise. The game was tested 18 times (21:441,459).

The researchers hypothesized that "students participating in a simulation will reveal more interest in such an exercise than in more conventional classroom activities [21:443]." The researchers cited previous work showing higher interest in simulation-games, then stated their study confirmed the earlier findings. While 51.2 percent of the participants strongly liked or disliked role-playing before the simulation, a paired samples t-test verified the significance of that percentage increasing to 77.4 percent after the exercise (21:443-444).

*Case 3*. The Norris and Snyder attempt to test the effectiveness of business games through external validation was unsuccessful. In their study, career success was used as the dependent variable and was operationalized on separate scales of job performance, monetary rewards, and positions. Data were gathered from 54 studies (24:79).

The results showed no significant relationship between simulation-gaming success and career success after five years since the game was played. Norris and Snyder stated that several other uncontrolled variables may have moderated the treatment effect such as inappropriate criteria to judge game and career success (24:81).

Case 4. Glenn et al. conducted research on a set of three simulation-games, primarily using role playing activities. Of 307 students in 18 classrooms, 166 students in nine classes participated in simulation-games, while 141 students in nine other classes served as comparison group students. Those in the comparison groups were given instruction by conventional lectures. Students in the treatment and comparison groups were pretested and posttested using a decision-making strategy test developed by the researchers (19:201-203).

The results of the posttest showed a total of 29 percent of the treatment group students exactly followed the steps of the decision-making model compared to only nine percent of the comparison group students. This was a notable change from the pretest scores which were not significantly different for both groups (19:201-205).

Case 5. Sandver conducted an experiment to test the effectiveness of a simulation game called "Teach-Neg" designed to cause attitudinal change in both management and labor representatives (32:382).

The research design involved randomly assigning 64 seminar students (16 management representatives and 40 labor representatives) to four-person groups which were paired against each other in an employer versus union role-playing game. All participants were pretested and posttested with a 60-item questionaire based on Kornhauser's Union-Management Attitudinal Scale. Responses to questions were then translated into four views: anti-union, pro-employer, pro-union, and anti-employer (32:383).

Out of the 16 paired comparisons, the only significant change was a positive shift for the management-management group on the pro-union views. Measuring decreases in anti-union or anti-management views and increases in pro-union or pro-management views as the desired learning objective of the game, slight improvement was shown in seven other groups (32:388).

Pierfy's Meta-analysis. In a review of 22 empirical studies, Pierfy built an analysis on the basis of four variables which predominated the field: learning information, retaining information, changing attitudes, and student interest (29:256-258).

Virtually every study collected data on learning, primarily tested by measuring knowledge of facts and principles. Researchers in three studies reported statistically significant differences in favor of simulation-game treatment, three significantly in favor of conventional instruction, and 15 showed no significant differences (29:257-259).

On retention, 11 studies, using an identical pretest and posttest, showed that eight significantly favored simulation-games and three showed no significant differences. In 11 studies on attitude change, the results were identical to those for retention. Seven out of eight empirical studies comparing student interest in simulation-games to conventional classroom instruction found the former to be significantly superior (29:259-260).

Effectiveness of Computer-aided Instruction in the Military. The only comprehensive research located on the effectiveness of computer-aided instruction (CAI) in the military was a study conducted by Orlansky and String. On two independent variables, student achievement and student time saved, the researchers were able to collect data from 48 different CAI programs used in the Air Force and Navy (27:48).

Using student achievement as a measure of learning effectiveness, they found CAI superior to conventional instruction in 15 programs, the same in 32, and inferior in only one case (27:48).

The results of measuring learning effectiveness by student time saved, indicated that CAI was superior to conventional instruction in 44 cases, the same in one, and inferior in three programs, with a median time savings value for CAI of 33 percent (27:48).

Orlansky and String concluded that, "Overall, the existing evidence, despite its sprinkling of shortfalls, tends to verify the value and suitability of computer based training in the military [27:54]."

## III. Model Methodology

The logical division between the methodology for developing and applying the simulation model resulted in the separation of their presentations. The methodology for the model development is presented in this section and the methodology for the training program is presented in Section IV.

### Data Collection

Data for this simulation were produced by one of three methods:

1. Prescribing directive (USAF, AFLC, or AFSC).
2. Expert interview.
3. Research assumption (only to account for information vital to the simulation model which were not obtained by method 1 or 2 and still verified by either HQ AFLC/MMAPP or AFALC/XRH.)

A fourth method, gathering historical data from AFLC computer records, was not used. The USAF provisioning system is undergoing a period of substantial change due to the gradual automation of documentation and suspense control. The D220 computer system, developed by HQ AFLC, is rapidly taking over many forms of manual documentation. However, it is not a "turn key" transition and both automated and manual methods are currently in use. As a result, there is no centralized data base capable of being easily interrogated for the type of information desired for this research effort (23).

Another problem with using empirical data was the many options and variations in the way items may be provisioned by the USAF. It would have been highly difficult and far beyond the scope and requirements of this project to collect, analyze, and utilize data obtained in that manner (23).

There were three types of data sought:

1. Identification of provisioning events/activities.
2. Relationships between activities.
3. Activity time distributions.

Identification of Provisioning Events/Activities. As stated in Section I, a list of 148 events/activities were obtained from AFALC/XRH (38). At first, it appeared that this model of the provisioning network could be used with only minor alterations, but after extensive interviews with personnel from AFALC/XRH and HQ AFLC/MMAPP, it became obvious that the initial network would require significant modifications to be usable for the intended simulation model (18; 23; 28).

The process of developing a provisioning network which was both accurate and appropriate for the training application, began by simplifying the network by consolidating segmented activities back into whole activities, i.e. three activities such as "prepare document", "coordinate document", and "forward document" became "process document", provided that all three activities took place within the same functional office. Decisions on how activities would be identified for the model were initially made by the researchers, then changed and/or verified by personnel at HQ AFLC/MMAPP or AFALC/XRH.

Some difficulty was encountered since the original network used several probabilistic, yes/no branches which cannot be used in the type of simulated network designed for the training exercise. The type of network simulation program devised used all branches during each run of the simulation and cannot utilize probabilistic branching in the same way as flowcharts or computer programs (30:121).

Also, the initial network obtained from AFALC/XRH contained several different methods of provisioning. For the purposes of the simulation model, the Full Scale Development (FSD) contract with production option and formal Provisioning Conference was decided to be the most realistic and appropriate; therefore, other methods incorporated into the network were eliminated, i.e. the activities listed in the network associated with the Depot Provisioning Committee (DPC) were ommitted, because a Provisioning Conference was used instead (28).

After cutting the network down to one method and consolidating the activities, applicable USAF, AFLC, and AFSC regulations were researched to insure that all pertinent activities were included. The information obtained from these sources was reviewed by both HQ AFLC/MMAPP and AFALC/XRH to finalize the list of events/activities used in the network. A list is provided in Appendix B (13; 18; 23; 28; 11).

Relationships Between Activities. As noted above, in describing the method used to determine the events or activities the network developed for the simulation could not include any probabilistic branching. The other problem regarding relationship of activities involved "optional" paths through the network. Optional relationships were not included in the network. This was not an issue which affected the accuracy of the network, because the optional paths occurred at a level of detail lower than that which was used to model the provisioning process. In other cases, where elimination of a path could affect the accuracy of the network, the most common paths were used in each case. The completed network is shown in Appendix B (23; 28).

Activity Time Distributions. As stated earlier, historical data was not accessible for activities in the provisioning process for several reasons. Therefore, estimates for the optimistic, most likely, and pessimistic times for each activity in the network were obtained from interviews with provisioning policy and guidance offices at HQ AFLC/MMAPP and AFALC/XRH. Activity time distributions obtained are listed in Appendix B (23; 28).

## Selection of the Simulation Technique

The heart of the simulation-game is the internally constructed model and the means of making it function to give the desired output. Presenting the USAF provisioning process in a computerized training format for this project required that the software meet the following criteria:

1. Cost--can the various costs involved be kept to a minimum, not only for purchasing software, but additional costs of special files maintenance, etc?

2. Time to develop--can the research effort be complete by the August 1984 deadline?

3. Time to run--how long does it take the simulation to execute?

4. Systems available--what computer systems can the simulation be run on?

5. Format of simulation output--how easy is it to transform program output into the form meeded by the training program?

6. Special features--what capabilities does the program have built in that do not have to be designed separately, i.e. random number generators?

7. Simulation validity--is it a tested method or a new development?

8. Modification capability--how hard is it to modify the simulation program if changes are needed in the future?

9. Familiarity with simulation method--are AFIT staff members knowledgeable enough of the method employed to provide in-house assistance for modifications or troubleshooting?

Based on the above criteria, Graphical Evaluation and Review Technique with Queuing (Q-GERT) was chosen as the means to perform the computerized simulation of the USAF provisioning process.

An existing simulation technique was chosen instead of writing a set of programs for virtually every criteria listed above. The purpose of this research was not to invent a simulation technique, but rather to apply one. Q-GERT's fast execution time, availability on the most capable local computer system (CDC CYBER), and ease of development and modification, outweighed the capability possessed by other simulation languages.

Q-GERT

A. A. B. Pritsker, author of Modeling and Analysis Using Q-GERT Networks and inventor of Graphical Evaluation and Review Technique (GERT) and Q-GERT, stated that one of the reasons for developing Q-GERT was to better perform network analysis (30).

Network analysis uses a series of events connected by activity lines to represent the path through the network, while Q-GERT uses a series of nodes representing events with connecting activity lines. Both methods allow the analyst to code additional information to clarify the network. Q-GERT, however, allows for this directly on the network diagram. The codes are exactly as they appear in the computer instructions, which makes it much easier to transfer from paper to the machine readable code (30:7-15).

To go with the basic Q-GERT routines, Pritsker developed an analysis program, an error list, and explanations that are easily understood. Q-GERT was developed in ANSI FORTRAN, a widely used computer language, thus making it usable on many computer systems. In addition to being written in FORTRAN, Q-GERT allows the analyst to add FORTRAN subroutines and programs to make the model more specific to the desired application (30).

Examples of Q-GERT's use include both military and industrial situations. The following list provides a sample of the documented applications:

1. Claims processing in an insurance company
2. Production lines
3. Quality control in manufacturing
4. Assessment of job performance aids
5. Refueling of military airlift forces
6. Planning for contract negotitations
7. Research and development planning
8. System reliability (30:5).

## Model Assumptions

Five assumptions were made by the researchers in constructing the network model:

1. The events/activities/relationships were for provisioning of a single reparable subassembly to a major USAF weapon system.

2. The network was made up entirely of deterministic branches--each branch was used once in each execution of the simulation program.

3. The items provisioned were for spares and not to be installed into production systems.

4. The provisioning method modeled was for a FSD contract with production option, utilizing a Provisioning Conference.

5. The activity time distribution estimates were for

approximatley four standard deviations (95 percent confidence) around the mean value. Note--some activities had very measurable completion points, such as the production option decision and source selection. The completion points of many activities in "real world" provisioning however, overlap with starting points of other activities. The simulation (as well as manual PERT network analysis) cannot exactly model this overlapping of activity times. The modeling method used was made to "fit" the provisioning process as accurately as possible (23).

Developing the Model

The first step in developing any model is to identify the types of variables and draw a structural model of the system. The following items are defined to explain the structural model:

Endogenous variables - are variables which are produced within the system or resulting from internal causes. They are often referred to as dependent variables (33:46-47).

Exogenous variables - are variables originating outside the system. They are also referred to as input variables or independent variables (33:46-47).

Criterion variables - are variables which provide measurement information about the overall system. They are used by the modeler to evaluate system performance, success, or relationships to other systems (33:46-47).

Variables:

| NAME | TYPE | CONTROLLABLE |
|---|---|---|
| Optimistic time estimate (a) | endogenous(status) | |
| Pessimistic time estimate (b) | endogenous(status) | |
| Most likely time estimate (m) | endogenous(status) | |
| Start time (s) | exogenous | no |
| Operational need date (n) | exogenous | no |
| Activity precedence (p) | endogenous | yes |
| Activity time (t) | endogenous | yes |
| Criterion Variable: | | |
| Total time (T) | endogenous | |

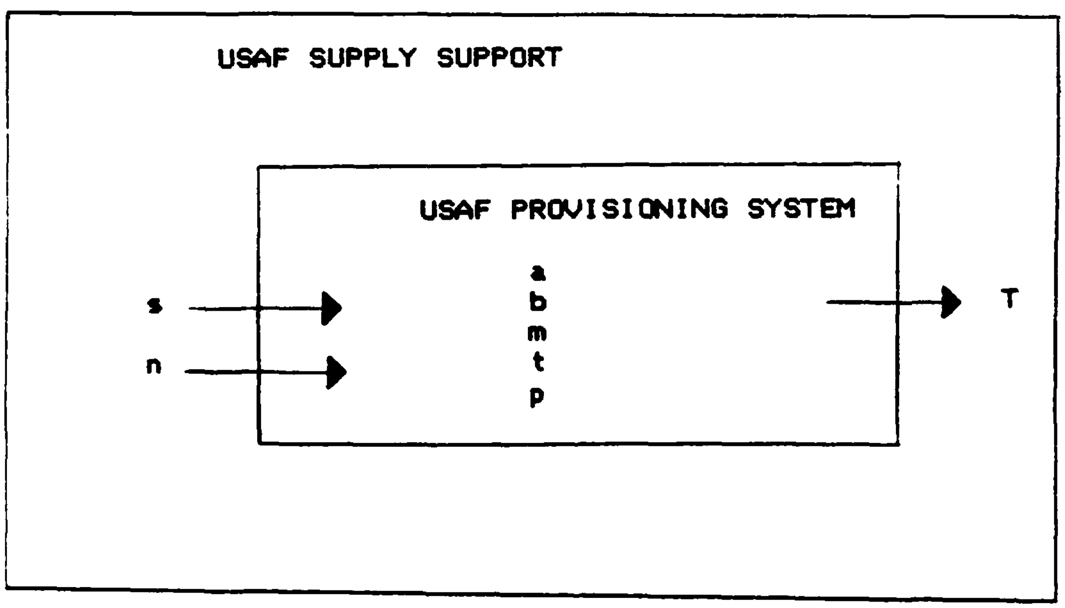


Fig 1. Structural Model of Provisioning Process

## Research Design

Deciding on the appropriate experimental design for the simulation model included both tactical and strategic planning.

*Tactical Planning*. Tactical planning determines the way each of the simulation runs will be accomplished. Included are: determining the number of repetitions required, the method of minimizing adverse effects of startup and autocorrelation, and confidence in the activity time distribution.

The number of repetitions required for transactions sent through the simulated network was determined by the formula below (33:189):

$$n = \frac{(\sigma Z\alpha/2)^2}{d^2} \qquad (1)$$

$$n = \frac{[307(1.96)]^2}{14^2}$$

$$n = 1847.2804 \text{ or } 1848 \text{ repetitions}$$

where

n = number of repetitions
d = the half-width of the desired confidence interval
$\alpha$ = .05
$Z\alpha/2$ = confidence level
$\sigma$ = the standard deviation obtained from the range of possible network completion values (Appendix D, Atch1)

The effects of system startup and autocorrelation were ignored for the running of this network, because with only one repetition per run and no other variables affected, the design is unaffected by startup or autocorrelation.

The Beta-PERT distribution was used for all activities in the simulation model. Pritsker identified this technique as generally accepted by experts to be the best theoretical distribution to be applied when modeling PERT networks. Since theoretical distributions were used rather than collecting historical data, a Chi-square goodness of fit test was unnecessary (30:204-208).

Strategic Planning. Strategic planning describes how the experimental model is designed to achieve the intended research objective. Included are the number of factors, the number of levels, the number of simulation runs, the original values for variables, and the overall length of the simulation (10).

Only one factor and level were necessary for the simulation, because none of the input variables were being varied. The different total times for the network (T) were only affected by the combinations of the different activity times obtained from the Beta-PERT distributions. For that reason, the single statistical test for the model was computation of a 95 percent confidence interval, based on the calculated versus the theoretical t-statistic. Most researchers claim an alpha value of .05 as sufficient for the purpose of the network simulation model (33).

The number of simulation runs for a one-factor, one-level experiment equals the number of repetitions, based on the following formula from Shannon (33:156):

$$N = pq^{k} \qquad (2)$$

$$N = (1848)(1)^{1}$$

$$N = 1848$$

where

N = number of runs required
p = number of repetitions (n value from repetition formula)
q = number of factors in the experiment
k = number of levels for each factor

The original values for the variables in the model were as follows (in terms of the structural model):

$a_i$ = (refer to the i-th activity, Appendix [B])

$b_i$ = (refer to the i-th activity, Appendix [B])

$c_i$ = (refer to the i-th activity, Appendix [B])

s = 1 Jan 85 (julian date:85001)

n = 1 Jul 87 (julian date:87120)

$p_i$ = (refer to the i-th activity, Appendix [B])

$t_i$ = 0 (then random number from Beta-PERT distribution for the i-th event, from Appendix [B])

T = 0

The length of the simulation, equal to n-s days, was initially set at 900 days. (The length of the simulation was not pertinent to the development and testing of the model, but it was necessary for the training exercise.) That figure was chosen as a "ballpark" estimate of a realistic provisioning system. Based on earlier tests made by the AFALC, it appeared that the optimal system completion time was around 400 days. If the time allowed for the simulation run was less than that, there was a strong possibility that the process would not be complete at the end of the simulation (38).

## Flowchart

The provisioning system network is graphically displayed using both PERT and Q-GERT in Appendix B. Observation of the two charts readily shows the parallel construction. PERT is easily converted to Q-GERT and the Q-GERT flowchart adapts readily into the code necessary to run the computer program.

## Parameters

The parameters for the simulation consisted of those endogenous variables which were held constant throughout the testing. However, after verifying that the model functioned properly, some of those parameters were not used to allow the instructor to introduce "real world" problems into the training package. In those cases, an activity time distribution was given an arbitrary constant value.

Computerization

As stated earlier, the simulation model was computer coded in Q-GERT and FORTRAN V for use on the CDC CYBER NOS 2.1 operating system. The FORTRAN code is in Appendix D.

Validating the Model

The validity of the simulation model was determined in a two-stage process of verification and validation.

Verification was defined as the method of proving, with reasonable confidence, that the experimental design was appropriate and that the model performs as intended. More specifically, it was measured by error-free program compilation.

The validation of the model was performed by comparing the results of the simulation runs to the results obtained by manually using PERT for the same set of activity times (Appendix C). Values obtained by simulation were within a 95 percent confidence interval of the value obtained by using PERT (Appendix C).

## IV. Training Exercise Methodology

### Developing the Training Exercise

The training exercise was designed to allow students to: (1) understand more about network modeling using programmed learning exercise, (2) understand more about the Air Force provisioning process through the use of network modeling, and (3) become more comfortable using computers through interaction with a computer terminal. The network model depicts the real world of provisioning and the training exercise provides the student the opportunity to interact with that world in a simulated environment.

The training package contains five procedures for the student and five procedures for the instructor. After the instructor's initialization, each stage requires student interaction. The complete exercise need not be finished in one sitting. Each of the five student procedures can be run separately as long as they are run in the correct order. The programmed text, however, since it is so long, can be restarted at any question based on the last question answered. The computer provides the questions and the students respond with answers. The computer keeps track of right and wrong answers for display at the end of each stage and retains the same information on a data file. The students receive a display of the provisioning network worked out by HQ AFLC/MMAPP, AFALC/XRH, and the researchers based on what is currently being used in the Air Force (Appendix B). Along with this display, they receive a list describing each activity in the network. Finally, the student gains experience in dealing with some of the factors that may change the critical path in a network. Appendix F includes a complete set of student and course director instructions.

## The Exercise

The instructor has five procedures available throughout the exercise. They include: a procedure to set up the library file, a procedure to create the executable code from the source programs, a procedure to print a diagram of the network for each group, a procedure to check on student progress, and a procedure to purge the files at the end of the exercise. These procedures all reside on the CYBER user-ID that is assigned to the instructor and should not be provided to the student to use. The instructor initializes the data files that will contain information used later during student interaction. Computer availability and the number of different groups used during a particular class determine the amount of time necessary to run the initialization. The initialization should be done at least one day before intended student use of the exercise.

The students also have five procedures that make up their part of the exercise. The students should be divided into groups of about four each. More than four students cannot sit comfortably at, or near, one computer terminal.

Each group must have its own user-ID, so that files can be separate to insure data integrity.

The five procedures are: (1) an introduction, (2) a programmed text lesson on network modeling, (3) precedence determination, (4) critical path determination, and (5) sensitivity analysis.

Stage One: Introduction. The credits for the exercise are given during this introduction. In addition, several computer generated errors are explained, as well as things that the student should remember while using the exercise. It is during this stage that the Q-GERT simulation is run.

It is run in the "background" so the student is not even aware that it is running, except for a message that says "Submit Complete". The simulation is run once for each group, so the times and possibly the critical path will be unique to each group.

Stage Two: Programmed Text on Network Analysis. Students should complete the 64 questions in the programmed text before the classroom lectures on network modeling. The questions are the ones from a booklet formerly given to each student as extra reading. This should last about two hours. A file is provided with information so that the instructor can monitor the progress of the student groups and so the scores for each group are recorded.

Stage Three: Determining Precedence of Activities. A question and answer sequence allows students to determine the precedence of the activities in the network. The LOG 260 course materials include copies of regulations and guidelines for structuring the activities in the provisioning process for student research. Students receive 90 chances to determine the order of the 43 activities in the network. The students match a description of the activities with a printed display of the network, based on the experience of the designers and the pertinent regulations. Following the end of student inputs or the exhaustion of the number of trials, the computer lists the correct network and the completion times for the simulation. The number of activities that students placed in the correct order and the number of tries taken are reported to the instructor, so he can provide a grade or score comparison for each section.

Stage Four: Critical Path. To compute the critical path for the network, students are given the actual activity completion times for the network and they must identify the critical path. The computer compares the time it calculates with the students' inputs to determine correctness. Students are given the opportunity to input all the activities on the critical path. The computer compares the input with the optimal solution to determine correct or incorrect inputs. The computer will not interrupt the student as he/she inputs the activities. The student has two chances to get the complete critical path correct. The activities that the student inputs are recorded so the instructor can compare them with the correct critical path for each group, which will be seen on the instructor's same file. As before, the computer tallies scores and provides them if desired.

Stage Five: Sensitivity Analysis. For students to perform sensitivity analysis on the network model, a procedure shows the the total network time, the three times for each activity (optimistic, pessimistic, and most likely), the critical path, the actual completion time, and the elapsed time for each activity in the network. Students must think about what managerial decisions are necessary to complete the provisioning process when the projected operational need date will be exceeded. There can be as many different answers as there are possible critical paths. Students utilize their knowledge of network analysis and the provisioning process to manipulate the actual activity times and critical paths, in order to resolve the problem. Each group is provided space on the instructor's file to answer the essay questions from this procedure.

Eight hours are allotted for phase I of PROV-MAN-X during the LOG 260 course at AFIT. The newly developed training exercise, from stage one thru stage five, should take six hours and provide the same material coverage to the students as the former manual exercise while providing more time and an improved method for performing sensitivity analysis.

## Flowchart

Appendix E contains the flowcharts for the complete exercise and each of the eight programs involved.

## Computerization

The programs for the training package were written in ANSI FORTRAN V to be compatible with the simulation model. The complete exercise was developed on the NOS 2.1 operating system on the CDC CYBER computer at Aeronautical Systems Division (AFSC/ASD) Wright-Patterson Air Force Base (WPAFB), Ohio. Appendix D contains the listing of the code and data files used. All "listings" refer to printouts that will be routed to the printer in building 640, room 133, of AFIT at WPAFB, Ohio. Appendix F contains complete game documentation and a modification guide for the programs and files.

## Validation

Internal validation of the exercise was shown by the results of the coding and compilation. Error-free compilation proved the absence of any fatal syntax errors, while the successful execution of the code proved that there were no programming logic errors.

Computer run time was a measure, to some degree, of the internal validity of the programs. Since central processor execution time is so expensive, one of the goals of the programmer is to keep that time at a minimum. All of the programs combined, take less than 50 seconds of central processor time to execute. However, since each program requires input from the student through the terminal, the span of time for running all the programs takes several hours. This terminal operating time does not take up significant processor time and, therefore, no great expense is involved.

Computer run time is a measure of efficiency; however, efficiency is a very nebulous concept since it is measured in terms of central processor usage, execution time, input/output time, and disc storage space. For the purposes of this research, efficiency was measured only by execution time.

External validation of the training exercise is a very subjective measure. One measure of external validity is whether the computer programs, in fact, do what the designers intended. In this case, the designers, the programmers, and the evaluators collaborated throughout the entire process from the conceptual stage through the production phase.

The training program's effectiveness, as a device for achieving the training objectives of Phase I of the PROV-MAN-X exercise, constituted the external validity. Its measurement was solely by expert opinion, because the LOG 260 course was not offered during a time when pretest and posttest measurements could be taken within the time available for this research. Research concerns over external validation are further addressed in the Sections V and VI.

# V. Results

Each of the three research objectives are answered below as a result of constructing and operating the provisioning network analysis exercise.

## Research Objective 1

> A current list of activities, relationships and times for the USAF provisioning process must be identified and then narrowed down to a size manageable by an interactive computerized simulation model.

The research ran into problems compiling a list of all current activities in the USAF provisioning process. Due to the many variations and combinations present in provisioning, it was impractical, if not impossible, to work from the bottom up gathering data to build the network. Instead, the researchers went back to the Offices of Primary Responsibility (OPRs) for provisioning policy and guidance at HQ AFLC and AFALC in order to collect information from the top down.

The 43 activities in the final network model reflect a sample provisioning process built upon a set of assumptions which were outlined in Section III. They are based on many recent changes in the way spares are provisioned for the USAF, such as starting provisioning in the Full Scale Development (FSD) phase of the acquisition process and the use of the D220 automated provisioning system. (Note, the D220 system has been online for several years, but as of the publication of this research probably half of the existing provisioning contracts are fully utilizing the system (23).

The Q-GERT simulation technique handled the programmed network with ease. By running the program as a batch job during student interaction with the INTRO program, the network analysis files were properly updated from the simulation for each of the more than 25 tests.

Research Objective 2

> A computerized network model must be designed in such a way that it accurately simulates the USAF provisioning process and fulfills the interactive requirements of the training objective of Phase 1 of PROV-MAN-X.

To test the network model's ability to accurately simulate the USAF provisioning process, representatives from the faculty of the AFIT School of Systems and Logistics actually participated in the training exercise. In several test runs of all, or part of the training program, the participants made favorable comments on their ability to make all the necessary inputs required to perform the exercise. Their recommendations accounted for changes to the sensitivity analysis phase, to correct some inconsistencies that were found.

Regarding accomplishment of training objectives for PROV-MAN-X and the LOG 260 course, faculty members from the AFIT School of Systems and Logistics evaluated the exercise in the following manner:

Positive Factors:

1. The ability of the game to compute student scores and pass them to an instructor's file.

2. The ability of the game to allow essay-style answers from the student for the sensitivity analysis stage (SNSANL).

3. The go-ahead passwords used to control student entry into the last three stages (ACORDR, CRPATH, SNSANL).

4. The detailed student and instructor manuals (Appendix F).

5. The provisioning network chart used by students while establishing activity precedence.

6. The modular capability of the program that allows the students to exit and then return to the programmed text without having to start from the beginning.

7. The ability of the simulation model to produce different activity times (from theoretical distributions) and critical paths for each run.

8. The comprehensiveness of the overall documentation of the simulation model and training exercise. That enable future modification to be done as easy as possible (9; 37).

Recommended improvements:

1. Transfer the training exercise program to floppy discs for use on AFIT's newly acquired Burroughs computer system.

2. Provide additional computer coding which would enable the student to vary the activity times in the

provisioning network so a new critical path could be calculated during the sensitivity analysis stage (SNSANL).

3. Build a recovery routine for the activity precedence stage (ACORDR) so that students do not have to complete the entire stage at one sitting (9; 37).

## Research Objective 3

> A "user friendly" program should be developed which provides a training medium especially suited to the experience level of the students and which will encourage their enthusiastic participation in the exercise.

The individuals that evaluated the accuracy and usefulness of the simulation exercise were also asked to comment on how easily they performed the exercise tasks via the computerized medium.

In general, their responses indicated that the training exercise was well organized and well documented. Based on two LOG 260 course director's opinions, the exercise is at a level of difficulty comparable with what is desired for the course (9; 37).

In addition, both course directors agreed that the automated method of presenting network analysis would probably motivate students to learn much more than the former manual method (9; 37).

## Analyzing the USAF Provisioning Process

Although the provisioning model was not intended to become an empirically based model for the "real world" provisioning process, the model was tested for accuracy in forecasting the total network time. Again, one must remember that the following data do not constitute empirical proof of the length of the USAF provisioning process, unless all of the model assumptions are proved to be appropriate.

Section III and Appendix C show the formulas and calculations made to test the provisioning model. Three major findings were noted:

1. Total network time for the provisioning process, from early FSD start-up activities to putting the item on the shelf at the depot, was predicted after 1848 repetitions of the simulations to be 917 days, based on a 95 percent confidence level and a "d" value of 14 days.

2. The PERT method of calculating total network time, showed a value of 840 days, while the Q-GERT simulation method showed a value of 917 days. However, the same value (840 days) was obtained from the Q-GERT model when constant values for the elapsed times were the same as the values used in the manual PERT. This demonstrated the ability of the simulation to more accurately predict total network time.

3. The range of values obtained from the 1848 simulation repetitions went from 728 days to 1161 days. In theory, using the times provided by the experts in the provisioning field, the lowest time could have been 362 days and the longest 1590 days, but the probability of reaching anywhere near those extremes would be very small.

## VI. Conclusion

The final chapter is devoted to an evaluation of the provisioning model and computerized training exercise that were developed. Future validation, modification, and enhancements are suggested, and then a summary of the thesis effort is discussed.

### Exercise Validation and Modification

Five possible ways to further validate or modify the provisioning model and computerized training exercise were determined.

1. Model Validation. The problems associated with building an accurate model of the USAF provisioning process were extensively covered in Section III. The model was difficult to validate because of the number of assumptions required to fit the "real world" to the needs of the simulation model. The paramount assumption was that the model was intended to support the concepts being taught in a classroom environment rather than empirical research aimed at producing a network for use by provisioners in the field.

The model of the provisioning process was made as accurate as possible, given the constraints of the training exercise, the simulation language employed, the capability of the researchers, and the intended research objectives.

Furthermore, fully expecting that the model could be flawed in original design and gradually outdated through evolutionary changes in the USAF provisioning process, the construction and programming of the model were intentionally kept as simple as possible; and all creative thought processes involved were documented to the maximum extent possible to ensure that the model could be modified in an orderly fashion by future graduate students or members of the AFIT faculty.

One potential method of further validating the model or updating it in the future would be to devise questionaires to be completed by "real world" provisioners assigned to the five Air Logistics Centers (ALCs). Their opinion of the provisioning process would probably constitute its most accurate appraisal. Prescribing directives such as AFLCR 65-5, simply cannot reflect the entire network, because of its size, complexity, and constant change (23; 28).

2. Exercise Validation. It is highly difficult, as noted in Section II on the effectiveness of simulation-games, to measure the validity of a learning process. Learning outcomes must be operationally defined and then tested if the training inputs are to be judged for effectiveness (26).

Unfortunately, the PROV-MAN-X exercise does not contain a validated means of measuring student outcomes, thereby making comparison of the past and proposed game versions virtually impossible (22).

On the assumption that the learning outcomes desired can be objectively measured, it is recommended that such achievement criteria be established to determine the learning effectiveness of the newly developed training exercise. Data was collected on student efficiency in answering questions and analyzing the provisioning network as part of the new training exercise and output to instructor-maintained files for evaluation of student performance. In addition, the final learning module provided for a more qualitative measurement of knowledge when students are asked to explain their network analysis decisions in an essay-style format which is also output to an instructor-maintained file.

A variety of data has been provided for instructor evaluation; all that remains is development and application of the measurement of student effectiveness relative to attaining desired learning outcomes.

3. Exercise Presentation. Performing necessary background research, constructing the simulation model, and developing and testing all of the thousands of lines of computer code to deliver a training exercise which was ready to go, took a huge amount of effort over a period of six months. While all modules developed for the training exercise function correctly, rudimentary graphic display methods were all that could be built into the programming within the research time frame available. This is not to say that the methods used were ineffective or that they detracted from the overall product, but future effort toward employing some of the advanced graphics capability of the CDC CYBER

computer, such as CALCOMP and PLOT-10, would enhance the visual appeal.

4. Enhanced Programming. The research assumption that only deterministic branching was used in the provisioning model limits its ability to accurately represent the "real world" process which is a very probabilistic network, full of countless loops and iterations. In an initial attempt to model the USAF provisioning process, that level of detail could not be attained.

Although the form of network analysis employed by the model is by nature deterministic and cannot be changed, the interactive programs in the training exercise could be made more probabilistic through addition of optional scenarios for the model. The Q-GERT simulation program could be modified with user-controlled functions which cause the model to perform differently according to each scenario chosen. While the result would still not be a totally probabilistic representation of provisioning, it would enable many optional processes common in the "real world" (30).

The Job Control Language (JCL) used to manipulate the seven programs which make up the training exercise could be manipulated or expanded to enhance the instructor's ability to control the amount and type of interaction between students and the training exercise. The JCL would also require ammendment in order to accomodate the program changes mentioned in the preceding paragraph (2).

5. Changing Computers. As mentioned in Section V, course directors for the LOG 260 course asked the researchers about running the exercise on AFIT's newly installed Burroughs computer system. The Burroughs terminals and visual monitors were used during the testing of the exercise, but only as asynchronous terminal emulators connected to the CDC CYBER.

The Burroughs system at the School of Systems and Logistics at AFIT, is capable of running the exercise completely with the changes discussed in Section III. If the Q-GERT library or a similar simulation program were written for the Burroughs system, changing the exercise from the CDC CYBER to the Burroughs would be a worthwhile effort.

The Burroughs system is a natural next step for the exercise since it is within the operational control of those who will be using the exercise, it was not considered as a possible system during the design phase of the exercise, because it was a new system and not fully operational at AFIT.

## Exercise Extension

There are two primary areas where this research could prove valuable in the future: (1) arranging for use of the training exercise at other organizations such as the ALCs, and (2) applying this method of teaching network analysis to a more generic process such as project management, for use Air Force-wide or DOD-wide.

The Provisioning Exercise. The training exercise was designed for immediate use by the AFIT School of Systems and Logistics for resident courses. However, most of the people who come to the school to participate in the exercise are traveling from the five ALCs where they are assigned to a variety of positions relating to the provisioning process. It seems logical that the training exercise could be taken to the students less expensively than the reverse (even though the exercise is not the singular reason for traveling to the school). It is at least worth considering to perform the minor changes necessary to run this training exercise on the CDC CYBER computers located at each of the ALCs. The two primary obstacles likely to be encountered are: (1) the CDC CYBER operating systems at the ALCs may not be the same as the one used to run this exercise, and (2) they may not have the Q-GERT simulation program loaded.

The feasibility and cost-effectiveness of a long distance terminal hook-up between the ALCs and the ASD CDC CYBER could also be considered. If implemented, individuals at the ALCs could participate in the exercise without traveling.

Finally, other learning institutions such as the Air Command and Staff College (ACSC) or the Air War College may have interest in obtaining a copy of the training exercise for supplementing their courses.

The Network Analysis Concept. The researchers felt that the interactive capability of the computer simulation method of teaching was an exciting means of learning network analysis. That thinking is in consonnance with a popular philosophy in the Air Force of "learning by doing".

Assuming that knowledge of network analysis is a useful tool for the Air Force manager (refer to quotation from AFLCP/AFSCP 800-34 in Section II), it seems that computerized simulations would be an excellent teaching medium, because of the player's capability to make decisions regarding various stages in complex, time-constrained processes and to receive immediate feedback regarding the impact of the decision on the entire process. Only a computer could provide an in-depth analysis of complex data relationships in order for the player to learn from all the "what if" hypotheses that should be tested to appreciate and understand a network's dynamic function.

The researchers recommend that the computer simulation technique be expanded for use in generic network/project analysis--a discipline which would be useful to almost any officer, senior NCO, or equivilent grade DOD civilian.

## Summary

From the problem statement to the conclusion, this research effort has attempted to identify a "real world" requirement, to perform the research necessary for an extensive background of the issue, to develop a method of satisfying that requirement, and maybe most importantly, to perform all tasks needed to actually develop a product which could be put into immediate service in the field.

In taking our idea all the way from the conceptual phase, through test and evaluation, the full scale development, and finally production and deployment, we may be faulted for a few assumptions made along the way, but we feel even more strongly that most critics would credit the fact that this effort, unlike so many others, will not be merely filed away and lie dormant for lack of an actual requirement or a follow-on research effort.

We have great faith that the training exercise will evolve into a highly useful method for teaching network analysis of the provisioning process and even if not perfect, one which is superior to its predecessor.

## Appendix A: Definitions

The USAF provisioning process has its own language consisting of many terms which may need further explanation for the reader.

### USAF Provisioning Process

Provisioning - The management process of determining and acquiring the range and quantity of support items necessary to oprate and maintain an end item of materiel for an initial period of service (15:2-1).

End Items - A final combination of end products, component parts, and/or materials which is ready for its intended use . . . .(15:2-1).

Support Items - Items subordinate to, or associated with, and end item . . . and required to operate, service, repair or overhaul an end item (15:2-2).

Spares Parts - Repairable components or assemblies used for maintenance replacement purposes in major end items of equipment (15:2-2).

### Network Analysis

Network Analysis - A technique that assists the analyst in identifying relationships and components of a system. It is generally illustrated with a flowchart or a diagram to show the flow of materials, information, or tasks within major projects or systems. It also allows for the continous and iterative process of evaluating the effectiveness and efficiency of any system, by the responsible managers (20).

Program Evaluation and Review Technique (PERT) - A method for the analysis of networks. PERT was created by the Navy in 1958 when it was developing the Polaris missle program. It evolved from the planning techniques that were developed by a man named Gantt. The technique involves the use of a network of events that are interconnected with activities. PERT utilizes estimates of three times for each event; an optimistic, pessimistic and a most likely time. It is a probabilistic method for network analysis (34; 16:631-635).

Critical Path Method (CPM) - An analysis technique very similar to PERT, that also uses a network of events, but these events are secondary to the activities. This method of network analysis developed independently of PERT, but at approximately the same time. The Du Pont company developed CPM largely to devise a method for a computer to do most of the tedious work in the planning and scheduling of the company's engineering programs. CPM utilizes only one time estimate for each activity, making it a deterministic method for network analysis (4).

Critical Path - The sequence of events and activities that make up the shortest amount of time for the network to be completed. It also requires the most management attention, because it tells the manager that if an event along this path slips, so will the entire project. The events in this path provide the most success in shortening the entire process (1:17).

PERT/CPM - Today the names for the two methods of network analysis are used almost interchangably. The distinction comes mainly in the method of time estimating. For the purposes of this paper, the term PERT refers to the method of network analysis that involves the use of both events, activities, probabilistic analysis, and the critical path technique. For a more complete history and background on the development of PERT and CPM, Ewart and Nanney (17) made an extensive review of the literature involving the history of PERT (1:14).

<u>Event</u> - An event marks a definite, discrete beginning or end point for an activity or group of activities. Events are usually represented by circles or rectangles containing information about that event (1:16).

<u>Activity</u> - An activity is an operation which consumes time, money, or manpower resources. An activity usually is represented on a network as a solid line proceeding from one event to another (1:17).

<u>Slack</u> - The "extra" time the manager has to arrange the events in a non-critical path. Measurement of slack shows the manager how long an event can be delayed before that event changes the critical path. Zero slack indicates that an activity is on the critical path and negative slack indicates the amount of time that the network is already behind schedule in meeting the desired completion date/time (4:82).

<u>Q-GERT Terminology</u>

<u>Transactions</u> - The basic, measurable units which activate a Q-GERT network and create data for the Q-GERT analysis program. They are conceptually synonymous with a single electron passing through a wired circuit. The Q-GERT analysis program measures and reports where they go and how long it takes them to get there (30:47).

Activities - The part of a Q-GERT network where time elapses for a transaction, due to some action being taken. The amount of time spent in the activity by the transaction is determined by the number randomly selected out of the distribution of times prescribed for the activity (30:46).

Nodes - Decision points, or crossroads between activity paths, in a Q-GERT network. Although there are many different types of nodes in Q-GERT, only four of them are normally used for modeling PERT networks (30:47).

Source nodes - Used to start the Q-GERT network by generating transactions based on some prescribed distribution of predicted arrivals (30:46).

Regular nodes - Do not have any special function other than routing or receiving transactions (30:46).

Statistics nodes - Like regular nodes, except they are also used to collect statistical information on transactions that pass through them (30:46).

Sink nodes - Used to stop transactions and collect statistical information at the end of one or more paths in a Q-GERT network (30:46).

Branching - Occurs when more than one path originates at a node. A transaction can be split into parts, if more than one of the branches is taken. Several transactions can be combined into one, when several branches lead into a single node (30:46).

# Appendix B: Network Lists

CONTENTS

ACTIVITY: SSR/NIMSR processed by DOD agency

OPR: DOD agency

PRIOR ACTIVITY: SSR/NIMSR issued by SPM ALC

NEXT ACTIVITY: PR/MIPR processed by IM ALC (794)
SPM ALC reviews items coded by IM ALCs

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 14 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: Upon receipt of Supply Support Requests (SSRs) or Nonconsumable Item Material Support Requests (NIMSRs), the DOD agency responsible for the item requested determines if any of the requested items are available. Any items offered as substitutes are sent through DLA/GSA to AFLC/CASC (Cataloging and Standardization Center) for review and approval/disapproval. Inputs and outputs to this process are made through the D169 automated system. Status is monitored by the affected IM ALC/MMIS.

NOTE: The path taken by alternate item proposals are not modeled into this network, but the time which could be used in this effort is considered.

SOURCE: AFLCR 67-8, Chap 2, para 2-2a and 2-11d.

ACTIVITY: NSN forwarded to ACO by CASC

OPR: AFLC/CASC

PRIOR ACTIVITY: PIO (326) funded by PPCO (30)
Cancel PIO (sub found) or Assign NSN (no sub)

NEXT ACTIVITY: ACO negotiates sched/price w/contractor

MOST LIKELY TIME: 14 days

OPTIMISTIC TIME: 7 days

PESSIMISTIC TIME: 30 days

DESCRIPTION: National Stock Numbers (NSNs) which have been assigned by the Cataloging and Standardization Center (CASC), are forwarded to the Administrative Contracting Officer (ACO) for review and consolidation prior to presentation to the contractor.

SOURCE: AFLCP/AFSCP 800-34, Chap 11.

ACTIVITY: ACO negotiates sched/price w/contractor

OPR: ACO

PRIOR ACTIVITY: NSN forwarded to ACO
Due-in established in J041 system

NEXT ACTIVITY: PPL items produced by contractor

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 14 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: All System Program Manager (SPM) contact with the contractor must be made through their provisioning office and the appropriate Administrative Contracting Officer (ACO), with copies of all documents to the Provisioning Principal Contracting Officer (PPCO). The ACO negotiates the finalized schedule and price with the contractor, which becomes authority for production of the majority of items. Interim released items are also negotiated, but are done after the fact per whatever arrangements were established in the original contract/Request for Proposal (RFP).

SOURCE: AFLCR 65-5, Chap 2, para 2-3b(4); et al.

ACTIVITY: Contractor ships items to depots

OPR: Contractor

PRIOR ACTIVITY: Interim release items produced by contractor

NEXT ACTIVITY: NONE--end of provisioning network

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 7 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: After all identification and funding documentation have been completed and the requested items have been manufactured, the contractor ships property on DD Forms 250 to the depot where it will be stored awaiting issuance to users.

SOURCE: AFLC/MMAPP interview.

ACTIVITY: System start-up activities

OPR: HQ USAF, HQ AFLC, HQ AFSC

PRIOR ACTIVITY: NONE--start of provisioning network

NEXT ACTIVITY: MMIS prepares PTDDSS (1492-1), PRS (1492-2), PPS (718)
SPM determines agency w/contract responsibility
DPML develops ILSP

MOST LIKELY TIME: 30 days

PESSIMISTIC TIME: 30 days

OPTIMISTIC TIME: 30 days

DESCRIPTION: This activity is actually an aggregate of many processes which take place as the Air Force decides to fund a Full Scale Development (FSD) contract for a major weapon system (or subsystem). Because starting provisioning this early in the acquisition process is a fairly recent innovation, there are no reliable activity times or relationships yet stated in prescribing directives.

NOTE: The three (3) activity times above represent a constant distribution of 60 days, which is only a rough estimate that is not based on historical data.

SOURCE: Interview with AFALC/XRH.

ACTIVITY: Source selection

OPR: Source Selection Authority

PRIOR ACTIVITY: FSD CDRL to SPM ALC for review

NEXT ACTIVITY: FSD contract award & notification

MOST LIKELY TIME: 45 days

OPTIMISTIC TIME: 14 days

PESSIMISTIC TIME: 120 days

DESCRIPTION: Source selection is a process in its own right, with many participants and established criteria. The System Program Manager (SPM) contributes information to the Source Selection Advisory Council (SSAC) which then provides guidance for the Source Selection Authority (SSA). The SSA has ultimate authority to make the source selection decision.

SOURCE: AFR 70-15; AFLCP/AFSCP 800-34, Chap 11, para 11-4.

ACTIVITY: SPM ALC review of contractor PTD/SPTD

OPR: SPM ALC/MMIS

PRIOR ACTIVITY: PPLs developed by contractor & sent to SPM ALC

NEXT ACTIVITY: Provisioning Conference

MOST LIKELY TIME: 30 days

OPTIMISTIC TIME: 14 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: The SPM ALC/MMIS reviews the Provisioning Parts Lists (PPLs) and associated Provisioning Technical Documentation (PTD) and Supplementary Provisioning Technical Documentation (SPTD) for accuracy and completeness prior to the Provisioning Conference. Primary Inventory Control Activities (PICAs) may be assigned and any previously assigned Material Management Aggregation Codes (MMACs) are validated.

Note: Information regarding the MMIS review will be forwarded to involved IM ALCs, but that process was not considered important enough to be included in the model. In the same vein, information regarding non-AF managed consumables are forwarded to the office responsible for processing Supply Support Requests (SSRs), but that activity was also omitted.

SOURCE: AFLCR 65-5, Chap 8, para 8-5.

ACTIVITY: Production option decision

OPR: HQ AFSC (or higher in chain of command)

PRIOR ACTIVITY: FSD contract award & notification

NEXT ACTIVITY: Pre-Guidance Conference actions

MOST LIKELY TIME: 30 days

OPTIMISTIC TIME: 14 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: The production option decision is one which is made at a level higher than the SPM. Many provisioning programs are stopped at this point due to failure to obtain approval from the Defense Services Acquisition Review Council (DSARC), in which case the funds are stopped. When the SPM does implement the decision to continue into production (from FSD), the same contractor who had the FSD contract is authorized to begin production. At that time the FSD contract is transformed into a production contract and the SPM furnishes the contractor with a programming checklist.

SOURCE: AFLCR 65-5, Chap 2, para 2-3b(2); et al.

ACTIVITY: Post-Provisioning Conference actions

OPR: SPM and staff

PRIOR ACTIVITY: Provisioning Conference

NEXT ACTIVITY: SICN issued on non-NSN item by lateral ALC
SSR/NIMSR issued by SPM ALC

MOST LIKELY TIME: 14 days

OPTIMISTIC TIME: 7 days

PESSIMISTIC TIME: 21 days

DESCRIPTION: After the Provisioning Conference, meeting minutes are prepared and distributed to participants and affected agencies. They should be sent out in 7 days, but are sometimes delayed. In addition, requests for Supplementary Provisioning Technical Documentation (SPTD) are prepared and sent out on AFLC Forms 784. The contractor must provide the drawings, blueprints, and sketches used by both the prime contractor and vendors in their internal manufacturing processes to enable sufficient technical review and NSN action by the USAF.

SOURCE: AFLCR 65-5, Chap 2, para 2-3b(19); Chap 7, para 7-4.

ACTIVITY: FSD Guidance Conference

OPR: SPM and staff

PRIOR ACTIVITY: RFP prepared by SPO & sent to contractors

NEXT ACTIVITY: FSD CDRL to SPM ALC for review

MOST LIKELY TIME: 3 days

OPTIMISTIC TIME: 1 day

PESSIMISTIC TIME: 7 days

DESCRIPTION: Prior to FSD contract award, an FSD Guidance Conference will be held, if possible, within 15 days after the Request for Proposal (RFP) has been released by the Air Force. The conference alerts the contractor to the the provisioning requirements for the contract.

SOURCE: AFLCR 65-5, Chap 6, para 6-1a; et al.

ACTIVITY: DLSC screens data & returns to contractor

OPR: DLSC

PRIOR ACTIVITY: Contractor provides data for DLSC screen

NEXT ACTIVITY: PPLs developed by contractor & sent to SPM ALC

MOST LIKELY TIME: 7 days

OPTIMISTIC TIME: 3 days

PESSIMISTIC TIME: 30 days

DESCRIPTION: The Defense Logistics Service Center (DLSC) screens data obtained from the contractor against its central cataloging files to determine the existence/validity of NSNs, prevent unnecessary cataloging actions and determine if material managers are assigned.

SOURCE: AFLCR 65-5, Chap 8-4; et al.

ACTIVITY: SPM ALC reviews Provisioning Conference Data

OPR: SPM ALC/MMIS

PRIOR ACTIVITY: Provisioning Conference

NEXT ACTIVITY: SICN issued on non-NSN items by lateral ALC
SSR/NIMSR issued by SPM ALC

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 3 days

PESSIMISTIC TIME: 60 days

DESCRIPTION: In manual provisioning, the contractor prepares and submits the Post Conference List (PCL), complete with Supplementary Provisioning Technical Documentation (SPTD), not later than 21 days after the Provisioning Conference. The PCL lists all items selected as logical spares/repair parts at the Provisioning Conference and those items previously selected as logical spares to which changes were made during the conference. PCLs are forwarded to SPM ALC/MMIS, where they are reviewed for completeness.

SOURCE: AFLCR 65-5, Chap 9, para 9-5a and b.

ACTIVITY: DPML develops ILSP

OPR: SPM

PRIOR ACTIVITY: System start-up activities

NEXT ACTIVITY: FSD CDRL prepared by SPM ALC (1423)

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 1 day

PESSIMISTIC TIME: 45 days

DESCRIPTION: The Deputy Program Manager for Logistics (DPML) is responsible for developing overall provisioning strategy that will be effective in obtaining the best performance, price, schedule, and supportability for the items needed. An integral part of formulating that strategy is the preparation of the Integrated Logistics Support Plan (ILSP). Such things as the method of provisioning are considered and decided upon.

NOTE: There are three (3) basic methods of provisioning: Resident Provisioning Team (RPT), Provisioning Conference Team, and In-House or Depot Provisioning Committee (DPC). In the provisioning model presented, the formal Provisioning Conference method was used.

SOURCE: AFLCR 65-5, Chap 10, para 10; et al.

ACTIVITY: Contractor provides data for DLSC screen

OPR: Contractor

PRIOR ACTIVITY: FSD contract award & notification

NEXT ACTIVITY: DLSC screens data & returns to contractor

MOST LIKELY TIME: 30 days

OPTIMISTIC TIME: 14 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: After contract award, the contractor assembles the necessary data to submit a screening request to the Defense Logistic Service Center (DLSC). Screening requests should be submitted in time to permit return of results prior to, or at least concurrently with, the contractor's submission of Provisioning Technical Documentation (PTD) to the SPM.

SOURCE: AFLCR 65-5, Chap 8, para 8-4c.

ACTIVITY: PR/MIPR processed by IM ALC (794)

OPR: IM ALC

PRIOR ACTIVITY: IM assigns MOS code & sends to SPM ALC (778/773)
SSR/NIMSR processed by DOD agency

NEXT ACTIVITY: PR/MIPR funded by PPCO (794)

MOST LIKELY TIME: 45 days

OPTIMISTIC TIME: 30 days

PESSIMISTIC TIME: 120 days

DESCRIPTION: The Purchase Request (PR) or Military Interdepartmental Purchase Request (MIPR) is used to request contracting action for new systems/end articles or follow-on action for additional programmed requirements. Documents include, when applicable, the provision for acquisition of initial spares/repair parts and support equipment (SE), and citation of funds for the required initial support. Formal acceptance of an Air Force PR/MIPR is usually made within 30 days after release. PR/MIPR status is maintained by the IM ALC/MMIS. Specific guidance on MIPRs is contained in AFLCP/AFSCP 800-34.

SOURCE: AFLCR 65-5, Chap 3, para 3-3 and 3-5b.

ACTIVITY: PIO (326) reviewed by SPM ALC

OPR: SPM ALC/MMIS

PRIOR ACTIVITY: PIO (326) prepared by IM ALC

NEXT ACTIVITY: PIO (326) funded by PPCO (30)

MOST LIKELY TIME: 30 days

OPTIMISTIC TIME: 21 days

PESSIMISTIC TIME: 60 days

DESCRIPTION: The SPM ALC/MMIS reviews all Provisioning Technical Documentation (PTD) for completeness and consolidates all Provisioned Item Orders (PIOs), on AFLC Forms 326, for submission to the contractor through the Provisioning Principal Contracting Officer (PPCO).

SOURCE: AFLCR 65-5, Chap 8, para 8-5d; Chap 9, para 9-3e; Chap 12, para 12-4a.

ACTIVITY: I & S request (86) prepared by IM ALC

OPR: IM ALC/MMIS

PRIOR ACTIVITY: SPM ALC reviews items coded by IM ALCs

NEXT ACTIVITY: I & S review by CASC

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 14 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: Upon receipt of provisioning documentation for Secondary Item Control Number (SICN) items, MMIS will submit cataloging documents and data package to AFLC/CASC (Cataloging and Standardization Center) after receiving the Form 86 prepared by the IM.

SOURCE: AFLCR 65-5, Chap 12, para 12-3h and 4c.

ACTIVITY: Due-in established in J041 system

OPR: PPCO

PRIOR ACTIVITY: PR/MIPR funded by PPCO (794)
PIO (326) funded by PPCO (30)
Cancel PIO (sub found) or Assign NSN (no sub)

NEXT ACTIVITY: ACO negotiates sched/price w/contractor

MOST LIKELY TIME: 14 days

OPTIMISTIC TIME: 7 days

PESSIMISTIC TIME: 21 days

DESCRIPTION: After funding has been approved on either the Provisioned Item Order (PIO) or Purchase Request (PR), a due-in suspense record is established through input to the J041 automated system.

SOURCE: Interview with AFLC/MMAPP.

ACTIVITY: SICN issued on non-NSN item by lateral ALC

OPR: IM ALC/MMIS

PRIOR ACTIVITY: SPM ALC reviews PCL & SPTD
Post-Provisioning Conference actions

NEXT ACTIVITY: IM assigns MOS code & sends to SPM ALC
(778/773)

MOST LIKELY TIME: 14 days

OPTIMISTIC TIME: 7 days

PESSIMISTIC TIME: 30 days

DESCRIPTION: Secondary Item Control Numbers (SICN) are used to identify non-NSN items until they are converted to valid NSN's, i.e. part numbered items catalogued to NSNs.

SOURCE: Interview with AFLC/MMAPP.

ACTIVITY: Provisioning Conference

OPR: SPM ALC/MMIS

PRIOR ACTIVITY: SPM ALC review of PTD/SPTD

NEXT ACTIVITY: SPM ALC reviews Provisioning Conference data
Post-Provisioning Conference actions.

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 3 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: The Provisioning Conference provides for the USAF to make item selection and assign technical and management codes. The MMIS will:

- Coordinate all conference actions
- Provide a chairperson
- Resolve problems on Source, Maintenance and Recoverability (SMR) coding

The Engineering and Reliability Branch (MM?R) ensures that equipment specialists will:

- Assign SMR codes
- Assign failure factors
- Assign Expendability, Repairability, Recoverablity Codes (ERRCs) (on P-coded items)
- Assign Item Management Codes (IMCs)
- Assign Demilitarization (DEMIL) codes
- Assign Material Management Aggregation Codes (MMACs), when appropriate

AFLC/CASC (Cataloging and Standardization Center) performs a variety of functions regarding the Provisioning Technical Documentation (PTD), Supplementary Provisioning Technical Documentation (SPTD), and Defense Logistics Service Center (DLSC) screening results. The Directorate of Maintenance, Directorate of Distribution, and the using command are also active participants.

SOURCE: AFLCR 65-5, Chap 16.

ACTIVITY: Guidance Conference

OPR: SPM ALC/MMIS

PRIOR ACTIVITY: Pre-Guidance Conference actions

NEXT ACTIVITY: PPLs developed by contractor & sent to SPM ALC

MOST LIKELY TIME: 14 days

OPTIMISTIC TIME: 7 days

PESSIMISTIC TIME: 21 days

DESCRIPTION: The Guidance Conference is conducted to ensure that the selected contractor, major vendors, and Air Force personnel can achieve a mutual understanding of the contractual requirements of the acquisition document involved. The following topics are discussed at the conference:

- Introduction and purpose
- The provisioning process
- Contractor's presentation
- Programming information
- Maintenance concept
- Provisioning Requirements Statement (PRS)
- Interim release and recommended items
- Contract Data Requirements List, DD Form 1423
- Provisioning Conference
- Order and delivery schedules
- Preservation and packaging
- Other subjects, as required

SOURCE: AFLCR 65-5, Chap 2, para 2-3b(3); Chap 6, para 6-2a and 6-5.

ACTIVITY: FSD CDRL prepared by SPM ALC (1423)

OPR: SPM ALC/MMIS

PRIOR ACTIVITY: MMIS prepares PTDDSS (1949-1), PRS (1949-2), PPS (718)
SPM determines agency w/contract respnsibility
DPML develops ILSP

NEXT ACTIVITY: RFP prepared by SPM and sent to contractors

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 1 day

PESSIMISTIC TIME: 45 days

DESCRIPTION: The Contract Data Requirements List (CDRL), DD Form 1423, is used as a cover sheet and coordinating document for all of the information gathered by the SPM during the FSD data call. MMIS submits the completed CDRL to the Data Management Officer for formal approval by the SPM and inclusion in the Request for Proposal (RFP). It includes requirements for all necessary Provisioning Technical Documentation (PTD).

SOURCE: AFLCR 65-5, Chap 3, para 3-2a and 2e(2).

ACTIVITY: FSD contract award & notification

OPR: SPM

PRIOR ACTIVITY: Source selection

NEXT ACTIVITY: Production option decision
Contractor provides data for DLSC screen
SAIP/LLIL Guidance Conference by contractor
SPM sends PRSs to IM ALCs

MOST LIKELY TIME: 30 days

OPTIMISTIC TIME: 15 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: After source selection has been completed, formal award of the Full Scale Development (FSD) contract is made by the SPM and the the selected contractor is notified through the responsible Administrative Contracting Officer (ACO).

SOURCE: Interview with AFALC/XRH.

ACTIVITY: FSD proposal prepared & submitted by contractor

OPR: Contractor

PRIOR ACTIVITY: RFP prepared by SPO & sent to contractors

NEXT ACTIVITY: FSD CDRL sent to SPM ALC for review

MOST LIKELY TIME: 60 days

OPTIMISTIC TIME: 30 days

PESSIMISTIC TIME: 90 days

DESCRIPTION: Eligible contractors who have received Requests for Proposal (RFPs) review the RFP and determine whether or not they are interested in obtaining the contract. They must estimate their ability to produce the desired items in the quantity, of the quality, for the price quoted, and on the schedule specified, necessary to satisfy the RFP. When assembled, the reply is forwarded to the SPM ALC/MMIS through the responsible Administrative Contracting Officer (ACO).

SOURCE: Interview with AFALC/XRH.

ACTIVITY: IM assigns MOS code & sends to SPM ALC (778/773)

OPR: IM ALC/MM?R

PRIOR ACTIVITY: SICN issued on non-NSN items by lateral ALC

NEXT ACTIVITY: PR/MIPR processed by IM ALC (794)
SPM ALC reviews items coded by IM ALCs

MOST LIKELY TIME: 14 days

OPTIMISTIC TIME: 7 days

PESSIMISTIC TIME: 30 days

DESCRIPTION: The appropriate IM ALC branch, MM?R, assigns the correct Method of Support (MOS) code to any items not previously coded at the Provisioning Conference, then forwards the information on either AFLC Form 773 or AFLC Form 778 to the SPM ALC/MMIS for review.

SOURCE: AFLCR 65-5, Chap 14, para 14-3; et al.

ACTIVITY: SSR/NIMSR issued by SPM ALC

OPR: SPM ALC/MMIS (SSR processing unit)

PRIOR ACTIVITY: SPM ALC reviews Provisioning Conference data
Post-Provisioning Conference actions

NEXT ACTIVITY: SSR/NIMSR processed by DOD agency

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 7 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: The SPM ALC/MMIS screens all Supply Support Request (SSR) and Nonconsumable Item Material Support Request (NIMSR) cards to insure completeness and accuracy. After receiving initial provisioning documents from MMIS, the SSR Processing Unit prepares data for input to the D169 automated system.

SOURCE: AFLCR 67-8, Chap 2, para 2-2a and 2-6.

ACTIVITY: Cancel PIO (sub found) or Assign NSN (no sub)

OPR: AFLC/CASC

PRIOR ACTIVITY: I & S review by CASC

NEXT ACTIVITY: NSN forwarded to ACO
Due-in established in J041 system

MOST LIKELY TIME: 30 days

OPTIMISTIC TIME: 14 days

OPTIMISTIC TIME: 90 days

DESCRIPTION: Based on the review of suitable interchangeable or substitutes for the desired items, the Cataloging and Standardization Center (CASC) will either cancel the Provisioned Item Order (PIO) if one was found or they will assign a new NSN. When required, NSN assignment must be made before the contractor is authorized to ship finished products to USAF depots.

NOTE: Upon acceptance of a substitute item the IM actually cancels the PIO, but that action is included within the activity for the purposes of this deterministically branched model.

SOURCE: AFLCR 65-5, Chap 2, para 2-7b; Chap 12, para 12-3h.

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PROVISIONING PROCESS F..(U) AIR FORCE INST OF TECH
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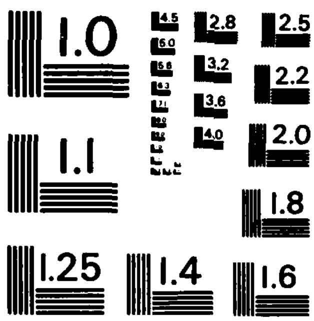
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4.5

ACTIVITY: SPM funds check

OPR: SPM

PRIOR ACTIVITY: PIO (326) prepared by IM ALC

NEXT ACTIVITY: PIO (326) funded by PPCO (30)

MOST LIKELY TIME: 7 days

OPTIMISTIC TIME: 3 days

PESSIMISTIC TIME: 30 days

DESCRIPTION: Prior to being forwarded to the procurement function at the SPM ALC, the SPM checks for funding on all Provisioned Item Orders (PIOs). This action is necessary to prioritize the release of PIOs on the basis of available funding.

SOURCE: Interview with AFLC/MMAPP.

ACTIVITY: Pre-Guidance Conference actions

OPR: SPM ALC/MMIS

PRIOR ACTIVITY: Production option decision

NEXT ACTIVITY: Guidance Conference

MOST LIKELY TIME: 3 days

OPTIMISTIC TIME: 1 day

PESSIMISTIC TIME: 7 days

DESCRIPTION: The SPM recommends a conference start date (through the Administrative Contracting Officer) not later than 45 days from the mailing date of the contract on an AFLC Form 771, Conference Notification, which includes a proposed conference agenda. The SPM chairs a closed Air Force familiarization meeting to discuss pertinent issues with Guidance Conference particpants (Air Force personnel only) in an effort to achieve a unified position which presents one face to industry.

SOURCE: AFLCR 65-5, Chap 6, para 6-2e; et al.

ACTIVITY: RFP prepared by SPO & sent to contractors

OPR: SPO

PRIOR ACTIVITY: FSD CDRL prepared by SPM ALC (1423)

NEXT ACTIVITY: FSD Guidance Conference
FSD proposal prepared & submitted by contractor

MOST LIKELY TIME: 30 days

OPTIMISTIC TIME: 10 days

PESSIMISTIC TIME: 90 days

DESCRIPTION: The Request for Proposal (RFP) is prepared by the System Program Office (SPO) based on the results of the data call conducted with relevant DOD agencies. The RFP includes the Provisioning Requirements Statement (PRS) and Provisioning Performance Schedule (PPS) plus any other provisioning requirements or data necessary for competing contractors to make proposals to the government regarding their desire and ability to produce the requested items. The RFP may become the legally binding contract, or some part of it, between the government and the selected contractor.

SOURCE: AFLCR 65-5, Chap 2, para 2-3b(2); et al.

ACTIVITY: PR/MIPR funded by PPCO (794)

OPR: PPCO

PRIOR ACTIVITY: PR/MIPR processed by IM ALC (794)

NEXT ACTIVITY: NSN forwarded to ACO
Due-in established in J041 system

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 14 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: The Provisioning Principal Contracting Officer (PPCO) reviews the Purchase Request (PR) or Military Interdepartmental Purchase Request (MIPR) for accuracy and completeness, then affixes the appropriate fund citation authorizing purchasing action. The PR/MIPR is forwarded to the Administrative Contracting Officer (ACO) after a due-in has been established in the computer.

SOURCE: AFLCR 65-5, Chap 3, para 3-3 and 3-4; et al.

ACTIVITY: PIO (326) prepared by IM ALC

OPR: IM ALC/MMIS

PRIOR ACTIVITY: SPM ALC reviews items coded by IM ALCs

NEXT ACTIVITY: SPM funds check
PIO (326) reviewed by SPM ALC

MOST LIKELY TIME: 45 days

OPTIMISTIC TIME: 30 days

PESSIMISTIC TIME: 120 days

DESCRIPTION: The IM ALC/MMIS prepares Provisioned Item Orders (PIOs), AFLC Forms 326, which are used to furnish the Provisioning Principal Contracting Officer (PPCO) with a written request for items to be bought through the provisioning process, or on a production contract. This form, when attached to Standard Form (SF) 30 by the PPCO, sets forth the specific items ordered, the estimated cost, and the required delivery schedule.

SOURCE: AFLCR 65-5, Chap 12, para 12-1a, b, and 12-3.

ACTIVITY: PPLs developed by the contractor & sent to SPM ALC

OPR: Contractor

PRIOR ACTIVITY: Guidance Conference
DLSC screens data & returns to contractor
SAIP/LLIL Guidance Conference by contractor
SPM ALC sends PRSs to IM ALCs

NEXT ACTIVITY: SPM ALC review of PTD/SPTD

MOST LIKELY TIME: 60 days

OPTIMISTIC TIME: 30 days

PESSIMISTIC TIME: 120 days

DESCRIPTION: After the Guidance Conference and receiving screening results from the Defense Logistics Service Center (DLSC), the contractor must prepare all of the information requested by the Air Force to complete the requirements for Provisioning Technical Documentation (PTD). A large portion of the PTD is a variety of Provisioning Parts Lists (PPLs) that, according to MIL-STD-1561, contain all components, assemblies, and support items which can be disassembled, reassembled or replaced, and when combined, constitute and end item. The PPL will contain all tools and test equipment required to maintain the end item, unless an exclusion statement is included in the Provisioning Requirements Statement (PRS). The following lists separate provisioned items into different categories and are a subset of the PPL:

- Common/Bulk Items List (CBIL)
- Long Lead Items List (LLIL)
- Recoverable Item Provisioning Parts List (RIPPL)
- Reparable Items List (RIL)
- Short Form Provisioning Parts List (SFPPL)

PPLs are submitted incrementally, but the completed PPL should be submitted by the contractor at least 30 days in advance of the scheduled Provisioning Conference.

SOURCE: AFLCR 65-5, Chap 9, para 9-1, 2a, and 3; Chap 13, para 13-3, 4, and 6.

ACTIVITY: FSD CDRL to SPM ALC for review

OPR: SPM ALC/MMIS

PRIOR ACTIVITY: FSD Guidance Conference
FSD proposal prepared & submitted by contractor

NEXT ACTIVITY: Source selection

MOST LIKELY TIME: 30 days

OPTIMISTIC TIME: 14 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: After receiving contractor proposals in response to the Air Force's Request for Proposal (RFP), SPM ALC/MMIS reviews all information received with the Contract Data Requiements List (CDRL) to insure completeness for the upcoming source selection.

SOURCE: AFLCR 65-5, Chap 3, para 3-2a and 2e(2).

ACTIVITY: SPM ALC reviews items coded by IM ALCs

OPR: SPM ALC/MMIS

PRIOR ACTIVITY: IM assigns MOS code & sends to SPM ALC (778/773)
SSR/NIMSR processed by DOD agency

NEXT ACTIVITY: PIO (326) prepared by IM ALC
I & S request (86) prepared by IM ALC

MOST LIKELY TIME: 14 days

OPTIMISTIC TIME: 7 days

PESSIMISTIC TIME: 30 days

DESCRIPTION: The SPM ALC/MMIS reviews all Provisioning Technical Documentation (PTD) provided before, during, and after the Provisioning Conference prior to preparation of Provisioned Item Orders (PIOs) and requests for review of Interchangeables and Substitutes (I & S ) to ensure that all necessary information is properly documented. MMIS also receives all output products from the D169 automated system provisioned item submissions as a result of Supply Support Requests (SSRs) or Nonconsumable Item Material Support Requests (NIMSRs).

SOURCE: AFLCR 65-5, Chap 2, para 2-2a; Atch 2.

ACTIVITY: PIO (326) funded by PPCO (30)

OPR: PPCO

PRIOR ACTIVITY: SPM funds check
PIO (326) reviewed by SPM ALC

NEXT ACTIVITY: NSN forwarded to ACO by CASC
Due-in established in J041 system

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 14 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: The Provisioning Principal Contracting Officer (PPCO) reviews all Provisioned Item Orders (PIOs) on AFLC Forms 326, and assigns the proper fund citatition authorizing release of the PIO to the contractor (through the Administrative Contracting Officer (ACO)). AFLC Forms 326 are the only documents used to authorize the issuance of or to be attached to SF 30, Amendment of Solicitation/Modification of Contract. The PPCO approves the order, prepares SF 30, and forwards the order with the SF 30 to the ACO with a copy of the SF 30 to finance. The PPCO also endorses an AFLC Form 773 or 778 back to the provisioning activity (SPM/IM ALC/MMIS).

SOURCE: AFLCR 65-5, Chap 12, para 12-3; Chap 42, para 42-5, b and e.

ACTIVITY: I & S review by CASC (86)

OPR: AFLC/CASC

PRIOR ACTIVITY: I & S request (86) prepared by IM ALC

NEXT ACTIVITY: Cancel PIO (sub found) or Assign NSN (no sub)

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 14 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: The Cataloging and Standardization Center (CASC) receives Form 86, Request for Cataloging Action, from IM ALCs and search central data files to determine the existence of potential interchangables and substitutes (I&S). CASC coordinates with equipment specialists at the appropriate ALCs to obtain technical information, but they are the ultimate authority for I&S decisions.

SOURCE: Interview with AFLC/MMAPP.

ACTIVITY: SAIP/LLIL Guidance Conference by contractor

OPR: Contractor

PRIOR ACTIVITY: FSD contract award & notification

NEXT ACTIVITY: PPLs developed by contractor & sent to SPM ALC

MOST LIKELY TIME: 2 days

OPTIMISTIC TIME: 1 day

PESSIMISTIC TIME: 5 days

DESCRIPTION: Spares Acquisition Integrated with Production (SAIP) is used to incorporate Air Force orders for spare recoverable assemblies with the prime contractor's order for production installations and will be included in appropriate production and/or modification contracts as an optional item. The Long Lead Items List (LLIL) indicates those items, which due to their complexity of design, complicated manufacturing processes, or limited production, require early ordering to insure adequate delivery schedules. The contractor determines candidates for both SAIP and LLIL, then furnishes Supplementary Provisioning Technical Documentation (SPTD) to SPM ALC/MMIS for review. Efforts are made to insure early Source, Maintenance, and Recoverability (SMR) and other coding to push long lead items through the provisioning process quickly.

SOURCE: AFLCR 65-5, Chap 2, para 2-5; Chap 8, para 8b; Chap 15, para 15-7.

ACTIVITY: PPL items produced by contractor

OPR: Contractor

PRIOR ACTIVITY: ACO negotiates sched/price w/contractor

NEXT ACTIVITY: Contractor ships items to depots

MOST LIKELY TIME: 120 days

OPTIMISTIC TIME: 45 days

PESSIMISTIC TIME: 270 days

DESCRIPTION: After agreeing to the final price and schedule, the contractor actually manufactures the provisioned item(s). The contractor must notify the SPM ALC/MMIS of all design changes by submitting Design Change Notices (DCNs). DCNs can be the result of major changes such as approved Engineering Change Proposals (ECPs) or minor changes, i.e. informational changes.

SOURCE: AFLCR 65-5, Chap 6, para 6-51; et al.

ACTIVITY: Interim release items produced by contractor

OPR: Contractor

PRIOR ACTIVITY: DLSC screens data & returns to contractor

NEXT ACTIVITY: Contractor ships items to depot

MOST LIKELY TIME: 120 days

OPTIMISTIC TIME: 45 days

PESSIMISTIC TIME: 270 days

DESCRIPTION: The intention to produce interim release items is reflected in the Provisioning Requirements Statement (PRS). To follow this concept in a contract, a funded spare or repair parts contract line item must be in the contract. The interim release concept is intended to permit the contractor to release to production those items which have a production leadtime greater than will permit placing an order for the items after a Provisioning Conference. Provisioning Technical Documentation (PTD) on interim release items from the the Long Lead Items List (LLIL) must be submitted to the SPM ALC/MMIS no later than 30 days after being released for production. Supplementary Provisioning Technical Documentation (SPTD) is also normally required.

SOURCE: AFLCP/AFSCP 800-34, Chap 19, para 19-5c; AFLCR 65-5, Chap 8, para 8-2b.

ACTIVITY: MMIS prepares PTDDSS (1949-1), PRS (1949-2), PPS (718)

OPR: SPM ALC/MMIS

PRIOR ACTIVITY: System start-up activities

NEXT ACTIVITY: FSD CDRL prepared by SPM ALC (1423)

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 7 days

PESSIMISTIC TIME: 45 days

DESCRIPTION: Based on the Statement of Work (SOW) provided by AFSC, SPM ALC/MMIS prepares DD Form 1949-1, Provisioning Technical Documentation Data Selection Sheet (PTDDSS); DD Form 1949-2, Provisioning Requirements Statement (PRS); and AFLC Form 718, Provisioning Performance Schedule (PPS), for input to the SPM in preparation of the Request for Proposal (RFP). MMIS also insures that adequate funds are cited for the contractor to get started, i.e. funds for Guidance Conference, preparation of Provisioning Technical Documentation (PTD) and interim release of items during the first six months after contract award.

SOURCE: AFLCR 65-5, Chap 3, para 3-3c, d, e, f and h.

ACTIVITY: SPM ALC sends PRSs to IM ALCs for review

OPR: SPM ALC/MMIS

PRIOR ACTIVITY: FSD contract award & notification

NEXT ACTIVITY: PPLs developed by contractor & sent to SPM ALC

MOST LIKELY TIME: 14 days

OPTIMISTIC TIME: 7 days

PESSIMISTIC TIME: 21 days

DESCRIPTION: At the time of contract award, or no later than submission of the first Provisioning Technical Documentation (PTD) on the contract, the SPM ALC/MMIS furnishes involved IM ALCs with the Provisioning Requirements Statements (PRSs) and programming checklists to be followed in determining initial support requirements.

SOURCE: AFLCR 65-5, Chap 3, para 3-5.

ACTIVITY: SPM determines agency w/contract responsibility

OPR: SPM

PRIOR ACTIVITY: System start-up activities

NEXT ACTIVITY: FSD CDRL prepared by SPM ALC (1423)

MOST LIKELY TIME: 21 days

OPTIMISTIC TIME: 1 day

PESSIMISTIC TIME: 45 days

DESCRIPTION: After appointment of the System Program Manager (SPM) and establishment of the System Program Office (SPO), the SPM must evaluate the contractual needs of the provisioning effort. The SPM then determines the DOD activity (USAF, USN, USA, or DCAS) which will have contracting responsibility for the system/end article involved. The action is documented on the Contract Data Requirements List (CDRL), AF Form 1423.

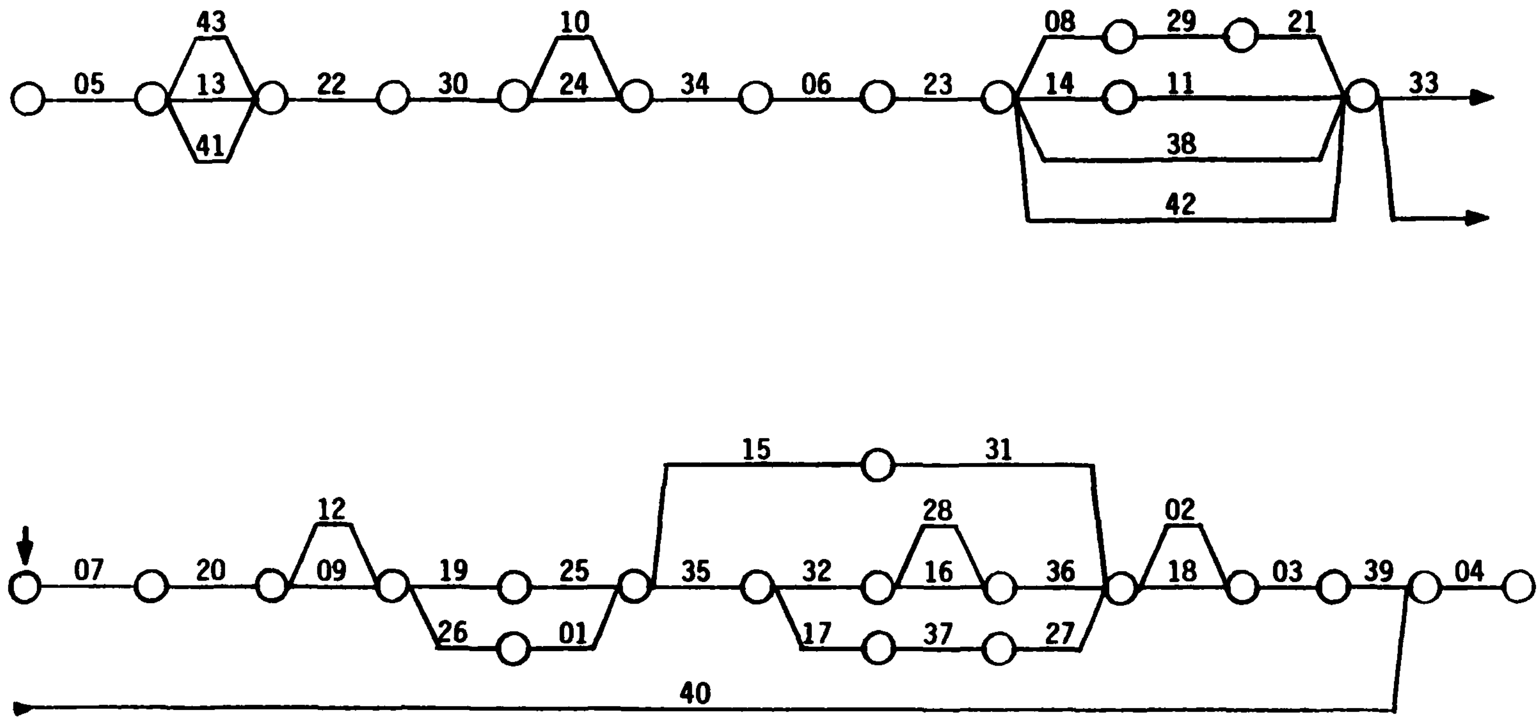
SOURCE: AFLCR 65-5, Chap 3, para 3-2g(1).

## Parameter Sets

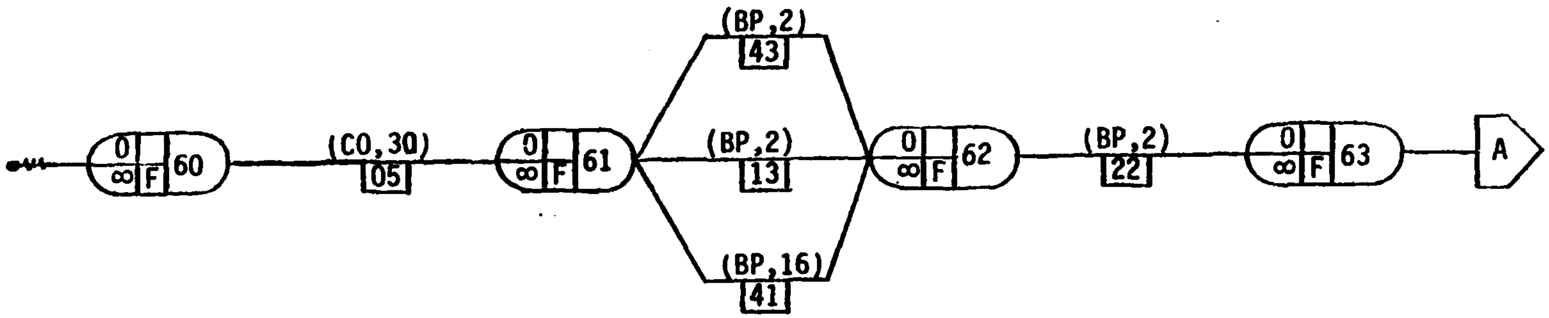
The following data shows the activity time distributions used in the QGERT simulation program:

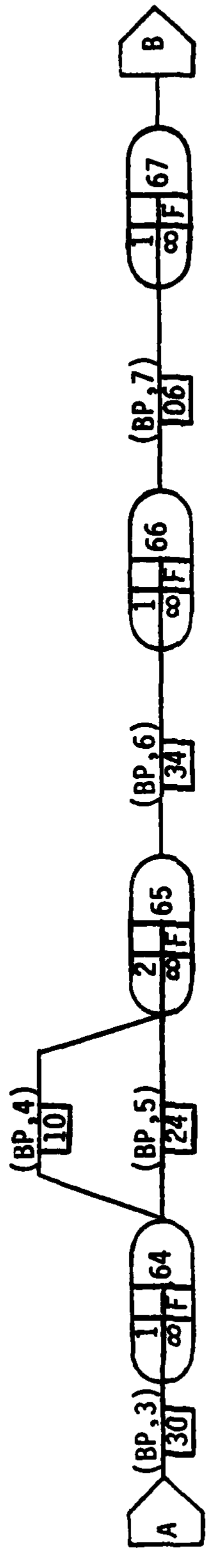
| SET NUMBER | OPTIMISTIC TIME | MOST LIKELY TIME | PESSIMISTIC TIME | ACTIVITIES |
|---|---|---|---|---|
| 1 | 30 | 30 | 30 | 5 |
| 2 | 1 | 21 | 45 | 13,22,43 |
| 3 | 10 | 30 | 90 | 30 |
| 4 | 1 | 3 | 7 | 10,29 |
| 5 | 30 | 60 | 90 | 24 |
| 6 | 14 | 30 | 45 | 34,23,07 08,14 |
| 7 | 14 | 45 | 120 | 06 |
| 8 | 1 | 2 | 5 | 38 |
| 9 | 3 | 7 | 30 | 11,28 |
| 10 | 7 | 14 | 21 | 21,18,42 09 |
| 11 | 30 | 60 | 120 | 33 |
| 12 | 3 | 21 | 45 | 20 |
| 13 | 3 | 21 | 60 | 12 |
| 14 | 14 | 30 | 90 | 27 |
| 15 | 7 | 14 | 30 | 19,25,35 02 |
| 16 | 7 | 21 | 45 | 26,04,41 |
| 17 | 14 | 21 | 45 | 01,31,17 37,36,03 |
| 18 | 45 | 120 | 270 | 40,39 |
| 19 | 30 | 45 | 120 | 32,15 |
| 20 | 21 | 30 | 60 | 16 |

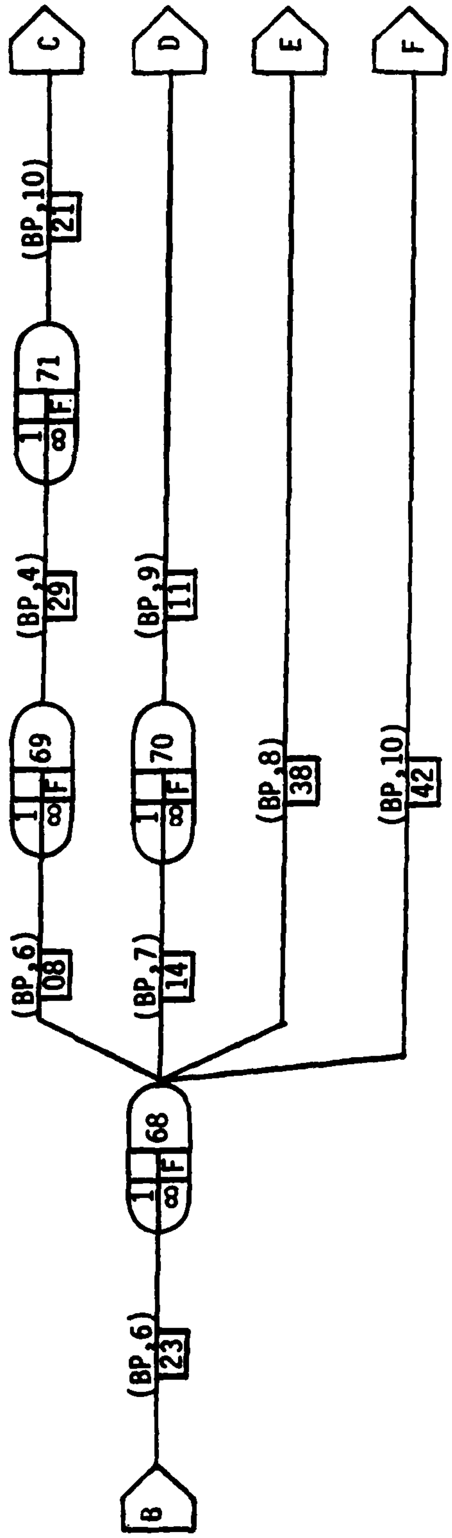
## ACTIVITY DIAGRAM OF THE USAF PROVISIONING PROCESS



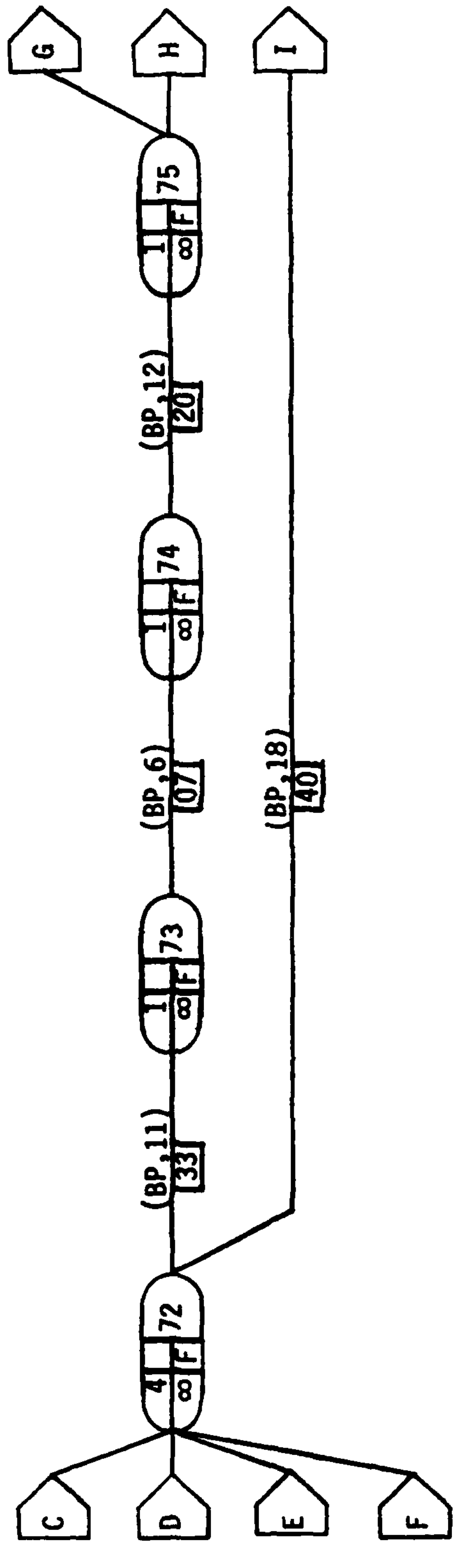
QGERT NETWORK OF THE USAF PROVISIONING PROCESS



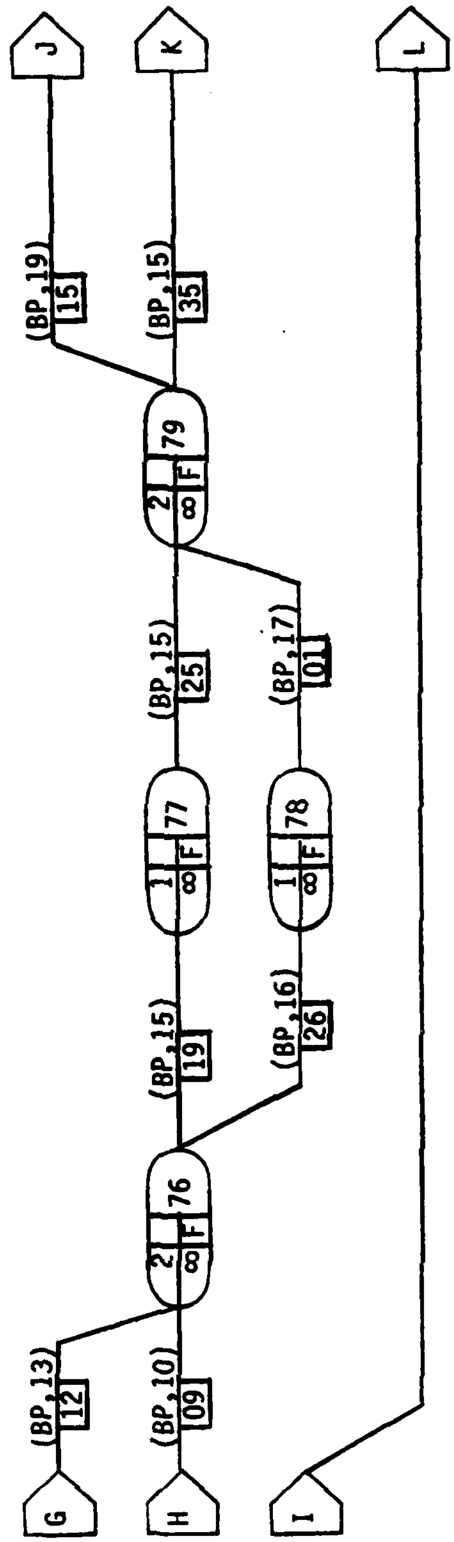

A
(BP,3)
30
1
∞
F
64
(BP,4)
10
(BP,5)
24
2
∞
F
65
(BP,6)
34
1
∞
F
66
(BP,7)
06
1
∞
F
67
B

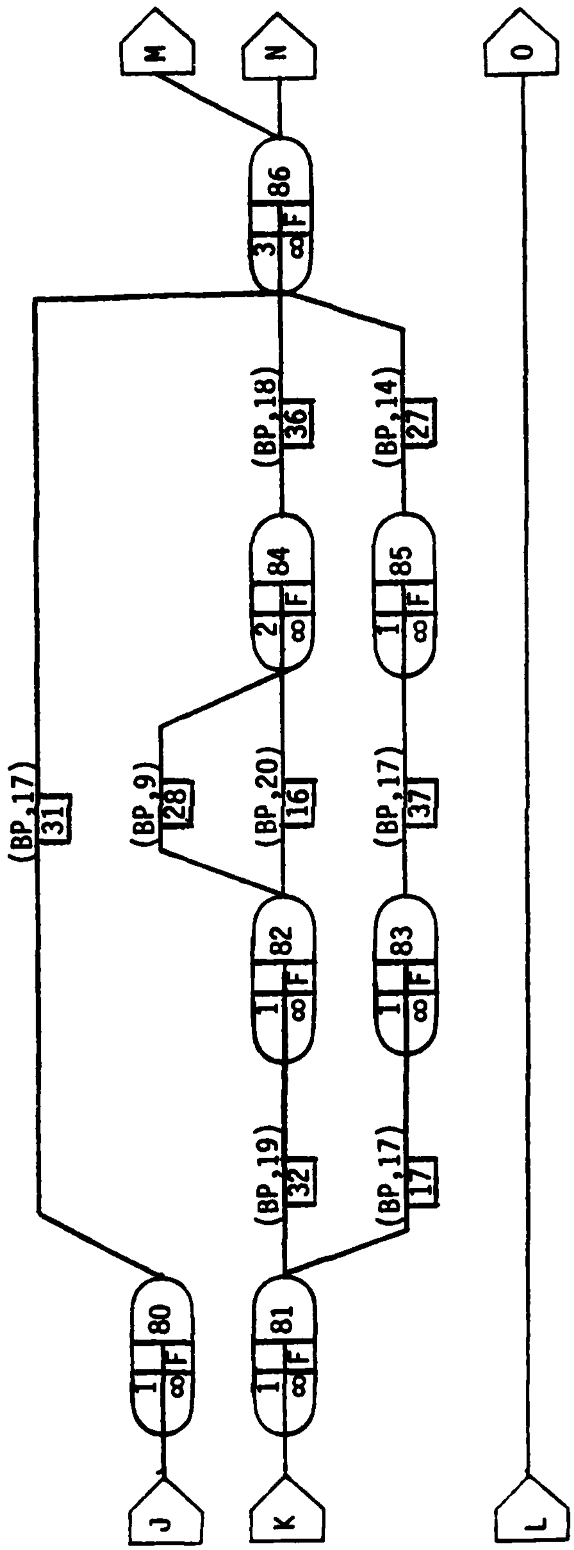


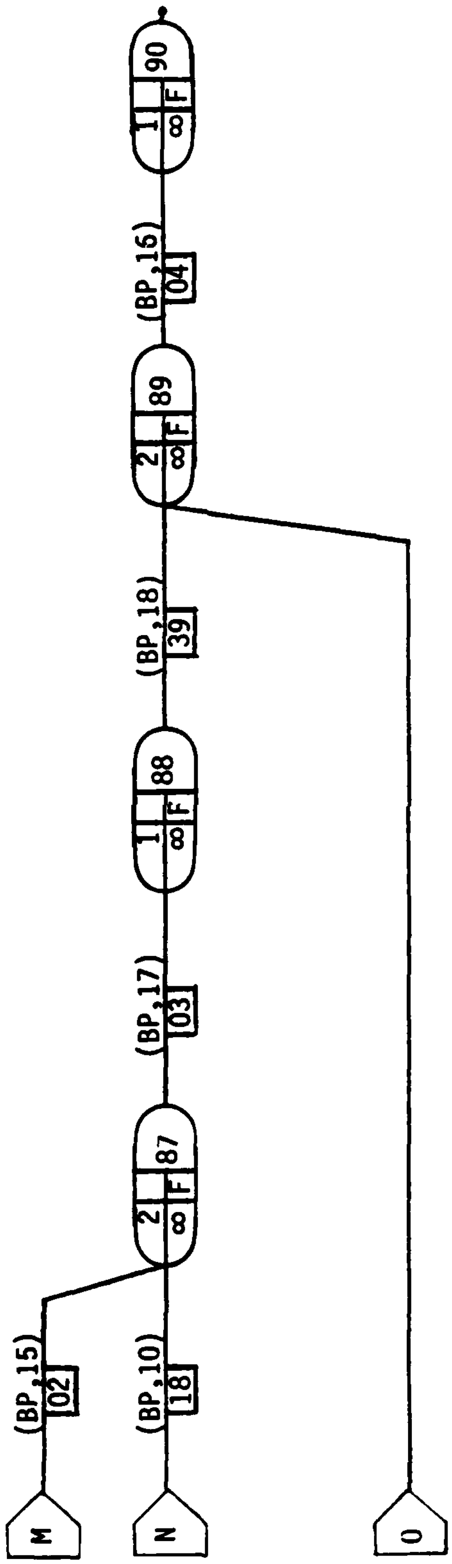
C
D
E
F
B
(BP,10) 21
71
(BP,4) 29
(BP,9) 11
69
70
(BP,8) 38
(BP,10) 42
(BP,6) 08
(BP,7) 14
68
(BP,6) 23



G
H
I
75
74
73
72
(BP,12)
20
(BP,6)
07
(BP,18)
40
(BP,11)
33
C
D
E
F


J
K
L
(BP,19)
15
(BP,15)
35
2
79
∞
F
(BP,15)
25
(BP,17)
01
1
77
∞
F
1
78
∞
F
(BP,15)
19
(BP,16)
26
2
76
∞
F
(BP,13)
12
(BP,10)
09
G
H
I


J
K
L
M
N
O
80
81
82
83
84
85
86
(BP,17) 31
(BP,9) 28
(BP,20) 16
(BP,17) 37
(BP,18) 36
(BP,14) 27
(BP,19) 32
(BP,17) 17



90
1
∞
F
(BP,15)
04
89
2
∞
F
(BP,18)
39
88
1
∞
F
(BP,17)
03
87
2
∞
F
(BP,15)
02
(BP,10)
18
M
N
O

## Appendix C: Validation Testing

1. Hypothesis testing:

Ho: Simulation mean equals PERT (manual) mean

Ha: Simulation mean does not equal PERT (manual) mean

Test Statistic:

$$Z = \frac{\bar{X} - \mu}{s/\sqrt{n}} \qquad (3)$$

$$Z = \frac{917.2520 - 840.322}{62.3638/42.9884}$$

$$Z = 53.0222$$

where

$\bar{X}$ = simulation mean
$\mu$ = PERT (manual) mean
s = standard deviation of the simulation mean
n = number in sample

Accept the null hypothesis Ho if:

$$-Z\alpha/2 \leq Z \leq Z\alpha/2 \qquad (4)$$

$$-1.96 \leq Z \leq 1.96$$

where $Z\alpha/2 = 1.96$.

Therefore reject Ho; that the simulation mean equals the PERT-calculated mean based on an alpha ($\alpha$) value of .05. At first sight, this indicates that the network model of the provisioning process does not compare favorably with the manual PERT method of calculating the length of time for network completion. However, in this case it is actually the PERT mean which does not compare favorably with the simulation mean. By inserting the expected activity completion times (te) from the PERT calculations into the Q-GERT simulation parameters, the same total network completion (T = 840.332) was obtained--that comparison proved that both networks were identical (Attachment 1 and 2). However, the PERT-calculated network time uses only one critical path and one set of times.

While the Q-GERT simulation network starts with the same parameters as the PERT network, it randomly picks and uses activity completion times from an actual beta distribution curve. The result in total network time is a more accurate estimatin of what might occur in an actual network (30).

2. Confidence interval (CI):

$$CI = \bar{X} \pm Z\alpha/2\ (s\ /n)^{1/2} \qquad (4)$$

$$CI = 917.2520 \pm 1.96(3889.2435/1848)^{1/2}$$

$$CI = (914.4086, 920.0954)$$

where

$\bar{X}$ = simulation mean
$\alpha$ = .05
$Z\alpha/2$ = 1.96
s = standard deviation of simulation mean
n = size of the sample

Therefore, the 95 percent confidence interval for the mean of the total system time is between 914 and 920 days. This means that 95 percent of the time, the provisioning system depicted in the network modeled here will take from 914 to 920 days to complete (based on the assumptions of the model).

Attachment 1 Appendix C

| END NODE | ACTIVITY | ACTIVITY TIME | END NODE TIME |
|---|---|---|---|
| 61 | 05 | 30.000 | 30.000 |
| 62 | 41 | 22.667 | 52.667 |
| 63 | 22 | 21.667 | 74.334 |
| 64 | 30 | 36.667 | 111.001 |
| 65 | 24 | 60.000 | 171.001 |
| 66 | 34 | 29.883 | 200.834 |
| 67 | 06 | 52.333 | 253.167 |
| 68 | 23 | 29.833 | 283.000 |
| 69 | 08 | 29.833 | 312.833 |
| 71 | 29 | 3.333 | 316.166 |
| 72 | 21 | 14.000 | 330.166 |
| 73 | 33 | 65.000 | 395.166 |
| 74 | 07 | 29.833 | 424.999 |
| 75 | 20 | 22.000 | 446.999 |
| 76 | 12 | 24.500 | 471.499 |
| 78 | 26 | 22.667 | 494.166 |
| 79 | 01 | 23.833 | 517.999 |
| 81 | 35 | 15.500 | 533.499 |
| 82 | 32 | 55.000 | 588.499 |
| 84 | 16 | 33.500 | 621.832 |
| 86 | 36 | 23.833 | 645.832 |
| 87 | 02 | 15.500 | 661.332 |
| 88 | 03 | 23.833 | 685.165 |
| 89 | 39 | 132.500 | 817.665 |
| 90 | 04 | 22.667 | 840.332 |

Attachment 2 Appendix C

The Q-GERT simulation was run for 1848 repetitions, per equations 1 and 2, with the following results:

| | | |
|---|---|---|
| Total system mean | = | 917.2520 days |
| Standard deviation | = | 62.3638 days |
| Minimum system time | = | 728.9681 days |
| Maximum system time | = | 1161.6229 days |

Additionally, the Q-GERT simulation was expanded (out of curiosity) to 10,000 repetitions with the following results:

| | | |
|---|---|---|
| Total system mean | = | 917.7011 days |
| Standard deviation | = | 62.9937 days |
| Minimum system time | = | 713.2984 days |
| Maximum system time | = | 1178.3682 days |

# Appendix D: Programs and Data File Listings

CONTENTS

```
*********************  PROCEDURE FILE MKLIB  *************************

*.PROC,LIBM1*I,STNO[ARE YOU A STUDENT TAKING THIS COURSE (Y/N)]=(Y,N),
STNR[WHAT IS YOUR 2 DIGIT GROUP NUMBER]=(*A),
  PWDI[WHAT IS YOUR STARTUP CODE (STUDENTS USE ST)]=(*A).
IF,$STNO$.EQ.$N$,INS1.
IF,$PWDI$.EQ.$ZP$,IOK1.
NOTE(OUTPUT). /////////////////////////////////////
NOTE(OUTPUT)./ HERE IS THE LIST OF GO AHEAD     /
NOTE(OUTPUT)./PASSWORDS FOR EACH GROUP          /
NOTE(OUTPUT)./WRITE THEM DOWN AND KEEP THE LIST /
NOTE(OUTPUT)./FROM YOUR STUDENTS--THE PASSWORDS /
NOTE(OUTPUT)./DO THE FOLLOWING: THE ONES LISTED /
NOTE(OUTPUT)./UNDER 'PGRTXT' ARE THOSE THAT     /
NOTE(OUTPUT)./ALLOW STUDENTS WHO HAVE COMPLETED /
NOTE(OUTPUT)./THAT PORTION OF THE EXERCISE TO   /
NOTE(OUTPUT)./YOUR SATISFACTION, TO GO AHEAD    /
NOTE(OUTPUT)./WITH THE NEXT SECTION 'ACORDR'    /
NOTE(OUTPUT)./  - - - - - - - - - - - - - - - - /
NOTE(OUTPUT)./ GROUP  PGRTXT  ACORDR  CRPATH    /
NOTE(OUTPUT)./  1     GHO      DOG     NAD      /
NOTE(OUTPUT)./  2     BOI      OKD     LAT      /
NOTE(OUTPUT)./  3     TES      RIT     YES      /
NOTE(OUTPUT)./  4     FIR      BOM     AFT      /
NOTE(OUTPUT)./  5     LAS      MAR     CAT      /
NOTE(OUTPUT)./  6     NAB      CAR     YEL      /
NOTE(OUTPUT)./ 7-99   GAM      APR     REM      /
NOTE(OUTPUT).//////////////////////////////////////
REPLACE,STARTUP.
REPLACE,PRITS.
REPLACE,ALPHA.
LIBGEN,F=XERCIZ,P=INSLIB.
REPLACE,INSLIB.
REPLACE,BTCH1.
LIBRARY,MYLIB,INSLIB.
RETURN,XERCIZ,RECVRY,INSTRK,TMPINS.
RETURN,MKLIB,BTCH1,ALPHA,PRITS.
CHANGE,BTCH1/CT=S.
NOTE(OUTPUT)./////////////////////////////////////////
NOTE(OUTPUT)./YOUR LIBRARIES ARE SET AND YOU        /
NOTE(OUTPUT)./ARE READY TO RUN 'BINARY'             /
NOTE(OUTPUT)./TO DO SO TYPE IN 'BINARY' AND HIT     /
NOTE(OUTPUT)./THE RETURN KEY                        /
NOTE(OUTPUT)./////////////////////////////////////////
ELSE,IOK1.
NOTE(OUTPUT)./////////////////////////////////////////
NOTE(OUTPUT)./YOU BETTER CHECK YOUR INSTRUCTORS       /
NOTE(OUTPUT)./MATERIAL FOR THE START UP               /
NOTE(OUTPUT)./PASSWORD,OR YOU WILL NOT BE ABLE TO     /
NOTE(OUTPUT)./USE THIS EXERCISE YOU MUST START        /
NOTE(OUTPUT)./'LIBM1' OVER WITH THE 'BEGIN'           /
```

```
NOTE(OUTPUT)./STATEMENT WHEN YOU HAVE THE CORRECT    /
NOTE(OUTPUT)./PASSWORD FOR START UP                   /
NOTE(OUTPUT)./IF, HOWEVER, YOU ARE A STUDENT          /
NOTE(OUTPUT)./TRYING TO GUESS THE PASSWORD, IT WILL  /
NOTE(OUTPUT)./NOT WORK,SO TYPE 'LIBM1' AND START     /
NOTE(OUTPUT)./THE INITIALIZATION OVER AGAIN          /
NOTE(OUTPUT).////////////////////////////////////////////
ENDIF,IOK1.
ELSE,INS1.
NOTE(OUTPUT).///////////////////////////////////////
NOTE(OUTPUT)./GIVE ME A MINUTE TO GET GOING    /
NOTE(OUTPUT).///////////////////////////////////////
REPLACE,STARTUP.
REPLACE,PRITS.
LIBGEN,F=XERCIZ,P=STULIB.
REPLACE,STULIB.
GET,MYLIB/UN=T841009.
REPLACE,BTCH1.
LIBRARY,STULIB,MYLIB.
REPLACE,RECVRY.
REPLACE,INSTRK.
CHANGE,INSTRK/CT=S.
CHANGE,BTCH1/CT=S.
CHANGE,RECVRY/CT=S.
RETURN,RECVRY,INSTRK,XERCIZ,MKLIB,ALPHA,DISN.
NOTE(OUTPUT).//////////////////////////////////////////////
NOTE(OUTPUT)./ YOU ARE NOW READY FOR THE INTRODUCTION /
NOTE(OUTPUT)./ TYPE 'INTRO' AND HIT THE RETURN KEY    /
NOTE(OUTPUT).//////////////////////////////////////////////
ENDIF,INS1.
REVERT,NOLIST.
EXIT.
REVERT,ABORT. LIBM1 ABORTED.
*.DATA,STARTUP.
*.IF,$PWDI$.EQ.$ZP$,INS.
*.PROC,BG.
SETTL,*.
NOTE(OUTPUT).  .TIME LIMIT SET TO MAXIMUM
GET,INSLIB.
GET,MYLIB.
LIBRARY,MYLIB,INSLIB.
REVERT,NOLIST.
EXIT.
REVERT,ABORT.
*.*
*.ELSE,INS.
*.PROC,BG.
GET,STULIB.
GET,MYLIB/UN=T841009.
SETTL,*.
NOTE(OUTPUT).  .TIME LIMIT SET TO MAXIMUM
GET,STULIB.
```

```
LIBRARY,STULIB,MYLIB.
REVERT,NOLIST.
EXIT.
REVERT,ABORT.
*.EOR
*.*
*.ENDIF,INS.
*.DATA,XERCIZ.
*.IF,$PWDI$.EQ.$ZP$,IOK2.
*.*
**** PROCEDURE BINARY ****
*.PROC,BINARY.
*.* THIS PROCEDURE IS TO BE USED BY THE INSTRUCTOR PRIOR TO EACH
*.*TIME THAT THE EXERCISE IS TO BE RUN. IT ATTACHES ALL THE
*.*EXECUTABLE BINARY. IF THE BINARY IS NOT PRESENT, THE SOURCE
*.*FILES ARE ATTACHED AND THE PROGRAMS COMPILED.
RETURN,TXTBIN,RNDBIN,CP1BIN,CP2BIN,INTBIN,DSPBIN,SA1BIN,CKUBIN.
IF,FILE(TXTBIN,.NOT.LO),LAB1.
GET,TXTBIN.
ELSE,LAB1.
EXIT.
GET,PGMTXT.
NOTE(OUTPUT).GETTINTG PGMTXT.
FTN5,I=PGMTXT,B=TXTBIN,L=0,ANSI=0.
REPLACE,TXTBIN.
RETURN,PGMTXT.
ENDIF,LAB1.
IF,FILE(RNDBIN,.NOT.LO),LAB2.
GET,RNDBIN.
ELSE,LAB2.
EXIT.
GET,RNDMPR.
NOTE(OUTPUT).COMPILING RNDMPR.
FTN5,I=RNDMPR,B=RNDBIN,L=0,ANSI=0.
REPLACE,RNDBIN.
RETURN,RNDMPR.
ENDIF,LAB2.
IF,FILE(CP1BIN,.NOT.LO),LAB3.
GET,CP1BIN.
ELSE,LAB3.
EXIT.
GET,CPATH1.
NOTE(OUTPUT).COMPILING CPATH1.
FTN5,I=CPATH1,B=CP1BIN,L=0,ANSI=0.
REPLACE,CP1BIN.
RETURN,CPATH1.
ENDIF,LAB3.
IF,FILE(CP2BIN,.NOT.LO),LAB4.
GET,CP2BIN.
ELSE,LAB4.
EXIT.
GET,CPATH2.
```

```
NOTE(OUTPUT).COMPILING CPATH2.
FTN5,I=CPATH2,B=CP2BIN,L=0,ANSI=0.
REPLACE,CP2BIN.
RETURN,CPATH2.
ENDIF,LAB4.
IF,FILE(INTBIN,.NOT.LO),LAB5.
GET,INTBIN.
ELSE,LAB5.
EXIT.
GET,INTROD.
NOTE(OUTPUT).COMPILING INTROD.
FTN5,I=INTROD,B=INTBIN,L=0,ANSI=0.
REPLACE,INTBIN.
RETURN,INTROD.
ENDIF,LAB5.
IF,FILE(DSPBIN,.NOT.LO),LAB6.
GET,DSPBIN.
ELSE,LAB6.
EXIT.
GET,DISPLY.
NOTE(OUTPUT). COMPILING DISPLY.
FTN5,I=DISPLY,B=DSPBIN,L=0,ANSI=0.
REPLACE,DSPBIN.
RETURN,DISPLY.
ENDIF,LAB6.
IF,FILE(SA1BIN,.NOT.LO),LAB7.
GET,SA1BIN.
ELSE,LAB7.
EXIT.
GET,SNSAN1.
NOTE(OUTPUT). COMPILING SNSAN1.
FTN5,I=SNSAN1,B=SA1BIN,L=0,ANSI=0.
REPLACE,SA1BIN.
RETURN,SNSAN1.
ENDIF,LAB7.
IF,FILE(CKUBIN,.NOT.LO),LAB8.
GET,CKUBIN.
ELSE,LAB8.
EXIT.
GET,PGMCKU.
NOTE(OUTPUT). COMPILING PGMCKU.
FTN5,I=PGMCKU,B=CKUBIN,L=0,ANSI=0.
REPLACE,CKUBIN.
RETURN,PGMCKU.
ENDIF,LAB8.
GET,ACTIVS/UN=T841009.
GET,ALPHA/UN=T841009.
GET,PRITS/UN=T841009.
CHANGE,INTBIN/CT=S.
CHANGE,TXTBIN/CT=S.
CHANGE,RNDBIN/CT=S.
CHANGE,CP1BIN/CT=S.
```

```
CHANGE,CP2BIN/CT=S.
CHANGE,SA1BIN/CT=S.
CHANGE,PRITS/CT=S.
CHANGE,ALPHA/CT=S.
CHANGE,ACTIVS/CT=S.
CHANGE,BTCH1/CT=S.
NOTE(OUTPUT)./////////////////////////////////////
NOTE(OUTPUT)./ IF OF THE FOLLOWING FILE PAIRS /
NOTE(OUTPUT)./ THE 'BIN' FILE IS NOT THERE    /
NOTE(OUTPUT)./ BUT ITS PAIRED FILE IS, RUN    /
NOTE(OUTPUT)./ BINARY AGAIN--IF NEITHER OF    /
NOTE(OUTPUT)./ THE PAIR IS THERE, YOU MUST    /
NOTE(OUTPUT)./ RUN THE TAPE JOB TO LOAD THE   /
NOTE(OUTPUT)./MISSING FILES-----              /
CATLIST.
NOTE(OUTPUT)./    PGMTXT ----- TXTBIN          /
NOTE(OUTPUT)./    INTROD ----- INTBIN          /
NOTE(OUTPUT)./    RNDMPR ----- RNDBIN          /
NOTE(OUTPUT)./    CPATH1 ----- CP1BIN          /
NOTE(OUTPUT)./    CPATH2 ----- CP2BIN          /
NOTE(OUTPUT)./    DISPLY ----- DSPBIN          /
NOTE(OUTPUT)./    SNSAN1 ----- SA1BIN          /
NOTE(OUTPUT)./    PGMCKU ----- CKUBIN          /
NOTE(OUTPUT)./////////////////////////////////////
RETURN,ACTIVS,PRITS,INTBIN,TXTBIN,RNDBIN,CP1BIN,CP2BIN,DSPBIN,SA1BIN.
RETURN,RECVRY,INSTRK,XERCIZ,BTCH1,ALPHA.
NOTE(OUTPUT).////////////////////////////////////////////
NOTE(OUTPUT).// BINARY IS FINISHED, AND ALL THE       /
NOTE(OUTPUT)./NECESSARY FILES ARE PRESENT, YOU CAN GO /
NOTE(OUTPUT)./AHEAD WITH THE EXERCISE, THE NEXT JOB   /
NOTE(OUTPUT)./TO DO IS DISPLAY THE NETWORKS FOR EACH  /
NOTE(OUTPUT)./GROUP, TO DO THAT TYPE IN 'PREP'        /
NOTE(OUTPUT).////////////////////////////////////////////
EXIT.
NOTE(OUTPUT). YOU MUST RUN THE TAPE JOB TO REPLACE SOME MISSING FILES.
*.*AT THIS POINT THE INSTRUCTOR CAN SET UP AND RUN THE TAPE JOB.
REVERT,NOLIST.
EXIT.
REVERT,ABORT. TRY BINARY AGAIN.
*.EOR
*.*
*.*
**** PROCEDURE PREP ****
*.PROC,PREP.
NOTE(OUTPUT)./////////////////////////////////////
NOTE(OUTPUT)./ DISNET IS A JOB TO PRINT THE   /
NOTE(OUTPUT)./NETWORK, IT ASSIGNS A RANDOM    /
NOTE(OUTPUT)./LETTER-NUMBER COMBINATION TO  THE/
NOTE(OUTPUT)./ACTIVITIES, THE CHARACTER PAIR IS/
NOTE(OUTPUT)./PLACED ON THE PRINTOUT WHERE THE /
NOTE(OUTPUT)./ACTIVITY GOES, DURING THE        /
NOTE(OUTPUT)./STUDENT PROCEDURE 'ACORDR'       /
```

```
NOTE(OUTPUT)./THEY DETERMINE THE PRECEDENCE OF /
NOTE(OUTPUT)./THE ACTIVITIES IN THE NETWORK--  /
NOTE(OUTPUT)./        ALL THE GROUPS WILL HAVE  /
NOTE(OUTPUT)./DIFFERENT LETTERS IN DIFFERENT   /
NOTE(OUTPUT)./PLACES TO MINIMIZE COLLABORATION,/
NOTE(OUTPUT)./HOWEVER, EXCEPT FOR THE LETTERS, /
NOTE(OUTPUT)./THE NETWORKS ARE EXACTLY THE SAME/
NOTE(OUTPUT)./THIS PROCEDURE IS A SHORT ONE FOR/
NOTE(OUTPUT)./THE MACHINE, BUT FOR YOU IT IS AN/
NOTE(OUTPUT)./ITERATIVE ONE--YOU MUST REPEAT   /
NOTE(OUTPUT)./IT ONCE FOR EACH GROUP YOU       /
NOTE(OUTPUT)./INTEND TO USE IN THE EXERCISE--  /
NOTE(OUTPUT)./               EACH NETWORK WILL  /
NOTE(OUTPUT)./BE PRINTED ON 15 PAPER, AND CAN  /
NOTE(OUTPUT)./BE PICKED UP IN BLDG 640 ROOM 133/
NOTE(OUTPUT)./IN CYBER BIN G, WITH A UJN OF    /
NOTE(OUTPUT)./GXX (WHERE XX IS THE TWO DIGIT   /
NOTE(OUTPUT)./GROUP NUMBER) --BEFORE THE       /
NOTE(OUTPUT)./EXERCISE BEGINS---               /
NOTE(OUTPUT)./THE PROCEEDURE WILL ASK YOU 3    /
NOTE(OUTPUT)./QUESTIONS       1-GROUP NUMBER   /
NOTE(OUTPUT)./OF THE GROUP YOU ARE PREPARING   /
NOTE(OUTPUT)./FOR AT THE MOMENT,2-ITS LOGIN    /
NOTE(OUTPUT)./USERID, AND IT WILL ASK YOU FOR  /
NOTE(OUTPUT)./A FILENAME FOR THAT GROUP, I     /
NOTE(OUTPUT)./SUGGEST A NAME THAT IS SIMILAR   /
NOTE(OUTPUT)./FOR EACH GROUP,IE--SSSSXX ---    /
NOTE(OUTPUT)./WHERE THE SSSS IS SOME FOUR      /
NOTE(OUTPUT)./LETTERS AND XX IS THE GROUP'S    /
NOTE(OUTPUT)./NUMBER---IT CAN ONLY BE SIX      /
NOTE(OUTPUT)./CHARACTERS ALTOGETHER            /
NOTE(OUTPUT)./-----------TO RUN DISNET         /
NOTE(OUTPUT)./ YOU MUST TYPE IN THE FOLLOWING  /
NOTE(OUTPUT)./ AT THE '/' PROMPT:              /
NOTE(OUTPUT)./GET,DISN     -----AND THEN TYPE  /
NOTE(OUTPUT)./BEGIN,DISNET,DISN                /
NOTE(OUTPUT).//////////////////////////////////////
REVERT,NOLIST.
EXIT.
REVERT,ABORT.
*.EOR
*.*
**** PROCEDURE CHECKU ****
*.PROC,CHECKU*I,
GRP[WHAT GROUP NUMBER(2 DIGIT) ARE YOU LOOKING AT]=(*S2(0123456789)),
LGIN[WHAT IS THAT GROUP'S LOGIN USER-ID(7 POSITIONS)]=(*S7(T0123456789)).
NOTE(OUTPUT). HERE IS THE STATUS OF GROUP GRP .
GET,INSTRK/UN=LGIN.
GET,CKUGIN.
CKUGIN.
RETURN,INSTRK.
NOTE(OUTPUT).//////////////////////////////////////
```

```
NOTE(OUTPUT)./ IT IS UP TO YOU TO PROVIDE EACH /
NOTE(OUTPUT)./ GROUP WITH ITS OWN GO AHEAD     /
NOTE(OUTPUT)./ PASSWORDS FOR EACH PROCEDURE,   /
NOTE(OUTPUT)./AS WELL AS THE FILE NAME YOU     /
NOTE(OUTPUT)./GAVE THE ACTIVITY FILES FOR      /
NOTE(OUTPUT)./EACH GROUP DURING YOUR PREP      /
NOTE(OUTPUT)./PROCEDURE AT THE BEGINNING,      /
NOTE(OUTPUT)./ THE PASSWORDS ARE IN YOUR       /
NOTE(OUTPUT)./ INSTRUCTOR' MANUAL.             /
NOTE(OUTPUT).///////////////////////////////////
REVERT,NOLIST.
*.EOR
*.*
**** PROCEDURE ADPGIT ****
*.PROC,ADPGIT*I,PWDP[WHAT IS THE PURGE PASSWORD ]=(*A).
IF,$PWDP$.EQ.$ZAP$,NOP.
NOTE(OUTPUT).//////////////////////////////////////////
NOTE(OUTPUT)./AT THE VERY MINIMUM YOU SHOULD HAVE     /
NOTE(OUTPUT)./THE FOLLOWING FILES REMAINING AFTER     /
NOTE(OUTPUT)./THE EXERCISE IS COMPLETE:               /
NOTE(OUTPUT)./ ACTIVS   PRITS   INTROD  PGMTXT  ALPHA /
NOTE(OUTPUT)./ RNDMPR CPATH1  CPATH2  DISPLY  MYLIB   /
NOTE(OUTPUT)./ SNSAN1 MKLIB   PROCFIL BTCH1   INSLIB  /
NOTE(OUTPUT)./ MAKE A NOTE OF THOSE TO KEEP FROM THE  /
NOTE(OUTPUT)./FOLLOWING LIST:                         /
CATLIST.
NOTE(OUTPUT).//////////////////////////////////////////
NOTE(OUTPUT)./ TO PURGE THE UNWANTED FILES USE        /
NOTE(OUTPUT)./ THE FOLLOWING COMMAND AT THE '/' PROMPT/
NOTE(OUTPUT)./         PURGE,FILENAME                 /
NOTE(OUTPUT)./WHERE 'FILENAME' IS THE NAME ON THE     /
NOTE(OUTPUT)./ABOVE LIST OF THE FILE NOT WANTED       /
NOTE(OUTPUT).//////////////////////////////////////////
ELSE,NOP.
NOTE(OUTPUT).//////////////////////////////////////////
NOTE(OUTPUT)./ REFER TO YOUR INSTRUCTOR'S MANUAL      /
NOTE(OUTPUT)./FOR THE PURGE PASSWORD, ENTER 'ADPGIT'  /
NOTE(OUTPUT)./AFTER YOU HAVE THE CORRECT PASSWORD     /
NOTE(OUTPUT).//////////////////////////////////////////
ENDIF,NOP.
NOTE(OUTPUT).///////////////////////////////////////////
NOTE(OUTPUT).IF YOU NEED TO SEE YOUR FILES OR          /
NOTE(OUTPUT).THESE INSTRUCTIONS AGAIN, SIMPLY          /
NOTE(OUTPUT).TYPE IN 'ADPGIT'                          /
NOTE(OUTPUT).///////////////////////////////////////////
REVERT,NOLIST.
EXIT.
REVERT,ABORT. TRY ADPGIT AGAIN.
*.EOR
*.*
*.*
*.ENDIF,IOK2.
```

```
*.*
*.*
**** PROCEDURE INTRO ****
*.PROC,INTRO.
GET,INTBIN/UN=T841009.
INTBIN.
IF,FILE(BTCH1,.NOT.LO).GET,BTCH1.
SUBMIT,BTCH1,N.
RETURN,INTBIN,BTCH1.
NOTE(OUTPUT).//////////////////////////////////////
NOTE(OUTPUT)./INTRO COMPLETED YOU ARE NOW      /
NOTE(OUTPUT)./READY TO RUN 'PRGTXT'            /
NOTE(OUTPUT)./TYPE 'PRGTXT' AND HIT RETURN KEY /
NOTE(OUTPUT).//////////////////////////////////////
REVERT,NOLIST.
EXIT.
REVERT,ABORT. TRY INTRO AGAIN.
*.EOR
*.*
*.*

**** PROCEDURE PRGTXT ****
*.PROC,PRGTXT.
GET,RECVRY.
GET,INSTRK.
GET,TXTBIN/UN=T841009.
TXTBIN.
REPLACE,RECVRY.
APPEND,INSTRK,TMPINS.
RETURN,TXTBIN,RECVRY,INSTRK,TMPINS.
NOTE(OUTPUT).//////////////////////////////////////////////
NOTE(OUTPUT)./ PRGTXT IS AT END IF YOU HAVE NOT          /
NOTE(OUTPUT)./ COMPLETED ALL 64 QUESTIONS OR             /
NOTE(OUTPUT)./ HAVE NOT GOTTEN YOUR INSTRUCTOR'S         /
NOTE(OUTPUT)./ OK, YOU PROBABLY NEED TO RUN PRGTXT       /
NOTE(OUTPUT)./ OVER AGAIN, OTHERWISE YOUR NEXT           /
NOTE(OUTPUT)./ STAGE IS 'ACORDR'                         /
NOTE(OUTPUT)./ TYPE EITHER 'PRGTXT' OR 'ACORDR' AND      /
NOTE(OUTPUT)./ HIT THE RETURN KEY                        /
NOTE(OUTPUT).//////////////////////////////////////////////
REVERT,NOLIST.
EXIT.
REVERT,ABORT. TRY PRGTXT AGAIN.
*.EOR
*.*
*.*
**** PROCEDURE ACORDR ****
*.PROC,ACORDR*I,
SAFLE[WHAT IS THE FILE NAME THE INSTRUCTOR GAVE YOUR GROUP]=(*F),
STNR[WHAT IS YOUR GROUP'S TWO DIGIT GROUP NUMBER]=(*S2(0123456789)),
           PWD[WHAT IS YOUR 3 POSITION GO AHEAD CODE]=(*A).
IF,$STNR$.EQ.$01$.AND.$PWD$.EQ.$GHO$.OR.$RVAL$.EQ.$02$.AND.$PWD$.EQ.
```

```
     $BOI$.OR.$STNR$.EQ.$03$.AND.$PWD$.EQ.$TES$.OR.$STNR$.EQ.
   $04$.AND.$PWD$.EQ.$FIR$.OR.$STNR$.EQ.$05$.AND.$PWD$.EQ.$LAS$.OR.
   $STNR$.EQ.$06$.AND.$PWD$.EQ.$NAB$.OR.$STNR$.GE.$07$.AND.
   $PWD$.EQ.$GAM$,LAB1.
NOTE(OUTPUT)./////////////////////////////////////
NOTE(OUTPUT)./YOU ARE CLEARED TO GO ON        /
NOTE(OUTPUT)./TO COMPLETE 'ACORDR'            /
NOTE(OUTPUT)./////////////////////////////////////
GET,SACT=SAFLE/UN=T841009.
GET,RNDBIN/UN=T841009.
RNDBIN.
APPEND,INSTRK,TMPINS.
NOTE(OUTPUT)./////////////////////////////////////
NOTE(OUTPUT)./YOU HAVE COMPLETED 'ACORDR'      /
NOTE(OUTPUT)./YOU MUST GET APPROVAL AND A      /
NOTE(OUTPUT)./PASSWORD FROM YOU INSTRUCTOR     /
NOTE(OUTPUT)./IN ORDER TO PROCEED TO THE       /
NOTE(OUTPUT)./NEXT STAGE 'CRPATH'              /
NOTE(OUTPUT)./WHEN YOU ARE READY TYPE 'CRPATH' /
NOTE(OUTPUT)./AND HIT THE RETURN KEY           /
NOTE(OUTPUT)./////////////////////////////////////
ELSE,LAB1.
NOTE(OUTPUT)./////////////////////////////////////////
NOTE(OUTPUT)./YOU MUST GET THE GO AHEAD PASSWORD  /
NOTE(OUTPUT)./FROM YOUR INSTRUCTOR, OTHERWISE YOU /
NOTE(OUTPUT)./DO NOT HAVE PERMISSION TO GO AHEAD  /
NOTE(OUTPUT)./WITH THE NEXT PART OF THIS EXERCISE /
NOTE(OUTPUT)./EACH GROUP HAS ITS OWN PASSWORD FOR /
NOTE(OUTPUT)./EACH PART OF THE EXERCISE, CHECK IT /
NOTE(OUTPUT)./OUT AND WHEN YOU GET THE '/' PROMPT /
NOTE(OUTPUT)./AGAIN TYPE 'ACORDR' AND ANSWER THE  /
NOTE(OUTPUT)./INITIALIZING QUESTIONS AGAIN,       /
NOTE(OUTPUT)./IF THE PASSWORD IS NOT RIGHT YOU    /
NOTE(OUTPUT)./ONCE AGAIN WILL GET THIS MESSAGE,   /
NOTE(OUTPUT)./YOU MUST THEN SEE YOUR INSTRUCTOR   /
NOTE(OUTPUT)./////////////////////////////////////////
ENDIF,LAB1.
RETURN,SACT,RNDBIN,RECVRY,INSTRK,TMPINS.
REVERT,NOLIST.
EXIT.
REVERT,ABORT. TRY ACORDR AGAIN.
*.EOR
*.*
*.*
**** PROCEDURE CRPATH ****
*.PROC,CRPATH*I,
STNR[WHAT IS YOUR TWO DIGIT GROUP NUMBER]=(*S2(0123456789)),
              PWD[WHAT IS YOUR 3 POSITION GO AHEAD CODE]=(*A).
IF,$STNR$.EQ.$01$.AND.$PWD$.EQ.$DOG$.OR.$STNR$.EQ.$02$.AND.$PWD$.EQ.
     $OKD$.OR.$STNR$.EQ.$03$.AND.$PWD$.EQ.$RIT$.OR.$STNR$.EQ.
   $04$.AND.$PWD$.EQ.$BOM$.OR.$STNR$.EQ.$05$.AND.$PWD$.EQ.$MAR$.OR.
   $STNR$.EQ.$06$.AND.$PWD$.EQ.$CAR$.OR.$STNR$.GE.$07$.AND.
```

```
   $PWD$.EQ.$APR$,LAB2.
NOTE(OUTPUT).//////////////////////////////////////
NOTE(OUTPUT)./YOU ARE CLEARED TO GO ON        /
NOTE(OUTPUT)./TO COMPLETE 'CRPATH'            /
NOTE(OUTPUT).//////////////////////////////////////
IF,FILE(QRSLTS,.NOT.LO),LAB1.
GET,QRSLTS=QRS_STNR/UN=T841009.
ELSE,LAB1.
REWIND,QRSLTS.
ENDIF,LAB1.
GET,CP1BIN/UN=T841009.
CP1BIN.
GET,CP2BIN/UN=T841009.
CP2BIN.
REPLACE,CTLPTH.
REPLACE,ACTTME.
APPEND,INSTRK,TMPINS.
NOTE(OUTPUT).//////////////////////////////////////////
NOTE(OUTPUT)./YOU HAVE COMPLETED 'CRPATH'         /
NOTE(OUTPUT)./YOU MUST GET APPROVAL AND A         /
NOTE(OUTPUT)./PASSWORD FROM YOU INSTRUCTOR        /
NOTE(OUTPUT)./IN ORDER TO PROCEED TO THE          /
NOTE(OUTPUT)./'SNSANL' PORTION OF THE EXERCISE    /
NOTE(OUTPUT)./IN ORDER TO SEE A PRINTOUT OF THE   /
NOTE(OUTPUT)./CORRECT CRITICAL PATH FOR YOUR RUN  /
NOTE(OUTPUT)./OF THE SIMULATION, YOU MUST GET     /
NOTE(OUTPUT)./THE GO AHEAD PASSWORD FOR 'SNSANL'  /
NOTE(OUTPUT)./THE CRITICAL PATH WILL BE THE FIRST/
NOTE(OUTPUT)./OUTPUT OF THAT PART                 /
NOTE(OUTPUT)./WHEN YOU ARE READY TYPE IN 'SNSANL'/
NOTE(OUTPUT)./AND HIT RHE RETURN KEY              /
NOTE(OUTPUT).//////////////////////////////////////////
ELSE,LAB2.
NOTE(OUTPUT).///////////////////////////////////////////
NOTE(OUTPUT)./YOU MUST GET THE GO AHEAD PASSWORD  /
NOTE(OUTPUT)./FROM YOUR INSTRUCTOR  OTHERWISE YOU /
NOTE(OUTPUT)./DO NOT HAVE PERMISSION TO GO AHEAD  /
NOTE(OUTPUT)./WITH THIS PART OF THE EXERCISE      /
NOTE(OUTPUT)./EACH GROUP HAS ITS OWN PASSWORD FOR /
NOTE(OUTPUT)./EACH PART OF THE EXERCISE, CHECK IT /
NOTE(OUTPUT)./OUT AND WHEN YOU GET THE '/' PROMPT /
NOTE(OUTPUT)./AGAIN TYPE 'CRPATH' AND ANSWER THE  /
NOTE(OUTPUT)./INITIALIZING QUESTIONS AGAIN,       /
NOTE(OUTPUT)./IF THE PASSWORD IS NOT RIGHT YOU    /
NOTE(OUTPUT)./ONCE AGAIN WILL GET THIS MESSAGE,   /
NOTE(OUTPUT)./YOU MUST THEN SEE YOUR INSTRUCTOR   /
NOTE(OUTPUT).///////////////////////////////////////////
ENDIF,LAB2.
RETURN,RECVRY,INSTRK,TMPINS,QRSLTS,CP1BIN,CP2BIN,CTLPTH.
REVERT,NOLIST.
EXIT.
REVERT,ABORT. 'CRPATH' BOMBED.
```

```
*.EOR
*.*
*.*
**** PROCEDURE SNSANL ****
*.PROC,SNSANL*I,
SAFLE[WHAT IS THE FILE NAME THE INSTRUCTOR GAVE YOUR GROUP]=(*F),
STNR[WHAT IS YOUR TWO DIGIT GROUP NUMBER]=(*S2(0123456789)),
              PWD[WHAT IS YOUR 3 POSITION GO AHEAD CODE]=(*A).
IF,$STNR$.EQ.$01$.AND.$PWD$.EQ.$NAD$.OR.$STNR$.EQ.$02$.AND.$PWD$.EQ.
     $LAT$.OR.$STNR$.EQ.$03$.AND.$PWD$.EQ.$YES$.OR.$STNR$.EQ.
   $04$.AND.$PWD$.EQ.$AFT$.OR.$STNR$.EQ.$05$.AND.$PWD$.EQ.$CAT$.OR.
   $STNR$.EQ.$06$.AND.$PWD$.EQ.$YEL$.OR.$STNR$.GE.$07$.AND.
   $PWD$.EQ.$REM$,LAB3.
NOTE(OUTPUT).////////////////////////////////////
NOTE(OUTPUT)./YOU ARE CLEARED TO GO ON        /
NOTE(OUTPUT)./TO COMPLETE 'SNSANL'            /
NOTE(OUTPUT).////////////////////////////////////
GET,SA1BIN/UN=T841009.
GET,PRITS/UN=T841009.
GET,ACTTME.
GET,SACT=SAFLE/UN=T841009.
GET,CTLPTH.
SA1BIN.
REWIND,INFORM.
APPEND,INSTRK,TMPINS.
GET,INSTRK.
COPYSBF,INSTRK,OOO.
REWIND,OOO.
ROUTE,OOO,UN=AF,UJN=G_STNR,DC=PR.
NOTE(OUTPUT).////////////////////////////////////
NOTE(OUTPUT)./YOU HAVE COMPLETED THE EXERCISE  /
NOTE(OUTPUT)./CONGRATULATIONS                  /
NOTE(OUTPUT).////////////////////////////////////
ELSE,LAB3.
NOTE(OUTPUT).////////////////////////////////////////
NOTE(OUTPUT)./YOU MUST GET THE GO AHEAD PASSWORD  /
NOTE(OUTPUT)./FROM YOUR INSTRUCTOR, OTHERWISE YOU /
NOTE(OUTPUT)./DO NOT HAVE PERMISSION TO GO AHEAD  /
NOTE(OUTPUT)./WITH THE NEXT PART OF THIS EXERCISE /
NOTE(OUTPUT)./EACH GROUP HAS ITS OWN PASSWORD FOR /
NOTE(OUTPUT)./EACH PART OF THE EXERCISE, CHECK IT /
NOTE(OUTPUT)./OUT AND WHEN YOU GET THE '/' PROMPT /
NOTE(OUTPUT)./AGAIN TYPE 'SNSANL' AND ANSWER THE  /
NOTE(OUTPUT)./INITIALIZING QUESTIONS AGAIN,       /
NOTE(OUTPUT)./IF THE PASSWORD IS NOT RIGHT YOU    /
NOTE(OUTPUT)./ONCE AGAIN WILL GET THIS MESSAGE,   /
NOTE(OUTPUT)./YOU MUST THEN SEE YOUR INSTRUCTOR    /
NOTE(OUTPUT).////////////////////////////////////////
ENDIF,LAB3.
RETURN,CTLPTH,SA1BIN,PRITS,ACTTME,SACT.
REVERT,NOLIST.
EXIT.
```

```
REVERT,ABORT.
*.DATA,RECVRY.
5 0 0
*.DATA,INSTRK.
GROUP  STNR
*.DATA,BTCH1.
/JOB
JM01,STCSB.
USER,T841009,OSPREY.
CHARGE,*.
GET,PRITS.
ATTACH,QGERT=QGERTS/UN=T841304,PW=SMALL,M=R.
COPYEI,QGERT,QGERTXY.
RETURN,QGERT.
REWIND,*.
GET,SEGQGRT/UN=T841304.
SEGLOAD,I=SEGQGRT.
LOAD,QGERTXY.
MAP,OFF.
EXECUTE,,PRITS,QRS_STNR,FL9,FL8,FL7,FL10,*PF=5000.
REPLACE,QRS_STNR.
RETURN,FL7,FL8,FL9,FL10,QGERT,PRITS,SEGQGRT,QGERTXY,QRS_STNR.
/EOF
*.DATA,ALPHA.
I3
I2
G3
H2
D3
B2
K1
L3
D1
B4
K3
D2
A3
M2
B3
C3
E2
M1
B1
E3
K2
F1
C2
F2
E1
G2
J2
J3
```

```
L2
G1
I1
A1
H1
A2
C1
F3
J1
L1
N1
M3
N3
P1
N2
*.DATA,PRITS.
GEN,JEM&RMD,PERT,7,10,1984,29,1,1,(15)1,2*
SEE,1,STNR/I,2,STNR/I,3,STNR/I,4,STNR/I,5,STNR/I,6,STNR/I,7,STNR/I,
8,STNR/I,9,STNR/I,10,STNR/I*
SOU,60*
SIN,90*
STA,61*
STA,62,3*
STA,63*
STA,64*
STA,65,2*
STA,66*
STA,67*
STA,68*
STA,69*
STA,70*
STA,71*
STA,72,4*
STA,73*
STA,74*
STA,75*
STA,76,2*
STA,77*
STA,78*
STA,79,2*
STA,80*
STA,81*
STA,82*
STA,83*
STA,84,2*
STA,85*
STA,86,3*
STA,87,2*
STA,88*
STA,89,2*
ACT,60,61,CO,30,5*
ACT,61,62,BP,2,13*
```

```
ACT,61,62,BP,2,43*
ACT,61,62,BP,2,41*
ACT,62,63,BP,2,22*
ACT,63,64,BP,3,30*
ACT,64,65,BP,4,10*
ACT,64,65,BP,5,24*
ACT,65,66,BP,6,34*
ACT,66,67,BP,7,6*
ACT,67,68,BP,6,23*
ACT,68,69,BP,7,8*
ACT,68,70,BP,6,14*
ACT,68,72,BP,8,38*
ACT,68,72,BP,10,42*
ACT,69,71,BP,4,29*
ACT,70,72,BP,9,11*
ACT,71,72,BP,10,21*
ACT,72,73,BP,11,33*
ACT,72,89,BP,18,40*
ACT,73,74,BP,6,7*
ACT,74,75,BP,12,20*
ACT,75,76,BP,13,12*
ACT,75,76,BP,14,9*
ACT,76,77,BP,15,19*
ACT,76,78,BP,16,26*
ACT,77,79,BP,15,25*
ACT,78,79,BP,17,1*
ACT,79,80,BP,18,15*
ACT,79,81,BP,15,35*
ACT,80,86,BP,17,31*
ACT,81,82,BP,19,32*
ACT,81,83,BP,17,17*
ACT,82,84,BP,9,28*
ACT,82,84,BP,20,16*
ACT,83,85,BP,17,37*
ACT,84,86,BP,17,36*
ACT,85,86,BP,14,27*
ACT,86,87,BP,15,2*
ACT,86,87,BP,10,18*
ACT,87,88,BP,17,3*
ACT,88,89,BP,18,39*
ACT,89,90,BP,16,4*
PAR,2,21.,1.,45.*
PAR,3,30.,10.,90.*
PAR,4,3.,1.,7.*
PAR,5,60.,30.,90.*
PAR,6,30.,14.,45.*
PAR,7,45.,14.,120.*
PAR,8,2.,1.,5.*
PAR,9,7.,3.,30.*
PAR,10,14.,7.,21.*
PAR,11,60.,30.,120.*
PAR,12,21.,3.,45.*
```

```
PAR,13,21.,3.,60.*
PAR,14,30.,14.,90.*
PAR,15,14.,7.,30.*
PAR,16,21.,7.,45.*
PAR,17,21.,14.,45.*
PAR,18,120.,45.,270.*
PAR,19,45.,30.,120.*
PAR,20,30.,21.,60.*
FIN*
*.EOF
**** PROCEDURE DISNET ****
*.PROC,DISNET*I,
 RVL[WHAT GROUP NUMBER(2 DIGIT) IS THIS NETWORK FOR]=(*A),
SAFLE[WHAT IS THE FILE NAME YOU WANT FOR THAT GROUP]=(*F),
   LGIN[WHAT IS THAT GROUPS LOGIN USERID (7 POSITIONS)]=(*A).
GET,DSPBIN/UN=T841009.
GET,ALPHA/UN=T841009.
GET,ACTIVS/UN=T841009.
DSPBIN.
SAVE,SACT=SAFLE.
PERMIT,SAFLE,LGIN=R.
ROUTE,DSPLY,UN=AF,UJN=G_RVL,DC=PR.
RETURN,DSPBIN,ALPHA,ACTIVS,DSPLY,SACT.
NOTE(OUTPUT).////////////////////////////////////////////
NOTE(OUTPUT)./ YOU HAVE SENT A COPY OF THE NETWORK   /
NOTE(OUTPUT)./FOR GROUP RVL TO BLDG 640 ROOM 133,    /
NOTE(OUTPUT)./YOU CAN PICK IT UP SHORTLY FROM BIN G   /
NOTE(OUTPUT)./CYBER OUTPUT, IT HAS THE UJN OF G_ RVL   /
NOTE(OUTPUT)./THIS JOB MUST BE RUN FOR EACH GROUP    /
NOTE(OUTPUT)./NUMBER THAT YOU HAVE ASSIGNED          /
NOTE(OUTPUT)./WHEN YOU HAVE DONE THAT YOU ARE        /
NOTE(OUTPUT)./READY TO RUN THE EXERCISE--            /
NOTE(OUTPUT)./IF YOU HAVE MORE GROUPS TO DO TYPE     /
NOTE(OUTPUT)./IN --BEGIN,DISNET,PREP----             /
NOTE(OUTPUT)./AND ANSWER THE QUESTIONS,              /
NOTE(OUTPUT)./OTHERWISE YOU CAN LOGOUT AND GO        /
NOTE(OUTPUT)./SEE ABOUT THE LISTINGS                 /
NOTE(OUTPUT).////////////////////////////////////////////
REVERT,NOLIST.
EXIT.
REVERT,ABORT.
```

```
******** NOTE ****************************************************
*                                                                *
* ALL THE LINES WITH AN ASTERISK IN COLUMN ONE, ACTUALLY HAVE AN *
*                                                                *
* PERIOD IN COLUMN ONE OF THE CYBER PROCEDURE                    *
*                                                                *
******************************************************************
```

```
************************** PROGRAM INTROD ***************************

      PROGRAM INTROD
      CHARACTER ANSW*2
      PRINT*,'WELCOME TO THE APPLIED SIMULATION EXERCISE THAT USES'
      PRINT*,'PERT TO HELP TEACH NETWORK MODELING AND THE PROVISIONING'
      PRINT*,'PROCESS THAT IS USED BY THE U.S. AIR FORCE. THIS '
      PRINT*,'EXERCISE WAS DEVELOPED BY CAPTAIN R. M. DOUGLAS AND MR.'
      PRINT*,'JAMES E. MULDER AS A THEISIS PROJECT AT THE AIR FORCE  '
      PRINT*,'INSTITUTE OF TECHNOLOGY IN 1984. WE WERE AIDED BY OUR'
      PRINT*,'TEAM OF ADVISORS THAT INCLUDED OUR COMMITTEE CHAIRMAN'
      PRINT*,'MR. PAT BRESNAHAN, AND MEMBERS MAJOR ART RASTETTER, AND'
      PRINT*,'DR. SAM STEBLETON.                                    '
      PRINT*,'    THE EXERCISE WAS DEVELOPED MAINLY BECAUSE OF THE '
      PRINT*,'CHANGES IN THE PROVISIONING PROCESS AND TO UPGRADE THE '
      PRINT*,'EXERCISE USED IN THE LOG260 COURSE FOR PROVISIONING'
      PRINT*,'MANAGERS. IN ADDITION IT WAS FELT THAT THE COMPUTER '
      PRINT*,'NEEDED TO BE INCLUDED IN THE COURSEWORK OF THOSE WHO'
      PRINT*,'WOULD BE PROVISIONING MANAGERS.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY TO CONTINUE....'
      READ(*,1000)ANSW
      PRINT*,' '
      PRINT*,'    THE COURSE INCLUDES 7 STAGES:'
      PRINT*,' '
      PRINT*,'                   STAGE 1    INTRODUCTION '
      PRINT*,' '
      PRINT*,' THIS STAGE STARTS THE EXERCISE UP AFTER THE INSTRUCTOR'
      PRINT*,'HAS INITIALIZED THE NECESSARY FILES, AND PROVIDES THE '
      PRINT*,'STUDENT WITH AN INTRODUCTION TO THE EXERCISE.          '
      PRINT*,' '
      PRINT*,'                   STAGE 2     SIMULATION             '
      PRINT*,' '
      PRINT*,' THIS STAGE RUNS A MODEL OF THE PROVISIONING PROCESS  '
      PRINT*,'THAT USES THE SIMULATION LANGUAGE QGERT. THIS SIMULATION'
      PRINT*,'IS TRANSPARENT TO THE STUDENT, IN THAT IT IS STARTED   '
      PRINT*,'IN THE BACKGROUND AND THE STUDENT HAS NO INPUT TO THE'
      PRINT*,'EXECUTION OF THE MODEL. THE OUTPUT OF THE MODEL WILL BE'
      PRINT*,'USED LATER THROUGHOUT THE EXERCISE TO AID IN LEARNING'
      PRINT*,'BOTH NETWORK MODELING AND THE PROVISIONING PROCESS.'
      PRINT*,' TYPE GO AND HIT RETURN TO CONTINUE.....  '
      READ(*,1000)ANSW
      PRINT*,' '
      PRINT*,'                   STAGE 3     PROGRAMMED TEXT      '
      PRINT*,' '
      PRINT*,' THIS STAGE IS AN ADAPTATION OF A HANDOUT USED IN THE '
      PRINT*,'CURRENT LOG260 COURSE. IT CONSISTS OF 64 QUESTIONS'
      PRINT*,'THAT DEVELOP THE STUDENTS KNOWLEDGE OF NETWORK MODELING.'
      PRINT*,'THERE ARE SEVERAL HANDOUTS TO AID THE STUDENT. IN '
      PRINT*,'ADDITION THE SCORES ARE RECORDED IN AN INSTRUCTORS FILE'
      PRINT*,'TO INSURE THE COMPLETION OF THIS PORTION OF THE COURSE.'
      PRINT*,'THIS PORTION SHOULD TAKE THE AVERAGE STUDENT ABOUT TWO'
```

```
PRINT*,'HOURS TO COMPLETE.'
PRINT*,' '
PRINT*,'                    STAGE 4     NETWORK BUILDING      '
PRINT*,' '
PRINT*,' DURING THIS PORTION OF THE EXERCISE THE STUDENTS WILL'
PRINT*,'USE THEIR KNOWLEDGE OF PROVISIONING. THEY WILL MATCH'
PRINT*,'LETTERS ON A HANDOUT THAT DEPICTS THE NETWORK IN USE'
PRINT*,'BY PROVISIONERS TODAY, WITH NUMBERS THAT CONTAIN A '
PRINT*,'DESCRIPTION OF THOSE EVENTS. ESSENTIALLY THIS IS AN'
PRINT*,'EXERCISE IN DEVELOPING THE PRECEDENCE OF THE EVENTS '
PRINT*,'AS THEY OCCUR IN THE REAL PROVISIONING PROCESS. THIS '
PRINT*,'MODEL WAS DEVELOPED WITH THE HELP OF MAJOR DON PETERS '
PRINT*,'AFALC/XRH, AND MR. HAL NEILSON OF HQAFLC/MMMAP.'
PRINT*,' THE STUDENTS ARE ALLOWED 90 CHANCES TO GET ALL 40 OF '
PRINT*,'THE EVENTS IN THE PROPER ORDER.              '
PRINT*,'TYPE GO AND HIT RETURN TO CONTINUE....            '
READ(*,1000)ANSW
PRINT*,' '
PRINT*,'                  STAGE 5      TIMES'
PRINT*,'         AND      STAGE 6 CRITICAL PATH'
PRINT*,'  '
PRINT*,' STAGE 5--TIMES AND STAGE 6--CRITICAL PATH HAVE'
PRINT*,'BEEN COMBINED IN ORDER TO EASE THE TRANSITION '
PRINT*,'BETWEEN THE TWO SIMILAR AND INTERCHANGABLE STAGES.'
PRINT*,' DURING THIS STAGE, THE QGERT SIMULATION HAVING'
PRINT*,'ALREADY BEEN RUN, THE ELAPSED TIMES WILL BE '
PRINT*,'SHOWN TO THE USER FOR ALL THE EVENTS.'
PRINT*,'THEN THE USER WILL BE ASKED TO FIGURE THE CRITICAL'
PRINT*,'PATH USING AVAILABLE INFORMATION. HE THEN WILL HAVE'
PRINT*,'TWO CHANCES TO GET IT CORRECT BY TYPING IN THE '
PRINT*,'ACTIVITIES IN ORDER FROM THE LAST TO FIRST. THE '
PRINT*,'CORRECT CRITICAL PATH WILL BE PRINTED IN THE LAST'
PRINT*,'STAGE AFTER THE INSTRUCTOR HAS HAD A CHANCE TO '
PRINT*,'EXAMINE EACH GROUPS WORK.'
PRINT*,'TYPE GO AND HIT THE RETURN KEY TO CONTINUE.....'
READ(*,1000)ANSW
PRINT*,' '
PRINT*,' '
PRINT*,'                  STAGE 7      SENSITIVITY ANALYSIS'
PRINT*,' '
PRINT*,' THIS STAGE IS THE MOST IMPORTANT STAGE, IN THAT IT'
PRINT*,'ALLOWS THE USER TO DISPLAY HIS ABILITIES IN HANDLING'
PRINT*,'DIFFICULT MANAGERIAL SITUATIONS. HAVING ALREADY '
PRINT*,'FIGURED OUT THE CRITICAL PATH OF THE NETWORK, THE'
PRINT*,'USER HAS A CHANCE TO SEE WHETHER THE CRITICAL PATH'
PRINT*,'STAYS THE SAME IN DIFFERENT SITUATIONS. '
PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN YOU ARE READY'
PRINT*,'TO CONTINUE WITH THE EXERCISE........'
READ(*,1000)ANSW
PRINT*,' '
PRINT*,'  HERE ARE SOME KEY INSTRUCTIONS FOR YOU THAT ARE '
PRINT*,'REPEATED FROM YOUR COURSE MATERIAL, THAT YOU    '
```

```
      PRINT*,'SHOULD TRY TO REMEMBER          '
      PRINT*,'THE PROCEDURES HAVE BEEN CONSTRUCTED WITH YOU THE '
      PRINT*,'STUDENT IN MIND. THEY ARE HOW DO YOU SAY IT ? '
      PRINT*,'   USER FRIENDLY.'
      PRINT*,'IF YOU GET A MESSAGE THAT SAYS---PROCEDURE NOT FOUND--'
      PRINT*,'YOU PROBABLY MISSPELLED IT SO TRY IT AGAIN.'
      PRINT*,'IF YOU GET A MESSAGE THAT SAYS ---< ERROR IN COL.0 '
      PRINT*,'IT MEANS THAT YOU HAVE ENTERED AN ALPHABETIC WHERE A '
      PRINT*,'NUMERIC WAS EXPECTED OR VICE VERSA, AND THE PROCEDURE'
      PRINT*,'WILL NOT CONTINUE UNTIL YOU ENTER THE RIGHT TYPE OF'
      PRINT*,'CHARACTER. -----DO NOT FORGET THE FOLLOWING THINGS----'
      PRINT*,'FIRST---WHAT YOUR GROUP NUMBER IS------------'
      PRINT*,'SECOND--WHAT YOUR GROUP LOGIN USERID AND PASSWORD IS---'
      PRINT*,'THIRD---WHAT THE PROCEDURE NAMES ARE FOR EACH STAGE----'
      PRINT*,'FOURTH--WHAT THE GO AHEAD PASSWORD IS FOR EACH STAGE---'
      PRINT*,'YOUR INSTRUCTOR WILL GIVE YOU THAT WHEN YOU PASS EACH'
      PRINT*,'STAGE TO HIS SATISFACTION. FINALLY,-------IT DOES NOT'
      PRINT*,'MATTER WHAT THE OTHER GROUPS HAVE FOR AN ANSWER, '
      PRINT*,'OR WHAT THIER GO AHEAD PASSWORD IS BECAUSE EACH IS '
      PRINT*,'DIFFERENT FOR EACH STAGE.'
      PRINT*,'TYPE GO TO CONTINUE......'
      READ(*,1000)ANSW
      PRINT*,'AFTER YOU HAVE COMPLETED THE PROGRAMMED TEXT AND'
      PRINT*,'SUBSEQUENT STAGES, YOU MUST TAKE YOUR RESULTS TO'
      PRINT*,'THE INSTRUCTOR FOR HIM TO LOOK AT. HE WILL GIVE '
      PRINT*,'YOU A GO AHEAD PASSWORD WHEN HE IS SATISFIED WITH '
      PRINT*,'YOUR ACCOMPLISHMENTS. YOU MUST USE THIS PASSWORD '
      PRINT*,'IN ORDER TO ACCESS THE NEXT STAGE OF THE EXERCISE.'
      PRINT*,'THE COMMANDS NECESSARY TO EXECUTE EACH STAGE ARE AS'
      PRINT*,'FOLLOWS:       '
      PRINT*,'  INTRO     STAGE 1--INTRODUCTION(THIS ONE)'
      PRINT*,'  PRGTXT    STAGE 2 & 3--SIMULATION AND PROGRAMMED TEXT'
      PRINT*,'  ACORDR    STAGE 4--NETWORK BUILDING '
      PRINT*,'  CRPATH    STAGE 5 & 6--TIMES AND CRITICAL PATH '
      PRINT*,'  SNSANL    STAGE 7--SENSITIVITY ANALYSIS '
      PRINT*,' '
      PRINT*,'DO NOT FORGET, YOU NEED A PASSWORD IN ADDITION '
      PRINT*,'TO THE ABOVE PASSWORDS.'
 1000 FORMAT(A2)
       END
```

********************** PROGRAM PGMTXT ************************

```
      PROGRAM PGMTXT
      INTEGER I,WRONG,RIGHT,J,QNBR,ANSW,L,RCVRY(64),DONE,WG,W,QBR38(11)
      INTEGER QBR39(11),QBR46(11)
      CHARACTER PGM*27,BRK*32,WRG*15,BAK*17,QTN*19,GOON*2
      REAL PERCT,TOT
      OPEN(UNIT=13,FILE='RECVRY')
      REWIND 13
      WRONG = 0
      DONE = 0
      WG = 0
      RIGHT = 0
      W = 0
      DATA QBR38/0,7,21,14,20,25,16,21,28,30,33/
      DATA QBR39/0,7,8,7,13,25,16,21,28,26,23/
      DATA QBR46/0,0,13,7,7,0,0,0,0,4,0/
      DATA PGM/' PERCENT IN PROGRAMMED TEXT'/
       DATA BRK/' IS WHERE WE STOPPED FOR A BREAK'/
       DATA QTN/'AT QUESTION NUMBER '/
       DATA WRG/'WE HAVE MISSED '/
       DATA BAK/' QUESTIONS SO FAR'/
      READ(13,*,END=4)RCVRY
    4 IF(RCVRY(1) .EQ. 5) THEN
      RCVRY(1) = 0
      DATA RCVRY/64*0/
      PRINT*,'WELCOME TO THE PROGRAMMED TEXT ON NETWORK MODELING. THIS '
      PRINT*,'EXERCISE CONSISTS OF 64 QUESTIONS DESIGNED TO HELP YOU'
      PRINT*,'SET UP AND ANALYZE A NETWORK, SO YOU CAN IMPROVE YOUR    '
      PRINT*,'PLANNING IN YOUR PROVISIONING JOB.  THE                  '
      PRINT*,'QUESTIONS WILL BE MULTIPLE CHOICE UNLESS OTHERWISE NOTED,'
      PRINT*,'THEY MAY REQUIRE SOME SIMPLE CALCULATIONS ON YOUR PART.  '
      PRINT*,'YOU MAY EXIT THE TEXT BY ANSWERING ANY QUESTION WITH     '
      PRINT*,'A ZERO; YOUR SCORE AND QUESTION NUMBER WILL BE '
      PRINT*,'RETAINED AND REPORTED TO YOUR INSTRUCTOR.'
      PRINT*,'WHEN ANSWERING THE QUESTIONS, TYPE IN THE '
      PRINT*,'ANSWER NUMBERS AND NOT THE WORDS THEMSELVES.'
      PRINT*,'IF YOU GET A RESPONSE THAT SAYS --< ERROR COL 0.'
      PRINT*,'THAT MEANS YOU DID NOT TYPE IN A NUMERIC RESPONSE'
      PRINT*,'YOU THEN CANNOT CONTINUE UNTIL YOU HAVE TYPED IN'
      PRINT*,'A NUMERIC RESPONSE.'
      PRINT*,'THERE IS A SPECIFIC TIME FRAME FOR THE COMPLETION OF'
      PRINT*,'THIS SECTION. WHEN YOU ARE FINISHED YOU MUST GET A'
      PRINT*,'GO AHEAD PASSWORD FROM YOUR INSTRUCTOR IN ORDER TO'
      PRINT*,'ADVANCE TO THE NEXT STAGE OF THE EXERCISE.'
      PRINT*,'TYPE GO AND THEN HIT THE RETURN KEY TO CONTINUE....... '
      READ(*,2400)GOON
      PRINT*,'I ENCOURAGE YOU TO TAKE SOME NOTES IF YOU ARE AT A SCREEN'
      PRINT*,'(CRT), OR UNDERLINE KEY POINTS (ESPECIALLY PERTINENT     '
      PRINT*,'INSTRUCTIONS) IF YOU ARE AT A TELETYPE (TERMINAL WITH AN '
      PRINT*,'ONLINE PRINTER). THIS GROUP OF PROGRAMS FOR PROVISIONING '
```

```
      PRINT*,'PERSONNEL INCLUDES VARIOUS STAGES OF NETWORK ANALYSIS;   '
      PRINT*,'EACH STAGE WILL INCLUDE ITS OWN INSTRUCTIONS.            '
      PRINT*,'PLEASE TYPE GO AND HIT THE RETURN KEY TO CONTINUE.. '
      PRINT*,' '
      READ(*,2400)GOON
      ENDIF
      DO 5 J = 1,64
      IF(RCVRY(J) .EQ. 0) THEN
      QNBR = J
       GO TO 6
       ENDIF
    5 CONTINUE
    6 CLOSE (13)
       REWIND 13
       OPEN (UNIT=13,FILE='RECVRY')
    8 GO TO (10,20,30,40,50,60,70,80,90,100,110,120,130,140,150,160,
     C170,180,190,200,210,220,230,240,250,260,270,280,290,300,310,320,
     C330,340,350,360,370,380,390,400,410,420,430,440,450,460,470,480,
     C490,500,510,520,530,540,550,560,570,580,590,600,610,620,630,
     C640(QNBR)
   10 PRINT*,'QUESTION NUMBER 1'
      QNBR = 1
  12  PRINT*,'IN THE PAST SEVERAL YEARS THERE HAS BEEN AN EXPLOSIVE '
      PRINT*,'GROWTH OF MANAGEMENT TECHNIQUES USED FOR PLANNING'
      PRINT*,'AND CONTROLLING COMPLEX INDUSTRIAL AND DEFENSE PROJECTS.'
      PRINT*,'PROGRAM EVALUATION AND REVIEW TECHNIQUE (PERT) IS ONE OF'
      PRINT*,'THE BEST KNOWN OF THESE MANAGEMENT TECHNIQUES. '
      PRINT*,'DEVELOPED BY THE NAVY IN 1957-1958 TO BE USED IN THE '
      PRINT*,'FLEET BALLISTIC MISSLE PROGRAM (POLARIS), PERT '
      PRINT*,'CONTRIBUTED TO COMPLETING THE INITIAL PROJECTS AHEAD OF '
      PRINT*,'SCHEDULE AND WAS USED WITH EQUAL SUCCESS IN THE LATTER '
      PRINT*,'PHASES OF THAT PROGRAM. THE WORD PERT IS FORMED FROM THE '
      PRINT*,'FIRST LETTERS OF WHAT WORDS?'
      PRINT*,' '
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS PROGRAM EVALUATION REVIEW '
      PRINT*,'TECHNIQUE. I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 20
      ENDIF
      PRINT*,'1. PROJECT EVALUATION RECYCLING TECHNIQUE'
      PRINT*,'2. PROGRAM EVALUATION REVIEW TECHNIQUE'
      PRINT*,'3. POST EXERCISE RECOVERY TECHNIQUE'
      PRINT*,'4. PROBLEM EXERCISE RECOMMENDATION TEST'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      PRINT*,' '
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
```

```
      GO TO 690
     ELSE IF (ANSW .EQ.2) THEN
     PRINT*,'CORRECT, GOOD SHOW FOR THE FIRST ONE'
     RCVRY(QNBR) = 1
     ELSE
     PRINT*,'THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
     RCVRY(QNBR) = 2
     ENDIF
     WRITE (13,*)RCVRY
     IF(RCVRY(QNBR) .EQ. 2)THEN
     WG = 1
     GO TO 12
     ENDIF
     PRINT*,' '
  20 PRINT*,'QUESTION NUMBER 2'
     QNBR = 2
     PRINT*,' '
  22 PRINT*,'THE MOST IMPORTANT CHARACTERISTIC OF PERT IS THAT IT '
     PRINT*,'ENABLES THE MANAGER TO CLEARLY SEE SIGNIFICANT INTER-'
     PRINT*,'RELATIONSHIPS BETWEEN THE TASKS THAT MUST BE PERFORMED '
     PRINT*,'ON THE PROJECT. PERT ALSO PROVIDES THE MEANS FOR '
     PRINT*,'HIGHLIGHTING EXACTLY WHERE TROUBLE SPOTS ARE LIKELY TO '
     PRINT*,'OCCUR IN THE PROJECT. BASED ON THIS BRIEF ACCOUNT, DO '
     PRINT*,'YOU THINK PERT CAN TELL THE MANAGER WHAT DECISION TO '
     PRINT*,'MAKE ?'
     PRINT*,' '
     PRINT*,'1. YES'
     PRINT*,'2. NO'
      PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
     IF(WG .EQ. 1)THEN
     PRINT*,'THE CORRECT ANSWER IS NO, BUT IT SURE CAN MAKE'
     PRINT*,'IT EASIER. I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
     PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
     PRINT*,' '
     WG = 0
     READ (*,2400)GOON
     GO TO 30
     ENDIF
     PRINT*,' '
     REWIND 13
     READ*,ANSW
      IF(ANSW .EQ. 0) THEN
      GO TO 690
     ELSE IF (ANSW .EQ.2) THEN
     PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
     RCVRY(QNBR) = 1
     ELSE
     PRINT*,'THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
     RCVRY(QNBR) = 2
     ENDIF
     WRITE (13,*)RCVRY
     IF(RCVRY(QNBR) .EQ. 2)THEN
```

```
      WG = 1
      GO TO 22
      ENDIF
      PRINT*,' '
   30 PRINT*,'QUESTION NUMBER 3'
      QNBR = 3
  32  PRINT*,' '
      PRINT*,'PERT DOES NOT TELL A MANAGER WHAT DECISION TO MAKE. '
      PRINT*,'PERT SUPPLIES IMPORTANT INFORMATION. IT MAY ALSO BE '
      PRINT*,'USED TO ASSESS THE EFFECT OF ALTERNATIVE ACTIONS.'
      PRINT*,'HOWEVER, IT IS UP TO YOU, THE MANAGER, TO MAKE DECISIONS.'
      PRINT*,'PERT IS A MANAGEMENT TOOL FOR DEFINING AND INTEGRATING'
      PRINT*,'EVENTS WHICH MUST BE ACCOMPLISHED ON A TIMELY BASIS TO '
      PRINT*,'ASSURE COMPLETION OF PROGRAM OBJECTIVES. IT DEFINES '
      PRINT*,'AREAS OF EFFORT WHEREBY TRADE-OFFS IN TIME, RESOURCES '
      PRINT*,'OR PERFORMANCE WILL ENABLE MANAGEMENT TO MEET SCHEDULED'
      PRINT*,'DATES. AS A MANAGEMENT TECHNIQUE, IT ASSISTS DECISION '
      PRINT*,'MAKERS, BUT DOES NOT MAKE DECISIONS FOR THEM.'
      PRINT*,' '
      PRINT*,'DO YOU THINK THE NEWER CONTROL TECHNIQUES EMPHASIZE THE'
      PRINT*,'CONTROL OF (TIME OR BUDGET)?'
      PRINT*,' '
      PRINT*,'1. TIME'
      PRINT*,'2. BUDGET'
      PRINT*,'3. NONE OF THE ABOVE'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS TIME '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 40
      ENDIF
      PRINT*,' '
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 32
      ENDIF
```

```
      PRINT*,' '
   40 PRINT*,'QUESTION NUMBER 4'
      QNBR = 4
  42  PRINT*,' '
      PRINT*,'IF A MANAGER IS TO MAKE INTELLIGENT DECISIONS, HE MUST'
      PRINT*,'UNDERSTAND THE SUBJECT MATTER WITH WHICH HIS PROJECT IS'
      PRINT*,'CONCERNED. HE MAY GAIN THIS UNDERSTANDING THROUGH '
      PRINT*,'TRAINING OR EXPERIENCE, OR HE MAY HAVE ASSISTANTS WHO '
      PRINT*,'EXPLAIN TECHNICAL DETAILS AND PROJECT OBJECTIVES TO HIM.'
      PRINT*,'REGARDLESS OF HOW HE GAINS HIS INFORMATION, THE '
      PRINT*,'MANAGER MUST UNDERSTAND THE LANGUAGE AND AT LEAST THE '
      PRINT*,'BROAD ASPECTS OF HIS PROJECT BEFORE HE CAN COMPREHEND '
      PRINT*,'THE EFFECTS OF HIS DECISIONS ON THE PROJECT OBJECTIVES. '
      PRINT*,'FOR EXAMPLE, A SUCCESSFUL MANAGER OF A HARDWARE STORE '
      PRINT*,'MAKES A POOR MANAGER OF A LADIES DRESS SHOP UNLESS HE '
      PRINT*,'FIRST LEARNS THE DRESS BUSINESS. THE LANGUAGE AND '
      PRINT*,'KNOWLEDGE OF HIS NEW PROJECT ARE COMPLETELY DIFFERENT '
      PRINT*,'FROM THOSE OF HIS OLD. '
      PRINT*,' '
      PRINT*,'IS A PERSON WITH EXTENSIVE EXPERIENCE IN ALL PHASES OF '
      PRINT*,'PERT PROCEDURES AND ANALYSIS, BUT WITHOUT ACCESS TO '
      PRINT*,'TECHNICAL AND SCIENTIFIC KNOWLEDGE, QUALIFIED TO MANAGE'
      PRINT*,'THE DEVELOPMENT OF A WEATHER SATELLITE SYSTEM?'
      IF(WG.NE.1)THEN
      PRINT*,' '
      PRINT*,'1. YES'
      PRINT*,'2. NO'
      PRINT*,'3. MAYBE'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      ENDIF
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS NO '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 50
      ENDIF
      PRINT*,' '
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
```

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      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 42
      ENDIF
      PRINT*,' '
   50 PRINT*,'QUESTION NUMBER 5'
      QNBR = 5
 52   PRINT*,' '
      PRINT*,'REFER TO THE SAMPLE PERT NETWORK IN CHART 1. THE FIRST'
      PRINT*,'EVENT IN THE LAST SEQUENCE IS CALLED ___A___, WHILE THE'
      PRINT*,'LAST EVENT IS CALLED ___B___.'
      PRINT*,' '
      PRINT*,'1. CHASSIS COMPONENTS FABRICATED--RECEIVED ORDER'
      PRINT*,'2. RECIEVED ORDER--COMPLETE UNIT ASSEMBLED'
      PRINT*,'3. RADIO PARTS ASSEMBLED--RADIO PARTS MANUFACTURED'
      PRINT*,'4. COMPLETED UNIT ASSEMBLED--RECEIVED ORDER'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS RECEIVED ORDER--COMPLETE UNIT'
      PRINT*,'ASSEMBLED. I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 60
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 52
      ENDIF
      PRINT*,' '
 60   PRINT*,'QUESTION NUMBER 6'
 62   QNBR = 6
      PRINT*,' '
      PRINT*,'IN THIS TEXT, WE SHALL HAVE A FAIRLY DETAILED COVERAGE'
      PRINT*,'OF THE ELEMENTS AND SOME COMPUTATIONAL PROCEDURES USED '
      PRINT*,'IN PERT. HOWEVER, THE EXAMPLES WILL BE MUCH SIMPLER THAN'
      PRINT*,'THOSE ENCOUNTERED IN ACTUAL MANAGERIAL SITUATIONS. THE '
      PRINT*,'TYPICAL APPLICATION OF PERT IN INDUSTRY INVOLVES '
      PRINT*,'HUNDREDS AND EVEN THOUSANDS OF EVENTS IN THE PERT '
```

```
      PRINT*,'NETWORK, WHEREAS OUR SAMPLE NETWORK IN CHART 1 ONLY '
      PRINT*,'HAS __?__ (NUMBER OF EVENTS). DO YOU THINK PERT CAN '
      PRINT*,'ALSO BE USED PROFITABLY ON SMALL PROJECTS ?'
      PRINT*,' '
      PRINT*,'1. 8,NO'
      PRINT*,'2. 7,YES'
      PRINT*,'3. 8,YES'
      PRINT*,'4. 7,NO'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS 8 EVENTS AND YES '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 70
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 62
      ENDIF
      PRINT*,' '
   70 PRINT*,'QUESTION NUMBER 7'
  72  QNBR = 7
      PRINT*,' '
      PRINT*,'REGARDLESS OF THE SIZE OF THE OPERATION, THE TYPE OF '
      PRINT*,'PROGRAM BEST SUITED TO PERT IS ONE THAT INVOLVES  ONCE'
      PRINT*,'THROUGH  OR NON-REPETITIVE PROCESSES. IT IS ESPECIALLY'
      PRINT*,'USEFUL IN CONSTRUCTION PROJECTS, SYSTEMS DEVELOPMENT, '
      PRINT*,'PRODUCTION ENGINEERING, ETC..'
      PRINT*,' '
      PRINT*,'WOULD THE USE OF PERT BE ESPECIALLY EFFECTIVE ON THE '
      PRINT*,'HIGH RATE OF MANUFACTURE OF AUTOMOBILES ?'
      PRINT*,' '
      PRINT*,'1. NO'
      PRINT*,'2. YES'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS NO '
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      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 80
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 82
      ENDIF
      PRINT*,' '
   80 PRINT*,'QUESTION NUMBER 8'
  82  QNBR = 8
      PRINT*,' '
      PRINT*,'AS WE HAVE JUST BRIEFLY INDICATED, A PERT NETWORK IS '
      PRINT*,'MADE UP OF A SEQUENCE OF EVENTS CONNECTED BY THE '
      PRINT*,'NECESSARY ACTIVITIES. IN CHART 1, AS IN ALL PERT NETWORK'
      PRINT*,'DIAGRAMS THE EVENTS ARE LOCATED WITHIN THE CIRCLES WHILE'
      PRINT*,'ACTIVITIES ARE INDICATED BY THE ARROWS CONNECTING THE '
      PRINT*,'CIRCLES. '
      PRINT*,'WOULD YOU CALL THESE STRUCTURAL OR FUNCTIONAL ?'
      PRINT*,' '
      PRINT*,'1. FUNCTIONAL'
      PRINT*,'2. STRUCTURAL'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS STRUCTURAL '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 90
      ENDIF
      PRINT*,' '
      PRINT*,'CHARACTERISTICS ?'
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
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 GO TO 690
ELSE IF (ANSW .EQ.2) THEN
PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
RCVRY(QNBR) = 1
ELSE
PRINT*,'THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
RCVRY(QNBR) = 2
ENDIF
WRITE (13,*)RCVRY
IF(RCVRY(QNBR) .EQ. 2)THEN
WG = 1
GO TO 82
ENDIF
PRINT*,' '
 90 PRINT*,'QUESTION NUMBER 9'
92  QNBR = 9
PRINT*,'IN PERT TERMINOLOGY, AN EVENT SIGNIFIES THE START OR '
PRINT*,'COMPLETION OF A SIGNIFICANT STEP IN A PROJECT. NOTICE '
PRINT*,'THE KINDS OF EVENTS INCLUDED IN CHART 1.'
PRINT*,'SINCE AN EVENT IS ALWAYS THE START OR COMPLETION OF SOME'
PRINT*,'WORK, DOES AN EVENT IN AND OF ITSELF CONSUME ANY TIME OR'
PRINT*,'RESOURCES ?'
PRINT*,' '
PRINT*,'1. NO'
PRINT*,'2. YES'
 PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
IF(WG .EQ. 1)THEN
PRINT*,'THE CORRECT ANSWER IS NO '
PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
PRINT*,' '
WG = 0
READ (*,2400)GOON
GO TO 100
ENDIF
PRINT*,' '
REWIND 13
READ*,ANSW
 IF(ANSW .EQ. 0) THEN
 GO TO 690
ELSE IF (ANSW .EQ.1) THEN
PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
RCVRY(QNBR) = 1
ELSE
PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
RCVRY(QNBR) = 2
ENDIF
WRITE (13,*)RCVRY
IF(RCVRY(QNBR) .EQ. 2)THEN
WG = 1
GO TO 92
ENDIF
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      PRINT*,' '
  100 PRINT*,'QUESTION NUMBER 10'
 102  QNBR = 10
      PRINT*,'THUS IN PERT, AN EVENT IS DISTINGUISHED FROM AN '
      PRINT*,'ACTIVITY, BECAUSE AN ACTIVITY UTILIZES _____ AND _____.'
      PRINT*,' '
      PRINT*,'1. TIME--ENERGY'
      PRINT*,'2. TIME--RESOURCES'
      PRINT*,'3. RESOURCES--DOLLARS'
      PRINT*,'4. PEOPLE--TIME'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS TIME--RESOURCES '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 110
      ENDIF
      PRINT*,' '
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
       WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 102
      ENDIF
  110 PRINT*,'QUESTION NUMBER 11'
 112  QNBR = 11
      PRINT*,'EVENTS ARE TYPICALLY REPRESENTED BY NUMBERS, WHILE '
      PRINT*,'ACTIVITIES ARE REPRESENTED BY LETTERS. THUS THE EVENTS '
      PRINT*,'IN CHART 1 ARE INDICATED BY __A__, WHILE THE ACTIVITIES '
      PRINT*,'ARE INDICATED BY __B__?'
      PRINT*,' '
      PRINT*,'1. NUMBERS 1 - 5, LETTERS A - C'
      PRINT*,'2. LETTERS A THRU H, NUMBERS 1 - 8'
      PRINT*,'3. NUMBERS 1 THRU 8, LETTERS A - H'
      PRINT*,'4.  A1, H8'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS EVENTS ARE NUMBERED AND'
      PRINT*,'ACTIVITIES ARE LETTERED. '
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      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 120
      ENDIF
      PRINT*,' '
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 112
      ENDIF
      PRINT*,' '
  120 PRINT*,'QUESTION NUMBER 12'
 122  QNBR = 12
      PRINT*,'IT IS ALSO FREQUENT PRACTICE TO LABEL AN ACTIVITY BY THE'
      PRINT*,'NUMBERS OF THE TWO EVENTS THAT IT CONNECTS: ACTIVITY 4-6'
      PRINT*,'IS AN ALTERNATIVE WAY OF IDENTIFYING ACTIVITY ____ IN '
      PRINT*,'CHART 1.'
      PRINT*,' '
      PRINT*,'1. D'
      PRINT*,'2. E'
      PRINT*,'3. F'
      PRINT*,'4. G'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS F '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 130
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
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      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 122
      ENDIF
      PRINT*,' '
  130 PRINT*,'QUESTION NUMBER 13'
 132  QNBR = 13
      PRINT*,'SIMILARLY , AN ALTERNATIVE LABEL FOR ACTIVITY G IN CHART'
      PRINT*,'1 WOULD BE ACTIVITY ___.'
      PRINT*,' '
      PRINT*,'1. 5-6'
      PRINT*,'2. 6-7'
      PRINT*,'3. 6-8'
      PRINT*,'4. 7-8'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS 6-7 '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 140
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 132
      ENDIF
      PRINT*,' '
  140 PRINT*,'QUESTION NUMBER 14'
 142  QNBR = 14
      PRINT*,'THUS THE BASIC STRUCTURE OF A PERT NETWORK CONSISTS OF '
      PRINT*,'A SERIES OF __A__ CONNECTED BY ___B___. AN ARROW '
      PRINT*,'REPRESENTS AN __C__ THAT CONNECTS TWO EVENTS. THE HEAD '
      PRINT*,'OF THE ARROW SHOWS THE DIRECTION OF TIME FLOW AND '
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      PRINT*,'TOUCHES THE LATER __D___.   '
      PRINT*,' '
      PRINT*,'1. EVENTS--ACTIVITIES--EVENT--ACTIVITY'
      PRINT*,'2. ACTIVITIES--EVENTS--ACTIVITY--EVENT'
      PRINT*,'3. EVENTS--ACTIVITIES--ACTIVITY--EVENT'
      PRINT*,'4. ACTIVITIES--EVENTS--EVENT--ACTIVITY'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS EVENTS--ACTIVITIES '
      PRINT*,'ACTIVITY--EVENT. I HOPE YOU DO BETTER ON THE NEXT ONE.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 150
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT-- GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 142
      ENDIF
      PRINT*,' '
150   PRINT*,'QUESTION NUMBER 15'
152   QNBR = 15
      PRINT*,'A  MEANINGFUL ACCOMPLISHMENT IN THE PROGRAM RECOGNIZABLE'
      PRINT*,'AS A PARTICULAR INSTANT IN TIME AND DOES NOT IN ITSELF '
      PRINT*,'CONSUME TIME OR RESOURCE  IS CALLED _____?'
      PRINT*,' '
      PRINT*,'1. AN EVENT'
      PRINT*,'2. A CIRCLE'
      PRINT*,'3. A SQUARE'
      PRINT*,'4. AN ACTIVITY'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS AN EVENT '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 160
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      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT-- GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 152
      ENDIF
      PRINT*,' '
  160 PRINT*,'QUESTION NUMBER 16'
 162  QNBR = 16
      PRINT*,'REFERRING TO CHART 1; IN A PERT DIAGRAM THE EVENTS ARE '
      PRINT*,'INDICATED BY ___A__ OR __B__, AND __C__.'
      PRINT*,' '
      PRINT*,'1. NUMBERS--CIRCLES--RECTANGLES'
      PRINT*,'2. ARROWS--LETTERS--SQUARES'
      PRINT*,'3. PAIRS OF NUMBERS--LETTERS--ARROWS'
      PRINT*,'4. LETTERS--NUMBERS--TRIANGLES'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS NUMBERS--CIRCLES--'
      PRINT*,'RECTANGLES. I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 170
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 162
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      ENDIF
      PRINT*,' '
 170  PRINT*,'QUESTION NUMBER 17'
 172  QNBR = 17
      PRINT*,'THE NUMBERS USED TO INDICATE THE EVENTS IN A NETWORK '
      PRINT*,'ARE NOT NECESSARILY IN A SEQUENTIAL ORDER; RATHER, THE'
      PRINT*,'NUMBERS SIMPLY SERVE AS LABELS. FROM THIS STANDPOINT, IS'
      PRINT*,'CHART 2 A VALID EXAMPLE OF A PERT NETWORK ? AS WE '
      PRINT*,'INDICATED, PERT IS PRIMARILY CONCERNED WITH CONTROL OVER'
      PRINT*,'TIME. ACCORDINGLY, THREE ESTIMATES (OPTIMISTIC, MOST '
      PRINT*,'LIKELY AND PESSIMISTIC) ARE MADE FOR EACH _____.'
      PRINT*,' '
      PRINT*,'1. NO, EVENT'
      PRINT*,'2. YES, ACTIVITY'
      PRINT*,'3. NO, ACTIVITY'
      PRINT*,'4. YES, EVENT'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS YES--ACTIVITY '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 180
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 172
      ENDIF
      PRINT*,' '
 180  PRINT*,'QUESTION NUMBER 18'
 182  QNBR = 18
      PRINT*,'MANY PROJECTS ON WHICH PERT IS EMPLOYED INVOLVE ORIGINAL'
      PRINT*,'RESEARCH AND DEVELOPMENT AND THE CONSTRUCTION OF DEVICES'
      PRINT*,'NEVER BUILT BEFORE. SINCE THE EXACT AMOUNT OF TIME '
      PRINT*,'REQUIRED FOR SUCH TASKS OR FOR THE ACHIEVEMENT OF A '
      PRINT*,'COMPLEX SYSTEM ARE NOT EASILY DETERMINED, FORECASTS OF '
      PRINT*,'THESE TIMES MUST BE UNCERTAIN. PERT TAKES ACCOUNT OF THE'
      PRINT*,'UNCERTAINTY BY REQUIRING THREE TIME ESTIMATES FOR EACH '
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      PRINT*,'ACTIVITY. THESE ARE RESPECTIVELY CALLED THE OPTIMISTIC '
      PRINT*,'TIME, THE PESSIMISTIC TIME, AND THE MOST LIKELY TIME. '
      PRINT*,'WHICH OF THESE DO YOU THINK SHOULD BE ESTIMATED FIRST ?'
      PRINT*,' '
      PRINT*,'1. PESSIMISTIC TIME'
      PRINT*,'2. OPTIMISTIC TIME'
      PRINT*,'3. MOST LIKELY TIME'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS MOST LIKELY TIME '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 180
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 182
      ENDIF
      PRINT*,' '
  190 PRINT*,'QUESTION NUMBER 19'
 192  QNBR = 19
      PRINT*,'THE TIME ESTIMATE WHICH IS BASED ON THE ASSUMPTION THAT '
      PRINT*,'EVERYTHING WILL BE RIGHT AND HAS ABOUT ONE CHANCE IN A '
      PRINT*,'HUNDRED OF BEING REALIZED. IS CALLED THE _____.'
      PRINT*,' '
      PRINT*,'1. PESSIMISTIC TIME'
      PRINT*,'2. OPTIMISTIC TIME'
      PRINT*,'3. MOST LIKELY TIME'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS OPTIMISTIC TIME '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 190
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      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 192
      ENDIF
      PRINT*,' '
  200 PRINT*,'QUESTION NUMBER 20'
 202  QNBR = 20
      PRINT*,'THE TIME ESTIMATE WHICH WOULD BE CORRECT MOST OFTEN IF'
      PRINT*,'THE ACTIVITY COULD BE REPEATED MANY TIMES UNDER EXACTLY '
      PRINT*,'THE SAME CONDITIONS IS THE _____.'
      PRINT*,' '
      PRINT*,'1. PESSIMISTIC TIME'
      PRINT*,'2. OPTIMISTIC TIME'
      PRINT*,'3. MOST LIKELY TIME'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS MOST LIKELY TIME '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 200
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 202
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      ENDIF
      PRINT*,' '
  210 PRINT*,'QUESTION NUMBER 21'
 212  QNBR = 21
      PRINT*,'THE TIME ESTIMATE BASED ON THE ASSUMPTION THAT '
      PRINT*,'EVERYTHING SHORT OF A CATASTROPHE GOES WRONG AND WHICH '
      PRINT*,'ALSO HAS ABOUT ONE CHANCE IN A HUNDRED OF BEING REALIZED'
      PRINT*,'IS CALLED THE ______.'
      PRINT*,' '
      PRINT*,'1. PESSIMISTIC TIME'
      PRINT*,'2. OPTIMISTIC TIME'
      PRINT*,'3. MOST LIKELY TIME'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS PESSIMISTIC TIME'
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 210
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 212
      ENDIF
      PRINT*,' '
  220 PRINT*,'QUESTION NUMBER 22'
 222  QNBR = 22
      PRINT*,'ACCORDINGLY, OF THE THREE ESTIMATES GIVEN BY THE '
      PRINT*,'SUPERVISOR OF AN ACTIVITY, THE LONGEST TIME ESTIMATE IS '
      PRINT*,'THE __A__ TIME, THE SHORTEST TIME ESTIMATE IS THE __B__ '
      PRINT*,'TIME, WHILE THE __C__ TIME IS BETWEEN THE TWO.'
      PRINT*,' '
      PRINT*,'1. PESSIMISTIC--OPTIMISTIC--MOST LIKELY'
      PRINT*,'2. OPTIMISTIC--MOST LIKELY--PESSIMISTIC'
      PRINT*,'3. MOST LIKELY--OPTIMISTIC--PESSIMISTIC'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS PESSIMISTIC--OPTIMISTIC '
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      PRINT*,'MOST LIKELY. I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 220
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 222
      ENDIF
      PRINT*,' '
  230 PRINT*,'QUESTION NUMBER 23'
 232  QNBR = 23
      PRINT*,'THE THREE TIME ESTIMATES ARE USUALLY WRITTEN OVER THE '
      PRINT*,'ARROWS THAT REPRESENT THE ACTIVITIES IN THE PERT '
      PRINT*,'NETWORK. FOR ACTIVITY A IN CHART 1, FOR EXAMPLE, THE '
      PRINT*,'OPTIMISTIC TIME IS __A__ DAYS, MOST LIKELY TIME IS __B__'
      PRINT*,'DAYS, AND PESSIMISTIC TIME IS __C__ DAYS.'
      PRINT*,' '
      PRINT*,'1. 8, 14, 12'
      PRINT*,'2. 8, 12, 14'
      PRINT*,'3. 1, 12, 2'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS 8--12--14 '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 230
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
```

```
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 232
      ENDIF
      PRINT*,' '
 240  PRINT*,'QUESTION NUMBER 24'
 242  QNBR = 24
      PRINT*,'MORE OFTEN, THE THREE TIME ESTIMATES FOR EACH ____ ARE'
      PRINT*,'COMBINED INTO A WEIGHTED AVERAGE, CALLED  EXPECTED '
      PRINT*,'ELAPSED TIME  WHICH IS DESIGNATED WITH A LOWER CASE T '
      PRINT*,'AND A SUBSCRIPT LOWER CASE E.'
      PRINT*,' '
      PRINT*,'1. EVENT'
      PRINT*,'2. NETWORK'
      PRINT*,'3. ACTIVITY'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS ACTIVITY '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 240
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 242
      ENDIF
      PRINT*,' '
 250  PRINT*,'QUESTION NUMBER 25'
 252  QNBR = 25
      PRINT*,'OPTIMISTIC TIME IS DESIGNATED BY LOWER CASE (A); '
      PRINT*,'MOST LIKELY TIME BY LOWER CASE (M); AND PESSIMISTIC TIME'
      PRINT*,'BY LOWER CASE (B). THE FORMULA USED TO COMPUTE LOWER '
```

```
      PRINT*,'CASE TE IS SHOWN IN CHART 3 OF THE PACKAGE PRESENTED '
      PRINT*,'WITH THIS COURSE. WHERE A = 3, M = 6, B = 9, LOWER CASE'
      PRINT*,'TE = ______.'
      PRINT*,' '
      PRINT*,'1. 6'
      PRINT*,'2. 9'
      PRINT*,'3. 3'
      PRINT*,'4. NONE OF THE ABOVE'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  6  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 250
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 252
      ENDIF
      PRINT*,' '
  260 PRINT*,'QUESTION NUMBER 26'
 262  QNBR = 26
      PRINT*,'THIS IS AN ESTIMATE OF THE AVERAGE TIME THE ACTIVITY '
      PRINT*,'WOULD TAKE IF IT WERE REPEATED MANY TIMES. THE TIME '
      PRINT*,'ESTIMATE WHICH IS MOST HEAVILY WEIGHTED IN THE FORMULA '
      PRINT*,'IS THE _____ TIME.'
      PRINT*,' '
      PRINT*,'1. PESSIMISTIC '
      PRINT*,'2. OPTIMISTIC'
      PRINT*,'3. MOST LIKELY'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS MOST LIKELY  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
```

```
      READ (*,2400)GOON
      GO TO 260
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 262
      ENDIF
      PRINT*,' '
  270 PRINT*,'QUESTION NUMBER 27'
 272  QNBR = 27
      PRINT*,'GIVEN THE FOLLOWING TABLE COMPUTE THE LOWER CASE TE FOR '
      PRINT*,'EACH ACTIVITY, USING DECIMALS (TO TWO PLACES) RATHER '
      PRINT*,'THAN FRACTIONS IN YOUR ANSWERS.'
      PRINT*,'ACTIVITY           A      M      B       LOWER CASE TE'
      PRINT*,'-----------------------------------------------------------'
      PRINT*,'   A               2      6      7         ___A___'
      PRINT*,'   B               4      7     10         ___B___'
      PRINT*,'   C               8     12     16         ___C___'
      PRINT*,' '
      PRINT*,'1. 6, 7, 11'
      PRINT*,'2. 5.5, 7, 12'
      PRINT*,'3. 5, 8, 12'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS 5.5--7--12  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 270
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
```

```
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 272
      ENDIF
      PRINT*,' '
  280 PRINT*,'QUESTION NUMBER 28'
 282  QNBR = 28
      PRINT*,'USING THE FORMULA GIVEN EARLIER FOR COMPUTING THE '
      PRINT*,'EXPECTED ELAPSED TIME (LOWER CASE TE) FOR ACTIVITIES, '
      PRINT*,'COMPUTE THE EXPECTED ELAPSED TIME FOR THE ACTIVITIES A, '
      PRINT*,'E, H ON CHART 1.'
      PRINT*,' '
      PRINT*,'1. 11.0, 4.1, 4.0'
      PRINT*,'2. 12.0, 4.0, 4.1'
      PRINT*,'3. 11.6, 4.2, 4.0'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  11.6--4.2--4.0  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 280
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 282
      ENDIF
      PRINT*,' '
  290 PRINT*,'QUESTION NUMBER 29'
 292  QNBR = 29
      PRINT*,'WE SHALL NOW TURN OUR ATTENTION TO EVENTS RATHER THAN '
      PRINT*,'ACTIVITIES. THE UPPER CASE TE OF AN EVENT IS THE '
      PRINT*,'EXPECTED COMPLETION DATE FOR THAT EVENT TO OCCUR, GIVEN '
      PRINT*,'THE EXPECTED ELAPSED TIMES IN A NETWORK. FOR THE NETWORK'
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      PRINT*,'OF CHART 2, WHAT IS THE (UPPER CASE) TE VALUE FOR EVENT'
      PRINT*,'5. THAT IS, HOW SOON CAN WE EXPECT TO ARRIVE AT EVENT 5,'
      PRINT*,'IN DAYS?'
      PRINT*,' '
      PRINT*,'1. 13'
      PRINT*,'2. 12'
      PRINT*,'3. 11.5'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  13  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 290
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 292
      ENDIF
      PRINT*,' '
  300 PRINT*,'QUESTION NUMBER 30'
 302  QNBR = 30
      PRINT*,'THERE ARE OFTEN SEVERAL  PATHS  THROUGH A NETWORK THAT '
      PRINT*,'CULMINATE AT AN EVENT ALONG THE WAY. FOR EXAMPLE, IN '
      PRINT*,'CHART 2, THE THREE PATHS THAT LEAD TO THE ATTAINMENT OF '
      PRINT*,'EVENT 6 ARE MADE UP OF EVENTS ___A__, ___B__, ___C__.'
      PRINT*,' '
      PRINT*,'1. 1-4-5-6, 1-2-7-6, 1-2-7-8-10-11-9-6'
      PRINT*,'2. 1-4-5-6, 1-3-6, 1-2-7-8-6'
      PRINT*,'3. 4-5-6, 4-1-3-6, 7-8-6'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  1-4-5-6, 1-3-6, 1-2-7-8-6  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
```

```
      GO TO 300
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 302
      ENDIF
      PRINT*,' '
  310 PRINT*,'QUESTION NUMBER 31'
 312  QNBR = 31
      PRINT*,'ALL THE NECESSARY PRECEDING EVENTS MUST BE COMPLETED '
      PRINT*,'BEFORE AN EVENT CAN ITSELF BE REACHED. FOR EXAMPLE, '
      PRINT*,'EVENT 6 IN CHART 2 CAN ONLY BE COMPLETED AFTER ALL '
      PRINT*,'EVENTS IN THE THREE PATHS THAT YOU JUST IDENTIFIED HAVE'
      PRINT*,'BEEN COMPLETED. THEREFORE, WHEN THERE ARE TWO OR MORE '
      PRINT*,'PATHS THAT LEAD TO AN EVENT, THE UPPER CASE TE FOR THAT'
      PRINT*,'EVENT IS EQUAL TO THE SUM OF EACH LOWER CASE TE IN THE '
      PRINT*,'_____ TIME CONSUMING PATH.'
      PRINT*,' '
      PRINT*,'1. LEAST'
      PRINT*,'2. MOST'
      PRINT*,'3. INSUFFICIENT INFORMATION'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  MOST   '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 310
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
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      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 312
      ENDIF
      PRINT*,' '
  320 PRINT*,'QUESTION NUMBER 32'
 322  QNBR = 32
      PRINT*,'COMPUTE THE VALUE OF THE EVENT EXPECTED COMPLETION DATE '
      PRINT*,'(UPPER CASE TE) FOR EVENT 6 IN CHART 2.'
      PRINT*,' '
      PRINT*,'1. 18'
      PRINT*,'2. 25'
      PRINT*,'3. 12'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  25  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 320
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 322
      ENDIF
      PRINT*,' '
  330 PRINT*,'QUESTION NUMBER 33'
 332  QNBR = 33
      PRINT*,'COMPLETE THE FOLLOWING TABLE FOR THE EVENTS IN CHART 2.'
      PRINT*,' '
      PRINT*,'EVENT                    UPPER CASE TE'
      PRINT*,'-----------------------------------'
      PRINT*,'  3                       ___A__'
      PRINT*,'  5                       ___B__'
      PRINT*,'  9                       ___C__'
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      PRINT*,' 11                        ___D__'
      PRINT*,' '
      PRINT*,'1. 8, 13, 24, 26'
      PRINT*,'2. 8, 13, 25, 28'
      PRINT*,'3. 8, 13, 28, 33'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS 8--13--28--33  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 330
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 332
      ENDIF
      PRINT*,' '
 340  PRINT*,'QUESTION NUMBER 34'
342   QNBR = 34
      PRINT*,'WHEREAS THE "EXPECTED ELAPSED TIME" IS REPRESENTED BY'
      PRINT*,'THE LOWER CASE TE, THE EVENT EXPECTED COMPLETION DATE IS'
      PRINT*,'REPRESENTED BY THE SYMBOL _______.'
      PRINT*,' '
      PRINT*,'1. UPPER CASE TE'
      PRINT*,'2. UPPER CASE ET'
      PRINT*,'3. UPPER CASE T'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS UPPER CASE TE  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 340
      ENDIF
      REWIND 13
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      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 342
      ENDIF
      PRINT*,' '
  350 PRINT*,'QUESTION NUMBER 35'
 352  QNBR = 35
      PRINT*,'THERE ARE TWO OTHER VALUES ASSOCIATED WITH EVENTS. UPPER'
      PRINT*,'CASE TS,  THE SCHEDULED COMPLETION DATE , IS THE '
      PRINT*,'CONTRACTURAL OBLIGATION DATE FOR THE WHOLE PROJECT, OR'
      PRINT*,'THE SCHEDULED COMPLETION DATE FOR CERTAIN MAJOR EVENTS'
      PRINT*,'WITHIN THE PROJECT. REFER TO CHART 2. WHAT IS THE '
      PRINT*,'SCHEDULE COMPLETION DATE (UPPER CASE TS) FOR EVENT 11, '
      PRINT*,'WHICH IS THE CULMINATION OF THE PROJECT ?'
      PRINT*,' '
      PRINT*,'1. 33'
      PRINT*,'2. 36'
      PRINT*,'3. 28'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  33  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 350
      ENDIF
      REWIND 13
      READ*,ANSW
      IF(ANSW.EQ.0)THEN
      GO TO 690
      ELSEIF (ANSW.EQ.1)THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
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      WG = 1
      GO TO 352
      ENDIF
      PRINT*,' '
  360 PRINT*,'QUESTION NUMBER 36'
 362  QNBR = 36
      PRINT*,'UPPER CASE TL, ON THE OTHER HAND, IS THE  LATEST '
      PRINT*,'ALLOWABLE COMPLETION DATE  FOR AN EVENT. THE UPPER CASE'
      PRINT*,'TL OF EACH EVENT MUST BE DEFINED SO THAT IF EVERY EVENT'
      PRINT*,'IN A NETWORK IS COMPLETED BY THIS TIME, THEN THE '
      PRINT*,'SCHEDULED COMPLETION DATE FOR THE PROJECT, UPPER CASE '
      PRINT*,'TS, WILL BE MET. IN CHART 2, WHAT MUST THE UPPER CASE TL'
      PRINT*,'FOR EVENT 11 BE ?'
      PRINT*,' '
      PRINT*,'1. 33'
      PRINT*,'2. 36'
      PRINT*,'3. 28'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  33  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 360
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      PRINT*,'TL IS THE SAME AS TS SINCE IT IS THE LAST EVENT '
      PRINT*,'IN THE NETWORK'
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 362
      ENDIF
      PRINT*,' '
 370  PRINT*,'QUESTION NUMBER 37'
372   QNBR = 37
      PRINT*,'EVENTS MAY HAVE SEVERAL PATHS COMING INTO THEM.'
      PRINT*,'REMEMBER: CALCULATE UPPER CASE TL VALUES OVER ALL'
      PRINT*,'PATHS COMING INTO AN EVENT AND THE SMALLEST UPPER CASE'
      PRINT*,'TL VALUE OF ALL THE PATHS WILL BE THE UPPER CASE TL '
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      PRINT*,'VALUE FOR THAT EVENT. ANOTHER HELPFUL HINT IS TO FOLLOW'
      PRINT*,'THE FEATHER END OF THE ARROW WHEN CALCULATING UPPER CASE'
      PRINT*,'TL VALUES.'
      REWIND 13
      RCVRY(QNBR) = 1
      WRITE (13,*)RCVRY
      PRINT*,' '
  380 PRINT*,'QUESTION NUMBER 38'
  382 QNBR = 38
      PRINT*,'NOW CALCULATE THE UPPER CASE TL VALUES FOR ALL EVENTS IN'
      PRINT*,' CHART 2.'
      PRINT*,'TYPE IN YOUR CALCULATIONS IN ORDER  FROM 1 TO 11 AT '
      PRINT*,'THE ? PROMPT. ONLY ONE ANSWER PER PROMPT.'
      REWIND 13
      DO 385 J=1,11
      READ*,ANSW
      IF(ANSW .NE.QBR38(J))THEN
      W = W+1
      ENDIF
  385 CONTINUE
      PRINT 3000,'YOU GOT ',W,' WRONG  OUT OF 11'
      IF(W .GT. 0)THEN
      PRINT*,'FOR OUR PURPOSES THAT MEANS YOU GOT QUESTION 38 WRONG'
      PRINT*,'THE RIGHT ANSWERS ARE 0,7,21,14,20,25,16,21,28,30,33'
      RCVRY(QNBR) = 2
      ELSE IF (W .EQ.0) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ENDIF
      PRINT*,' '
      WRITE(13,*)RCVRY
  390 PRINT*,'QUESTION NUMBER 39'
  392 QNBR = 39
      PRINT*,'NOW THAT WE CAN CALCULATE THE UPPER CASE TL VALUES, LET'
      PRINT*,'US REVIEW OUR CALCULATION OF THE UPPER CASE TE VALUES. '
      PRINT*,'REMEMBER, WE START WITH THE FIRST EVENT AND ADD THE '
      PRINT*,'LOWER CASE TE VALUES TO THE BEGINNING UPPER CASE TE '
      PRINT*,'VALUE WHICH IS EQUAL TO 0. IF AN EVENT HAS MORE THAN ONE'
      PRINT*,'PATH THEN WE CALCULATE THE UPPER CASE TE VALUES FOR ALL '
      PRINT*,'PATHS, AND THE LARGEST CALCULATED VALUE WILL BE THE '
      PRINT*,'UPPER CASE TE VALUE FOR THAT EVENT. EVENT 10 UPPER CASE '
      PRINT*,'TE = 26 EXAMPLE : EVENT 6, PATH 1-2-7-8-6 UPPER CASE '
      PRINT*,'TE = 25: PATHS 1-3-6 UPPER CASE TE = 12: PATH 1-4-5-6 '
      PRINT*,'UPPER CASE TE = 18: 25 IS THE LARGEST VALUE CALCULATED '
      PRINT*,'FOR EVENT 6 AND IS THEREFORE THE UPPER CASE TE VALUE FOR'
      PRINT*,'EVENT 6. NOW COMPUTE THE UPPER CASE TE VALUE FOR ALL '
      PRINT*,'TYPE IN YOUR CALCULATIONS IN ORDER  FROM 1 TO 11 AT '
      PRINT*,'THE ? PROMPT. ONLY ONE ANSWER PER PROMPT.'
      REWIND 13
      W = 0
      DO 395 J=1,11
      READ*,ANSW
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      IF(ANSW.NE.QBR39(J))THEN
      W = W + 1
      ENDIF
395   CONTINUE
      PRINT 3000,'YOU GOT ',W,' WRONG OUT OF 11'
      IF(W.GT.0)THEN
      PRINT*,'FOR OUR PURPOSES THAT MEANS YOU GOT QUESTION 39 WRONG'
      PRINT*,'THE RIGHT ANSWERS ARE 0,7,8,7,13,25,16,21,28,26,23'
      RCVRY(QNBR) = 2
      ELSE IF (W .EQ.0) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ENDIF
      WRITE (13,*)RCVRY
      PRINT*,' '
 400  PRINT*,'QUESTION NUMBER 40'
402   QNBR = 40
      PRINT*,'NOTICE ON CHART 2, THAT UNLESS EVENT 1 IS ACCOMPLISHED '
      PRINT*,'IMMEDIATELY, THE PROJECT WILL BE BEHIND SCHEDULE AT'
      PRINT*,'EVENT ______.'
      PRINT*,' '
      PRINT*,'1. 2'
      PRINT*,'2. 3'
      PRINT*,'3. 4'
      PRINT*,'0. EXIT THE PROGRAM AND TAKE A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  2  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 410
      ENDIF
      PRINT*,' '
      PRINT*,'SO FAR, WE HAVE COVERED THE COMPUTATION OF THE :'
      PRINT*,'     EXPECTED ELAPSED TIME                 LOWER CASE TE'
      PRINT*,'     EXPECTED COMPLETION DATE              UPPER CASE TE'
      PRINT*,'     LATEST ALLOWABLE COMPLETION DATE      UPPER CASE TL'
      PRINT*,'     SCHEDULED COMPLETION DATE             UPPER CASE TS'
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
```

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      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 402
      ENDIF
      PRINT*,' '
  410 PRINT*,'QUESTION NUMBER 41'
 412  QNBR = 41
      PRINT*,'NOW WE SHALL LOOK AT THE VALUES CALCULATED FOR '
      PRINT*,'INDIVIDUAL ACTIVITIES AND EVENTS AND SEE HOW THEY ARE'
      PRINT*,'USED IN THE OVERALL ANALYSIS AND MANAGERIAL CONTROL'
      PRINT*,'FUNCTIONS. CALCULATE THE UPPER CASE TL VALUE __A__ AND'
      PRINT*,'THE UPPER CASE TE VALUE __B__ FOR EVENT 6.'
      PRINT*,' '
      PRINT*,'1. 23,24'
      PRINT*,'2. 24,24'
      PRINT*,'3. 25,25'
      PRINT*,'4. 24,25'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  25--25  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 420
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 412
      ENDIF
      PRINT*,' '
  420 PRINT*,'QUESTION NUMBER 42'
  422 QNBR = 42
      PRINT*,'THE SLACK OF AN EVENT IS A MEASUREMENT OF THE EXCESS '
      PRINT*,'TIME AVAILABLE TO REACH THAT EVENT. SINCE IT IS THE '
      PRINT*,'NUMBER OF DAYS BY WHICH THE LATEST ALLOWABLE COMPLETION '
      PRINT*,'DATE EXCEEDS THE EXPECTED COMPLETION DATE FOR AN EVENT, '
      PRINT*,'THE APPROPRIATE FORMULA TO FIND THE SLACK FOR AN EVENT '
      PRINT*,'WOULD BE __A__. WHAT IS THE SLACK FOR EVENT 6 ?'
```

```
      PRINT*,' '
      PRINT*,'1. UPPER CASE TL - UPPER CASE TE = S, S = 0'
      PRINT*,'2. UPPER CASE TE - UPPER CASE TL = S, S = 2'
      PRINT*,'3. UPPER CASE TL - LOWER CASE TE = S, S = 2'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  UPPER CASE TL MINUS '
      PRINT*,'UPPER CASE TE = S WHERE S IS EQUAL TO 0.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 430
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 422
      ENDIF
      PRINT*,' '
  430 PRINT*,'QUESTION NUMBER 43'
 432  QNBR = 43
      PRINT*,'FOR EXAMPLE, IF THE LATEST ALLOWABLE COMPLETION DATE FOR'
      PRINT*,'AN EVENT (UPPER CASE TL) IS 10 DAYS FROM NOW, AND THE '
      PRINT*,'EXPECTED COMPLETION DATE FOR THE EVENT (UPPER CASE TE) '
      PRINT*,'IS 7 DAYS FROM NOW, THEN ______ DAYS OF SLACK ARE '
      PRINT*,'INVOLVED.'
      PRINT*,' '
      PRINT*,'1. 0'
      PRINT*,'2. -3'
      PRINT*,'3. 3'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  3  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 440
      ENDIF
```

```
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 432
      ENDIF
      PRINT*,' '
  440 PRINT*,'QUESTION NUMBER 44'
 442  QNBR = 44
      PRINT*,'ON THE OTHER HAND, SUPPOSE THAT THE TWO VALUES JUST '
      PRINT*,'GIVEN WERE REVERSED, GIVING US AN UPPER CASE TL OF 7 AND'
      PRINT*,'AN UPPER CASE TE OF 10. WHAT WOULD BE THE AMOUNT OF '
      PRINT*,'SLACK AVAILABLE FOR THIS EVENT, IN DAYS ?'
      PRINT*,' '
      PRINT*,'1. 3'
      PRINT*,'2. 0'
      PRINT*,'3. -3'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  -3  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 450
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 442
```

```
      ENDIF
      PRINT*,' '
  450 PRINT*,'QUESTION NUMBER 45'
 452  QNBR = 45
      PRINT*,'THUS THERE CAN BE POSITIVE, NEGATIVE OR ZERO SLACK '
      PRINT*,'ASSOCIATED WITH REACHING AN EVENT. FROM THE STANDPOINT '
      PRINT*,'OF MAKING USE OF THIS INFORMATION, THE LESS SLACK THERE '
      PRINT*,'IS (OR MORE NEGATIVE SLACK THERE IS, THE ________ '
      PRINT*,'CRITICAL IS THAT EVENT IN THE PROJECT.'
      PRINT*,' '
      PRINT*,'1. MORE'
      PRINT*,'2. LESS'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  MORE  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 460
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 452
      ENDIF
      PRINT*,' '
  460 PRINT*,'QUESTION NUMBER 46'
 462  QNBR = 46
      PRINT*,'COMPUTE THE VALUE OF  SLACK  ASSOCIATED WITH ATTAINING '
      PRINT*,'EACH EVENT FOR CHART 2.'
      PRINT*,'TYPE IN YOUR CALCULATIONS IN ORDER  FROM 1 TO 11 AT '
      PRINT*,'THE ? PROMPT. ONLY ONE ANSWER PER PROMPT.'
      REWIND 13
      W = 0
      DO 465 J=1,11
      READ*,ANSW
      IF(ANSW .NE.QBR46(J))THEN
      W = W+1
      ENDIF
```

```
465  CONTINUE
     PRINT 3000,'YOU GOT ',W,' WRONG  OUT OF 11'
     IF(W .GT. 0)THEN
     PRINT*,'FOR OUR PURPOSES THAT MEANS YOU GOT QUESTION 46 WRONG'
     PRINT*,'THE RIGHT ANSWERS ARE 0,0,13,7,7,0,0,0,0,4,0'
     RCVRY(QNBR) = 2
     ELSE IF (W .EQ.0) THEN
     PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
     RCVRY(QNBR) = 1
     ENDIF
     WRITE (13,*)RCVRY
     PRINT*,' '
 470 PRINT*,'QUESTION NUMBER 47'
472  QNBR = 47
     PRINT*,'APPLYING THE CONCEPT OF SLACK TO THE ENTIRE NET, RATHER '
     PRINT*,'THAN JUST TO INDIVIDUAL EVENTS, THE CRITICAL PATH IN A '
     PRINT*,'PERT NETWORK IS THE ONE THAT HAS THE ______ SLACK.'
     PRINT*,' '
     PRINT*,'1. MOST'
     PRINT*,'2. LEAST'
      PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
     IF(WG .EQ. 1)THEN
     PRINT*,'THE CORRECT ANSWER IS  LEAST  '
     PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
     PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
     PRINT*,' '
     WG = 0
     READ (*,2400)GOON
     GO TO 480
     ENDIF
     REWIND 13
     READ*,ANSW
      IF(ANSW .EQ. 0) THEN
      GO TO 690
     ELSE IF (ANSW .EQ.2) THEN
     PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
     RCVRY(QNBR) = 1
     ELSE
     PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
     RCVRY(QNBR) = 2
     ENDIF
     WRITE (13,*)RCVRY
     IF(RCVRY(QNBR) .EQ. 2)THEN
     WG = 1
     GO TO 472
     ENDIF
     PRINT*,' '
 480 PRINT*,'QUESTION NUMBER 48'
482  QNBR = 48
     PRINT*,'TO PUT IT ANOTHER WAY, THE PATH FROM THE FIRST EVENT '
     PRINT*,'TO GOAL ATTAINMENT WHICH CONSUMES THE MOST TIME IS THE '
     PRINT*,'______ PATH.'
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```
      PRINT*,' '
      PRINT*,'1. SLACK'
      PRINT*,'2. EVENT'
      PRINT*,'3. CRITICAL'
      PRINT*,'4. WORST'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  CRITICAL  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 490
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 482
      ENDIF
      PRINT*,' '
  490 PRINT*,'QUESTION NUMBER 49'
 492  QNBR = 49
      PRINT*,'REFER TO CHART 2, THE CRITICAL PATH FOR THIS NETWORK IS '
      PRINT*,'THE ONE CONNECTING EVENTS ________________.'
      PRINT*,' '
      PRINT*,'1. 1-2-7-8-6-9-11'
      PRINT*,'2. 1-3-6-9-11'
      PRINT*,'3. 1-2-7-10-11'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  1-2-7-8-6-9-11  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 500
      ENDIF
      REWIND 13
      READ*,ANSW
```

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      IF(ANSW .EQ. 0) THEN
      GO TO 690
     ELSE IF (ANSW .EQ.1) THEN
     PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
     RCVRY(QNBR) = 1
     ELSE
     PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
     RCVRY(QNBR) = 2
     ENDIF
     WRITE (13,*)RCVRY
     IF(RCVRY(QNBR) .EQ. 2)THEN
     WG = 1
     GO TO 492
     ENDIF
     PRINT*,' '
 500 PRINT*,'QUESTION NUMBER 50'
502  QNBR = 50
     PRINT*,'AS THE NAME IMPLIES, THE CRITICAL PATH IS CRITICAL '
     PRINT*,'BECAUSE A DELAY IN THE COMPLETION OF ANY OF THE EVENTS '
     PRINT*,'IN IT CAN RESULT IN A DELAY IN ACHIEVING THE PROJECT '
     PRINT*,'OBJECTIVE, UNLESS RESOURCES OR PERSONNEL CHANGES ARE '
     PRINT*,'MADE. IS IT POSSIBLE FOR THERE TO BE TWO OR MORE EQUALLY'
     PRINT*,'CRITICAL PATHS IN A PERT NETWORK ?'
     PRINT*,' '
     PRINT*,'1. YES'
     PRINT*,'2. NO'
      PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
     IF(WG .EQ. 1)THEN
     PRINT*,'THE CORRECT ANSWER IS  YES  '
     PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
     PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
     PRINT*,' '
     WG = 0
     READ (*,2400)GOON
     GO TO 510
     ENDIF
     REWIND 13
     READ*,ANSW
      IF(ANSW .EQ. 0) THEN
      GO TO 690
     ELSE IF (ANSW .EQ.1) THEN
     PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
     RCVRY(QNBR) = 1
     ELSE
     PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
     RCVRY(QNBR) = 2
     ENDIF
     WRITE (13,*)RCVRY
     IF(RCVRY(QNBR) .EQ. 2)THEN
     WG = 1
     GO TO 502
     ENDIF
```

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      PRINT*,' '
  510 PRINT*,'QUESTION NUMBER 51'
 512  QNBR = 51
      PRINT*,'BECAUSE IT DIRECTS THE MANAGERS ATTENTION TO THOSE '
      PRINT*,'EVENTS AND ACTIVITIES THAT ARE MOST LIKELY TO DELAY THE '
      PRINT*,'COMPLETION OF A PROJECT, CRITICAL ________ ANALYSIS IS '
      PRINT*,'IMPORTANT AS A CONTROL TECHNIQUE.'
      PRINT*,' '
      PRINT*,'1. EVENT'
      PRINT*,'2. TIME'
      PRINT*,'3. PATH'
      PRINT*,'4. ACTIVITY'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  PATH  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 520
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.3) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 3, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 512
      ENDIF
      PRINT*,' '
  520 PRINT*,'QUESTION NUMBER 52'
 522  QNBR = 52
      PRINT*,'DESPITE EFFORTS TO ADHERE TO SCHEDULED PLAN, THE MANAGER'
      PRINT*,'MAY BELIEVE THAT A GIVEN COMPLETION DATE IS UNREALISTIC.'
      PRINT*,'THIS JUDGEMENT MAY RESULT FROM CHANGES IN THE ORIGINAL '
      PRINT*,'PLAN, IN THE ORIGINAL OBJECTIVES, OR FROM THE MANAGERS '
      PRINT*,'EVALUATION OF THE SLACK VALUES ON THE CRITICAL PATH. '
      PRINT*,'REGARDLESS OF THE CAUSE, MANAGEMENT MUST THEN ACHIEVE AN'
      PRINT*,'EFFICIENT AND ECONOMICAL ADJUSTMENT TO THE ORIGINAL '
      PRINT*,'PLAN. AS A PRINCIPLE, EFFECTIVE ADJUSTMENTS IN THE '
      PRINT*,'SCHEDULED PLAN SHOULD BE ACCOMPLISHED WITH MINIMUM '
      PRINT*,'RECYCLING IN THE MANAGEMENT PROCESS. THEREFORE, PRIOR TO'
      PRINT*,'INCORPORATING ANY CHANGE INTO THE SCHEDULED PLAN ALL '
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      PRINT*,'PROMISING ALTERNATIVES SHOULD BE CONSIDERED. INHERENT IN'
      PRINT*,'THE PERT METHODOLOGY IS A SIMPLE MEANS WHEREBY THESE '
      PRINT*,'ALTERNATIVES MAY BE EVALUATED; THIS IS CALLED THE '
      PRINT*,'PROCESS OF SIMULATION.'
      RCVRY(QNBR) = 1
      WRITE (13,*)RCVRY
      PRINT*,' '
  530 PRINT*,'QUESTION NUMBER 53'
 532  QNBR = 53
      PRINT*,'THERE ARE THREE BASIC TYPES OF ACTIONS A MANAGER MAY '
      PRINT*,'TAKE TO REPLAN A NETWORK. EACH FULFILLS REQUIREMENTS '
      PRINT*,'PECULIAR TO A GIVEN SET OF CIRCUMSTANCES. A NETWORK MAY '
      PRINT*,'BE REPLANNED BY ONE OR MORE OF THE FOLLOWING THREE '
      PRINT*,'METHODS:'
      PRINT*,'1. CHANGING A CHAIN OF SERIES CONNECTED ACTIVITIES INTO '
      PRINT*,'  A SERIES-PARALLEL ARRANGEMENT.'
      PRINT*,'2. CHANGING RESOURCES APPLIED TO ACTIVITIES.'
      PRINT*,'3. CHANGING THE WORK SCOPE AND/OR LOWERING '
      PRINT*,'  SPECIFICATIONS OF VARIOUS ACTIVITIES. AS A LAST '
      PRINT*,'  RESORT, ACTIVITIES MAY BE ELIMINATED.'
      PRINT*,'THE REPLANNING PROCEDURES DESCRIBED ABOVE HAVE ONE '
      PRINT*,'PURPOSE IN COMMON. THEY ARE INTENDED TO ___________'
      PRINT*,'THE TIME REQUIRED TO COMPLETE THE NETWORK.'
      PRINT*,' '
      PRINT*,'1. INCREASE'
      PRINT*,'2. DECREASE'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  DECREASE  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 540
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 532
      ENDIF
```

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      PRINT*,' '
  540 PRINT*,'QUESTION NUMBER 54'
 542  QNBR = 54
      PRINT*,'FOR THE NEXT SEVERAL QUESTIONS A REFERENCE IS MADE TO'
      PRINT*,'CASE A AND TO CASE B. THESE TWO CASES CAN BE FOUND'
      PRINT*,'IN CHART 4 OF THE PROGRAMMED TEXT COURSE MATERIAL.'
      PRINT*,' '
      PRINT*,'ONE METHOD OF REDUCING THE TIME REQUIRED IS TO MAKE A'
      PRINT*,'SET OF SERIES CONNECTED ACTIVITIES INTO A SERIES-'
      PRINT*,'PARALLEL ARRANGEMENT.  NOTE IN CASE B EACH WORK ACTIVITY'
      PRINT*,'KEEPS ITS BEGINNING AND ENDING EVENTS, AND IS JOINED '
      PRINT*,'TO OTHERS BY SHORT CONSTRAINING ACTIVITIES WHICH '
      PRINT*,'MAINTAIN THE NECESSARY WORK SEQUENCE.'
      RCVRY(QNBR) = 1
      WRITE (13,*)RCVRY
      PRINT*,' '
  550 PRINT*,'QUESTION NUMBER 55'
 552  QNBR = 55
      PRINT*,' '
      PRINT*,'ALL THE LOWER CASE TE VALUES WRITTEN ABOVE THE'
      PRINT*,'ACTIVITIES ARE IN UNITS AND TENTHS OF A WEEK. IN '
      PRINT*,'QUESTION 54, CASE A, THE ACTIVITIES PATH EXTENDING FROM'
      PRINT*,'START DESIGN TO END SECOND TEST IS EXPECTED TO REQUIRE'
      PRINT*,'A TOTAL OF ___A__ WEEKS. IN CASE B WHERE THE SAME '
      PRINT*,'ACTIVITIES NOW INCLUDE A SERIES-PARALLEL ARRANGEMENT: '
      PRINT*,'THE TIME BETWEEN THESE SAME TWO EVENTS IS EXPECTED TO '
      PRINT*,'BE ___B___ WEEKS.'
      PRINT*,' '
      PRINT*,'1. CASE A = 19 WEEKS, CASE B = 12 WEEKS'
      PRINT*,'2. CASE A = 19 WEEKS, CASE B = 14 WEEKS'
      PRINT*,'3. CASE A = 18 WEEKS, CASE B = 12 WEEKS'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  CASE A=19 WEEKS, CASE B=12 WEEKS '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 560
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
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      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 552
      ENDIF
      PRINT*,' '
  560 PRINT*,'QUESTION NUMBER 56'
  562 QNBR = 56
      PRINT*,'ONE REPLANNING METHOD INVOLVES REARRANGING A CHAIN OF'
      PRINT*,'ACTIVITIES WHICH ARE CONNECTED IN SERIES INTO A __A__'
      PRINT*,'CONFIGURATION. IN OTHER WORDS, ACTIVITIES WILL BE'
      PRINT*,'PLANNED TO TAKE PLACE __B__.'
      PRINT*,' '
      PRINT*,'1. SERIES-PARALLEL, SEQUENTIALLY'
      PRINT*,'2. SERIES-PARALLEL, CONCURRENTLY'
      PRINT*,'3. SERIES, SEQUENTIALLY'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS SERIES-PARALLEL--CONCURRENTLY '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 570
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 562
      ENDIF
      PRINT*,' '
  570 PRINT*,'QUESTION NUMBER 57'
  572 QNBR = 57
      PRINT*,'ANOTHER PLANNING METHOD THAT REDUCES THE TIME REQUIRED '
      PRINT*,'ON THE CRITICAL PATH IS TO INCREASE THE RESOURCES '
      PRINT*,'APPLIED TO VARIOUS ACTIVITIES ON THIS PATH. SUCH'
      PRINT*,'RESOURCES INCLUDE MANPOWER AND EQUIPMENT AS WELL AS'
      PRINT*,'SPACE OR CAPITAL THAT PERMIT THE USE OF MORE MANPOWER'
      PRINT*,'AND EQUIPMENT. OVERTIME WORK IS ALSO A __A__ THAT MAY'
      PRINT*,'BE APPLIED TO MANY ACTIVITIES.'
```

```
      PRINT*,' '
      PRINT*,'1. METHOD'
      PRINT*,'2. RESOURCE'
      PRINT*,'3. PLAN'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  RESOURCE  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 580
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 572
      ENDIF
      PRINT*,' '
  580 PRINT*,'QUESTION NUMBER 58'
 582  QNBR = 58
      PRINT*,'AN ACCEPTABLE METHOD OF OBTAINING ADDITIONAL RESOURCES'
      PRINT*,'FOR ACTIVITIES ON THE CRITICAL PATH IS TO TAKE SOME'
      PRINT*,'RESOURCES AWAY FROM OTHER ACTIVITY PATHS THAT CAN'
      PRINT*,'AFFORD TO LOSE THEM. THIS MAY INCREASE THE TIME'
      PRINT*,'REQUIRED FOR THESE PATHS BUT AS LONG AS THE INCREASE '
      PRINT*,'DOES NOT CLOSELY APPROXIMATE THAT TIME VALUE FOR THE '
      PRINT*,'CRITICAL PATH, THE PROCEDURE IS PERMISSIBLE. THOSE'
      PRINT*,'ACTIVITY PATHS WHICH CAN AFFORD TO LOSE SOME'
      PRINT*,'RESOURCES HAVE SLACK VALUES (TL-TE) MUCH __A__'
      PRINT*,'THAN THAT OF THE CRITICAL PATH.'
      PRINT*,' '
      PRINT*,'1. GREATER'
      PRINT*,'2. LESS'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  GREATER  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
```

```
      WG = 0
      READ (*,2400)GOON
      GO TO 590
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 582
      ENDIF
      PRINT*,' '
  590 PRINT*,'QUESTION NUMBER 59'
 592  QNBR = 59
      PRINT*,'WHAT METHOD/METHODS ARE OFTEN USED IN REDUCING THE '
      PRINT*,'REQUIRED TIME TO COMPLETE A PROGRAM ON SCHEDULE ?'
      PRINT*,' '
      PRINT*,'1.CHANGE SERIES CONNECTED ACTIVITIES TO SERIES-PARALLEL'
      PRINT*,'2. SHIFT OR ADD RESOURCES'
      PRINT*,'3. NONE OF THE ABOVE'
      PRINT*,'4. BOTH 1 AND 2'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS BOTH 1 AND 2'
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 600
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.4) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 4, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
```

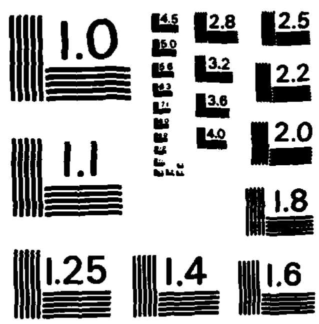
```
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 592
      ENDIF
      PRINT*,' '
  600 PRINT*,'QUESTION NUMBER 60'
 602  QNBR = 60
      PRINT*,'NOT ALL ACTIVITIES CAN BE SHORTENED IN TIME BY APPLYING'
      PRINT*,'INCREASED RESOURCES TO THEM. AN ENGINEER MAY DESIGN'
      PRINT*,'NEW EQUIPMENT BASED ON NEW PRINCIPLES.  FOR EXAMPLE,'
      PRINT*,'ACTIVITIES INVOLVING CHEMICAL ACTION USUALLY CANNOT'
      PRINT*,'BE SPEEDED UP APPRECIABLY. WE __A__ EASILY REDUCE THE'
      PRINT*,'TIME REQUIRED TO MAKE DRAWINGS FOR A NEW SYSTEM BY'
      PRINT*,'USING MORE DRAFTSMAEN. WE __B__ EASILY REDUCE THE TIME'
      PRINT*,'REQUIRED TO HARDEN CONCRETE.'
      PRINT*,' '
      PRINT*,'1. CANNOT, CAN'
      PRINT*,'2. CAN, CANNOT'
      PRINT*,'3. CANNOT, CANNOT'
      PRINT*,'4. CAN, CAN'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  CAN--CANNOT  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 610
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 602
      ENDIF
      PRINT*,' '
  610 PRINT*,'QUESTION NUMBER 61'
 612  QNBR = 61
      PRINT*,'A THIRD METHOD OF REPLANNING TO REDUCE THE TIME REQUIRED'
      PRINT*,'ON A CRITICAL PATH IS TO DECREASE THE WORK SCOPE OR '
      PRINT*,'LOWER SPECIFICATIONS OF VARIOUS CRITICAL PATH ACTIVITIES,'
```

```
      PRINT*,'IF THIS IS FEASIBLE. BY REDUCING THE WORK INVOLVED IN '
      PRINT*,'THE ACTIVITY, WE DECREASE THE SCOPE OF THE ACTIVITY. FOR'
      PRINT*,'EXAMPLE, AN ACTIVITY MAY BE AN ENVIRONMENTAL TEST '
      PRINT*,'INVOLVING OPERATION OF A UNIT UNDER DIFFERENT '
      PRINT*,'CONDITIONS; EXTREME COLD, EXTREME HEAT, AND SEVERE '
      PRINT*,'VIBRATION. BY ELIMINATING THE VIBRATION TEST WE CAN '
      PRINT*,'REDUCE THE __A__ REQUIRED TO ACCOMPLISH THE ACTIVITY.'
      PRINT*,' '
      PRINT*,'1. COST'
      PRINT*,'2. TIME'
      PRINT*,'3. RESOURCES'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  TIME  '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 620
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 612
      ENDIF
      PRINT*,' '
  620 PRINT*,'QUESTION NUMBER 62'
 622  QNBR = 62
      PRINT*,'OF THE THREE MAJOR METHODS FOR REDUCING THE TIME '
      PRINT*,'NECESSARY TO COMPLETE A NETWORK , WHICH WILL NOT CHANGE'
      PRINT*,'THE EXPECTED ELAPSED TIME (LOWER CASE TE) FOR THE '
      PRINT*,'ACTIVITY ?'
      PRINT*,' '
      PRINT*,'1. CHANGE SERIES CONNECTED ACTIVITIES TO SERIES-PARALLEL'
      PRINT*,'2. SHIFT OR ADD RESOURCES'
      PRINT*,'3. REDUCE SCOPE AND OR SPECIFICATIONS OF THE ACTIVITY'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS CHANGE SERIES CONNECTED ACTIVITIES '
      PRINT*,'TO SERIES-PARALLEL. '
```

```
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 630
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 622
      ENDIF
      PRINT*,' '
  630 PRINT*,'QUESTION NUMBER 63'
 632  QNBR = 63
      PRINT*,'WHAT WILL CHANGE AS A RESULT OF MAKING ACTIVITIES'
      PRINT*,'CONCURRENT ?'
      PRINT*,' '
      PRINT*,'1. LATEST ALLOWABLE DATE (UPPER CASE TL)'
      PRINT*,'2. EVENT EXPECTED COMPLETION DATE (UPPER CASE TE)'
      PRINT*,'3. NONE OF THE ABOVE'
      PRINT*,'4. BOTH 1 AND 2.'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'THE CORRECT ANSWER IS  UPPER CASE TE '
      PRINT*,' I HOPE YOU DO BETTER ON THE NEXT QUESTION.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 640
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.2) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 2, YOU SHOULD READ THAT AGAIN'
      RCVRY(QNBR) = 2
```

AD-A148 485 DEVELOPMENT OF A NETWORK ANALYSIS OF THE AIR FORCE PROVISIONING PROCESS F..(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. 3/4

UNCLASSIFIED R M DOUGLAS ET AL. SEP 84 F/G 5/9 NL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1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
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4.5
5.0

```
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 632
      ENDIF
      PRINT*,' '
  640 PRINT*,'QUESTION NUMBER 64'
 642  QNBR = 64
      PRINT*,'CIRCUMSTANCES MAY OCCUR IN WHICH IT IS POSSIBLE TO GAIN'
      PRINT*,'TIME BY REDUCING THE EXPECTED ELAPSED TIME (LOWER CASE '
      PRINT*,'TE) FOR ONE OR MORE ACTIVITIES ON THE CRITICAL PATH. FOR'
      PRINT*,'INSTANCE, NEW PERSONNEL MAY PROVE TO BE MUCH MORE '
      PRINT*,'EFFECTIVE THAN THE LINE MANGER HAD EXPECTED, OR A MORE '
      PRINT*,'EFFICIENT TECHNIQUE MAY BE DEVELOPED. EVEN WITH NO NEW '
      PRINT*,'SITUATION, THE LINE MANAGER MAY DECIDE UNDER SERIOUS '
      PRINT*,'RECONSIDERATION, THAT HIS ORIGINAL ESTIMATE WAS TOO '
      PRINT*,'HIGH. TO CHANGE THE EXPECTED ELAPSED TIME WITHOUT ANY '
      PRINT*,'JUSTIFICATION IS NOT CONSIDERED CRICKET. EXPERIENCE HAS '
      PRINT*,'SHOWN THAT THESE ESTIMATES AS FIRST PROVIDED BY '
      PRINT*,'PERSONNEL WHO WILL BE RESPONSIBLE FOR ACCOMPLISHING THE '
      PRINT*,'ACTIVITIES, ARE AS RELIABLE AS ANY THAT MAY BE OBTAINED'
      PRINT*,'LATER. PRESSURE SHOULD NEVER BE APPLIED TO MAKE '
      PRINT*,'RESPONSIBLE PERSONNEL CHANGE THEIR ESTIMATES IN ORDER '
      PRINT*,'TO REDUCE ACTIVITY TIMES. THIS ONLY REDUCES THE '
      PRINT*,'EFFECTIVENESS AND RELIABILITY OF THE NETWORK.'
      PRINT*,'DO YOU THINK NETWORK MODELING IS COMPATIBLE WITH THE '
      PRINT*,'COMPUTER ?'
      PRINT*,' '
      PRINT*,'1. YES'
      PRINT*,'2. NO'
       PRINT*,'0. EXIT THE PROGRAM FOR A BREAK'
      IF(WG .EQ. 1)THEN
      PRINT*,'HOW COULD YOU MISS THAT ONE. YOU SHOULD BE SHOT '
      PRINT*,'IMMEDIATELY. SERIOUSLY THOUGH, MODELING AND THE'
      PRINT*,'COMPUTER WERE MADE FOR ONE ANOTHER.'
      PRINT*,'I BET YOU ARE GLAD THAT WE FINALLY REACHED THE END.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY WHEN READY TO CONTINUE.'
      PRINT*,' '
      WG = 0
      READ (*,2400)GOON
      GO TO 650
      ENDIF
      REWIND 13
      READ*,ANSW
       IF(ANSW .EQ. 0) THEN
       GO TO 690
      ELSE IF (ANSW .EQ.1) THEN
      PRINT*,'CORRECT, GOOD SHOW FOR THAT ONE'
      RCVRY(QNBR) = 1
      ELSE
      PRINT*,'WRONG,THE CORRECT ANSWER IS 1, YOU SHOULD READ THAT AGAIN'
```

```
      RCVRY(QNBR) = 2
      ENDIF
      WRITE (13,*)RCVRY
      IF(RCVRY(QNBR) .EQ. 2)THEN
      WG = 1
      GO TO 642
      ENDIF
      PRINT*,' '
 650  PRINT*,'CONGRATULATIONS, YOU HAVE COMPLETED THE PROGRAMMED TEXT.'
      PRINT*,'I WILL SHOW YOU YOUR SCORE, CHECK YOUR RESULTS AND SEE'
      PRINT*,'WHETHER YOU AND I HAVE COUNTED THE SAME NUMBER WRONG,'
      PRINT*,'TO SEE IF IF I HAVE MISSED ANY ....'
      DONE = 1
       CLOSE (13)
       OPEN(13,FILE='RECVRY')
       REWIND 13
       READ(13,*,END = 690)RCVRY
  690  CONTINUE
       DO 700 I=1,64
       IF (RCVRY(I).EQ.1)THEN
       RIGHT = RIGHT +1
       ELSE IF (RCVRY(I).EQ.2)THEN
       WRONG = WRONG+1
       ENDIF
  700 CONTINUE
  720 CONTINUE
      OPEN(15,FILE='TMPINS')
      REWIND 15
       IF (DONE .EQ.1)THEN
       PRINT*,'YOU HAVE MISSED ',WRONG,' QUESTIONS.'
       PERCT = RIGHT/64.0
       IF (RIGHT .EQ. 0) THEN
        PERCT = 0.0
       TOT = 0.0
       ELSE
       TOT = PERCT * 100
       ENDIF
       PRINT 2150,'YOUR SCORE IS ',TOT,' PERCENT.'
       IF (TOT .EQ. 99) THEN
       PRINT*,'I BET YOU THOUGHT YOU GOT 100%......NOBODY GETS 100%!'
       PRINT*,'IN MY CLASSES. YOU DID GET THEM ALL RIGHT, HOWEVER.'
       PRINT*,'THAT WAS A VERY GOOD JOB, YOU MUST KNOW A LITTLE '
       PRINT*,'ABOUT NETWORK MODELING.'
       ELSE IF (TOT .GE. 90) THEN
       PRINT*,'A PRETTY GOOD SCORE FOR A NOVICE, YOU HAVE A GOOD'
       PRINT*,'START WITH NETWORK MODELING, KEEP UP THE GOOD WORK!'
       ELSE IF (TOT .GE. 80) THEN
       PRINT*,'NOT BAD, BUT YOU STILL CAN LEARN A FEW THINGS ABOUT'
       PRINT*,'NETWORK MODELING, KEEP AT IT, SOMEDAY YOU WILL KNOW '
       PRINT*,'IT ALL...'
       ELSE
       PRINT*,'YOU NEED TO READ OVER YOUR COURSE WORK, AND APPLY'
```

```
      PRINT*,'YOURSELF BETTER, I THINK YOU WERE ASLEEP. KEEP AT IT'
      PRINT*,'THOUGH, SOMEDAY YOU MAY BE TELLING ME WHAT TO PRINT.'
      ENDIF
      WRITE(15,2200)TOT,PGM,QTN,QNBR
      ELSE
      PRINT*,'YOU HAVE MISSED ',WRONG,' QUESTIONS SO FAR.'
      PRINT*,'WHEN YOU COME BACK FROM YOUR BREAK TYPE IN '
      PRINT*,'THE COMMAND---PRGTXT-- AS YOU DID BEFORE, AND'
      PRINT*,'YOU WILL START IN WHERE YOU LEFT OFF.'
      WRITE(15,2250)QTN,QNBR,BRK
     WRITE(15,2300)WRG,WRONG,BAK
     ENDIF
     CLOSE (15)
2100 FORMAT(5X,I5,1X,28A)
2150 FORMAT(A19,F6.2,A9)
2200 FORMAT(1X,F6.2,1X,A27,1X,A19,1X,I2)
2250 FORMAT(1X,A19,1X,I2,1X,A32,2X)
2300 FORMAT(3X,A15,1X,I2,1X,A17,19X)
2400 FORMAT(A2)
3000 FORMAT(A10,I2,A17)
      END
```

************************** PROGRAM RNDMPR ***************************

```
      PROGRAM RNDMPR
      INTEGER I,J,K,L,NBR,ANSW,TRYCTR,OKCTR,WRONG
      REAL RNDM,T
      CHARACTER IDENTA(43)*72,IDENTB(43)*72,STRING*56,GOON*2,ALPHS*2
      CHARACTER WHLINE*72,NUMS*2,TRIES*6,RGHT*6,CHEKR(43)*2,WRG*2
      DATA TRIES/'-TRIES'/
      DATA RGHT/'-RIGHT'/
      DATA CHEKR/43*'00'/
      DATA WRG/'-WRONG'/
      TRYCTR = 0
      OKCTR = 0
      OPEN(13,FILE='SACT')
      REWIND 13
      DO 2 I=1,43
      READ(13,1020,END=4)WHLINE
      IDENTA(I) = WHLINE
    2 CONTINUE
    4 CLOSE (13)
      DO 10 J=43,1,-1
      CALL SECOND (T)
      CALL RANSET (T)
      RNDM = RANF ()
      NBR = RNDM * J
      IF (NBR .EQ. 0) THEN
       NBR = 1
      ENDIF
      IDENTB(J) = IDENTA(NBR)
      DO  8 K = 1,J
      IF (K.LT.NBR)THEN
        IDENTA(K) = IDENTA(K)
      ELSE
        IDENTA(K) = IDENTA(K+1)
      ENDIF
    8 CONTINUE
   10 CONTINUE
      PRINT*,'THIS PART OF THE COURSE WILL BE USED TO TEST WHAT '
      PRINT*,'YOU HAVE LEARNED ABOUT NETWORK MODELING SO FAR. TO DO'
      PRINT*,'THIS I WILL USE YOUR BACKGROUND IN PROVISIONING.  I HAVE'
      PRINT*,'DERIVED A NETWORK THAT HAS 43 EVENTS, THAT ARE SIMILAR'
      PRINT*,'IN MANY WAYS TO SOME THAT YOU ARE FAMILIAR WITH. I HAVE '
      PRINT*,'DEVELOPED A MODEL THAT WILL SIMULATE THAT NETWORK. EACH'
      PRINT*,'GROUP FROM YOUR CLASS WILL HAVE A DIFFERENT MODEL'
      PRINT*,'SO GETTING HELP FROM ANOTHER GROUP WILL NOT HELP YOU. '
      PRINT*,'YOU MUST COMPLETE THIS PORTION DURING ONE LOGIN PERIOD,'
      PRINT*,'EXCEPT AS EXPLAINED UNDER  --JOB DETACH-- , IN YOUR '
      PRINT*,'COURSE MATERIAL.'
      PRINT*,'THE WAY THIS PART WILL WORK IS LIKE THIS......'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY TO CONTINUE......'
      READ(*,1010)GOON
```

```
      PRINT*,'FIND THE PRINTOUT THAT YOUR INSTRUCTOR GAVE YOU THAT'
      PRINT*,'CONTAINS THE GRAPHIC DISPLAY OF THE NETWORK. ON THAT '
      PRINT*,'SHEET YOU MUST FILL IN THE EVENTS AND OTHER INFORMATION '
      PRINT*,'AS WE GO OVER IT. FIRST, I WILL PROVIDE YOU WITH A LIST'
      PRINT*,'OF ALL THE EVENTS IN THE NETWORK, YOU HAVE A COMPLETE'
      PRINT*,'LIST OF THEM IN YOUR CLASS MANUAL. THE EVENTS LISTED ON'
       PRINT*,'THE SCREEN HAVE A NUMERIC CODE, WHILE THOSE ON THE '
      PRINT*,'PRINTOUT FROM YOUR INSTRUCTOR HAVE A MIXED TWO POSITION'
      PRINT*,'CODE. TO TEST YOUR KNOWLEDGE OF PROVISIONING YOU MUST  '
      PRINT*,'MATCH THE NUMERIC CODE WITH THE CORRECT MIXED CODE. I'
      PRINT*,'WILL PROVIDE TWO SCREENS OF EVENTS.  YOU WILL BE ABLE'
      PRINT*,'TO PRINT THEM ON THE SCREEN AS MANY TIMES AS NEEDED (IF '
      PRINT*,'YOU ARE AT A TELETYPE, IT IS NOT NECESSARY TO PRINT '
      PRINT*,'EACH SCREEN MORE THAN ONCE). '
      PRINT*,'TYPE GO AND HIT THE RETURN KEY TO CONTINUE........'
      READ(*,1010)GOON
      PRINT*,' THIS IS SCREEN 1 '
   15 PRINT*,'YOU HAVE 90 TOTAL CHANCES TO GET ALL 43 CORRECT, SCORE '
      PRINT*,'WILL BE BASED ON THE NUMBER OF CHANCES THAT YOU DID NOT '
      PRINT*,'USE. YOU WILL BE SHOWN THE NUMBER OF CHANCES REMAINING '
      PRINT*,'AFTER EACH TRY. ENTER THE NUMBER FIRST AND THE ALPHA '
      PRINT*,'SECOND, EACH AT ITS OWN ? PROMPT LIKE THIS EXAMPLE ... '
      PRINT*,'?53                   '
      PRINT*,'?Y1   '
      PRINT*,' ...MEANS NUMBER 53 FROM THE LIST GOES WHERE EVENT Y1 '
      PRINT*,'IS SHOWN ON YOUR COURSE MATERIAL. I WILL GIVE YOU 3  '
      PRINT*,'ACTIVITIES AND THEIR LOCATION AS HELP AT THE START,    '
      PRINT*,' '
      DO 16 J=1,3
      CHECKR(J) = IDENTB(J)
      PRINT*,IDENTB(J)
   16 CONTINUE
      PRINT*,' '
      PRINT*,'TYPE GO AND HIT RETURN WHEN YOU ARE READY TO CONTINUE'
      READ(*,1010)GOON
      PRINT*,'PLEASE USE YOUR PRINTOUT TO HELP KEEP TRACK OF WHAT  '
      PRINT*,'GOES WHERE IN THE NETWORK......BECAUSE I WILL NOT KEEP '
      PRINT*,'TRACK OF PREVIOUS ATTEMPTS THAT WERE WRONG.          '
   18 PRINT*,'BY TYPING IN THE SCREEN NUMBER YOU CAN SEE THE SCREENS '
      PRINT*,'AGAIN.        1 - THIS SCREEN OF INSTRUCTIONS (SCREEN 1)'
      PRINT*,'              2 - SCREEN 2 OF DATA                 '
      PRINT*,'              3 - SCREEN 3 OF DATA                    '
      PRINT*,'              4 - TO ENTER A CHOICE IN THE NETWORK   '
      PRINT*,'ENTER YOUR CHOICE 1 THRU 4 AT THIS TIME PLEASE.'
   19 READ*,ANSW
   20 GO TO (15,30,40,80)ANSW
   30 PRINT*,' THIS IS SCREEN 2  '
      PRINT*,' '
      DO 34 J=4,23
      PRINT*,IDENTB(J)(1:2),' -- ',IDENTB(J)(7:60)
   34 CONTINUE
      PRINT*,'TYPE YOUR CHOICE 1 THRU 4 AND HIT RETURN KEY...'
```

```
      READ*,ANSW
      GO TO 20
   40 PRINT*,' THIS IS SCREEN 3  '
      PRINT*,' '
      DO 44 J=24,43
      PRINT*,IDENTB(J)(1:2),' -- ',IDENTB(J)(7:60)
   44 CONTINUE
      PRINT*,' '
      PRINT*,'TYPE YOUR CHOICE 1 THRU 4 AND HIT RETURN KEY...'
      READ*,ANSW
      GO TO 20
   80 PRINT*,' YOU CAN NOW ENTER A CHOICE OF A NUMERIC/ALPHABETIC  '
      PRINT*,' CODE PAIR FOR A NETWORK ACTIVITY....REMEMBER, NUMERIC'
      PRINT*,' FIRST THEN ALPHABETIC, ENTER THEM AT THE ? PROMPT'
   90 READ(*,1010)NUMS
      DO 91 J=1,43
      IF (CHEKR(J) .EQ. NUMS) THEN
       PRINT*,'YOU ALREADY DID THAT ONE  AND GOT IT RIGHT. TRY'
       PRINT*,'ANOTHER NUMBER.........'
       GO TO 90
      ENDIF
   91 CONTINUE
      READ(*,1010)ALPHS
   92 DO 94 J=4,43
      IF(NUMS .EQ. IDENTB(J)(1:2))THEN
       IF(ALPHS .EQ. IDENTB(J)(4:5))THEN
        PRINT*,' '
      CHEKR(J) = IDENTB(J)(1:2)
       TRYCTR = TRYCTR + 1
        OKCTR = OKCTR + 1
        PRINT*,'GOOD, ANOTHER ONE RIGHT, YOU HAVE ',90-TRYCTR,' TRIES
     CLEFT.'
      GO TO 96
        ELSE
       PRINT*,' '
       PRINT*,'THAT IS A VALID NUMBER, BUT THE ALPHA NOT CORRECT.'
       TRYCTR = TRYCTR + 1
       PRINT*,'YOU HAVE ',90 -TRYCTR, ' TRIES LEFT.'
       PRINT*,' '
      IF(90-TRYCTR .GT. 0)THEN
      PRINT*,'DO YOU WANT TO SEE (1)INSTRUCTIONS,(2)SCREEN 2,'
      PRINT*,'(3)SCREEN 3,(4)MAKE A CHOICE ? TYPE IN ONE OF THE'
      PRINT*,'ABOVE NUMBERS FOR WHAT YOU WANT..........'
      GO TO 19
      ELSE
       PRINT*,' '
       PRINT*,'SORRY, YOU HAVE USED UP ALL 90 OF YOUR CHANCES.'
       PRINT*,'YOU GOT ',OKCTR,' CORRECT IN THAT NUMBER OF CHANCES.'
      PRINT*,'YOU SHOULD TALK TO YOU INSTRUCTOR, TO HAVE HIM HELP'
      PRINT*,'YOU IN UNFAMILIAR AREAS.'
      GO TO 97
      ENDIF
```

```
      ENDIF
      ENDIF
   94 CONTINUE
       PRINT*,' '
       PRINT*,'SORRY, YOU SHOULD CHECK YOUR NUMERIC CHOICES,BECAUSE'
       PRINT*,'THAT WAS NOT A VALID NUMERIC ENTRY, TRY AGAIN.'
       PRINT*,' '
      PRINT*,'DO YOU WANT TO SEE (1)INSTRUCTIONS,(2)SCREEN 2,'
      PRINT*,'(3)SCREEN 3,(4)MAKE A CHOICE ? TYPE IN ONE OF THE'
      PRINT*,'ABOVE NUMBERS FOR WHAT YOU WANT..........'
      GO TO 19
   96 IF(OKCTR .EQ.40 ) THEN
       PRINT*,' '
       PRINT*,' YOU ARE FINALLY FINISHED, YOU DID IT IN '
       PRINT*,' ',TRYCTR,' TRIES. '
       PRINT*,' '
      ELSE
       PRINT*,' YOU HAVE GOTTEN ',OKCTR,' CORRECT SO FAR. '
      PRINT*,'DO YOU WANT TO SEE (1)INSTRUCTIONS,(2)SCREEN 2,'
      PRINT*,'(3)SCREEN 3,(4)MAKE A CHOICE ? TYPE IN ONE OF THE'
      PRINT*,'ABOVE NUMBERS FOR WHAT YOU WANT..........'
      GO TO 19
   97 WRONG = TRYCTR - OKCTR
      ENDIF
      OPEN(14,FILE='TMPINS')
      REWIND 14
      WRITE(14,1100)
      WRITE(14,1040)TRYCTR,TRIES,OKCTR,RGHT,WRONG,WRG
      WRITE(14,1150)
      CLOSE (14)
 1000 FORMAT(A72)
 1010 FORMAT(A2)
 1020 FORMAT(A72)
 1030 FORMAT(A2,A2)
 1040 FORMAT(5X,I3,1X,A6,1X,I3,1X,A6,1X,I3,1X,A6)
 1100 FORMAT(3X,'.............WE ARE ATTEMPTING  ACORDR..........')
 1150 FORMAT(3X,'..........WE HAVE COMPLETED PROCEDURE ACORDR.....')
      END
```

************************* PROGRAM CPATH1 **************************

```
      PROGRAM CPATH1
*       THIS PROGRAM CREATES FILES TO BE USED IN DETERMINING
*       THE CRITICAL PATH OF A QGERT NETWORK OF A PERT MODEL,
*     USING THE FILE OUTPUT FROM THE QGERT PROGRAM. IT WILL ONLY
*     WORK IF THERE IS ONE SOURCE NODE AND ONE SINK NODE, BUT THAT
*     IS NORMAL IN A NETWORK MODELING SITUATION.
      CHARACTER WHLINE*133,SOURC*2,SINC*2
      CHARACTER TMP1ST*3,TMP2ND*2,TMP3RD*2,STRING*20
      CHARACTER TMP4TH*3,TMP5TH*2,TMP6TH*2
      INTEGER I,J,M,INDICA
      J = 0
      M = 0
      PRINT*,' IT WILL BE A MINUTE OR TWO UNTIL YOU GET TO'
      PRINT*,' INTERACT WITH ME, I AM FIGURING OUT WHAT I '
      PRINT*,' AM GOING TO SAY TO YOU............'
      OPEN(UNIT=13,FILE='QRSLTS')
      REWIND 13
      OPEN(UNIT=14,FILE='TSTAFL')
      REWIND 14
      OPEN(UNIT=16,FILE='TSTTFL')
      REWIND 16
    2 READ(13,2000,END=15)WHLINE
      IF (WHLINE(2:4) .EQ. 'SOU') THEN
       DO 5 I=1,3
       IF (WHLINE(5+I:5+I) .EQ. '*') THEN
        IF (I .EQ. 3) THEN
         SOURC = WHLINE(6:7)
      INDICA = 1
      WRITE(16,2400)INDICA,SOURC
        ELSE
         SOURC = WHLINE(6:6)
      INDICA = 1
      WRITE(16,2400)INDICA,SOURC
        ENDIF
       ENDIF
    5  CONTINUE
      ELSE IF (WHLINE(2:4) .EQ. 'SIN') THEN
            DO 6 I = 1,3
            IF (WHLINE(5+I:5+I) .EQ. '*') THEN
             IF (I .EQ. 3) THEN
              SINC = WHLINE (6:7)
            INDICA = 2
            WRITE(16,2400)INDICA,SINC
             ELSE
              SINC = WHLINE(6:6)
            INDICA = 2
            WRITE(16,2400)INDICA,SINC
             ENDIF
            ENDIF
```

```
 6  CONTINUE
    ELSE IF (WHLINE(2:4) .EQ. 'ACT') THEN
    J = J+1
    DO 7 I=1,20
    IF (WHLINE(I:I).EQ.'0'.OR.WHLINE(I:I).EQ.'1'.OR.WHLINE
   C(I:I).EQ.'2'.OR.WHLINE(I:I)
   C.EQ.'3'.OR.WHLINE(I:I).EQ.'4'.OR.
   CWHLINE(I:I).EQ.'5'.OR.WHLINE(I:I).EQ.'6'.OR.WHLINE(I:I)
   C.EQ.'7'.OR.WHLINE(I:I).EQ.'8'.OR.WHLINE(I:I).EQ.'9')THEN
    STRING(I:I) = WHLINE(I:I)
    ELSE
    STRING(I:I) = ' '
    ENDIF
 7  CONTINUE
    WRITE(14,2070)STRING
     ELSE IF (WHLINE(2:4) .EQ. 'FIN') THEN
           CLOSE (14)
           REWIND 14
           GO TO 15
           ENDIF
           GO TO 2
15  OPEN(15,FILE='TSTCFL')
    REWIND 15
    OPEN(17,FILE='TSTT2F')
    REWIND 17
20  READ(13,2000,END=25)WHLINE
    IF (WHLINE(15:17) .EQ. '***') THEN
    M = M+1
    IF (WHLINE (47:47) .NE. ' ') THEN
     TMP1ST = WHLINE(47:49)
     TMP2ND = WHLINE(51:52)
    ELSE IF (WHLINE(48:48) .NE. ' ') THEN
           TMP1ST = WHLINE(48:49)
           TMP2ND = WHLINE(51:52)
          ELSE
           TMP1ST = WHLINE(49:49)
           TMP2ND = WHLINE(51:52)
    ENDIF
    IF(WHLINE(56:56) .NE. ' ') THEN
     TMP3RD = WHLINE(56:57)
    ELSE
     TMP3RD = WHLINE(57:57)
    ENDIF
    WRITE(15,2200)TMP1ST,TMP2ND,TMP3RD
    ELSE
    IF(WHLINE(40:40) .GE.'0'.AND.WHLINE(40:40).LE.'9')THEN
     IF (WHLINE(35:35).NE.' ') THEN
         TMP4TH = WHLINE(35:37)
          TMP5TH = WHLINE(39:40)
      ELSE IF (WHLINE(36:36) .NE. ' ') THEN
          TMP4TH = WHLINE(36:37)
          TMP5TH = WHLINE(39:40)
```

```
         ELSE
          TMP4TH = WHLINE(37:37)
          TMP5TH = WHLINE(39:40)
         ENDIF
         IF (WHLINE(56:56) .NE. ' ') THEN
             TMP6TH = WHLINE(56:57)
         ELSE
             TMP6TH = WHLINE(57:57)
         ENDIF
      IF(WHLINE(47:47) .NE. ' ') THEN
       TMP1ST = WHLINE(47:49)
       TMP2ND = WHLINE(51:52)
      ELSE IF (WHLINE(48:48) .NE. ' ') THEN
             TMP1ST = WHLINE(48:49)
             TMP2ND = WHLINE(51:52)
            ELSE
             TMP1ST = WHLINE(49:49)
             TMP2ND = WHLINE(51:52)
      ENDIF
      WRITE(17,2250)TMP1ST,TMP2ND,TMP4TH,TMP5TH,TMP6TH
       GO TO 20
      ENDIF
      ENDIF
      IF(M .GE. J) THEN
       CLOSE (15)
       CLOSE (16)
       CLOSE (13)
       CLOSE (17)
      ELSE
       GO TO 20
      ENDIF
   25 CONTINUE
 2000 FORMAT(A133)
 2200 FORMAT(A3,2X,A2,1X,A2)
 2070 FORMAT(A19)
 2250 FORMAT(A3,2X,A2,5X,A3,2X,A2,2X,A2)
 2400 FORMAT(I1,A2)
      END
```

######################### PROGRAM CPATH2 ############################

```
      PROGRAM CPATH2
*     THIS PROGRAM DETERMINES THE CRITICAL PATH OF A QGERT NETWORK
*     USING THE FILE OUTPUT FROM THE QGERT PROGRAM. IT WILL ONLY
*     WORK IF THERE IS ONE SOURCE NODE AND ONE SINK NODE, BUT THAT
*     IS NORMAL IN A NETWORK MODELING SITUATION. IT FIGURES THE
*     CRITICAL PATH BY GOING BACKWARDS FROM THE SINK NODE (END)
*     TO THE SOURCE NODE(BEGINNING) AND TAKING THE LARGEST TIME AT
*     EACH JUNCTURE. IN ADDITION IT WILL FIGURE THE EXPECTED ELAPSED
*     TIMES FOR EACH ACTIVITY IN THE NETWORK.
      CHARACTER ACACT*3,ACDIST*2,PTH*22,TME*24,GOON*2
      INTEGER I,J,K,L,M,SOURCE,SINK,NROACT,TRCNBR,ACTVYS(100)
      INTEGER HOLDND,ACSTRT,ACEND,ACPARM,ACNBR,NEXTAC(100),TRTNTS
      INTEGER NBR1,NBR2,NBR4,NBR5,NBR6,CHOIC,CHOICS(43),N
      INTEGER HOLDAC,STARTH(100),CPATH(100),INDICA,NODES,TRUNTS
      INTEGER HOLDTM,TRCTME,TIME,TIMES(100),CPTIME(100),TENTHS,TNT(100)
      INTEGER START,END
      DATA CPATH/100*0/
      DATA CHOICS/43*0/
      DATA CPTIME/100*0/
      DATA PTH/'CRITICAL PATH ACTIVITY'/
      DATA TME/'EXPECTED COMPLETION TIME'/
      SINK = 0
      SOURCE = 0
      J = 0
      M = 0
      N = 0
   25 OPEN(16,FILE='TSTTFL')
      REWIND 16
      DO 27 I=1,2
      READ(16,2450,END=30)INDICA,NODES
      IF (INDICA .EQ. 1) THEN
       SOURCE = NODES
      ELSE IF (INDICA .EQ. 2) THEN
         SINK = NODES
      ENDIF
   27 CONTINUE
   30 CLOSE (16)
      OPEN (18,FILE='TSTT3F')
      REWIND 18
      OPEN (15,FILE='TSTCFL')
      REWIND 15
      CLOSE (17)
      OPEN(17,FILE='TSTT2F')
      REWIND 17
      HOLDTM = 0
      NROACT = 0
      OPEN(20,FILE='ACTTME')
      REWIND 20
```

```
35 READ(15,*,END=37)TRUNTS,TRTNTS,TRCNBR
   IF(TRTNTS.GT.50)THEN
   TENTHS = 1
   ELSE
   TENTHS = 0
   ENDIF
   TRCTME = TRUNTS + TENTHS
   WRITE (18,2300)TRCTME,TRCNBR
   GO TO 35
37 READ(17,*,END=40)NBR1,NBR2,NBR4,NBR5,NBR6
   NROACT = NROACT + 1
   IF(NBR2.GT.50)THEN
   END=NBR1 +1
   ELSE
   END = NBR1+0
   ENDIF
   IF(NBR5.GT.50)THEN
   START = NBR4+1
   ELSE
   START = NBR4 +0
   ENDIF
   TIME = END - START
   ACTVYS(NROACT) = NBR6
   TIMES(NROACT) = TIME
   WRITE(20,*)ACTVYS(NROACT),TIMES(NROACT)
   GO TO 37
40 REWIND (15)
   CLOSE(20)
   OPEN(14,FILE='TSTAFL')
    HOLDND = SINK
   M = 1
   DO 60 L =1,NROACT
   J = 0
   DATA NEXTAC/100*0/
   DATA STARTH/100*0/
   HOLDAC = 0
41 REWIND 14
44 READ(14,*,END=45) ACSTRT,ACEND,ACPARM,ACNBR
   IF(ACEND .EQ. HOLDND) THEN
     J = J+1
     NEXTAC(J) = ACNBR
     STARTH(J) = ACSTRT
   ENDIF
   GO TO 44
45 CLOSE (18)
   OPEN(18,FILE='TSTT3F')
46 REWIND 18
   HOLDTM = 0
47 READ(18,*,END=55)TRCTME,TRCNBR
   N=N+1
   IF(N.LE.43)THEN
   TNT(N)=TRCTME
```

```
      ENDIF
      DO 50 K=1,J
      IF (TRCNBR .EQ. NEXTAC(K)) THEN
       IF (TRCTME .GT. HOLDTM) THEN
          HOLDAC = NEXTAC(K)
          HOLDTM = TRCTME
           HOLDND = STARTH(K)
       ENDIF
      ENDIF
   50 CONTINUE
      IF(HOLDND .EQ. SOURCE) THEN
      IF (TRCNBR .NE. SOURCE) THEN
       GO TO 47
      ENDIF
      ELSE
       GO TO 47
      ENDIF
   55 CPATH(M) = HOLDAC
      CPTIME(M) = HOLDTM
      M = M+1
   60 CONTINUE
   61 CONTINUE
      PRINT*,'THE FOLLOWING IS A LIST OF THE ACTIVITIES AND THEIR'
      PRINT*,'EXPECTED COMPLETION TIMES, THAT OCCURRED DURING YOUR RUN'
      PRINT*,'OF THE SIMULATION. YOU SHOULD TRANSFER THEM TO YOUR'
      PRINT*,'WORK SHEET IN THE APPROPRIATE PLACES (BESIDE THE '
      PRINT*,'ACTIVITY NUMBERS, YOU WORKED OUT DURING THE LAST  '
      PRINT*,'PART OF THE EXERCISE). THE TIMES ARE IN DAYS.'
      PRINT*,'TYPE GO AND HIT RETURN WHEN YOU ARE READY TO CONTINUE'
      READ(*,2650)ACACT
      PRINT*,' '
      PRINT*,'                ACTIVITY        EXPECTED COMPLETION TIME   '
      DO 64 I=1,NROACT
      IF (I .EQ. 23 ) THEN
      PRINT*,'WHEN YOU HAVE COPIED THESE,TYPE GO TO CONTINUE...'
      READ(*,2650)ACACT
   63 PRINT*,'               ACTIVITY         EXPECTED COMPLETION TIME '
      ENDIF
      PRINT 2500,ACTVYS(I),TNT(I)
   64 CONTINUE
      PRINT*,'WHEN YOU HAVE COPIED THESE,TYPE GO TO CONTINUE...'
      READ(*,2660)GOON
      CLOSE (14)
      CLOSE (15)
      CLOSE (16)
      CLOSE (18)
      PRINT*,'NOW IT IS TIME FOR YOU TO COMPUTE THE CRITICAL PATH.'
      PRINT*,'PLEASE INPUT EACH ACTIVITY FROM THE LAST ONE TO '
      PRINT*,'THE FIRST ONE IN ORDER, AT THE ? PROMPT.'
      PRINT*,'WHEN YOU HAVE TYPED IN THE TOTAL NUMBER OF ACTIVITIES'
      PRINT*,'IN THE CRITICAL PATH, I WILL CONSIDER YOUR '
      PRINT*,'ANSWER AND TELL YOU IF YOU ARE CORRECT. IF YOU '
```

```
      PRINT*,'WANT TO RECONSIDER AN ACTIVITY ALREADY TYPED IN'
      PRINT*,'YOU MAY START OVER BY ENTERING A ''0'' AT THE'
      PRINT*,'QUESTION MARK THAT IS THE PROMPT.  THIS '
      PRINT*,'RETYPING OF A CHOICE WILL NOT BE COUNTED AGAINST '
      PRINT*,'FOR SCORING PURPOSES.                          '
      PRINT*,'IF YOU ARE COMPLETED WITH YOUR CRITICAL PATH AND THERE'
      PRINT*,'IS STILL A ? PROMPT SHOWING, YOU SHOULD TYPE IN'
      PRINT*,'THE VALUE 100, TO INDICATE THAT YOU ARE FINISHED.'
      PRINT*,'IF IN YOUR ANSWER,YOU HAVE ONE EVENT WRONG, YOU WILL'
      PRINT*,'HAVE ONE MORE CHANCE TO GET ALL THE ACTIVITIES'
      PRINT*,'CORRECT BEFORE I REPORT YOUR SCORE TO THE '
      PRINT*,'INSTRUCTOR AND TELL YOU THE CORRECT CRITICAL PATH.'
      L=0
      OPEN(13,FILE='TMPINS')
      REWIND 13
      WRITE(13,2850)
      WRITE(13,2855)
      DO 66 I=1,M
      IF (L.EQ.0) THEN
      IF(CPATH(I).EQ.0)THEN
      L=I-1
      ENDIF
      ENDIF
   66 CONTINUE
   67 CONTINUE
   68 DO 70 J=1,L
      READ(*,2600,END=75)CHOIC
      IF (CHOIC.GE.100)THEN
      PRINT*,'OK, SO YOU ARE DONE, LET US SEE IF YOU GOT IT RIGHT.'
      GO TO 75
      ELSE
      IF(CHOIC.NE.0)THEN
      CHOICS(J) = CHOIC
      IF (CHOIC .NE. CPATH(J)) THEN
      ACDIST = '**'
      ENDIF
      ELSE
      PRINT*,'SO YOU FEEL YOU HAVE TYPED IN SOMETHING WRONG.'
      PRINT*,'OK, LET US WIPE THE SLATE CLEAN AND START ENTERING'
      PRINT*,'YOUR CHOICES OVER AGAIN.  '
      GO TO 67
      ENDIF
      ENDIF
   70 CONTINUE
   75 IF (ACDIST .EQ. '**'.OR.J.NE.L) THEN
      IF(NODES .EQ. 2) THEN
      PRINT*,'SORRY, YOU SHOULD TALK TO YOUR INSTRUCTOR. YOU NEED'
      PRINT*,'SOME HELP ON UNDERSTANDING WHAT CRITICAL PATH IS.'
      WRITE(13,2222)
      WRITE(13,*)CHOICS
      ELSE
      PRINT*,'YOU HAVE MISSED AT LEAST ONE ACTIVITY ON THE CRITICAL'
```

```
      PRINT*,'PATH, YOU MUST TRY AGAIN. '
      WRITE(13,2200)
      WRITE(13,*)CHOICS
      NODES = 2
      DO 76 J=1,L
      CHOICS(J) = 0
   76 CONTINUE
      GO TO 68
      ENDIF
      ELSE
      PRINT*,'EXCELLENT, YOU HAVE GOTTEN THE CRITICAL PATH CORRECT.'
      PRINT*,'DID YOU ANNOTATE YOUR LISTING FOR FUTURE REFERENCE? '
      WRITE(13,2250)
      WRITE(13,*)CHOICS
      ENDIF
      OPEN(19,FILE='CTLPTH')
      REWIND 19
      WRITE(19,2800)PTH,TME
      DO 80 I=1,M
      IF(CPATH(I) .NE. 0)THEN
       WRITE (19,2700) CPATH(I),CPTIME(I)
       ENDIF
   80 CONTINUE
      WRITE(13,*)'THE FOLLOWING IS WHAT THE CRITICAL PATH SHOULD BE...'
      WRITE(13,*)CPATH
      WRITE(13,2856)
      CLOSE (19)
      CLOSE (13)
 2200 FORMAT('WE HAVE USED UP OUR 1 TRY, IT WAS................')
 2222 FORMAT('WE MISSED IT ON THE SECOND TRY ALSO,IT WAS.......')
 2250 FORMAT('WE HAVE GOTTEN THE CRITICAL PATH CORRECT')
 2300 FORMAT(I4,2X,I2)
 2450 FORMAT(I1,I2)
 2500 FORMAT(20X,I3,15X,I4)
 2600 FORMAT(I3)
 2650 FORMAT(A3)
 2660 FORMAT(A2)
 2700 FORMAT(13X,I2,20X,I4,7X)
 2800 FORMAT(3X,A22,3X,A24)
 2850 FORMAT(3X,'THE FOLLOWING IS WHAT OUR GROUP DID DURING THE ')
 2855 FORMAT(3X,'PROCEDURE CRPATH...............')
 2856 FORMAT(3X,'........WE ARE NOW FINISHED WITH CRPATH.........')
      END
```

************************* PROGRAM SNSAN1 **************************

```
      PROGRAM SNSAN1
      CHARACTER WHLINE*72,STRING*22,ALPHS*2,DESCRP*49,LINEIN*72
      CHARACTER PTH*22,TME*24,GOON*3,WHLANS(25)*72,LINE(43)*72
      INTEGER CPATH(43),CT,J,K,L,N,P,R,S,I
      INTEGER A(30),M(30),B(30),AA,MM,BB,ST,ED,PARM,ACT,PAR
      INTEGER ACTVYS(43),NUMS,TT
      INTEGER TIMES(43),CPTIME(43),TTIME,MIN
      TT=0
      CT=0
      P=1
      N= 0
      TTIME=0
      DATA CPATH/43*0/
      OPEN(19,FILE='CTLPTH')
      REWIND 19
      PRINT*,'THE FOLLOWING IS THE CORRECT CRITICAL PATH AND THE'
      PRINT*,'EXPECTED COMPLETION TIMES FOR YOUR SIMULATION RUN.      '
      PRINT*,'YOU SHOULD HAVE FIGURED OUT DURING THE LAST PART  '
      PRINT*,'OF THE EXERCISE.'
      READ(19,1800,END=3)PTH,TME
      PRINT 1800,PTH,TME
      PRINT*,' '
    2 READ(19,1700,END=3)CPATH(P),CPTIME(P)
      PRINT 1700,CPATH(P),CPTIME(P)
      CT=CT+1
      P=P+1
      IF(CT.EQ.18)THEN
      PRINT*,'TYPE GO AND HIT THE RETURN KEY TO CONTINUE....'
      READ(*,1000)GOON
      GO TO 2
      ELSE
      GO TO 2
      ENDIF
    3 PRINT*,' '
      PRINT*,'THE TOTAL NETWORK TIME FOR YOUR SIMULATION WAS '
      PRINT*,CPTIME(1),' DAYS.'
      CLOSE (19)
      PRINT*,'IN JUST A MINUTE I WILL SHOW YOU SEVERAL SCREENS OF'
      PRINT*,'INFORMATION THAT WILL BE USEFUL TO YOU IN ANALYZING'
      PRINT*,'THIS NETWORK. FIRST, HOWEVER, YOU SHOULD UNDERSTAND'
      PRINT*,'A LITTLE ABOUT THE DISTRIBUTION USED IN THE SIMULATION'
      PRINT*,'RUN. IF YOU WILL RECALL FROM THE PROGRAMMED TEXT'
      PRINT*,'EXERCISE, WE USE A FORMULA WITH A PESSIMISTIC, '
      PRINT*,'OPTIMISTIC, AND MOST LIKELY TIME. THE MOST LIKELY '
      PRINT*,'TIME IS WEIGHTED BY A FACTOR OF FOUR. WHAT THIS MEANS'
      PRINT*,'IS THAT THE RESULTANT LOWER CASE TE TIME FOR EACH  '
      PRINT*,'ACTIVITY IN THE SIMULATION, WILL BE SKEWED TOWARDS'
      PRINT*,'THE MOST LIKELY TIME.'
      PRINT*,'  THE TOTAL NETWORK TIME FOR YOUR SIMULATION ,'
```

```
      PRINT*,CPTIME(1),' DAYS HAS OVER SHOT THE OPERATIONAL NEED DATE'
      PRINT*,'FOR THE SYSTEM YOU ARE PROVISIONING BY 120 DAYS. THAT'
      PRINT*,'MEANS THAT YOU MUST FIND A WAY TO GET THE TIME FOR THE'
      PRINT*,'NETWORK DOWN TO ',CPTIME(1)-120,' DAYS TOTAL. '
      PRINT*,'TYPE GO AND HIT THE RETURN KEY TO CONTINUE.....'
      READ (*,1000)GOON
      PRINT*,'THAT MEANS THAT FOR EVERY ACTIVITY IN THE CRITICAL PATH'
      PRINT*,'YOU MUST EXAMINE THE TIMES BY COMPARING THEM TO THE MOST'
      PRINT*,'LIKELY AND THE OPTIMISTIC TIMES. YOU MUST BE CAREFUL'
      PRINT*,'WHERE YOU SUBTRACT THE TIME, BECAUSE YOU COULD EASILY'
      PRINT*,'MAKE A TIME LESS THAN THE OPTIMISTIC TIME. THAT IS NOT'
      PRINT*,'REALLY FEASIBLE, BECAUSE IN THE EYES OF THE EXPERTS'
      PRINT*,'FROM AFALC AND AFLC/MMAPP, THE OPTIMISTIC TIMES ARE JUST'
      PRINT*,'THAT --OPTIMISTIC--.'
      PRINT*,'   YOU WILL NOTICE ALSO, THAT AS YOU CUT THE TIMES FOR'
      PRINT*,'THE ACTIVITIES, THE CRITICAL PATH WILL CHANGE.'
      PRINT*,'NOW HERE ARE THE TIMES AND ACTIVITIES YOU WILL NEED '
      PRINT*,'TO ADJUST THE NETWORK.........'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY TO SEE THE INFORMATION..'
      READ (*,1000)GOON
      OPEN(13,FILE='PRPAR')
      OPEN(14,FILE='PRACT')
      REWIND 13
      REWIND 14
      OPEN(12,FILE='PRITS')
      REWIND 12
   4  READ(12,1010,END=11)WHLINE
      IF(WHLINE(1:3).EQ.'PAR')THEN
      DO 5 I=1,22
      IF (WHLINE(I:I).EQ.'0'.OR.WHLINE(I:I).EQ.'1'.OR.WHLINE
     C(I:I).EQ.'2'.OR.WHLINE(I:I)
     C.EQ.'3'.OR.WHLINE(I:I).EQ.'4'.OR.
     CWHLINE(I:I).EQ.'5'.OR.WHLINE(I:I).EQ.'6'.OR.WHLINE(I:I)
     C.EQ.'7'.OR.WHLINE(I:I).EQ.'8'.OR.WHLINE(I:I).EQ.'9')THEN
      STRING(I:I) = WHLINE(I:I)
      ELSE
      STRING(I:I) = ' '
      ENDIF
    5 CONTINUE
      WRITE(13,*)STRING
      ELSE IF(WHLINE(1:3).EQ.'ACT')THEN
      DO 10 J=1,22
      IF (WHLINE(J:J).EQ.'0'.OR.WHLINE(J:J).EQ.'1'.OR.WHLINE
     C(J:J).EQ.'2'.OR.WHLINE(J:J)
     C.EQ.'3'.OR.WHLINE(J:J).EQ.'4'.OR.
     CWHLINE(J:J).EQ.'5'.OR.WHLINE(J:J).EQ.'6'.OR.WHLINE(J:J)
     C.EQ.'7'.OR.WHLINE(J:J).EQ.'8'.OR.WHLINE(J:J).EQ.'9')THEN
      STRING(J:J) = WHLINE(J:J)
      ELSE
      STRING(J:J) = ' '
      ENDIF
   10 CONTINUE
```

```
      WRITE(14,*)STRING
      ENDIF
      GO TO 4
   11 CLOSE(12)
      CLOSE(13)
      CLOSE(14)
      OPEN(13,FILE='PRPAR')
      OPEN(14,FILE='PRACT')
      OPEN(16,FILE='ACTTME')
      REWIND 13
      REWIND 14
      REWIND 16
      DO 12 K=1,43
      READ(16,*)ACTVYS(K),TIMES(K)
   12 CONTINUE
   19 READ(13,*,END=20)PAR,MM,AA,BB
      A(1)=30
      M(1)=30
      B(1)=30
      A(PAR) = AA
      M(PAR) = MM
      B(PAR) = BB
      GO TO 19
   20 CLOSE (13)
      OPEN(15,FILE='AMBFL')
      REWIND 15
   22 READ (14,*,END=25)ST,ED,PARM,ACT
      IF(PARM.EQ.30)THEN
      PARM = 1
      ENDIF
      WRITE(15,2000)ACT,A(PARM),M(PARM),B(PARM)
      GO TO 22
   25 CLOSE(15)
      OPEN(18,FILE='INFORM')
      REWIND 18
      OPEN(17,FILE='SACT')
      REWIND 17
      OPEN(15,FILE='AMBFL')
      REWIND 15
   30 READ(17,3100,END=45)NUMS,ALPHS,DESCRP
      DO 40 L=1,43
      IF(NUMS.EQ.ACTVYS(L))THEN
       REWIND 15
   35 READ(15,2000)ACT,AA,MM,BB
      IF(NUMS.EQ.ACT)THEN
      WRITE(18,3000)ACT,DESCRP,TIMES(L),AA,MM,BB
      REWIND 15
      ELSE
      GO TO 35
      ENDIF
      ENDIF
 40   CONTINUE
```

```
      GO TO 30
   45 CLOSE(17)
      CLOSE(18)
      K = 0
      OPEN(18,FILE='INFORM')
      REWIND 18
   46 READ(18,1010,END=47)LINEIN
      K= K+1
      LINE(K)=LINEIN
      GO TO 46
   47 PRINT*,'YOUR INSTRUCTIONS INCLUDE:'
      PRINT*,'ENTER 1 FOR SCREEN 1  TIMES FOR ACTIVITIES 1 THRU 17'
      PRINT*,'ENTER 2 FOR SCREEN 2  TIMES FOR ACTIVITIES 18 THRU 35'
      PRINT*,'ENTER 3 FOR SCREEN 3  TIMES FOR ACTIVITIES 36 THRU 43'
      PRINT*,'ENTER 4 TO GO ON. ENTER A CHOICE 1 - 4 NOW...'
      READ(*,1031)NUMS
      IF(NUMS.EQ.1)THEN
        J=1
        K=17
       ELSE IF (NUMS.EQ.2)THEN
        J=18
        K=35
       ELSE IF(NUMS.EQ.3)THEN
        J=36
        K=43
       ELSE IF (NUMS.EQ.4)THEN
         GO TO 49
         ELSE
         J=1
         K=17
        ENDIF
      PRINT 2800
      PRINT 2900
      DO 48 I=J,K
      PRINT 1010,LINE(I)
   48 CONTINUE
      GO TO 47
   49 CLOSE(15)
      OPEN(20,FILE='TMPINS')
      REWIND 20
      WRITE(20,3200)
      PRINT*,' '
      PRINT*,'THINK ABOUT HOW YOU WOULD CHANGE THE TIMES IN ORDER'
      PRINT*,'TO MEET THE OPERATIONAL NEED DATE OF ',CPTIME(1)-120,' DAYS.'
      PRINT*,'I WILL PROVIDE YOU WITH FILE SPACE TO WRITE YOUR '
      PRINT*,'ANSWER, A LINE AT A TIME, TO THOSE QUESTIONS.'
      PRINT*,'TYPE GO AND HIT THE RETURN KEY TO CONTINUE.....'
      READ(*,1000)GOON
      PRINT*,'I WILL PROVIDE YOU WITH A MARKER TO KEEP YOU WITHIN 70'
      PRINT*,'CHARACTERS PER LINE FOR YOUR ANSWER. YOU WILL GET 50 '
      PRINT*,'LINES IF YOU NEED IT TO EXPLAIN YOUR ANSWER,SO BE'
      PRINT*,'JUDICIOUS IN WHAT YOU SAY. I WILL TELL YOU IF YOU'
```

```
      PRINT*,'HAVE GONE BEYOND COLUMN 70, AND GIVE YOU ANOTHER '
      PRINT*,'CHANCE TO TYPE THAT LINE. AT LINE 45 I WILL TELL YOU'
      PRINT*,'THAT YOU HAVE 5 LINES LEFT. WHEN YOU ARE FINISHED,'
      PRINT*,'TYPE IN  XXXXX AT THE ? PROMPT FOR THE'
      PRINT*,'NEXT LINE AFTER YOUR LAST ONE.'
      PRINT*,'I WILL SHOW YOU WHAT YOU HAVE WRITTEN AT THAT TIME.'
      PRINT*,'          IN ADDITION YOU WILL HAVE THE CHANCE'
      PRINT*,'TO CHANGE IT FROM THE BEGINNING OR FROM ANY LINE.'
      PRINT*,'HOWEVER, ONCE YOU CHOOSE A LINE TO CHANGE, YOU MUST '
      PRINT*,'CHANGE EACH LINE AFTER THAT.'
      PRINT*,'ONCE YOU HAVE WRITTEN YOUR RESPONSE, A COPY WILL BE'
      PRINT*,'SENT TO YOUR INSTRUCTOR AND HE WILL MAKE COMMENTS  '
      PRINT*,'AND WRITE THEM ON IT. YOU WILL RECEIVE A LISTING '
      PRINT*,'DURING THE CRITIQUE PORTION OF THIS CLASS AND A '
      PRINT*,'CLASSROOM DISCUSSION WILL BE HELD ABOUT THE METHODS'
      PRINT*,'AND REASONS FOR CUTTING TIMES AND ACTIVITIES.'
      PRINT*,'HERE IS YOUR GAUGE FOR 70 CHARACTERS.............'
      PRINT*,'         1         2         3         4         5
     C 6         7'
      PRINT*,' 1234567890123456789012345678901234567890123456789012345677
     C8901234567890'
      J=1
53    DO 59 N=J,50
      IF(N.EQ.45) THEN
      PRINT*,'THIS LINE IS LINE NUMBER 45 YOU HAVE IT AND 5 MORE LEFT'
      ENDIF
   55 READ(*,1010,END=60)WHLANS(N)
      S=72
   56 IF(S.GT.70.AND.WHLANS(N)(S:S).EQ.' ')THEN
      S=S-1
      GO TO 56
      ELSE
      IF(S.GT.70.AND.WHLANS(N)(S:S).NE.' ')THEN
      PRINT*,'YOU HAVE GONE OVER 70 POSITIONS TYPE THAT LINE OVER...'
      GO TO 55
      ENDIF
      ENDIF
      IF(WHLANS(N)(1:4).EQ.'XXXX'.OR.N.EQ.50)THEN
      PRINT*,'HERE IS YOUR ANSWER TO THE ABOVE QUESTIONS.'
      GO TO 60
      ENDIF
   59 CONTINUE
  60  DO 65 R=1,N
      PRINT 1010,WHLANS(R)
      IF(R.EQ.20.OR.R.EQ.40)THEN
      PRINT*,'TYPE GO TO SEE THE REST OF YOUR MASTERPIECE...'
      READ(*,1000)GOON
      ENDIF
  65  CONTINUE
      PRINT*,'TYPE IN THE NUMBER OF THE LINE YOU WISH TO CHANGE.'
      PRINT*,'IF YOU DO NOT WISH TO CHANGE ANY THEN TYPE IN 0.'
      READ *,P
```

```
      IF (P.EQ.0)THEN
      PRINT*,'OK, YOUR FILE IS BEING WRITTEN TO THE INSTRUCTORS '
      PRINT*,'FILE FOR HIS PERUSAL.'
      DO 70 I=1,N
      WRITE(20,1010)WHLANS(I)
 70   CONTINUE
      ELSE
      J = P
      GO TO 53
      ENDIF
      WRITE(20,3300)
      CLOSE (20)
1000  FORMAT(A3)
1010  FORMAT(A72)
1020  FORMAT(A22)
1030  FORMAT(I3)
1031  FORMAT(I2)
1700  FORMAT(13X,I2,20X,I4)
1800  FORMAT(3X,A22,3X,A24)
2000  FORMAT(I2,2X,I3,2X,I3,2X,I3)
2700  FORMAT(48X,'SIMUL')
2800  FORMAT('ACT DESCRIPTION OF THE ACTIVITY                          TI
     CME A    M    B')
2900  FORMAT(72('-'))
3000  FORMAT(1X,I2,1X,A49,1X,I4,1X,I3,1X,I3,1X,I3)
3100  FORMAT(I2,1X,A2,1X,A49)
3200  FORMAT(3X,'-HERE ARE OUR ANSWERS TO THE SENSITIVITY ANALYSIS-')
3300  FORMAT(3X,'...THAT CONCLUDES OUR ANSWER ......................')
      END
```

```
**************************  PROGRAM DISPLY  **************************

      PROGRAM DISPLY
      CHARACTER WHLINE*72,AA*2,P(43)*2,ALPHS(43)*2,S*8,SACT*4
      CHARACTER R*47,Q*10,ALPHSN(43)*2
      INTEGER I,J,K,L
      REAL RNDM,T
      DATA S/' **     '/
      DATA R/'*  *......*  *......*  *......*  *......*  *...'/
      DATA Q/'**        '/
      OPEN(11,FILE='ALPHA')
      REWIND 11
      DO 5 I=1,43
      READ(11,1000,END=6)AA
      ALPHS(I) = AA
    5 CONTINUE
    6 CLOSE (11)
      DO 10 J=43,1,-1
      CALL SECOND (T)
      CALL RANSET (T)
      RNDM = RANF ()
      NBR = RNDM * J
      IF (NBR .EQ. 0 ) THEN
      NBR = 1
      ENDIF
      ALPHSN(J) = ALPHS(NBR)
      DO 8 K=1,J
      IF (K.LT.NBR)THEN
      ALPHS(K) = ALPHS(K)
      ELSE
      ALPHS(K) = ALPHS(K+1)
      ENDIF
   8  CONTINUE
   10 CONTINUE
      OPEN(12,FILE='ACTIVS')
      OPEN(13,FILE='SACT')
      REWIND 12
      REWIND 13
      DO 20 L=1,43
      READ(12,2000,END=25)WHLINE
      P(L) = ALPHSN(L)
      WRITE(13,2100)WHLINE(1:3),ALPHSN(L),WHLINE(6:72)
  20  CONTINUE
  25  CLOSE (12)
      CLOSE (13)
      OPEN(14,FILE='DSPLY')
      REWIND 14
      WRITE(14,2301)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
```

```
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2415)
      WRITE(14,2418)
      WRITE(14,2420)
      WRITE(14,2430)
      WRITE(14,2440)P(41),P(29)
      WRITE(14,2450)
      WRITE(14,2460)P(43),P(10)
      WRITE(14,2470)P(8),P(21)
      WRITE(14,2480)
      WRITE(14,2490)
      WRITE(14,2390)S,P(5),S,P(13),S,P(22),S,P(30),S,P(24),S,P(34),
     CS,P(6),S,P(23),S,P(14),S,P(11),S,P(33),S,P(7),' ## '
      WRITE(14,2400)R,R
      WRITE(14,2410)Q,Q,Q,Q,Q,Q,Q,Q,Q,Q,Q,Q,Q
      WRITE(14,2500)
      WRITE(14,2510)P(38)
      WRITE(14,2520)
      WRITE(14,2530)P(42)
      WRITE(14,2540)
      WRITE(14,2301)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
```

```
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2300)
      WRITE(14,2980)P(40)
      WRITE(14,3100)
      WRITE(14,3200)
      WRITE(14,3300)P(15)
      WRITE(14,3400)
      WRITE(14,3500)P(31)
      WRITE(14,3600)P(12),P(28),P(2)
      WRITE(14,3700)
      WRITE(14,3800)
      WRITE(14,3900)
      WRITE(14,4000)P(20),P(9),P(19),P(25),P(35),P(32),P(16),P(36),
     CP(18),P(3),P(39),P(4)
      WRITE(14,4100)
      WRITE(14,4200)
      WRITE(14,4300)
      WRITE(14,4400)
      WRITE(14,4500)P(26),P(1),P(17),P(37),P(27)
      WRITE(14,4600)
      WRITE(14,4700)
      CLOSE (14)
 1000 FORMAT(A2)
 2000 FORMAT(A72)
 2100 FORMAT(A3,A2,A67)
 2300 FORMAT(133X)
 2301 FORMAT('1',132X)
 2390 FORMAT(1X,12(A8,A2),A4,5X)
 2400 FORMAT(1X,A47,'...',A47,'...*  *......*  *......*  *....1')
 2410 FORMAT(1X,1X,13(A10))
 2415 FORMAT(1X,112X,15('.'),'2')
 2418 FORMAT(1X,111X,'.')
 2420 FORMAT(1X,110X,'.','  CONNECTS TO')
 2430 FORMAT(1X,109X,'.',4X,'NEXT PAGE ')
 2440 FORMAT(1X,17X,A2,65X,'**',7X,A2,4X,'**',7X,'.',6X,'AT 2 ')
 2450 FORMAT(1X,12X,10('.'),60X,'.*  *',11('.'),'*  *.',4X,'.')
 2460 FORMAT(1X,12X,'.',4X,A2,'  .',25X,A2,33X,'. **',13X,'** .',3X,'.')
 2470 FORMAT(1X,12X,'.  ....  .',23X,'....',31X,A2,'.',17X,A2,'.  .')
 2480 FORMAT(1X,12X,'. .',4X,'. .',22X,'.',4X,'.',32X,'.',19X,'. .')
 2490 FORMAT(1X,12X,'..',6X,'..',21X,'.',6X,'.',31X,'.',19X,'..')
 2500 FORMAT(1X,82X,'..',16X,'..')
 2510 FORMAT(1X,83X,'..',11X,A2,' . .',11X,'CONNECTS TO')
 2520 FORMAT(1X,84X,15('.'),' .',13X,'NEXT PAGE')
 2530 FORMAT(1X,85X,'.',6X,A2,5X,'.',15X,'AT 1')
 2540 FORMAT(1X,86X,13('.'))
 2980 FORMAT(1X,42X,A2)
 3100 FORMAT(1X,'2',98('.'))
 3200 FORMAT(1X,98X,'.')
 3300 FORMAT(1X,45X,A2,2X,'**',49X,'.')
 3400 FORMAT(1X,44X,'....*  *',21('.'),28X,'.')
 3500 FORMAT(1X,43X,'.',5X,'**',22X,'. ',A2,25X,'.')
```

```
3600 FORMAT(1X,13X,A2,27X,'.',20X,A2,9X,'.',8X,A2,18X,'.')
3700 FORMAT(1X,11X,'....',26X,'.',19X,'....',10X,'.',5X,'....',19X,'.')
3800 FORMAT(1X,10X,'.',4X,'.',24X,'.',19X,'.',4X,'.',10X,'.',3X,'.',4X,
    C'.',19X,'.')
3900 FORMAT(1X,9X,'.',6X,'.',22X,'.',19X,'.',6X,'.',10X,'. .',6X,'.',
    C19X,'.')
4000 FORMAT(1X,4X,12(A2,' **',5X))
4100 FORMAT(1X,'1',5('.'),'*  *',11('......*  *'))
4200 FORMAT(1X,12(7X,'** '))
4300 FORMAT(1X,19X,'.',17X,'.',10X,'.',27X,'.',22X)
4400 FORMAT(1X,20X,'.',15X,'.',12X,'.',25X,'.',24X)
4500 FORMAT(20X,A2,'.',10X,'** .',A2,9X,A2,' . **',5X,A2,
    C' ** . ',A2,5X,'.',31X)
4600 FORMAT(1X,22X,9('.'),'*  *',16X,'*  *','......*  *',9('.'),28X)
4700 FORMAT(1X,32X,'**',18X,'**',8X,'**',39X)
     END
```

************************ PROGRAM PGMCKU ***************************

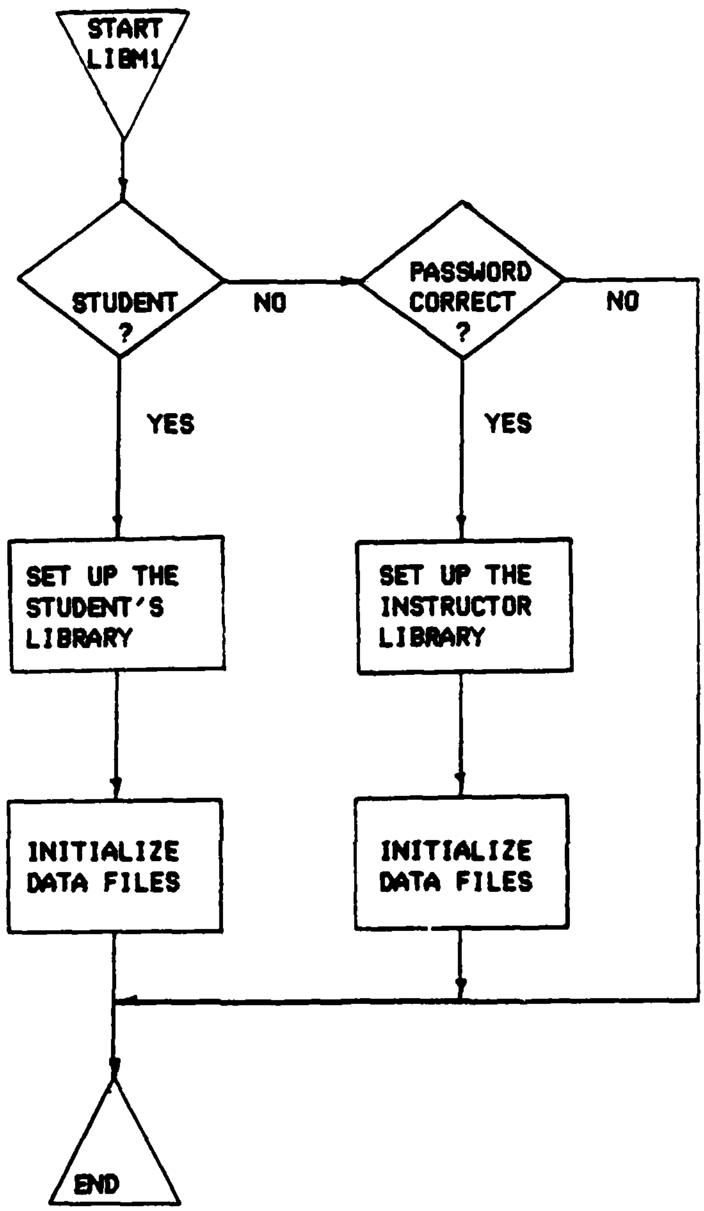
```
      PROGRAM PGMCKU
      CHARACTER WHLINE*100
      OPEN(13,FILE='INSTRK')
      REWIND 13
    5 CONTINUE
      READ(13,100,END=15)WHLINE
      PRINT 100,WHLINE
      GO TO 5
   15 CONTINUE
  100 FORMAT(A100)
      END
```

############ ACTIVITY LIST FROM THE NETWORK #############

01 SSR/NIMSR PROCESSED BY DOD AGENCY
02 NSN FORWARDED TO ACO BY CASC
03 ACO NEGOTIATES SCHED/PRICE W/CONTRACTOR
04 CONTRACTOR SHIPS ITEMS TO DEPOTS
05 SYSTEM START-UP ACTIVITIES
06 SOURCE SELECTION
07 SPM ALC REVIEW OF CONTRACTOR PTD/SPTD
08 PRODUCTION OPTION DECISION
09 POST-PROVISIONING CONFERENCE ACTIONS
10 FSD GUIDANCE CONFERENCE
11 DLSC SCREENS DATA & RETURNS TO CONTRACTOR
12 SPM ALC REVIEWS PROVISIONING CONFERENCE DATA
13 DPML DEVELOPS ILSP
14 CONTRACTOR PROVIDES DATA FOR DLSC SCREEN
15 PR/MIPR PROCESSED BY IM ALC (794)
16 PIO (326) REVIEWED BY SPM ALC
17 I & S REQUEST (86) PREPARED BY IM ALC
18 DUE-IN ESTABLISHED IN J041 SYSTEM
19 SICN ISSUED ON NON-NSN ITEM BY LATERAL ALC
20 PROVISIONING CONFERENCE
21 GUIDANCE CONFERENCE
22 FSD CDRL PREPARED BY SPM ALC (1423)
23 FSD CONTRACT AWARD & NOTIFICATION
24 FSD PROPOSAL PREPARED & SUBMITTED BY CONTRACTOR
25 IM ASSIGNS MOS CODE & SENDS TO SPM ALC (778/773)
26 SSR/NIMSR ISSUED BY SPM ALC
27 CANCEL PIO (SUB FOUND) OR ASSIGN NSN (NO SUB)
28 SPM FUNDS CHECK
29 PRE-GUIDANCE CONFERENCE ACTIONS
30 RFP PREPARED BY SPO & SENT TO CONTRACTORS
31 PR/MIPR FUNDED BY PPCO (794)
32 PIO (326) PREPARED BY IM ALC
33 PPL'S DEVELOPED BY CONTRACTOR & SENT TO SPM ALC
34 FSD CDRL TO SPM ALC FOR REVIEW (1423)
35 SPM ALC REVIEWS ITEMS CODED BY IM ALC'S
36 PIO (326) FUNDED BY PPCO (30)
37 I & S REVIEW BY CASC (86)
38 SAIP/LLIL GUIDANCE CONFERENCE BY CONTRACTOR
39 PPL ITEMS PRODUCED BY CONTRACTOR
40 INTERIM RELEASE ITEMS PRODUCED BY CONTRACTOR
41 MMIS PREPARES PTDOSS(1949-1),PRS(1949-2),PPS(718)
42 SPM ALC SENDS PRS TO IM ALC(S) FOR REVIEW
43 SPM DETERMINES AGENCY W/CONTRACT RESPONSIBILITY

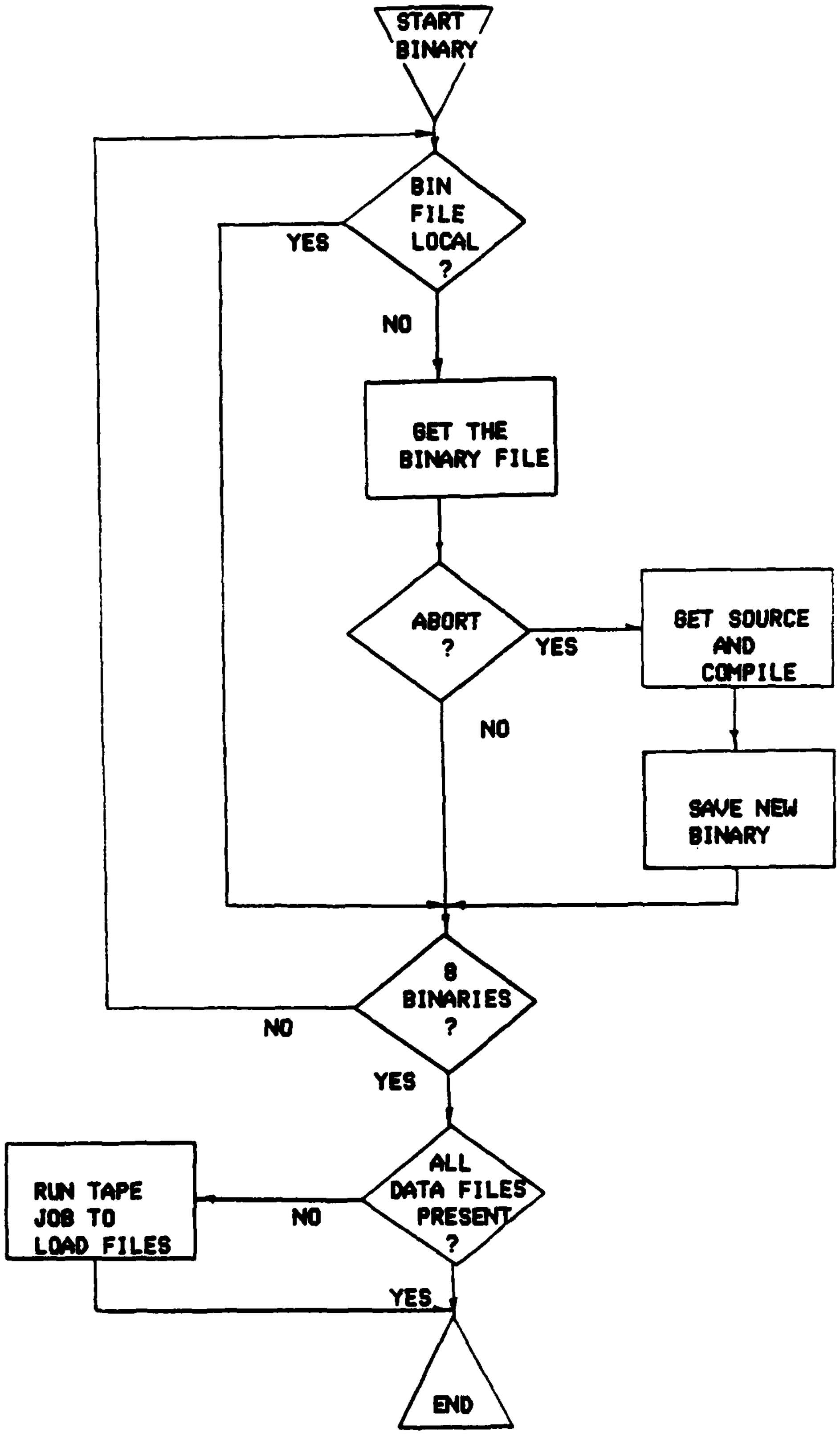
## Appendix E: Flowcharts of the Programs and the Exercise

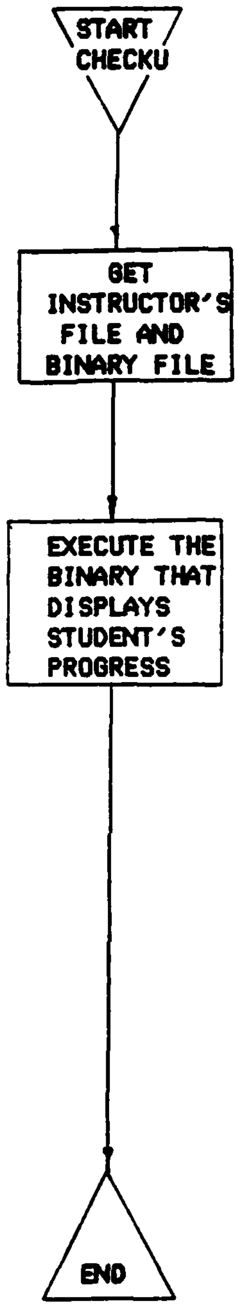
CONTENTS

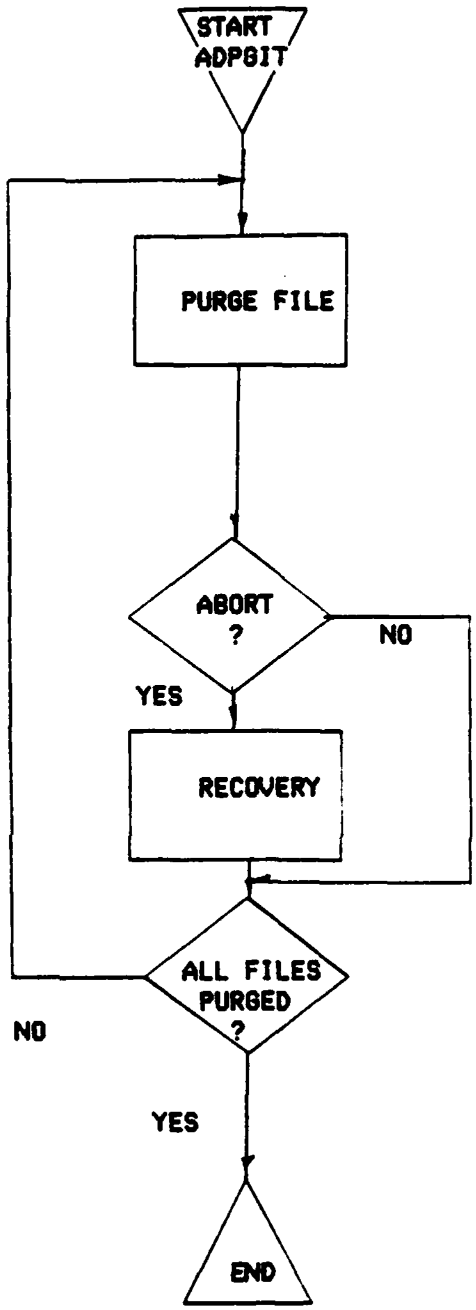



NOTE**

Procedure LIBM1 is run by both the student and the instructor. The only difference apparent to them is the answers to the questions at the beginning of the procedure. Both the student and the instructor use the same initializing commands. See the instructor's manual for the exact commands.


START BINARY
BIN FILE LOCAL ?
YES
NO
GET THE BINARY FILE
ABORT ?
YES
GET SOURCE AND COMPILE
NO
SAVE NEW BINARY
8 BINARIES ?
NO
YES
ALL DATA FILES PRESENT ?
NO
RUN TAPE JOB TO LOAD FILES
YES
END



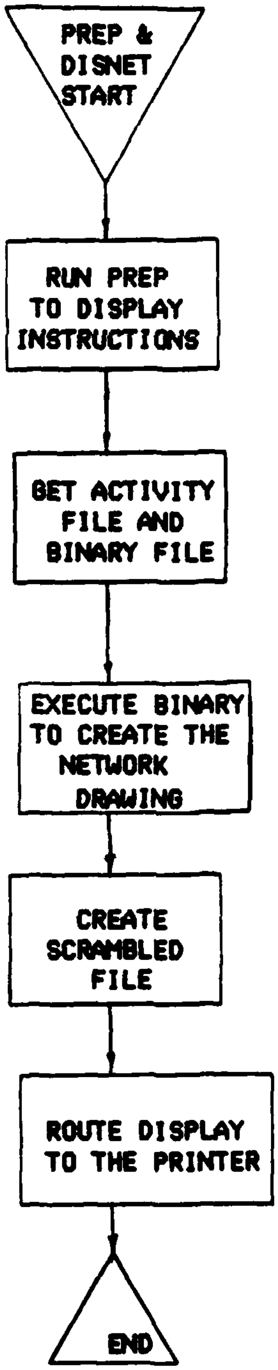




NOTE**

This should be done once for each group you have playing the game. It can be run any time during student play, after they have completed the introduction.

NOTE**

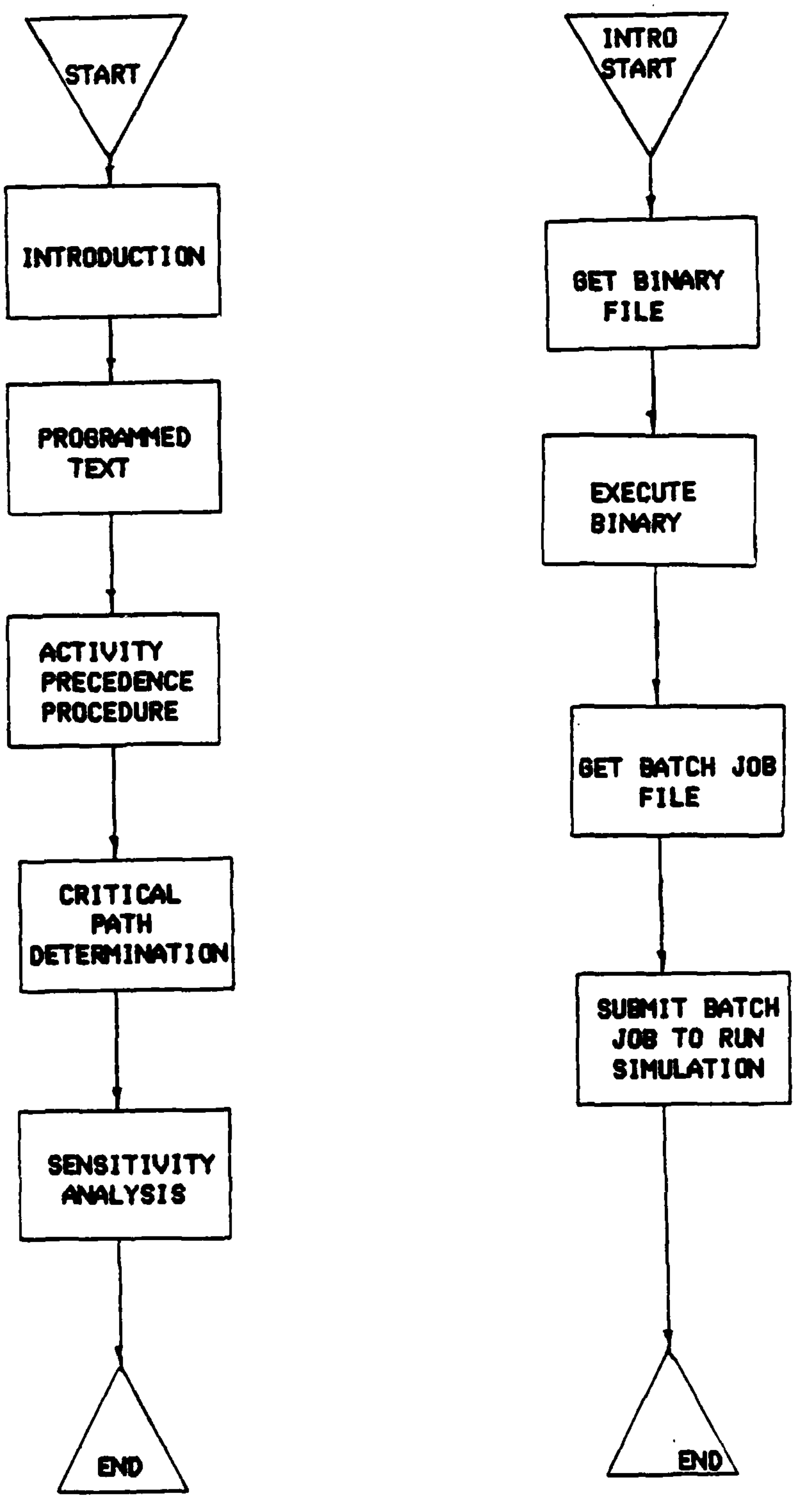
This procedure should be run only between offerings of the exercise. The binary files will remain after this procedure.

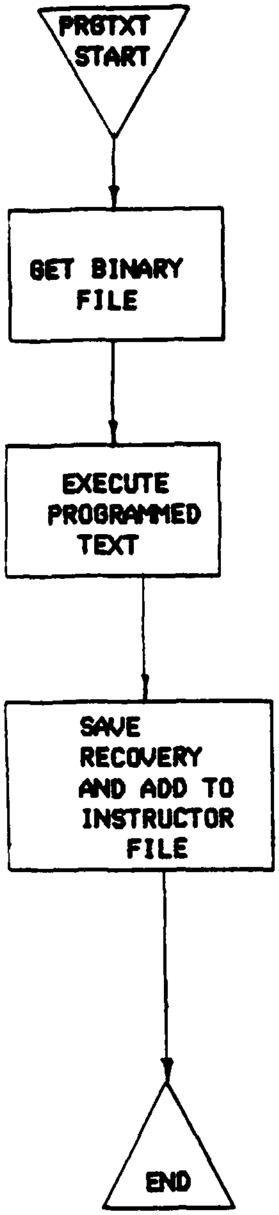



NOTE**

Run PREP over until you have completely understood the instructions. Run DISNET over once for each group that you intend to have play the game.

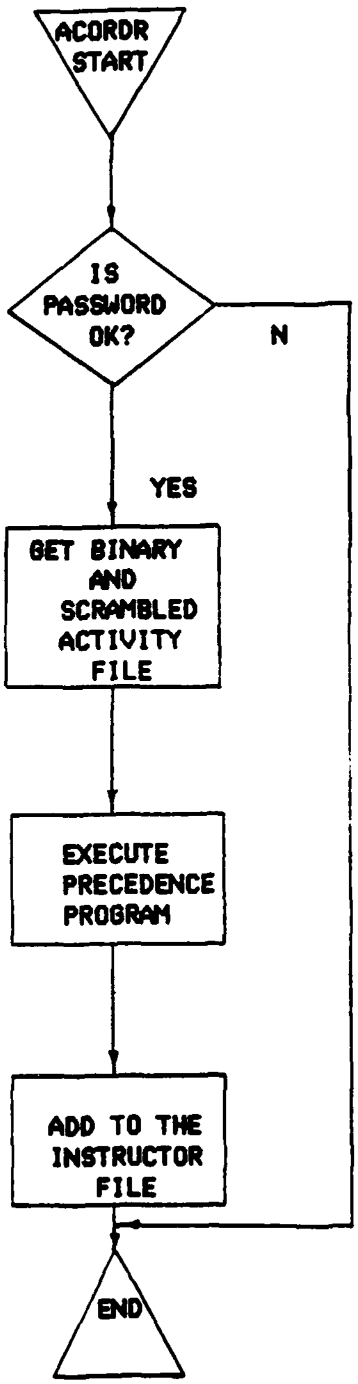
ORDER OF EXECUTION OF PROCEDURES





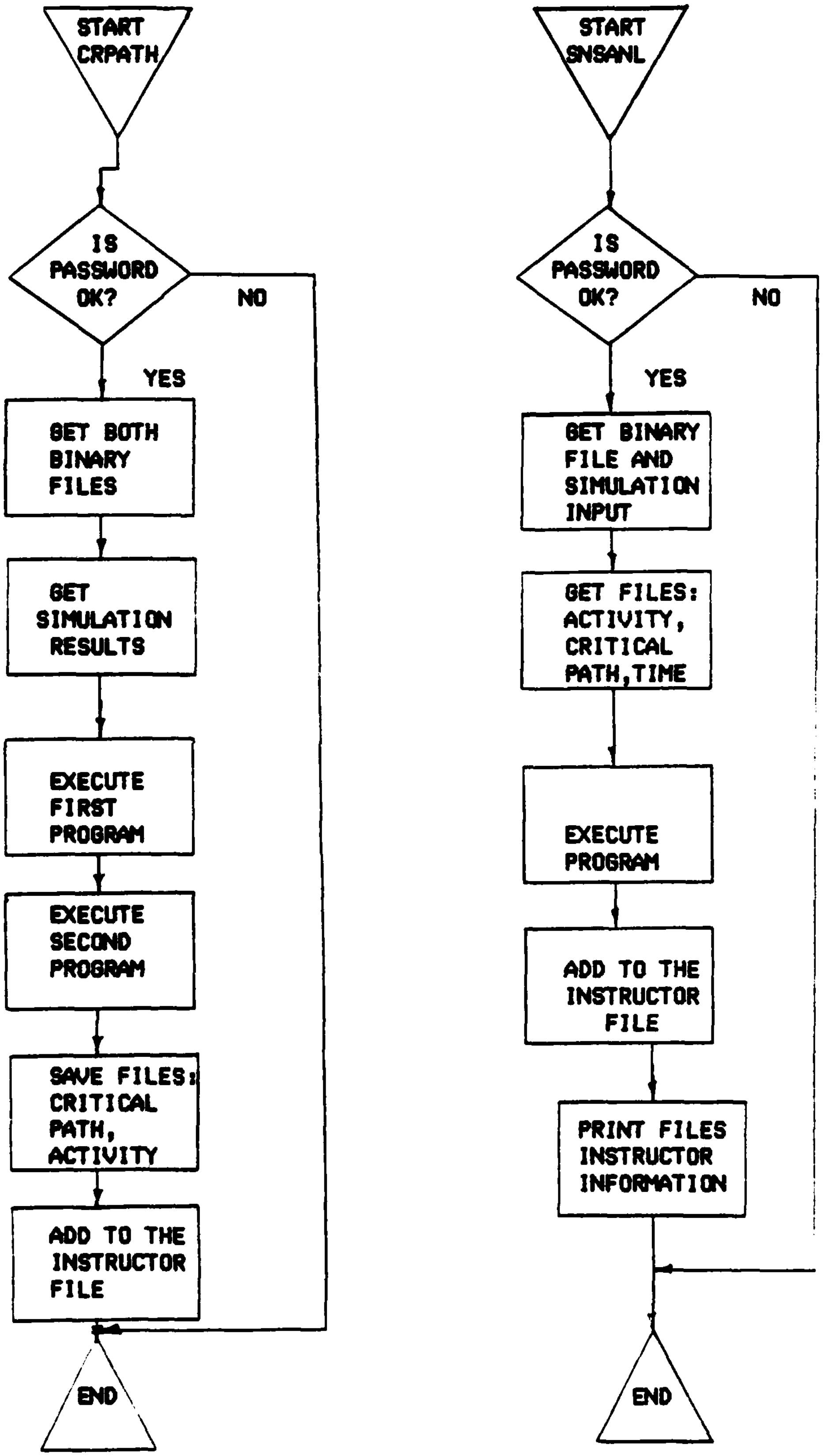

NOTE**

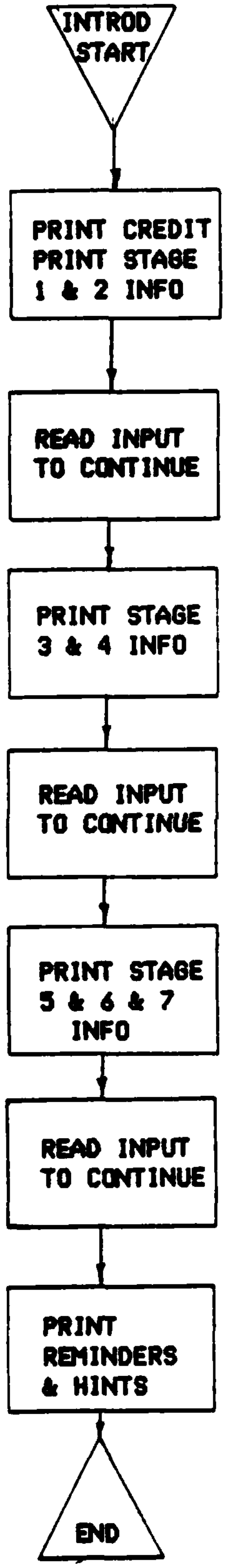
This procedure is a stand alone procedure. All 64 questions need not be answered before logging out. The recovery file allows you to re-enter the program after the last question that you answered before logging out.

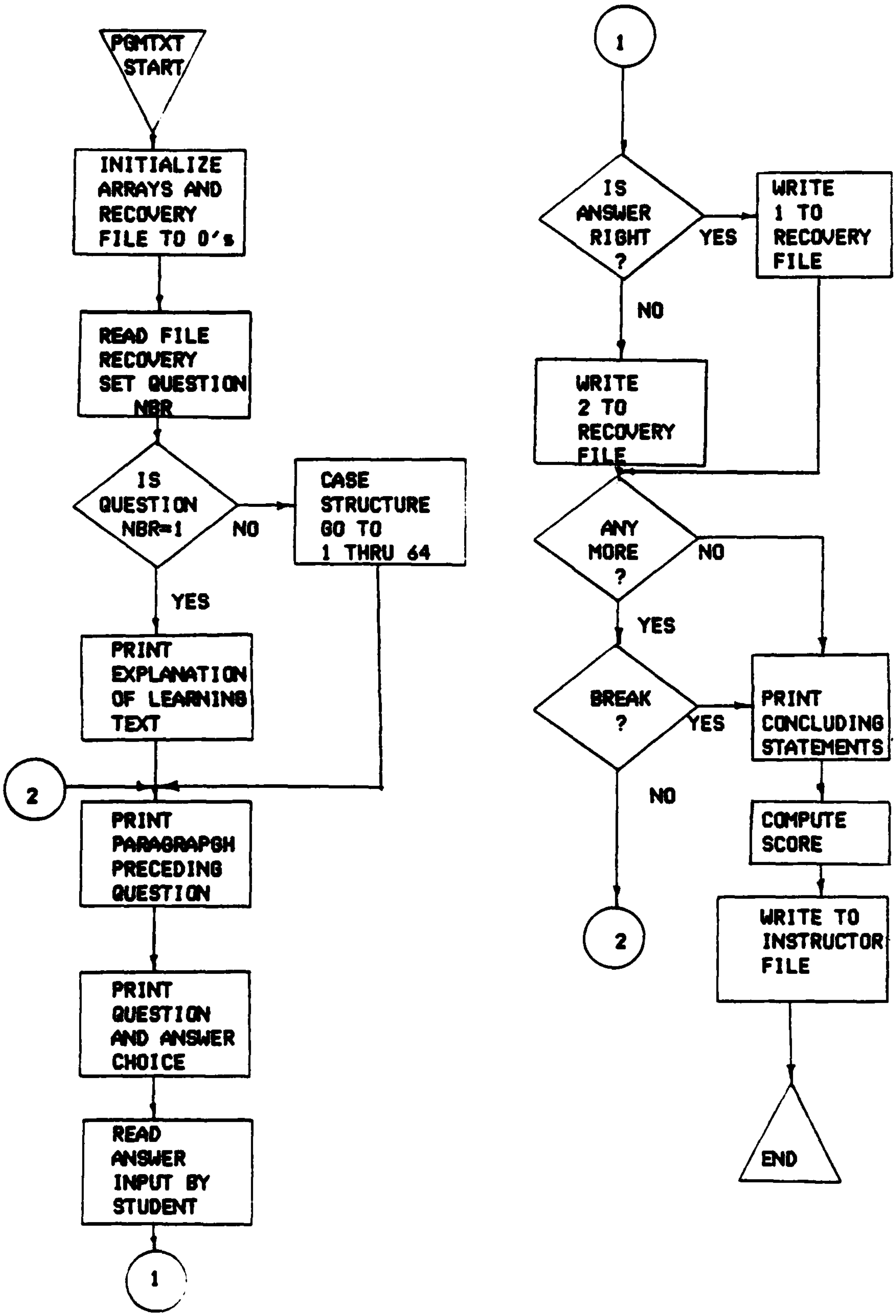


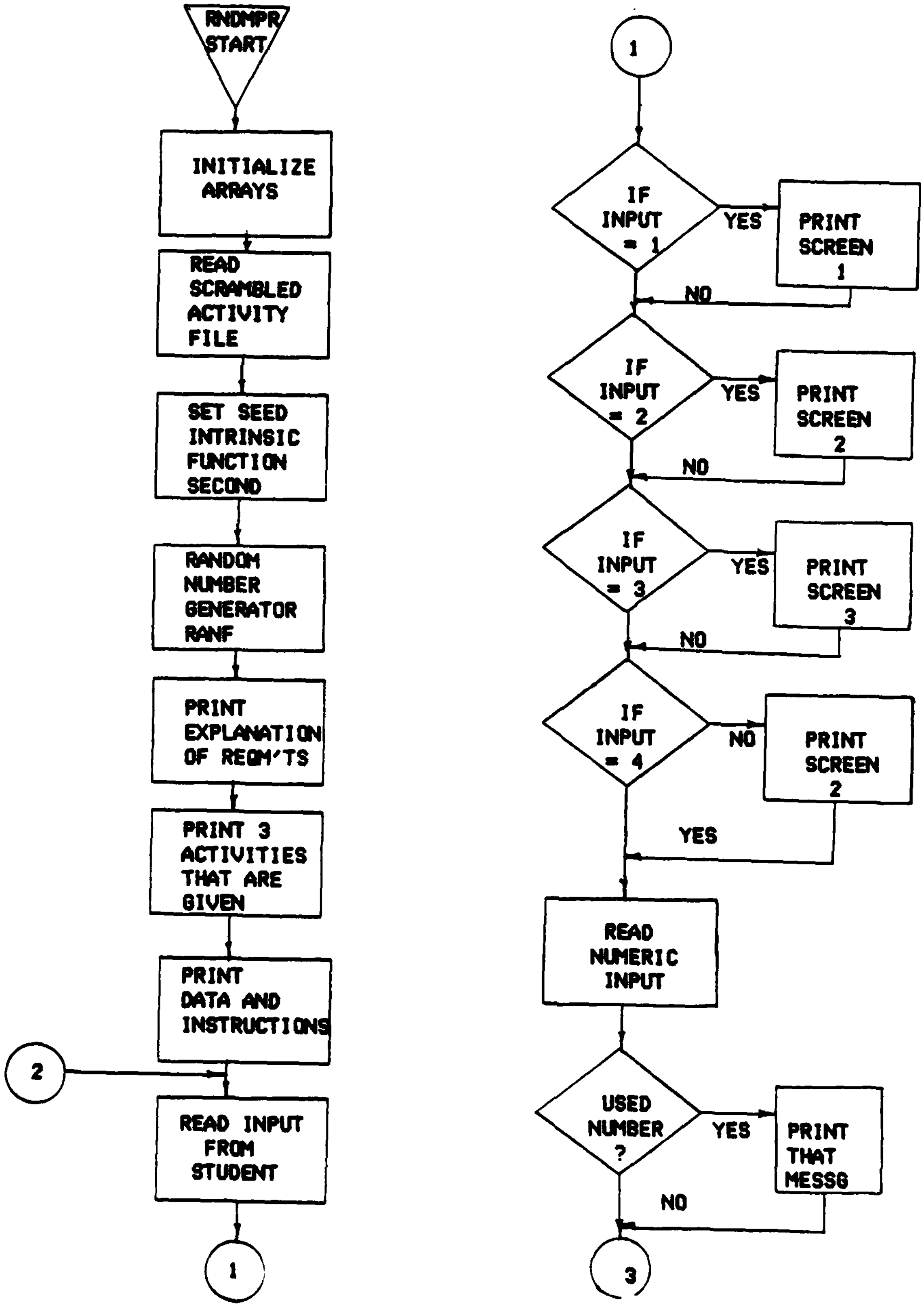

NOTE**

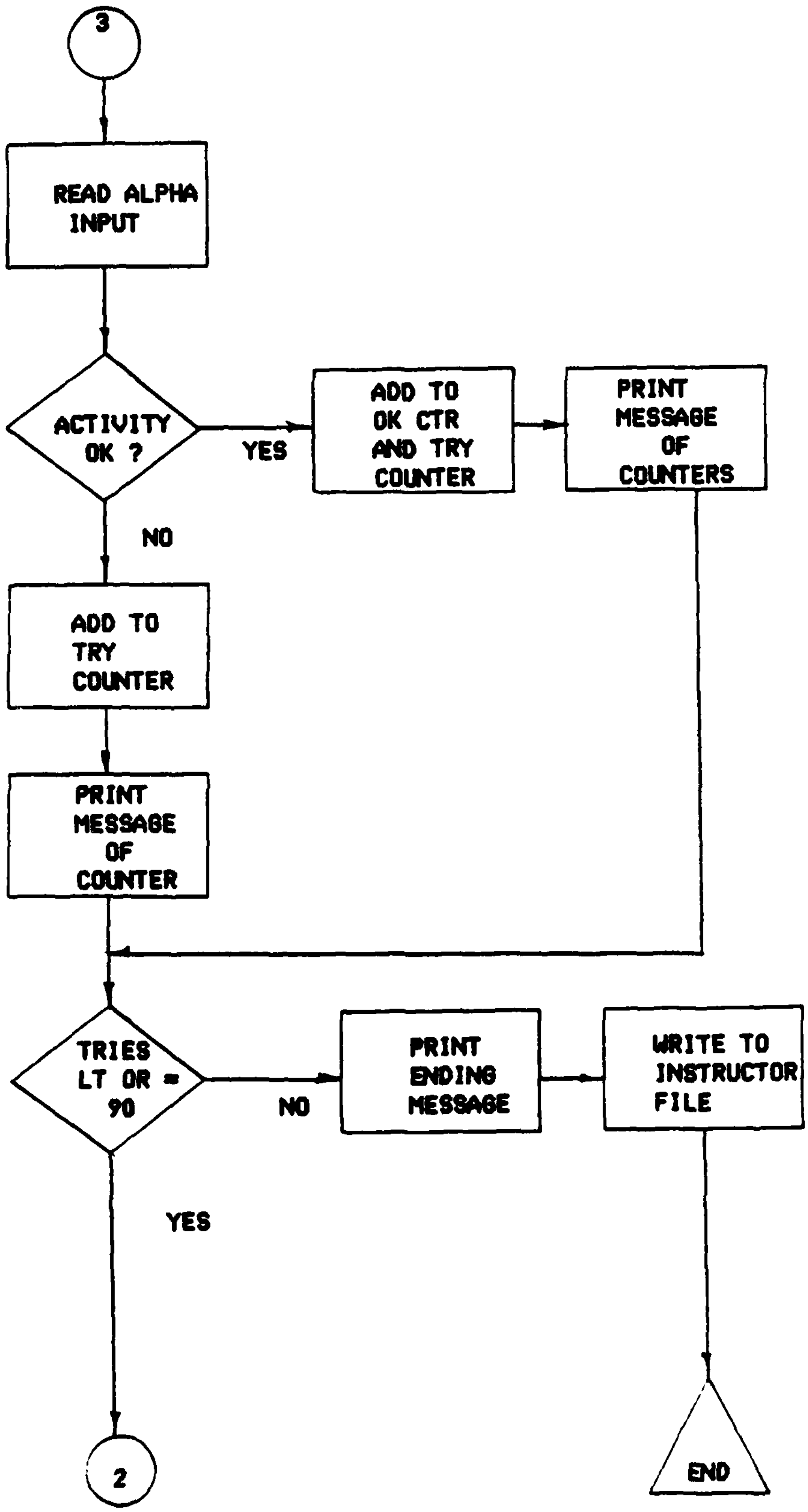
This procedure requires a password and a filename before the student can run it.

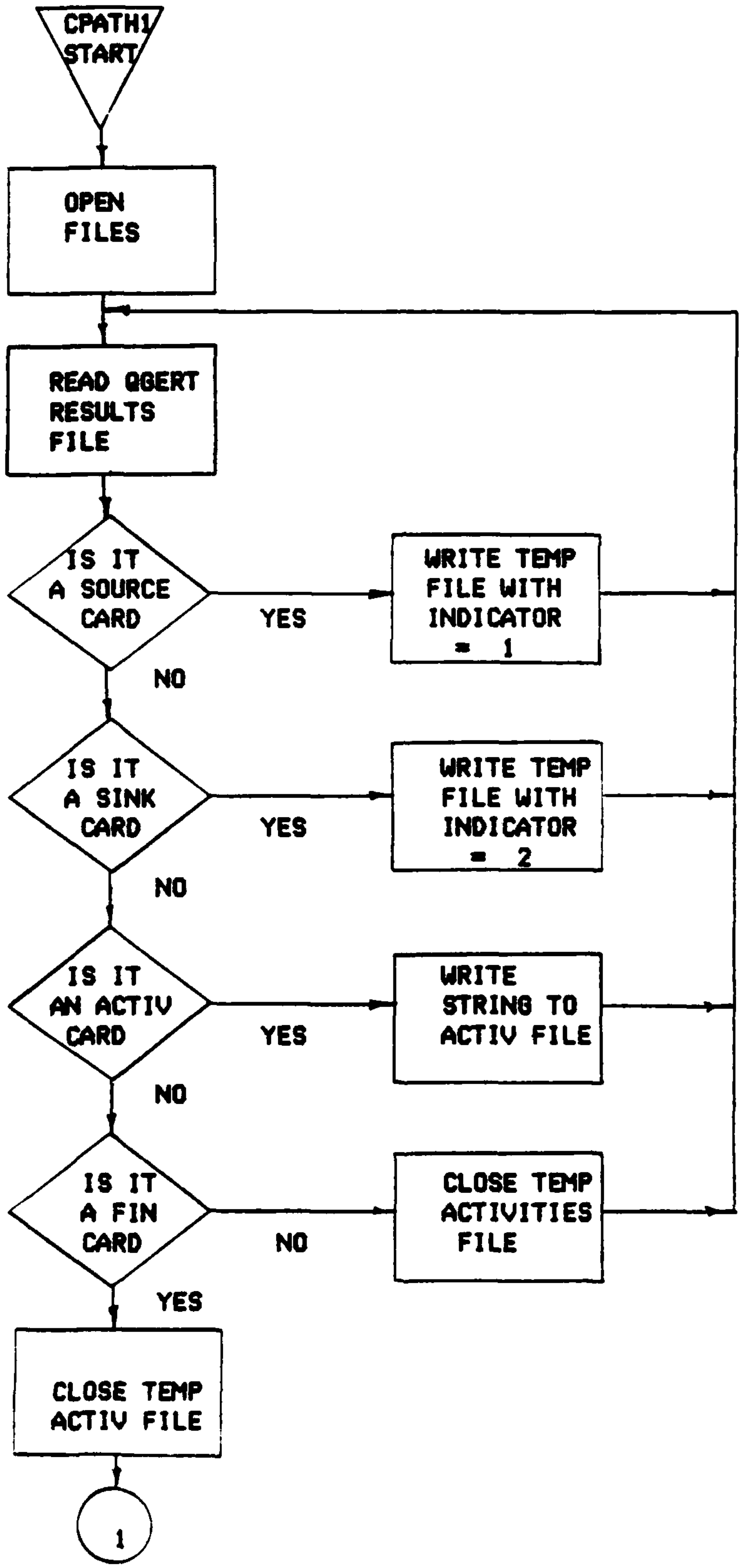

START CRPATH
IS PASSWORD OK?
NO
YES
GET BOTH BINARY FILES
GET SIMULATION RESULTS
EXECUTE FIRST PROGRAM
EXECUTE SECOND PROGRAM
SAVE FILES: CRITICAL PATH, ACTIVITY
ADD TO THE INSTRUCTOR FILE
END
START SNSANL
IS PASSWORD OK?
NO
YES
GET BINARY FILE AND SIMULATION INPUT
GET FILES: ACTIVITY, CRITICAL PATH, TIME
EXECUTE PROGRAM
ADD TO THE INSTRUCTOR FILE
PRINT FILES INSTRUCTOR INFORMATION
END

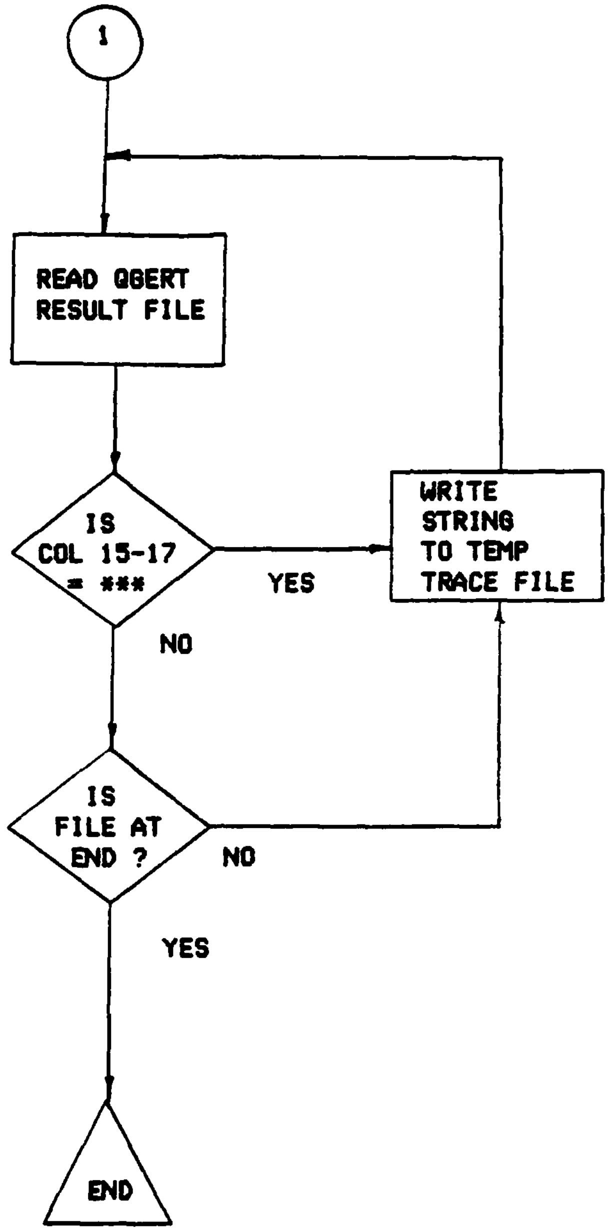

INTROD START
PRINT CREDIT PRINT STAGE 1 & 2 INFO
READ INPUT TO CONTINUE
PRINT STAGE 3 & 4 INFO
READ INPUT TO CONTINUE
PRINT STAGE 5 & 6 & 7 INFO
READ INPUT TO CONTINUE
PRINT REMINDERS & HINTS
END

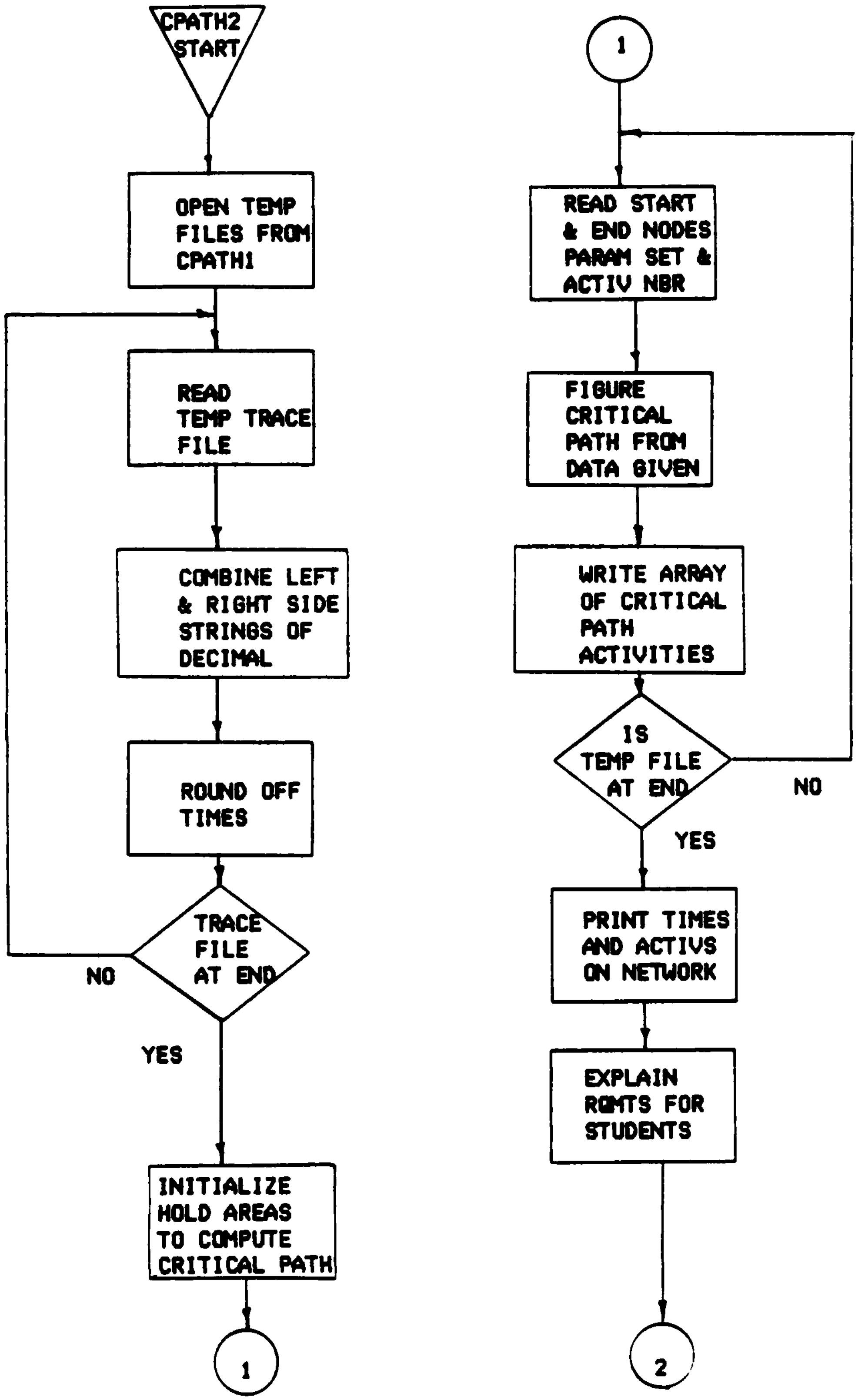

PGMTXT START
INITIALIZE ARRAYS AND RECOVERY FILE TO 0's
READ FILE RECOVERY SET QUESTION NBR
IS QUESTION NBR=1
NO
CASE STRUCTURE GO TO 1 THRU 64
YES
PRINT EXPLANATION OF LEARNING TEXT
2
PRINT PARAGRAPGH PRECEDING QUESTION
PRINT QUESTION AND ANSWER CHOICE
READ ANSWER INPUT BY STUDENT
1
1
IS ANSWER RIGHT ?
YES
WRITE 1 TO RECOVERY FILE
NO
WRITE 2 TO RECOVERY FILE
ANY MORE ?
NO
YES
BREAK ?
YES
PRINT CONCLUDING STATEMENTS
NO
COMPUTE SCORE
2
WRITE TO INSTRUCTOR FILE
END

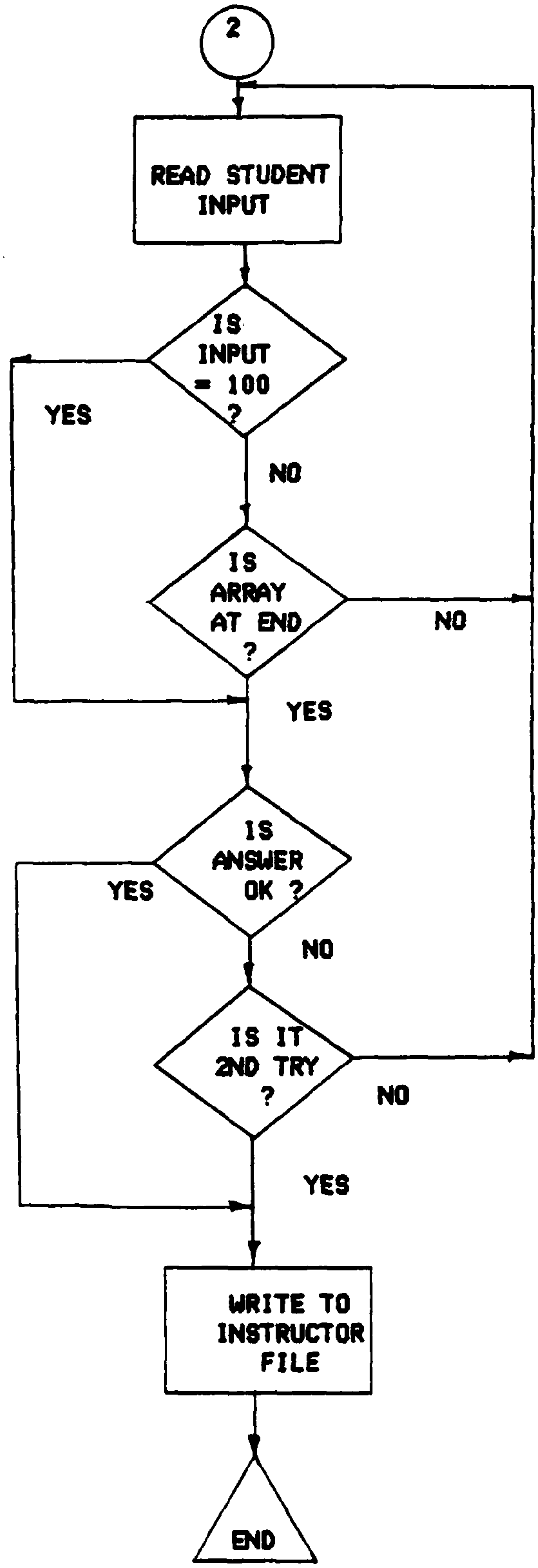

RNDMPR START
INITIALIZE ARRAYS
READ SCRAMBLED ACTIVITY FILE
SET SEED INTRINSIC FUNCTION SECOND
RANDOM NUMBER GENERATOR RANF
PRINT EXPLANATION OF REQM'TS
PRINT 3 ACTIVITIES THAT ARE GIVEN
PRINT DATA AND INSTRUCTIONS
2
READ INPUT FROM STUDENT
1
1
IF INPUT = 1
YES
PRINT SCREEN 1
NO
IF INPUT = 2
YES
PRINT SCREEN 2
NO
IF INPUT = 3
YES
PRINT SCREEN 3
NO
IF INPUT = 4
NO
PRINT SCREEN 2
YES
READ NUMERIC INPUT
USED NUMBER ?
YES
PRINT THAT MESSG
NO
3

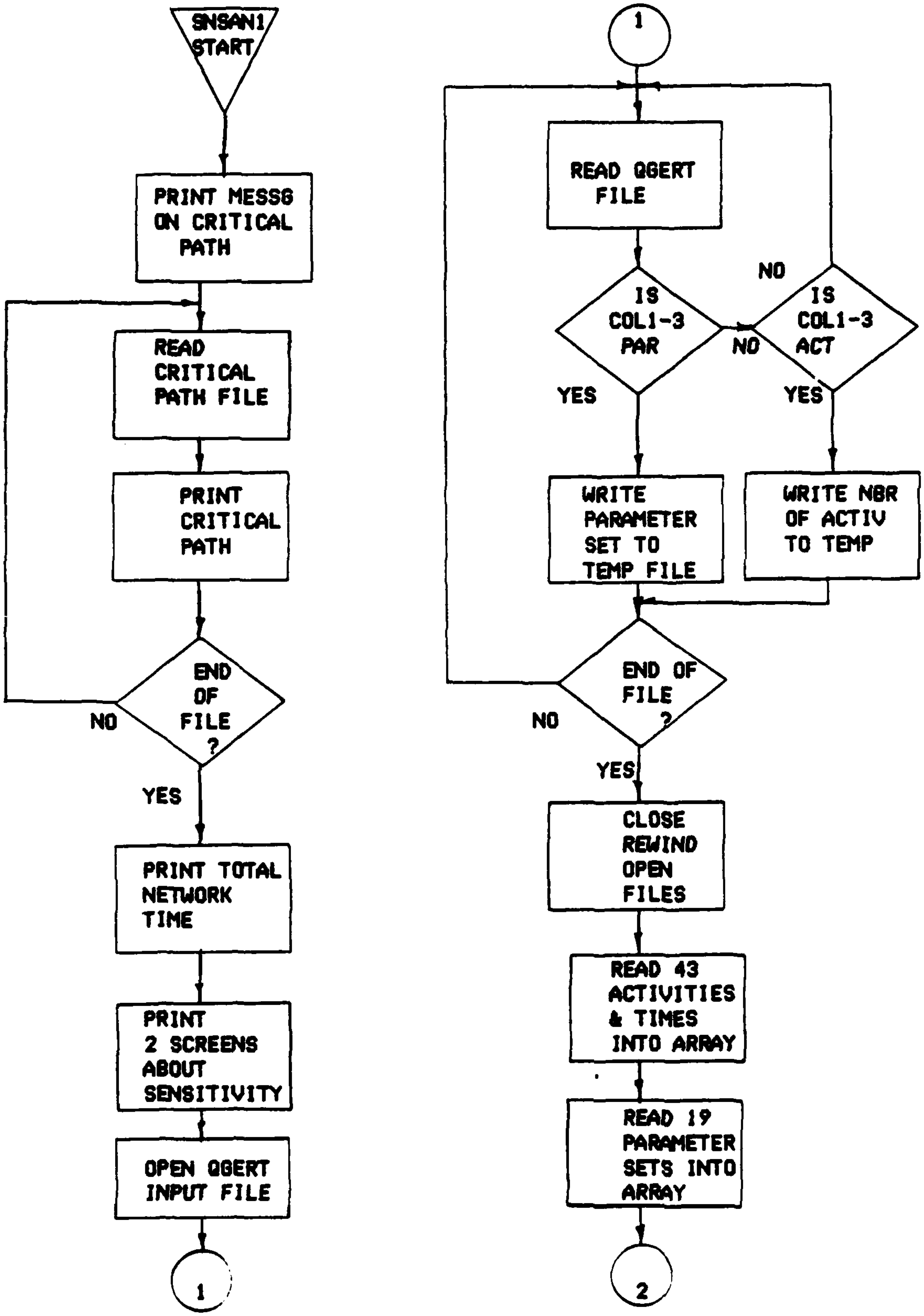

3
READ ALPHA INPUT
ACTIVITY OK ?
YES
ADD TO OK CTR AND TRY COUNTER
PRINT MESSAGE OF COUNTERS
NO
ADD TO TRY COUNTER
PRINT MESSAGE OF COUNTER
TRIES LT OR = 90
NO
PRINT ENDING MESSAGE
WRITE TO INSTRUCTOR FILE
YES
2
END


CPATH1 START
OPEN FILES
READ QGERT RESULTS FILE
IS IT A SOURCE CARD
YES
WRITE TEMP FILE WITH INDICATOR = 1
NO
IS IT A SINK CARD
YES
WRITE TEMP FILE WITH INDICATOR = 2
NO
IS IT AN ACTIV CARD
YES
WRITE STRING TO ACTIV FILE
NO
IS IT A FIN CARD
NO
CLOSE TEMP ACTIVITIES FILE
YES
CLOSE TEMP ACTIV FILE
1

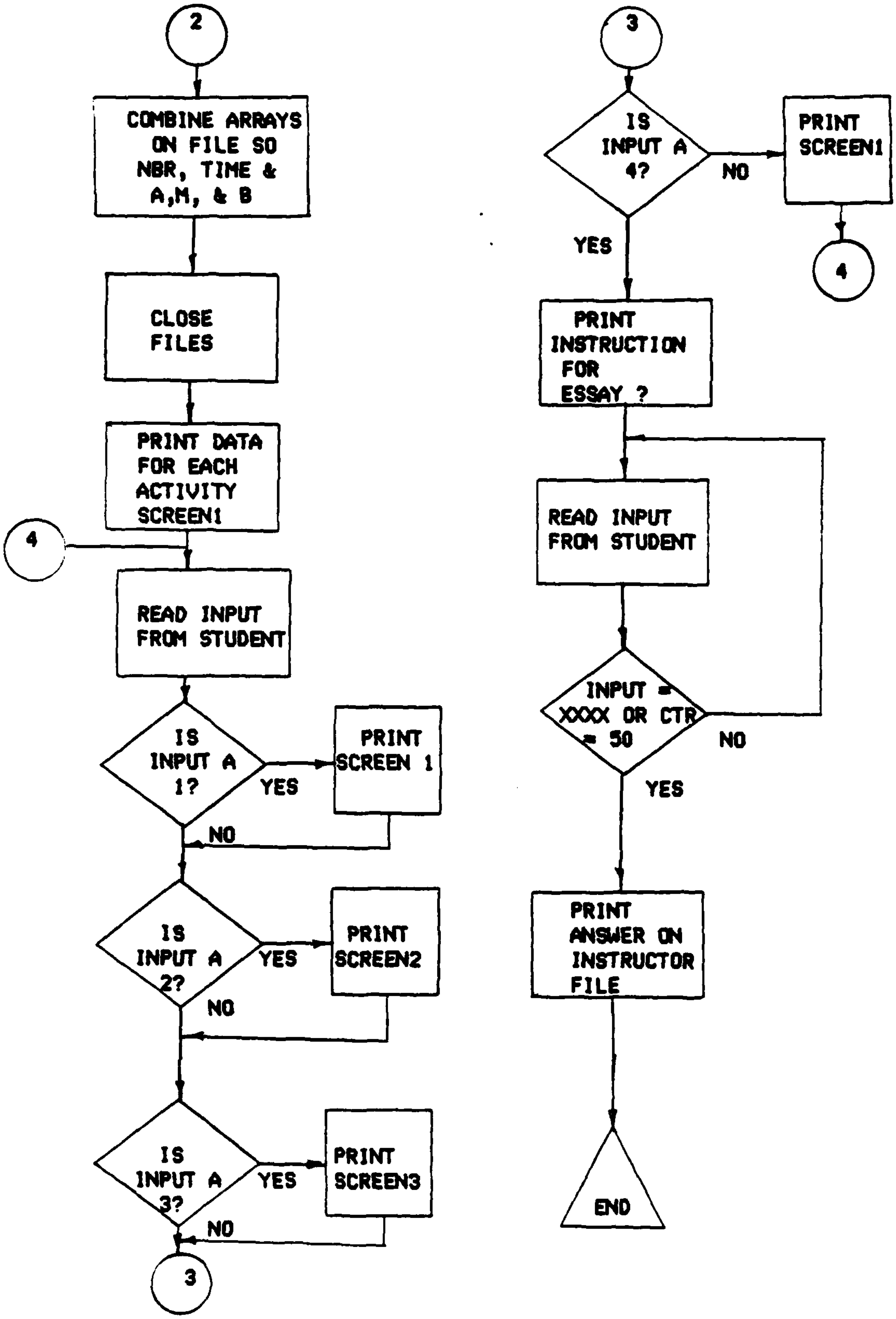

1
READ QGERT RESULT FILE
IS COL 15-17 = ***
YES
WRITE STRING TO TEMP TRACE FILE
NO
IS FILE AT END ?
NO
YES
END

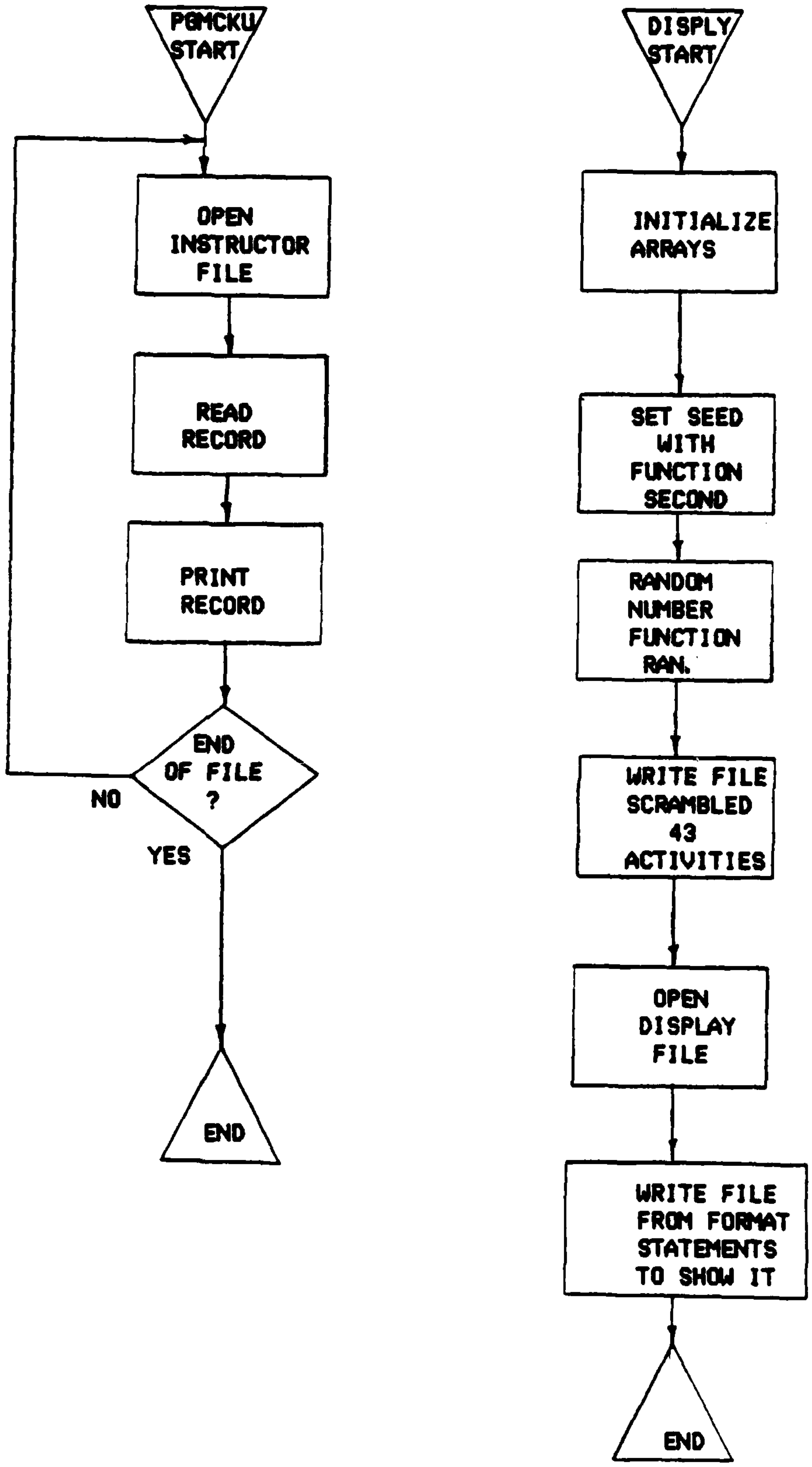

CPATH2 START
OPEN TEMP FILES FROM CPATH1
READ TEMP TRACE FILE
COMBINE LEFT & RIGHT SIDE STRINGS OF DECIMAL
ROUND OFF TIMES
TRACE FILE AT END
NO
YES
INITIALIZE HOLD AREAS TO COMPUTE CRITICAL PATH
1
1
READ START & END NODES PARAM SET & ACTIV NBR
FIGURE CRITICAL PATH FROM DATA GIVEN
WRITE ARRAY OF CRITICAL PATH ACTIVITIES
IS TEMP FILE AT END
NO
YES
PRINT TIMES AND ACTIVS ON NETWORK
EXPLAIN RQMTS FOR STUDENTS
2


2
READ STUDENT INPUT
IS INPUT = 100 ?
YES
NO
IS ARRAY AT END ?
NO
YES
IS ANSWER OK ?
YES
NO
IS IT 2ND TRY ?
NO
YES
WRITE TO INSTRUCTOR FILE
END



SNSAN1 START
PRINT MESSG ON CRITICAL PATH
READ CRITICAL PATH FILE
PRINT CRITICAL PATH
END OF FILE ?
NO
YES
PRINT TOTAL NETWORK TIME
PRINT 2 SCREENS ABOUT SENSITIVITY
OPEN QGERT INPUT FILE
1
1
READ QGERT FILE
IS COL1-3 PAR
NO
IS COL1-3 ACT
NO
YES
YES
WRITE PARAMETER SET TO TEMP FILE
WRITE NBR OF ACTIV TO TEMP
END OF FILE ?
NO
YES
CLOSE REWIND OPEN FILES
READ 43 ACTIVITIES & TIMES INTO ARRAY
READ 19 PARAMETER SETS INTO ARRAY
2


2
COMBINE ARRAYS ON FILE SO NBR, TIME & A,M, & B
CLOSE FILES
PRINT DATA FOR EACH ACTIVITY SCREEN1
4
READ INPUT FROM STUDENT
IS INPUT A 1?
YES
PRINT SCREEN 1
NO
IS INPUT A 2?
YES
PRINT SCREEN2
NO
IS INPUT A 3?
YES
PRINT SCREEN3
NO
3
3
IS INPUT A 4?
NO
PRINT SCREEN1
4
YES
PRINT INSTRUCTION FOR ESSAY ?
READ INPUT FROM STUDENT
INPUT = XXXX OR CTR = 50
NO
YES
PRINT ANSWER ON INSTRUCTOR FILE
END


PGMCKU START
OPEN INSTRUCTOR FILE
READ RECORD
PRINT RECORD
END OF FILE ?
NO
YES
END
DISPLY START
INITIALIZE ARRAYS
SET SEED WITH FUNCTION SECOND
RANDOM NUMBER FUNCTION RAN.
WRITE FILE SCRAMBLED 43 ACTIVITIES
OPEN DISPLAY FILE
WRITE FILE FROM FORMAT STATEMENTS TO SHOW IT
END

## Appendix F: Game Manual

CONTENTS

## INSTRUCTOR'S SECTION

This exercise contains five procedures for the students as well as five procedures for the instructor. It is contained completely on the CDC CYBER located at ASD WPAFB, Ohio. A valid login user-ID and password is required for the instructor, as well as a number of user-IDs and passwords for students, depending on the number of student groups expected to run the exercise. (Contact the course director of LOG 260 at AFIT WPAFB, Ohio, for more information).

The programs and procedures in this exercise will not help the students or the instructor become programmers, nor will they need to know how to operate the CYBER or its command statements. All the necessary statements to run the exercise are contained within these instructions or in comments within the exercise itself. The only thing necessary is for the instructor to explain how to log in to the CYBER through the type of terminal that is available.

Due to the variation in terminals available to the user of the CYBER, there will be no discussion concerning how to initialize a particular terminal. However, for whatever type of terminal used, it is important to find out what the ESCAPE and CONTROL keys are. On the Burroughs terminals in room 210 of building 641 at AFIT, for example, the GO key emulates the ESCAPE key of the CYBER, while the CODE key emulates the CONTROL key of the CYBER.

Procedure LIBM1 is the initializing procedure for both students and the instructor. It builds the libraries that will be used during the execution of the exercise. Once this procedure is complete there is no longer any procedure that the students and the instructor both use.

There are three questions that are asked of the user at the beginning of LIBM1. The first one, "ARE YOU A STUDENT TAKING THIS COURSE ?", is self explanatory. The second one, "WHAT IS YOUR 2 DIGIT GROUP NUMBER ?", requires the input of the group number that you assign to the student groups before the exercise starts. In your case, as an instructor, your group number can be any two digit number that you did not assign to a student group. It is important at this point to remember that the students should always enter a two digit number even when their group number is less than 09. Remember groups with numbers higher than 07 will all have the same 'go ahead' passwords, so it behooves you to keep the size of the groups sufficient to have less than eight groups per class.

The third question, "WHAT IS YOUR STARTUP CODE (STUDENTS USE ST)?", is to insure that students cannot access your portion of the exercise. Only your password matters; it does not matter what the students put in as long as it does not match your password. Your "start-up" password is provided later under the section entitled "Passwords". This procedure takes about three minutes to complete.

Instructor's Procedures

A. BINARY.

This procedure assures all of the programs necessary to run the exercise are present under the instructor's user-ID. If a source program is not present, it is necessary to load the missing files from the Burroughs floppy disc see the section describing the tape job for a list of the required BIN (binary) files. In addition, this procedure lists for the instructor the required passwords for later use by the students. This procedure has no introductory questions that must be answered. Depending on the number of files necessary to compile and the CYBER environment, this procedure takes between three and 20 minutes.

B. PREP.

This procedure is simply a preparatory explanation for the instructor. It explains the execution of the procedure DISNET, and provides the necessary commands to execute this procedure. There are two screens of information in this procedure. It may be necessary to run this one several times in order to get all the information. Simply type in PREP as many times as needed to get all the information on the screens. This procedure can be completed in less than two minutes.

C. DISNET.

This procedure is for the instructor to generate a scrambled file of the activities in the network. Each group running the exercise receives a unique file. The purpose is to insure the groups have independent listings to work from in order to minimize collaboration between the groups. This procedure also generates a two page display that will be printed on 15" paper so that the group using it has plenty of room to make notes and to calculate the various times.

There are three questions that this procedure will ask of you. The first one, "WHAT GROUP NUMBER (2 DIGIT) IS THIS NETWORK FOR ?", is expecting a two digit number so that an identifier can be put on the listing for you to determine which group gets which listing.

The second question, "WHAT IS THE FILE NAME YOU WANT FOR THAT GROUP ?", is expecting a six digit or less name that will be unique to that group. The third question, "WHAT IS THAT GROUPS LOGIN USERID (7 POSITIONS) ?", is expecting the user-id that you passed out to the group at the beginning of the exercise.

All three of these questions are to insure the groups do not get their listings of the network mixed up with the wrong file of scrambled activities. As long as you provide answers to these questions that are unique to each group, the computer will do the rest. By itself, this procedure takes about two minutes to complete, but remember, it must be done once for each group in the exercise.

D. CHECKU.

This procedure allows you to check on each group from your own terminal when it is hooked up to the CYBER. You may use this procedure to see what stage the students have completed. Each student procedure in the exercise writes a message to a file and that file is printed in this procedure. The message provides a means of determining how a particular group is progressing, without them knowing the instructor is checking on them. This procedure will be very useful for verifying students' progress when it comes time to give out the "go ahead" passwords or filenames to the various groups.

This procedure asks two questions at the beginning. Both questions, "WHAT GROUP NUMBER (2 DIGIT) ARE YOU LOOKING AT ?", and "WHAT IS THAT GROUP'S USER-ID (7 POSITIONS) ?", are self-explanatory. This procedure is a very short one and can be completed in under two minutes.

E. ADPGIT.

This procedure is for use only by the instructor, before the exercise has begun, (before he has done the start-up procedure LIBM1) or after the exercise has been completed by the students. With it you can purge all unnecessary files on the instructor's user-ID that are left over from running the exercise. It does not purge any files for which it does not know the filename (only filenames from the exercise will be purged).

The only question that this procedure asks at the beginning is, "WHAT IS THE PURGE PASSWORD ?". That password is provided for you later in the section entitled "Passwords". The procedure takes a very short time to run.

## Students Procedures

The procedures on the students' library all pertain to running the exercise and are not useful for any other purpose. Those procedures are as follows:

A. INTROD.

This procedure is the introduction to the exercise for the student. It provides the credits, a brief description of the exercise, and gives some general guidelines for helping the student during the running of the exercise.

It is during this procedure that the simulation job is batched and the necessary files catalogued. The simulation, using Graphical Evaluation Review Techniques with Queing (Q-GERT) to manipulate the network, is run in the "background" so it does not interfere with the execution of the exercise. The student is not even aware of its running except for a message that says "Submit Complete".

There are no questions at the beginning of this procedure. It can be completed in about 15 minutes.

B. PRGTXT.

This procedure is based upon 64 questions that pertain to Program Evaluation Review Techniques (PERT) and network analysis. Multiple choice answers were added to the questions to provide absolute right or wrong answers. Then everything was computerized in the format of a programmed text learning exercise.

This procedure is designed so it need not be completed in one sitting. In addition, if there are enough terminals available, students can be assigned numbers from one to 99 and this portion of the exercise can be completed individually. (Be careful, however, in assigning numbers so that an individual does not have the same number as a group.) There are no prompting questions at the beginning of this procedure.

You can examine the instructor's file any time during this procedure to see how the students are doing, simply by using your procedure called CHECKU as described before. The minimum time necessary to complete this procedure is an hour and a half. The time can be extended by including break time or if a group gets an inordinate number of questions wrong. The average time to complete this portion is two hours, with no break.

C. ACORDR.

This procedure provides a means for the students to determine the precedence of the activities in the provisioning process. The list of activities presented to them is randomized, both in order of presentation and the letter pairs that are to be matched with the numbers. This is intended to make intergroup collaboration very difficult.

In order to run this procedure, the instructor must provide the individual groups with a "go ahead" password and a filename. The file contains the scrambled activities that match the copy of the displayed network for each group and the password allows them to continue. Ideally this permission would be given after the instructor has run the CHECKU procedure to determine how well the group did on the programmed text (PRGTXT) procedure. Team members then determine activity relationships.

There are three questions asked at the beginning of this procedure. Each question expects as a response from the student, the same information that you, the instructor, provided earlier to the computer during your DISNET procedure. You must be certain that you have provided each group with the necessary information. The questions for this procedure are (1) "WHAT IS THE FILE NAME THE INSTRUCTOR GAVE YOUR GROUP ?", (2) "WHAT IS YOUR GROUPS 2 DIGIT GROUP NUMBER ?", and (3) "WHAT IS YOUR 3 POSITION GO AHEAD CODE ?".

With good interaction among at least three group members, familiar with provisioning, this procedure can be done in two hours. Most likely, however, one should plan on three hours.

D. CRPATH.

This procedure builds on the last one, because the student now knows the activity order and the expected completion times for all the activities. The student is expected to take down pertinent information as it comes on the screen, so that he/she can compute the critical path.

The student will type in his choice for the critical path from the operational need date going backwards to the start date. Students will get two chances to get the critical path correct. If one activity is out of sequence in the path, the attempt is counted as wrong. The correct critical path will be displayed for the students at the start of the next procedure.

You will be provided with a copy of the correct critical path when you run the CHECKU procedure which was explained earlier. You will then be able to compare the correct path with those produced by the students.

Once again, the students cannot go to the next procedure until you provide the "go ahead" password and a filename for them. There are two questions the students must answer at the beginning of this procedure. They are (1) "WHAT IS YOUR 2 DIGIT GROUP NUMBER ?", and (2) "WHAT IS YOUR 3 POSITION GO AHEAD CODE ?". This procedure takes about one hour to complete.

E. SNSANL.

This procedure is for sensitivity analysis of the provisioning process as depicted in the simulation. First, the procedure displays the critical path and associated expected completion times from the previous procedure. Next, it displays for the students a complete list of all the activities, along with their associated elapsed time from the simulation, and their optimistic, most likely, and pessimistic times (a, m, b) used in the simulation.

A very limited explanation of the possibilities when the activity times are changed is printed next. At this point, or sometime before, the instructor must supply questions for the student. These questions are essay type and require some thought and discussion within the groups. Space (up to 50 lines) is provided for groups to input their answers to the questions. They have the opportunity to change their answer as often as they wish. When students are satisfied with their answer, it is written to a file and a hardcopy is made for the instructor to comment on. In addition, you can examine the answers with your CHECKU procedure as before.

The three questions at the beginning of this procedure are exactly the same as those in the ACORDR procedure. The time for this procedure is totally at the discretion of the instructor. A knowledgeable student could conceivably finish in half an hour.

## Running the Exercise

A. Initializing.

Initializing the procedures is an easy task. The first time a student or an instructor logs on the CYBER, they both use the same statements. The following statements need only be used after the first login:

GET,MKLIB/UN=T841009 (return key)

BEGIN,LIBM1,MKLIB (return key)

From then on, it is a simple matter to log in and type the correct procedure name to take up where you left off. The instructor should log in and run the BINARY, PREP, and DISNET procedures at least one day before the students are expected to log in and run INTROD. Once these three procedures have been run they need not be run again.

B. Order of Execution.

The running of the exercise should be in the following order for the students:

1--INTROD
2--PRGTXT
3--ACORDR
4--CRPATH
5--SNSANL

Although there is a specific order for completion, the amount of time allotted is up to you, the instructor. Each procedure, except PRGTXT, must be run from start to finish without logging out, unless the student uses the DETACH command explained in the students' manual.

## Reloading Files and Modifying Passwords

A. Loading files.

The files are all contained on a double sided double density floppy disc fromatted for the Burroughs B20 system. Prior to running the exercise it is necessary to load the files from the disc to the CYBER. To do this, it is necessary to use the file transfer functions of the asynchronous terminal emulator on the B20 system, if the proper files are not permanent indirect access files on the instructor's user-ID on the CDC CYBER.

Procedure file --MKLIB

Data files ------ACTIVS PRITS

If any of the following binary files are not present on the instructor's user-ID, the procedure BINARY will replace them as long as the source file that generates it is present:

| SOURCE FILE | BINARY FILE |
|---|---|
| PGMTXT | TXTBIN |
| INTROD | INTBIN |
| RNDMPR | RNDBIN |
| CPATH1 | CP1BIN |
| CPATH2 | CP2BIN |
| DISPLY | DSPBIN |
| SNSAN1 | SA1BIN |
| PGMCKU | CKUBIN |

B. Passwords.

The instructor's startup code is "ZP". It is used in the procedure that prepares the libraries for the student as well as the instructor. In the studnt's procedure the password shown is "ST". The instructor's purge code is "ZAP". This password is used in the ADPGIT procedure by the instructor at the end of the exercise. The following passwords are the "go ahead" passwords the students need to access the procedures ACORDR, CRPATH, and SNSANL. The instructor should provide each group with a "go ahead" password as that group successfully completes each procedure. It is essential that the instructor keep this list safeguarded from the students. The passwords are listed under the procedure in which they are used. For example, when group one successfully completes PRGTXT they need the "go ahead" password "GHO" in order to run ACORDR.

| Group | ACORDR | CRPATH | SNSANL |
|---|---|---|---|
| 1 | GHO | DOG | NAD |
| 2 | BOI | OKD | LAT |
| 3 | TES | RIT | YES |
| 4 | FIR | BOM | AFT |
| 5 | LAS | MAR | CAT |
| 6 | NAB | CAR | YEL |
| 7-99 | GAM | APR | REM |

When the instructor assigns group numbers, he must insure that the students know that whenever the computer asks for a group number it needs two digits. So, if the group numbers are from one through nine the students must input them as "01" thru "09".

C. Changing Passwords.

If an instructor wishes to change the "go ahead" passwords, the "purge" password, the instructor's access password, or filenames, he only needs to use the CYBER XE editor. The necessary variable names are located on the procedure file listed above. There are no passwords or permissions necessary to modify this file from the instructor's user-ID. It is recommended that every couple of months (or classes) the instructor should change his login password. Use the "passwor" command as described in the NOS User's Guide.

## File Descriptions

A. Program Source and Binary files.

The program listings for these files can be found in Appendix D, and the flowcharts can be found Appendix E of AFIT Thesis LSSR 84-16. In the following descriptions, the binary files are those that end in BIN, the other of the pair is the source code file. For a description of the files utilized by each program, see Attachment 2 of this appendix.

1. INTROD---INTBIN.

This program is simply a series of print statements that explain the exercise and what will occur during it. The program also reminds the students of several error messages and things that are important to remember throughout the game.

2. PGMTXT---TXTBIN.

This program contains the 64-question programmed text exercise. For each question there are three or four multiple choice answers. If the wrong answer is chosen, the paragraph preceding the question and the question will be printed again. Several questions require calculations. On these questions, there are multiple answers. All the answers for each of these questions must be correct in order to get credit for the question. Scores are maintained and written to an instructor's file.

There is an option at each question that offers a chance to take a break. It is, therefore, not necessary to complete the entire programmed text at one sitting.

3. RNDMPR---RNDBIN.

This program scrambles the order of presentation of the activities in the network. The program uses the CYBER function SECOND to initialize the seed for the random number generator RANF, another CYBER intrinsic function. The resulting numbers randomize the array containing the the activities. After some explanation, the program asks the student for input.

The input is the student's attempt to give some order to the events on the list. He must match the two position alpha-numeric code on his printout with the two digit numeric code presented on the screen. Even though the presentation is scrambled and the order on the diagram is scrambled, the original matched file is kept in an array to use in determining whether the answer is right or wrong.

The program keeps track of wrong answers, right answers already used, inputs that are not valid numeric choices (choices are from four to 40), and number of chances left. The first three activities after the scramble are given at the beginning to provide a starting point. The student is allowed 90 chances to get all 40 activities correct.

4. CPATH1---CP1BIN.

This program takes the output file from the Q-GERT run and extracts data to be used in subsequent programs. Pertinent information used include start and stop times for activities and the start and end nodes for each activity. The output file from Q-GERT is 132 characters long and contains every conceivable character. It was necessary to write files from this file so that later on in the programs, the arithmetic operations could be performed on the fields after they were described as integers. There are several temporary files used in CPATH2 that are created in this program.

5. CPATH2---CP2BIN.

This program takes the files from CPATH1 and uses them to determine the critical path from the Q-GERT simulation. It then provides the students with the opportunity to determine the critical path. The program computes the critical path using the actual completion times from the simulation.

The student inputs are all expected to be completed before the computer responds with a correct or incorrect reply. It provides a "?" prompt every time it expects an activity number to be input. If the student feels he made an error he can input a zero (0) and start over, since all the activities must be correct to get the computer to agree that he has figured the correct critical path.

The answers input to the computer are kept and written to the instructor's file. The instructor also gets a list of the correct critical path so he can make a comparison to what the students have input to see if there are specific problem areas.

6. SNSAN1---SA1BIN.

This program prints out the correct critical path to the student. A short explanation of the changes that can occur when the times for the activities on the critical path are changed is next.

Using the Q-GERT program file, the optimistic (m), most likely (a), and pessimistic (b) times are matched up with the activities. The times (a,m,b) and the actual elapsed time for each activity from the simulation, along with its description and number, are then listed for the student.

Space is provided on the instructor's file to write the answers to several essay type questions the instructor can supply. A simple, short "word processor" is provided to allow only 70 characters per line, and up to 50 lines for the answer. The students have unlimited rewrite capability for their answers. The instructor's file is then printed, so the instructor can make written comments on the answers.

7. DISPLY---DSPBIN.

This program scrambles the alphabetic codes on the activity file, and then prints a display of the network to match the scrambled file. The program uses the same method of randomizing that was used in program RNDMPR. The resulting numbers randomize the array that contains the alphabetic codes for the activities.

8. PGMCKU---CKUBIN.

This is a short program that prints the information contained in the instructors file INSTRK.

9. BTCH1---PRITS.

These files, although not source and binary files, have the same relationship. BTCH1 is the executable batch job that runs the executable Q-GERT program called PRITS. BTCH1 conforms to NOS 2.1 syntax on the CYBER for batching jobs, while PRITS contains the necessary syntax to execute the simulation based on the instructions provided in Q-GERT.

B. Data File Descriptions.

1. QRSLTS-- this file is the oputput file from the Q-GERT simulation. The file is printable output in 132-character format. It is a permanent file on the instructor's user-ID.

2. TMPINS-- this file is written to from programs PGMTXT, RNDMPR, CPATH2, AND SNSAN1. It contains information for the instructor that will help him determine if his teaching objectives are being met. In each procedure that the temporary file is used, it is appended to the permanent file INSTRK.

3. INSTRK-- this file is a permanent file under each groups user-id. It contains that group's status after each of the following programs: PGMTXT, RNDMPR, CPATH2, and SNSAN1.

4. SACT-- this is the local file name for the permanent file SAFLE. File SAFLE is a pseudonym for the file that the instructor created in the procedure DISNET. The file contains the scrambled activities for a particular group, along with the description and number of the activity. Each user-ID has its own SAFLE that is unique and is a permanent file. SAFLE is a substitutable name, that is, when the instructor answers the filename question in procedure DISNET, the name he uses is substituted wherever SAFLE occurs in the procedure.

5. RECVRY-- this file is used only in the programmed text portion of the exercise. It contains the question number and a code for a right answer (1), or a code for a wrong answer (2). This file is used to reposition everything in the programmed text procedure so it is possible to take a break during the procedure. The "0" option for each answer gives the student a chance to take a break. Each user-ID contains this file as a permanent file.

6. TSTAFL-- this file contains four fields: the start node, ending node, parameter set number, and the activity number. These data fields are extracted from file QRSLTS for each activity. After the file is used in CPATH2, the temporary file is discarded.

7. TSTTFL-- this file passes the beginning and ending events from program CPATH1 to CPATH2. After the file is read into CPATH2, it is discarded. The first field on the

record is an indicator code to tell whether the event is the starting or the ending event in the network. The second field is the event number itself.

8. TSTCFL-- this temporary file contains three fields that were extracted to form the QRSLTS file. Field 1 has the left side and field 2 has the right side of the decimal from the character string that is the ending time of an activity on a line of the QRSLTS file. Field 3 has the activity number from that line of the QRSLTS file.

9. TSTT3F-- this temporary file contains two fields. Field 1 is the time of completion of the activity after the left and right side of the decimal were combined and rounded off. If the right side of the decimal was greater than 50, then one was added to it, otherwise zero (0) was added. Field 2 is the activity number involved. AFter CPATH2 has run this file is discarded.

10. ACTTME-- this file contains all the activities and their elapsed times in two fields. The first field is the activity number and the second is the elapsed time for that activity. This file is discarded when CPATH2 is complete.

11. CTLPTH-- this file is a permanent file on each students user-id. The first record on it is a header. After that it contains two fields for each activity on the critical path. Field 1 is the activity number and field 2 is the completion time for that activity. This file is printed in

SNSANL procedure to show the student the correct critical path.

12. PRACT-- this temporary file, used in program SNSAN1, contains the activity card data from the Q-GERT input file, PRITS. It contains four fields: field 1 is the start node, field 2 is the end node, field 3 is the parameter set indicator, and field 4 is the activity number itself.

13. PRPAR-- this temporary file, used in program SNSAN1, contains the parameter sets from the Q-GERT input file PRITS. It contains four fields, the parameter set number is field 1, field 2 is the optimistic time, field 3 is the most likely time, and field 4 is the pessimistic time. These times are those that were used in the simulation to arrive at the elapsed time for each activity.

14. AMBFL-- this temporary file contains four fields taken from files PRACT and PRPAR: field 1 is the activity number, field 2 is the optimistic time, field 3 is the most likely time, and field 4 is the pessimistic time. Each activity on the PRACT file is shown only once and each parameter set (a,m,b) on the PRPAR file appears only once. However, there are 19 parameter sets and 43 activities, so they have to be matched up.

It may appear as though many files contain the same information, and they do; but when the originating file contains all the characters of the character set, it is necessary to treat the complete line as a character string.

In doing so, it is impossible to compare a character variable to an integer variable. To alleviate this incompatibility, it is easy to write the information to a file as a character string with spaces in the format and read it back from that file in list-directed mode and call it an integer.

15. INFORM-- this file contains all the information presented to the student during the sensitivity analysis procedure. After it is printed it is discarded.

16. ALPHA-- this file contains all the two position alpha-numeric codes that appear on the display of the network for each group. There is only one field on this file, the two position alpha-numeric code.

17. DSPLY-- this file contains the drawing of the network along with the coded activities. It is printed during the execution of the procedure DISNET and then released.

C. Files Associated with Q-GERT.

1. PRITS-- this file is the executable Q-GERT program, containing activity cards, parameter cards, stat-node cards, and the remainder of the cards necessary for a Q-GERT program.

2. QRSLTS-- this file, addressed earlier, is the output of the Q-GERT simulation. It is created in the batch job BTCH1.

3. QGERTS and SEGQGRT-- are ASD library files that contain Q-GERT execution commands. They are required files

when running a Q-GERT program on the CYBER.

D. Procedure Related Files.

1. MKLIB-- this is the file that contains most of the procedures used in this exercise. It is a permanent file on the instructor's user-ID.

2. DISN-- this file contains the DISNET procedure used by the instructor to display the network for each group.

3. STULIB-- this is the file containing the student procedures. It was created using the LIBGEN command referenced in the NOS User's Guide . It is a permanent file on each student user-ID after the initial login procedure is accomplished.

4. INSLIB-- this is the file containing the instructors procedures in library format. It is a permanent file on the instructor's user-ID.

5. MYLIB and PROCFIL are AFIT associated files that will help a novice with the CYBER system commands. They contain short forms of the normal CYBER commands in use at ASD. They are only needed if things other than the exercise itself will be run.

## STUDENT'S SECTION

Welcome to the provisioning exercise. This exercise is meant to increase your knowledge, skills, and abilities in three areas: the provisioning process as it is used today in the Air Force, network analysis as it pertains to that process and, hands-on computer experience, intended to give you confidence in using the computer.

The computer experience is very limited. For most, the exprience will not be a new one, but for some the computer is still something to leave alone and to let somebody else worry about. These are the individuals who will gain computer confidence from this exercise.

A. Machine Generated Messages.

There are several things you should remember while working on this exercise.

----PROCEDURE NOT FOUND----

This message indicates that you probably have mispelled the procedure name that you want to execute. If that is not the case and you still get this message, see your instructor.

---- <---ERROR IN COL 0 OR COL 1----

This message indicates that you have entered an alphabetic character where a numeric character should have been, or vice versa. At any rate, the machine will not let you continue until you have typed in the correct character.

----0END OF FILE ENCOUNTERED----

This message indicates that when the machine was expecting some information from you, you hit the carriage return and had nothing in front of it. Unfortunately, when you get this error, you must go back and start that procedure over again. There is no other cure for this error, so be careful and pay attention to what you type in.

----TIME OUT IN 30 SECONDS----

This message indicates you have not entered anything into the computer for five minutes. This is an internal machine restriction. When this occurs, you have 30 seconds to input something into the machine. If you do not input in time, the machine will DETACH your job. This means the machine has put your job on hold. If, within the next 30 minutes, you log back in and tell the machine to get a specific job and continue it, you will be in exactly the same position as you were before you were DETACHED. All your files will be opened and the pointer will be in the same place as before, as if you were never logged out.

By the same token, you can DETACH your job yourself. To DETACH your job, hit the ESCAPE key, then hit the "D" key followed by the RETURN key, in that order. Your job will then be DETACHED, or put on hold for 30 minutes. You have 30 minutes to log back in and recover your job. Attachment 2, Sample Computer Responses, illustrate these login and logout techniques.

B. Things to Remember.

Throughout the running of the exercise there are a few things that you, the student, should remember.

1. To begin the game, only the very first time that you login to the CYBER, you need to type the following lines:

GET,MKLIB/UN=T841009 (hit return key)

BEGIN,LIBM1,MKLIB (hit return key)

Each subsequent time after you login, you only need to type in the procedure name that you wish to enter.

2. At the beginning of the exercise, the instructor will assign you to a group. The number for your group will always be a two digit number. If your number is in the range one through nine your number will have a zero prefix (i.e. 01,02,03). Whenever the machine asks for your group number, be sure to use the zero prefix otherwise the machine will not recognize the input.

3. The instructor also assigned you a user-ID and password. It is imperative that you not forget them, nor that you compromise them to other groups. You will need them each time you log in.

4. Although the machine will tell you what to type when, it will be helpful to remember what procedure is for what part of the exercise. Here is a list of what's what:

(1) INTROD --Introduction and Run Simulation
(2) PRGTXT --Programmed Text
(3)* ACORDR --Activity Precedence
(4)* CRPATH --Critical Path Calculation

(5)* SNSANL --Sensitivity Analysis

The procedures with the asterisks require special permission and a special filename that your instructor will give you. Upon completion of a procedure, you must go to your instructor and he will check your work. Upon satisfactorily completing that procedure, the instructor will give you a password and a filename, if it is required, for the next one. In addition, each procedure must be completed in the order shown above.

## Appendix F, Attachment 1: FILE USAGE CHART

| PROCEDURE NAME | INPUT FILES | BINARY FILE | SOURCE FILE | OUTPUT FILES | PERMANENT FILES |
|---|---|---|---|---|---|
| INTROD | BTCH1 | INTBIN | INTROD | QRSLTS | BTCH1 |
| | PRITS | | | | PRITS |
| | | | | | QRSLTS |
| | | | | | INTBIN |
| PRGTXT | | TXTBIN | PGMTXT | TMPINS | RECVRY |
| | | | | RECVRY | INSTRK |
| ACORDR | SACT | RNDBIN | RNDMPR | TMPINS | SAFLE |
| | | | | | INSTRK |
| | | | | | RNDBIN |
| CRPATH | QRSLTS | CP1BIN | CPATH1 | TSTAFL | QRSLTS |
| | | | | TSTTFL | CP1BIN |
| | | | | TSTCFL | |
| | | | | TSTT2F | |
| | TSTAFL | CP2BIN | CPATH2 | ACTTME | CP2BIN |
| | TSTCFL | | | TSTT3F | CTLPTH |
| | TSTT2F | | | TMPINS | INSTRK |
| | TSTT3F | | | CTLPTH | |
| | ACTTME | | | | |
| SNSANL | CTLPTH | SA1BIN | SNSAN1 | PRACT | CTLPTH |
| | PRITS | | | PRPAR | PRITS |
| | PRPAR | | | AMBFL | SAFLE |
| | PRACT | | | INFORM | INSTRK |
| | ACTTME | | | TMPINS | SA1BIN |
| | AMBFL | | | | |
| | SACT | | | | |
| DISNET | ALPHA | DSPBIN | DISPLY | SACT | ACTIVS |
| | ACTIVS | | | DSPLY | ALPHA |

| PROCEDURE | INPUT | BINARY | SOURCE | OUTPUT | PERMANENT |
|---|---|---|---|---|---|
| CHEKU | INSTRK | CKUBIN | PGMCKU | | CKUBIN<br>INSTRK |
| BTCH1 * | QGERTS<br>SEGQGRT | PRITS ** | | QRSLTS | PRITS<br>QRSLTS<br>QGERTS<br>SEGQGRT |

* Batch job to execute QGERT
** Not a binary file, but an executable QGERT program

Appendix F, Attachment 2: SAMPLE COMPUTER RESPONSES

A normal login would appear like the example below:

```
84/07/23.  09.59.49. N141411
(01) * ASD COMPUTER NOS CSA *      NOS 2.1-580/577A
USER NAME: xxxxxxx
PASSWORD : yyyyyyy
JSN: zzzz, NAMIF

WELCOME TO NOS PRODUCTION

TIME LIMIT SET TO MAXIMUM

/
```

---

A normal logout would appear like the example below:

```
/logout
UN=T843301   LOG OFF   10.01.34.
JSN=ABCD     SRU-S        2.063
IAF     CONNECT TIME  00.01.27.
LOGGED OUT.

HOST DISCONNECTED   CONTROL CHARACTER=(ESC)
ENTER INPUT TO CONNECT TO HOST
```

The logout and login to recover a "DETACHED" job or a job that was detached because the terminal "timed out"would appear like the example below:

```
TERMINAL TIMEOUT IN 30  SECONDS

UN=T843301    LOG OFF    11.01.34.
JSN=ABCD      SRU-S         2.163
IAF      CONNECT TIME   00.11.27.
LOGGED OUT.

HOST DISCONNECTED   CONTROL CHARACTER=(ESC)
ENTER INPUT TO CONNECT TO HOST

 (hit the return key )




84/07/26.  19.59.49. N141411
(01) * ASD COMPUTER NOS CSA *      NOS 2.1-580/577A
USER NAME: xgxgxgx
PASSWORD : yayayay
JSN: SDFG, NAMIF


WELCOME TO NOS PRODUCTION


TIME LIMIT SET TO MAXIMUM


   RECOVERABLE JOB(S)

   JSN     UJN        STATUS             TIMEOUT


   ABCD    ADEQ       SUSPENDED          28 MIN.
```

```
ENTER GO TO CONTINUE CURRENT JOB,
      RELIST TO LIST RECOVERABLE JOBS,
OR DESIRED JSN:
```

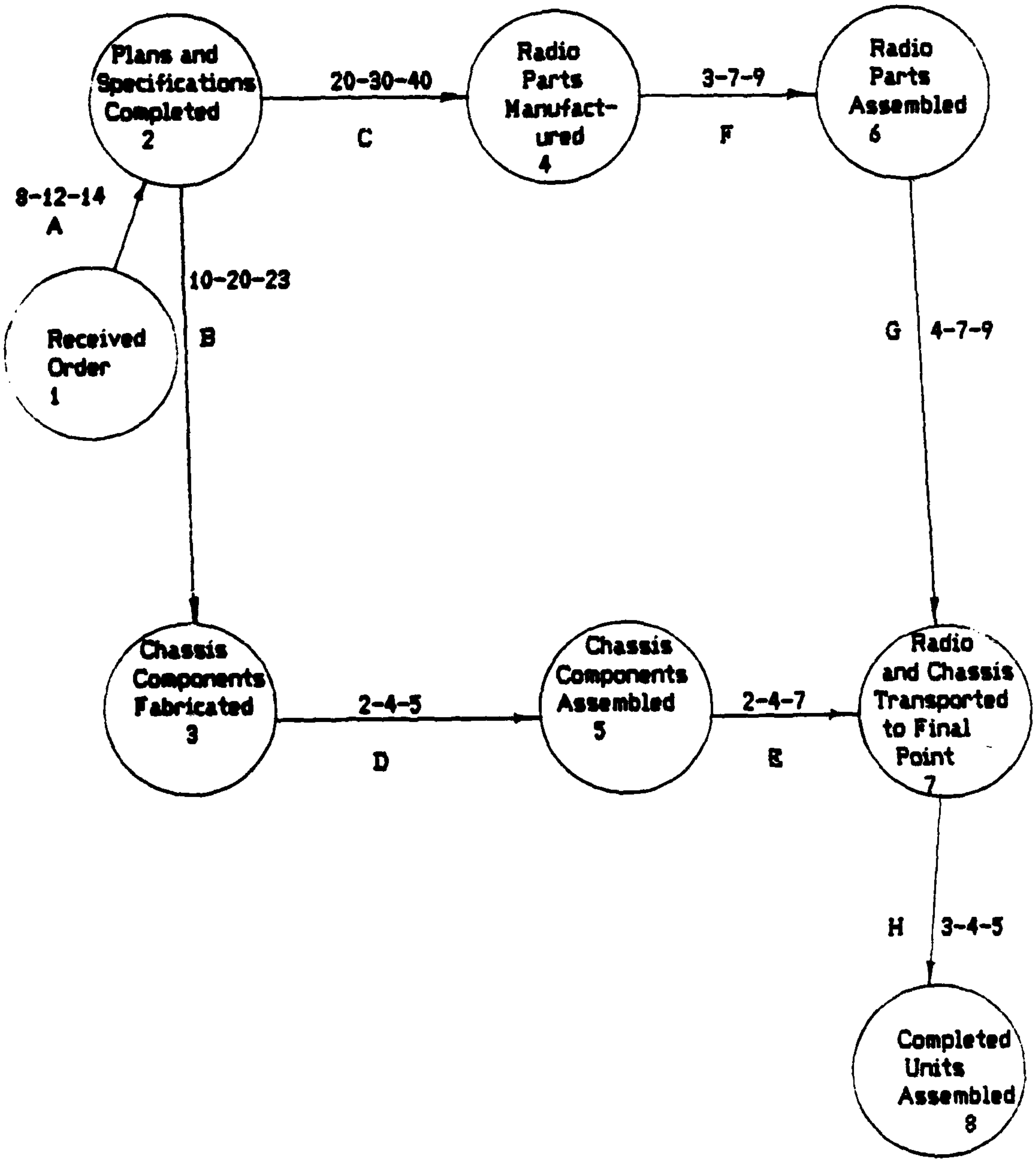
(enter jsn number of job that you want to continue)

```
JSN: ABCD  SYSTEM: BATCH   SRU: 2.059

STATUS: IDLE  CHARACTER SET: NORMAL

MODES: PROMPT OFF   ENTER COMMAND.
```

Appendix F, Attachment 3: CHARTS FOR PROGRAMMED TEXT

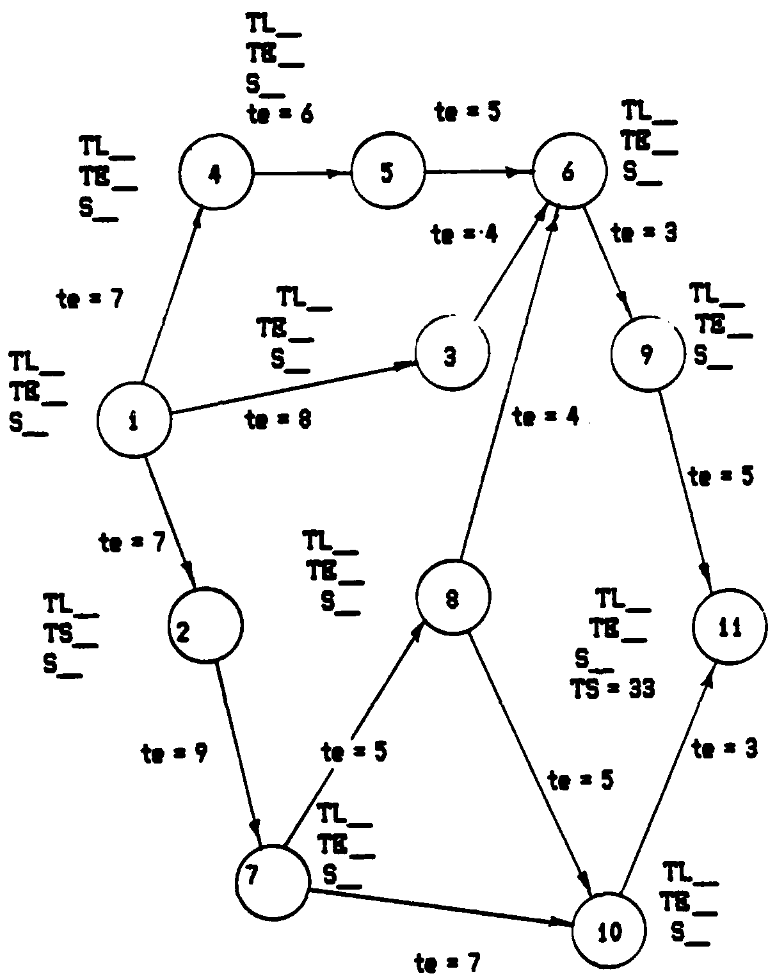
A SIMPLIFIED PERT NETWORK

CHART 1



A SIMPLIFIED PERT NETWORK

CHART 2



## PERT FORMULA AND CASES

### CHART 3

$$te = \frac{a + 4m + b}{6}$$

where

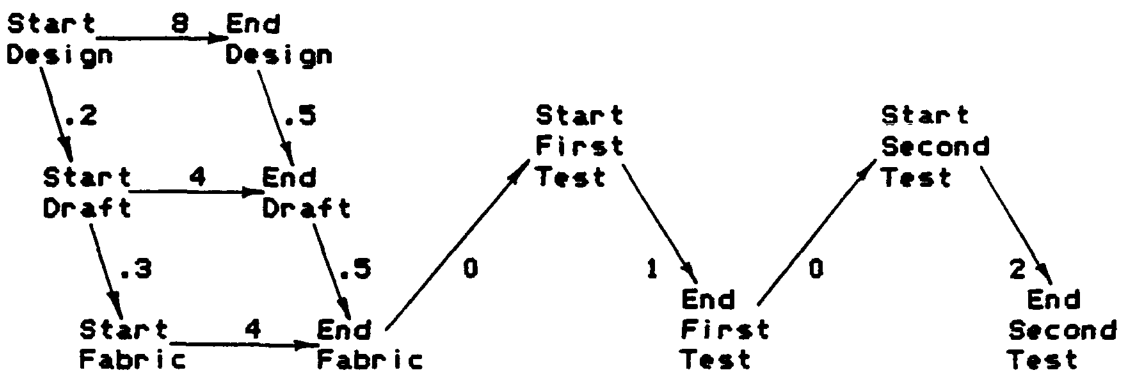
a = the most likely time
m = the pessimistic time
b = the optimistic time
te = the expected elapsed time for and activity

NOTE: In the statements that come across the screen during the programmed text lesson, all the letters appear as capital letters.

### CASE A for question 54 and 55

| Start | | End |
|---|---|---|
| Design | $\xrightarrow{8.0}$ | Design |
| Draft | $\xrightarrow{4.0}$ | Draft |
| Fabric | $\xrightarrow{4.0}$ | Fabric |
| First Test | $\xrightarrow{1.0}$ | First Test |
| Second Test | $\xrightarrow{2.0}$ | Second Test |

CASE B for questions 54 and 55



## Appendix F, Attachment 4: PROVISIONING ACRONYMS

The following acronyms are identified for the student to use while participating in the Network Analysis exercise.

ACO - Administrative Contracting Officer
ALC - Air Logisitcs Center
CASC - Cataloging And Standardization Center
CBIL - Common/Bulk Items List
CDRL - Contract Data Requirements List
DCN - Design Change Notice
DLSC - Defense Logistics Supply Center
DPC - Depot Provisioning Committee
DPML - Deputy Program Manager for Logistics
DSARC - Defense Services Acquisition Review Council
ECP - Engineering Change Proposal
ERRC - Expendability, Recoverability, Repairability Code
I & S - Interchangeability and Substitutability
ILSP - Integrated Logistics Support Plan
IM - Item Manager
IMC - Item Management Code
LLIL - Long Lead Items List
MIPR - Military Interdepartmental Purchase Request
MMIS - Material Management Branch (at ALC's)
MOS - Method of Support
NIMSR - Nonconsumable Item Material Support Request
NSN - National Stock Number
PCL - Post Conference Lists
PIO - Provisioned Item Order
PPCO - Provisioning Principal Contracting Officer
PPL - Provisioning Parts List
PPS - Provisioning Performance Schedule
PRS - Provisioning Requirements Statements
PTD - Provisioning Technical Documentation
PTDDSS- Provisioning Technical Documnetation Data Selection Sheet
RFP - Request For Proposal
RIL - Reparable Items List
RIPPL - Recommended Items Provisioning Parts List
RPT - Resident Provisioning Team
SAIP - Spares Acquisition Integrated With Production
SFPPL - Short Form Provisioning Parts List
SICA - Secondary Item Control Activity
SICN - Serialized Interagency Control Number
SMR - Source, Maintainability, Recoverableity
SOW - Statement Of Work
SPM - System Program Manager
SPO - System Program Office
SPTD - Supplementary Provisioning Technical Documentation

## Appendix f, Attachment 5: PROVISIONING FORMS

The following list provides the numbers and names of several of the forms commonoly used in provisioning:

AF Form 86, Request for Cataloging Data/Actions

AFLC Form 326, Provisioned Item Order (PIO)

AFLC Form 718, Provisioning Performance Schedule (PPS)

AFLC Form 771, Conference Notification

AFLC Form 773, Provisioning Document Transmittal

AFLC Form 778, Provisioning Document Internal Routing

AFLC Form 784, Provisioning Technical Data Requirement

AFLC Form 794, Provisioning Management Control-Spare Parts

AFLC Form 1423, Contract Data Requirements List (CDRL)

DD Form 1664, Data Item Description (DID)

DD Form 1949-1, Provisioning Technical Documentation Data Selection Sheet (PTDDSS)

DD Form 1949-2, Provisioning Requirements Statements (PRS)

SF 30, Amendment of Solicitation/Modification of Contract

## Appendix F, Attachment 6: SAMPLE TERMINAL DISPLAYS

### Instructor's Checkup File

This display shows the file after the Sensitivity Analysis procedure. It shows the messages that appear after each procedure has been completed. In addition, it can be seen that group 01 took a break after question 5, and then completed the rest of the questions at one sitting. During the CRPATH procedure, group 01 missed the critical path by one activity the first time through. Notice that the correct critical path is provided so that the instructor is able to see the trouble areas easily.

```
GROUP  01
 AT QUESTION NUMBER   5  IS WHERE WE STOPPED FOR A BREAK
   WE HAVE MISSED   2  QUESTIONS SO FAR
 AT QUESTION NUMBER  64  IS WHERE WE STOPPED FOR A BREAK
   WE HAVE MISSED   4  QUESTIONS SO FAR
  ..............WE ARE ATTEMPTING  ACORDR..........
      47 -TRIES  43 -RIGHT  4 -WRONG
    ..........WE HAVE COMPLETED PROCEDURE ACORDR.....
    THE FOLLOWING IS WHAT OUR GROUP DID DURING THE
    PROCEDURE CRPATH...............
WE HAVE USED UP OUR 1 TRY, IT WAS................
 4 39 5 15 64 89 22 47 45 65 23 88 43 29 3 18 33 2 35 41 6 7
WE MISSED IT ON THE SECOND TRY ALSO,IT WAS.......
 22 15 5 15 64 89 22 47 45 65 23 88 43 29 3 18 33 2 35 41 6 7
THE FOLLOWING IS WHAT THE CRITICAL PATH SHOULD BE
 4 39 5 15 89 64 22 47 45 65 23 88 43 29 3 18 33 2 35 41 6 7
    ........WE ARE NOW FINISHED WITH CRPATH.........
    -HERE ARE OUR ANSWERS TO THE SENSITIVITY ANALYSIS-
THIS IS A TEST TO SHOW THE INSTRUCTOR WHAT TO
EXPECT FROM THE SENSITIVITY ANALYSIS
PROCEDURE IN THE EXERCISE
XXXX
    ...THAT CONCLUDES OUR ANSWER .......................
```

Sample Display From Procedure ACORDR

```
FIND THE PRINTOUT THAT YOUR INSTRUCTOR GAVE YOU THAT
CONTAINS THE GRAPHIC DISPLAY OF THE NETWORK. ON THAT
SHEET YOU MUST FILL IN THE EVENTS AND OTHER INFORMATION
AS WE GO OVER IT. FIRST, I WILL PROVIDE YOU WITH A LIST
OF ALL THE EVENTS IN THE NETWORK, YOU HAVE A COMPLETE
LIST OF THEM IN YOUR CLASS MANUAL. THE EVENTS LISTED ON
THE SCREEN HAVE A NUMERIC CODE, WHILE THOSE ON THE
PRINTOUT FROM YOUR INSTRUCTOR HAVE A MIXED TWO POSITION
CODE. TO TEST YOUR KNOWLEDGE OF PROVISIONING YOU MUST
MATCH THE NUMERIC CODE WITH THE CORRECT MIXED CODE. I
WILL PROVIDE TWO SCREENS OF EVENTS.  YOU WILL BE ABLE
TO PRINT THEM ON THE SCREEN AS MANY TIMES AS NEEDED (IF
YOU ARE AT A TELETYPE, IT IS NOT NECESSARY TO PRINT
EACH SCREEN MORE THAN ONCE).
TYPE GO AND HIT THE RETURN KEY TO CONTINUE........
?   THIS IS SCREEN 1
YOU HAVE 90 TOTAL CHANCES TO GET ALL 43 CORRECT, SCORE
WILL BE BASED ON THE NUMBER OF CHANCES THAT YOU DID NOT
USE. YOU WILL BE SHOWN THE NUMBER OF CHANCES REMAINING
AFTER EACH TRY. ENTER THE NUMBER FIRST AND THE ALPHA
SECOND, EACH AT ITS OWN ? PROMPT LIKE THIS EXAMPLE ...
?53
?Y1
 ...MEANS NUMBER 53 FROM THE LIST GOES WHERE EVENT Y1
IS SHOWN ON YOUR COURSE MATERIAL. I WILL GIVE YOU 3
ACTIVITIES AND THEIR LOCATION AS HELP AT THE START,

43 L3 SPM ASSIGNS CONTRACT RESPONS. TO DOD AGENCY

37 N1 I & S REVIEW BY CASC (86)

02 M3 NSN FORWARDED TO ACO BY CASC


TYPE GO AND HIT RETURN WHEN YOU ARE READY TO CONTINUE
?  PLEASE USE YOUR PRINTOUT TO HELP KEEP TRACK OF WHAT
GOES WHERE IN THE NETWORK......BECAUSE I WILL NOT KEEP
TRACK OF PREVIOUS ATTEMPTS THAT WERE WRONG.
BY TYPING IN THE SCREEN NUMBER YOU CAN SEE THE SCREENS
AGAIN.          1 - THIS SCREEN OF INSTRUCTIONS (SCREEN 1)
                2 - SCREEN 2 OF DATA
                3 - SCREEN 3 OF DATA
                4 - TO ENTER A CHOICE IN THE NETWORK
ENTER YOUR CHOICE 1 THRU 4 AT THIS TIME PLEASE.
```

```
?   THIS IS SCREEN 2

 27 -- CANCEL PIO (SUB FOUND) OR ASSIGN NSN (NO SUB)
 05 -- SYSTEM START-UP ACTIVITIES
 16 -- PIO (326) REVIEWED BY SPM ALC
 09 -- POST-PROV CONFERENCE ACTIONS
 12 -- SPM ALC REVIEWS PCL & SPTD
 18 -- DUE-IN ESTABLISHED IN J041 SYSTEM
 25 -- IM ASSIGNS MOS CODE & SENDS TO SPM ALC (778/773)
 24 -- FSD PROPOSAL PREPARED & SUBMITTED BY CONTRACTOR
 20 -- PROVISIONING CONFERENCE
 35 -- SPM ALC REVIEWS ITEMS CODED BY IM ALC'S
 33 -- PPL'S DEVELOPED BY CONTRACTOR & SENT TO SPM ALC
 30 -- RFP PREPARED BY SPM & SENT TO CONTRACTORS
 31 -- PR/MIPR FUNDED BY PPCO (794/796)
 41 -- MMIS PREPARES PTDDSS(1949-1),PRS(1949-2),PPS(718)
 40 -- INTERIM RELEASE ITEMS PRODUCED BY CONTRACTOR
 07 -- SPM ALC REVIEW OF CONTRACTOR PTD
 01 -- SSR/NIMSR PROCESSED BY DOD AGENCY
 10 -- FSD GUIDANCE CONFERENCE
 08 -- PRODUCTION OPTION DECION BY SPM
 15 -- PR/MIPR PROCESSED BY IM ALC (794/796)
 TYPE YOUR CHOICE 1 THRU 4 AND HIT RETURN KEY...
?
```

Sample Display From Procedure CRPATH

```
 WHAT IS YOUR TWO DIGIT GROUP NUMBER?  xx
  WHAT IS YOUR 3 POSITION GO AHEAD CODE? yyy

//////////////////////////////////////
/YOU ARE CLEARED TO GO ON           /
/TO COMPLETE 'CRPATH'               /
//////////////////////////////////////

  IT WILL BE A MINUTE OR TWO UNTIL YOU GET TO
  INTERACT WITH ME, I AM FIGURING OUT WHAT I
  AM GOING TO SAY TO YOU............

 THE FOLLOWING IS A LIST OF THE ACTIVITIES AND THEIR
 EXPECTED COMPLETION TIMES, THAT OCCURRED DURING YOUR RUN
 OF THE SIMULATION. YOU SHOULD TRANSFER THEM TO YOUR
 WORK SHEET IN THE APPROPRIATE PLACES (BESIDE THE
 ACTIVITY NUMBERS, YOU WORKED OUT DURING THE LAST
 PART OF THE EXERCISE). THE TIMES SHOWN ARE DAYS.
 TYPE GO AND HIT RETURN WHEN YOU ARE READY TO CONTINUE.
 ?GO

                ACTIVITY        EXPECTED COMPLETION TIME
                       5                    1
                      13                   29
                      43                   36
                      41                   39
                      22                   59
                      30                   94
                      10                   99
                      24                  163
                      34                  192
                       6                  236
                      23                  264
                       8                  266
                      14                  277
                      38                  290
                      42                  302
                      11                  308
                      29                  312
                      21                  324
                      33                  381
                      40                  410
                       7                  431
                      20                  447

 WHEN YOU HAVE COPIED THESE,TYPE GO TO CONTINUE...
 ?GO
```

```
ACTIVITY          EXPECTED COMPLETION TIME
      12                457
       9                470
      19                491
      26                500
      25                509
       1                519
      15                539
      35                555
      32                569
      17                583
      37                589
      27                614
      28                626
      16                638
      36                640
      31                660
       2                676
      18                679
       3                700
      39                761
       4                786
WHEN YOU HAVE COPIED THESE,TYPE GO TO CONTINUE...
?GO

NOW IT IS TIME FOR YOU TO COMPUTE THE CRITICAL PATH.
PLEASE INPUT EACH ACTIVITY FROM THE LAST ONE TO
THE FIRST ONE IN ORDER, AT THE ? PROMPT.
WHEN YOU HAVE TYPED IN THE TOTAL NUMBER OF ACTIVITIES
IN THE CRITICAL PATH, I WILL CONSIDER YOUR
ANSWER AND TELL YOU IF YOU ARE CORRECT. IF YOU
WANT TO RECONSIDER AN ACTIVITY ALREADY TYPED IN
YOU MAY START OVER BY ENTERING A '0' AT THE
QUESTION MARK THAT IS THE PROMPT.  THIS
RETYPING OF A CHOICE WILL NOT BE COUNTED AGAINST
FOR SCORING PURPOSES.
IF YOU ARE COMPLETED WITH YOUR CRITICAL PATH AND THERE
IS STILL A ? PROMPT SHOWING, YOU SHOULD TYPE IN
THE VALUE 100, TO INDICATE THAT YOU ARE FINISHED.
IF IN YOUR ANSWER,YOU HAVE ONE EVENT WRONG, YOU WILL
HAVE ONE MORE CHANCE TO GET ALL THE ACTIVITIES
CORRECT BEFORE I REPORT YOUR SCORE TO THE
INSTRUCTOR AND TELL YOU THE CORRECT CRITICAL PATH.
?4
?13
?24
?26
?11
?0
SO YOU FEEL YOU HAVE TYPED IN SOMETHING WRONG.
OK, LET US WIPE THE SLATE CLEAN AND START ENTERING
YOUR CHOICES OVER AGAIN.
```

```
?4
?13
?39
?28
?27
?26
?100
 OK, SO YOU ARE DONE, LET US SEE IF YOU GOT IT RIGHT.
YOU HAVE MISSED AT LEAST ONE ACTIVITY ON THE CRITICAL
PATH, YOU MUST TRY AGAIN.
```

Sample Display of Activities From SNSANL Procedure

| ACT | DESCRIPTION OF THE ACTIVITY | TIME | A | M | B |
|---|---|---|---|---|---|
| 1 | SSR/NIMSR PROCESSED BY DOD AGENCY | 29.67 | 21 | 14 | 45 |
| 2 | NSN FORWARDED TO ACO BY CASC | 15.27 | 14 | 7 | 30 |
| 3 | ACO NEGOTIATES SCHED/PRICE W/CONTRACTOR | 25.74 | 21 | 14 | 45 |
| 4 | CONTRACTOR SHIPS ITEMS TO DEPOT | 20.04 | 21 | 7 | 45 |
| 5 | SYSTEM START-UP ACTIVITIES | 1.00 | 1 | 1 | 1 |
| 6 | SOURCE SELECTION | 72.71 | 45 | 14 | 120 |
| 7 | SPM ALC REVIEW OF CONTRACTOR PTD/SPTD | 34.95 | 30 | 14 | 45 |
| 8 | PRODUCTION OPTION DECISION | 48.28 | 45 | 14 | 120 |
| 9 | POST-PROVISIONING ACTIONS | 33.51 | 30 | 14 | 90 |
| 10 | FSD GUIDANCE CONFERENCE | 2.74 | 3 | 1 | 7 |
| 11 | DLSC SCREENS DATA & RETURNS TO CONTRACTOR | 15.15 | 7 | 3 | 30 |
| 12 | SPM ALC REVIEWS PROVISIONING CONFERENCE DATA | 40.93 | 21 | 3 | 60 |
| 13 | DPML DEVELOPS ILSP | 23.44 | 21 | 1 | 45 |
| 14 | CONTRACTOR PROVIDES DATA FOR DLSC SCREEN | 46.78 | 45 | 14 | 120 |
| 15 | PR/MIPR PROCESSED BY IM ALC (794) | 132.65 | 120 | 45 | 270 |
| 16 | PIO (326) REVIEWED BY SPM ALC | 25.23 | 30 | 21 | 60 |
| 17 | I & S REQUEST (86) PREPARED BY IM ALC | 16.64 | 21 | 14 | 45 |
| 18 | DUE-IN ESTABLISHED IN J041 SYSTEM | 16.57 | 14 | 7 | 21 |
| 19 | SICN ISSUED ON NON-NSN ITEM BY LATERAL ALC | 10.74 | 14 | 7 | 30 |
| 20 | PROVISIONING CONFERENCE | 29.85 | 21 | 3 | 45 |
| 21 | GUIDANCE CONFERENCE | 15.06 | 14 | 7 | 21 |
| 22 | FSD CDRL PREPARED BY SPM ALC (1423) | 17.73 | 21 | 1 | 45 |
| 23 | FSD CONTRACT AWARD & NOTIFICATION | 34.98 | 30 | 14 | 45 |
| 24 | FSD PROPOSAL PREPARED & SUBMITTED BY CONTRACTOR | 48.71 | 60 | 30 | 90 |
| 25 | IM ASSIGNS MOS CODE & SENDS TO SPM ALC (778/773) | 13.04 | 14 | 7 | 30 |

## Appendix F, Attachment 7: ACTIVITY DESCRIPTIONS

01 SSR/NIMSR PROCESSED BY DOD AGENCY
02 NSN FORWARDED TO ACO BY CASC
03 ACO NEGOTIATES SCHED/PRICE W/CONTRACTOR
04 CONTRACTOR SHIPS ITEMS TO DEPOT (250)
05 SYSTEM START-UP ACTIVITIES
06 SOURCE SELECTION
07 SPM ALC REVIEW OF CONTRACTOR PTD/SPTD
08 PRODUCTION OPTION DECISION
09 POST-PROV CONFERENCE ACTIONS
10 FSD GUIDANCE CONFERENCE
11 DLSC SCREENS DATA & RETURNS TO CONTRACTOR
12 SPM ALC REVIEWS PROVISIONING CONFERENCE DATA
13 DPML DEVELOPS ILSP
14 CONTRACTOR PROVIDES DATA FOR DLSC SCREEN
15 PR/MIPR PROCESSED BY IM ALC (794)
16 PIO (326) REVIEWED BY SPM ALC
17 I & S REQUEST (86) PREPARED BY IM ALC
18 DUE-IN ESTABLISHED IN J041 SYSTEM
19 SICN ISSUED ON NON-NSN ITEM BY LATERAL ALC
20 PROVISIONING CONFERENCE
21 GUIDANCE CONFERENCE
22 FSD CDRL PREPARED BY SPM ALC (1423)
23 FSD CONTRACT AWARD & NOTIFICATION
24 FSD PROPOSAL PREPARED & SUBMITTED BY CONTRACTOR
25 IM ASSIGNS MOS CODE & SENDS TO SPM ALC (778/773)
26 SSR/NIMSR ISSUED BY SPM ALC
27 CANCEL PIO (SUB FOUND) OR ASSIGN NSN (NO SUB)
28 SPM FUNDS CHECK
29 PRE-GUIDANCE CONFERENCE ACTIONS
30 RFP PREPARED BY SPO & SENT TO CONTRACTORS
31 PR/MIPR FUNDED BY PPCO (794/796)
32 PIO (326) PREPARED BY IM ALC
33 PPL'S DEVELOPED BY CONTRACTOR & SENT TO SPM ALC
34 FSD CDRL TO SPM ALC FOR REVIEW (1423)
35 SPM ALC REVIEWS ITEMS CODED BY IM ALC'S
36 PIO (326) FUNDED BY PPCO (30)
37 I & S REVIEW BY CASC (86)
38 SAIP/LLIL GUIDANCE CONFERENCE BY CONTRACTOR
39 PPL ITEMS PRODUCED BY CONTRACTOR
40 INTERIM RELEASE ITEMS PRODUCED BY CONTRACTOR
41 MMIS PREPARES PTDDSS(1949-1),PRS(1949-2),PPS(718)
42 SPM ALC SENDS PRS TO IM ALC(S) FOR REVIEW
43 SPM DETERMINES AGENCY WITH CONTRACT RESPONSIBILITY

AD-A148 485 DEVELOPMENT OF A NETWORK ANALYSIS OF THE AIR FORCE PROVISIONING PROCESS F..(U) AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. 4/4

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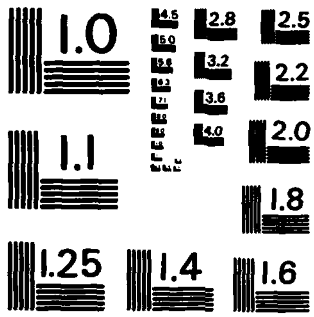


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ACTIVITY 01: SSR/NIMSR processed by DOD agency

DESCRIPTION: Upon receipt of Supply Support Requests (SSRs) or Nonconsumable Item Material Support Requests (NIMSRs), the DOD agency responsible for the item requested determines if any of the requested items are available. Any items offered as substitutes are sent through DLA/GSA to AFLC/CASC (Cataloging and Standardization Center) for review and approval/disapproval. Inputs and outputs to this process are made through the D169 automated system. Status is monitored by the affected IM ALC/MMIS.

NOTE: The path taken by alternate item proposals are not modeled into this network, but the time which could be used in this effort is considered.

ACTIVITY 02: NSN forwarded to ACO by CASC

DESCRIPTION: National Stock Numbers (NSNs) which have been assigned by the Cataloging and Standardization Center (CASC), are forwarded to the Administrative Contracting Officer (ACO) for review and consolidation prior to presentation to the contractor.

ACTIVITY 03: ACO negotiates sched/price w/contractor

DESCRIPTION: All System Program Manager (SPM) contact with the contractor must be made through their provisioning office and the appropriate Administrative Contracting Officer (ACO), with copies of all documents to the Provisioning Principal Contracting Officer (PPCO). The ACO negotiates the finalized schedule and price with the contractor, which becomes authority for production of the majority of items. Interim released items are also negotiated, but are done after the fact per whatever arrangements were established in the original contract/Request for Proposal (RFP).

ACTIVITY 04: Contractor ships items to depots

DESCRIPTION: After all identification and funding documentation have been completed and the requested items have been manufactured, the contractor ships property on DD Forms 250 to the depot where it will be stored awaiting issuance to users.

ACTIVITY 05: System start-up activities

DESCRIPTION: This activity is actually an aggregate of many processes which take place as the Air Force decides to fund a Full Scale Development (FSD) contract for a major weapon system (or subsystem). Because starting provisioning this early in the acquisition process is a fairly recent innovation, there are no reliable activity times or relationships yet stated in prescribing directives.

NOTE: The three (3) activity times above represent a constant distribution of 60 days, which is only a rough estimate that is not based on historical data.

ACTIVITY 06: Source selection

DESCRIPTION: Source selection is a process in its own right, with many participants and established criteria. The System Program Manager (SPM) contributes information to the Source Selection Advisory Council (SSAC) which then provides guidance for the Source Selection Authority (SSA). The SSA has ultimate authority to make the source selection decision.

ACTIVITY 07: SPM ALC review of contractor PTD/SPTD

DESCRIPTION: The SPM ALC/MMIS reviews the Provisioning Parts Lists (PPLs) and associated Provisioning Technical Documentation (PTD) and Supplementary Provisioning Technical Documentation (SPTD) for accuracy and completeness prior to the Provisioning Conference. Primary Inventory Control Activities (PICAs) may be assigned and any previously assigned Material Management Aggregation Codes (MMACs) are validated.

Note: Information regarding the MMIS review will be forwarded to involved IM ALCs, but that process was not considered important enough to be included in the model. In the same vein, information regarding non-AF managed consumables are forwarded to the office responsible for processing Supply Support Requests (SSRs), but that activity was also omitted.

ACTIVITY 08: Production option decision

DESCRIPTION: The production option decision is one which is made at a level higher than the SPM. Many provisioning programs are stopped at this point due to failure to obtain approval from the Defense Services Acquisition Review Council (DSARC), in which case the funds are stopped. When the SPM does implement the decision to continue into production (from FSD), the same contractor who had the FSD contract is authorized to begin production. At that time the FSD contract is transformed into a production contract and the SPM furnishes the contractor with a programming checklist.

ACTIVITY 09: Post-Provisioning Conference actions

DESCRIPTION: After the Provisioning Conference, meeting minutes are prepared and distributed to participants and affected agencies. They should be sent out in 7 days, but are sometimes delayed. In addition, requests for Supplementary Provisioning Technical Documentation (SPTD) are prepared and sent out on AFLC Forms 784. The contractor must provide the drawings, blueprints, and sketches used by both the prime contractor and vendors in their internal manufacturing processes to enable sufficient technical review and NSN action by the USAF.

ACTIVITY 10: FSD Guidance Conference

DESCRIPTION: Prior to FSD contract award, an FSD Guidance Conference will be held, if possible, within 15 days after the Request for Proposal (RFP) has been released by the Air Force. The conference alerts the contractor to the the provisioning requirements for the contract.

ACTIVITY 11: DLSC screens data & returns to contractor

DESCRIPTION: The Defense Logistics Service Center (DLSC) screens data obtained from the contractor against its central cataloging files to determine the existence/validity of NSNs, prevent unnecessary cataloging actions and determine if material managers are assigned.

ACTIVITY 12: SPM ALC reviews Provisioning Conference Data

DESCRIPTION: In manual provisioning, the contractor prepares and submits the Post Conference List (PCL), complete with Supplementary Provisioning Technical Documentation (SPTD), not later than 21 days after the Provisioning Conference. The PCL lists all items selected as logical spares/repair parts at the Provisioning Conference and those items previously selected as logical spares to which changes were made during the conference. PCLs are forwarded to SPM ALC/MMIS, where they are reviewed for completeness.

ACTIVITY 13: DPML develops ILSP

DESCRIPTION: The Deputy Program Manager for Logistics (DPML) is responsible for developing overall provisioning strategy that will be effective in obtaining the best performance, price, schedule, and supportability for the items needed. An integral part of formulating that strategy is the preparation of the Integrated Logistics Support Plan (ILSP). Such things as the method of provisioning are considered and decided upon.

NOTE: There are three (3) basic methods of provisioning: Resident Provisioning Team (RPT), Provisioning Conference Team, and In-House or Depot Provisioning Committee (DPC). In the provisioning model presented, the formal Provisioning Conference method was used.

ACTIVITY 14: Contractor provides data for DLSC screen

DESCRIPTION: After contract award, the contractor assembles the necessary data to submit a screening request to the Defense Logistic Service Center (DLSC). Screening requests should be submitted in time to permit return of results prior to, or at least concurrently with, the contractor's submission of Provisioning Technical Documentation (PTD) to the SPM.

ACTIVITY 15: PR/MIPR processed by IM ALC (794)

DESCRIPTION: The Purchase Request (PR) or Military Interdepartmental Purchase Request (MIPR) is used to request contracting action for new systems/end articles or follow-on action for additional programmed requirements. Documents include, when applicable, the provision for acquisition of initial spares/repair parts and support equipment (SE), and citation of funds for the required initial support. Formal acceptance of an Air Force PR/MIPR is usually made within 30 days after release. PR/MIPR status is maintained by the IM ALC/MMIS. Specific guidance on MIPRs is contained in AFLCP/AFSCP 800-34.

ACTIVITY 16: PIO (326) reviewed by SPM ALC

DESCRIPTION: The SPM ALC/MMIS reviews all Provisioning Technical Documentation (PTD) for completeness and consolidates all Provisioned Item Orders (PIOs), on AFLC Forms 326, for submission to the contractor through the Provisioning Principal Contracting Officer (PPCO).

ACTIVITY 17: I & S request (86) prepared by IM ALC

DESCRIPTION: Upon receipt of provisioning documentation for Secondary Item Control Number (SICN) items, MMIS will submit cataloging documents and data package to AFLC/CASC (Cataloging and Standardization Center) after receiving the Form 86 prepared by the IM.

ACTIVITY 18: Due-in established in J041 system

DESCRIPTION: After funding has been approved on either the Provisioned Item Order (PIO) or Purchase Request (PR), a due-in suspense record is established through input to the J041 automated system.

ACTIVITY 19: SICN issued on non-NSN item by lateral ALC

DESCRIPTION: Secondary Item Control Numbers (SICN) are used to identify non-NSN items until they are converted to valid NSN's, i.e. part numbered items catalogued to NSNs.

ACTIVITY 20: Provisioning Conference

DESCRIPTION: The Provisioning Conference provides for the USAF to make item selection and assign technical and management codes. The MMIS will:

- Coordinate all conference actions
- Provide a chairperson
- Resolve problems on Source, Maintenance and Recoverability (SMR) coding

The Engineering and Reliability Branch (MM?R) ensures that equipment specialists will:

- Assign SMR codes
- Assign failure factors
- Assign Expendability, Repairability, Recoverablity Codes (ERRCs) (on P-coded items)
- Assign Item Management Codes (IMCs)
- Assign Demilitarization (DEMIL) codes
- Assign Material Management Aggregation Codes (MMACs), when appropriate

AFLC/CASC (Cataloging and Standardization Center) performs a variety of functions regarding the Provisioning Technical Documentation (PTD), Supplementary Provisioning Technical Documentation (SPTD), and Defense Logistics Service Center (DLSC) screening results. The Directorate of Maintenance, Directorate of Distribution, and the using command are also active participants.

ACTIVITY 21: Guidance Conference

DESCRIPTION: The Guidance Conference is conducted to ensure that the selected contractor, major vendors, and Air Force personnel can achieve a mutual understanding of the contractual requirements of the acquisition document involved. The following topics are discussed at the conference:

- Introduction and purpose
- The provisioning process
- Contractor's presentation
- Programming information
- Maintenance concept
- Provisioning Requirements Statement (PRS)
- Interim release and recommended items
- Contract Data Requirements List, DD Form 1423
- Provisioning Conference
- Order and delivery schedules
- Preservation and packaging
- Other subjects, as required

ACTIVITY 22: FSD CDRL prepared by SPM ALC (1423)

DESCRIPTION: The Contract Data Requirements List (CDRL), DD Form 1423, is used as a cover sheet and coordinating document for all of the information gathered by the SPM during the FSD data call. MMIS submits the completed CDRL to the Data Management Officer for formal approval by the SPM and inclusion in the Request for Proposal (RFP). It includes requirements for all necessary Provisioning Technical Documentation (PTD).

ACTIVITY 23: FSD contract award & notification

DESCRIPTION: After source selection has been completed, formal award of the Full Scale Development (FSD) contract is made by the SPM and the the selected contractor is notified through the responsible Administrative Contracting Officer (ACO).

ACTIVITY 24: FSD proposal prepared & submitted by contractor

DESCRIPTION: Eligible contractors who have received Requests for Proposal (RFPs) review the RFP and determine whether or not they are interested in obtaining the contract. They must estimate their ability to produce the desired items in the quantity, of the quality, for the price quoted, and on the schedule specified, necessary to satisfy the RFP. When assembled, the reply is forwarded to the SPM ALC/MMIS through the responsible Administrative Contracting Officer (ACO).

ACTIVITY 25: IM assigns MOS code & sends to SPM ALC (778/773)

DESCRIPTION: The appropriate IM ALC branch, MM?R, assigns the correct Method of Support (MOS) code to any items not previously coded at the Provisioning Conference, then forwards the information on either AFLC Form 773 or AFLC Form 778 to the SPM ALC/MMIS for review.

ACTIVITY 26: SSR/NIMSR issued by SPM ALC

DESCRIPTION: The SPM ALC/MMIS screens all Supply Support Request (SSR) and Nonconsumable Item Material Support Request (NIMSR) cards to insure completeness and accuracy. After receiving initial provisioning documents from MMIS, the SSR Processing Unit prepares data for input to the D169 automated system.

ACTIVITY 27: Cancel PIO (sub found) or Assign NSN (no sub)

DESCRIPTION: Based on the review of suitable interchangeable or substitutes for the desired items, the Cataloging and Standardization Center (CASC) will either cancel the Provisioned Item Order (PIO) if one was found or they will assign a new NSN. When required, NSN assignment must be made before the contractor is authorized to ship finished products to USAF depots.

NOTE: Upon acceptance of a substitute item the IM actually cancels the PIO, but that action is included within the activity for the purposes of this deterministically branched model.

ACTIVITY 28: SPM funds check

DESCRIPTION: Prior to being forwarded to the procurement function at the SPM ALC, the SPM checks for funding on all Provisioned Item Orders (PIOs). This action is necessary to prioritize the release of PIOs on the basis of available funding.

ACTIVITY 29: Pre-Guidance Conference actions

DESCRIPTION: The SPM recommends a conference start date (through the Administrative Contracting Officer) not later than 45 days from the mailing date of the contract on an AFLC Form 771, Conference Notification, which includes a proposed conference agenda. The SPM chairs a closed Air Force familiarization meeting to discuss pertinent issues with Guidance Conference particpants (Air Force personnel only) in an effort to achieve a unified position which presents one face to industry.

ACTIVITY 30: RFP prepared by SPO & sent to contractors

DESCRIPTION: The Request for Proposal (RFP) is prepared by the System Program Office (SPO) based on the results of the data call conducted with relevant DOD agencies. The RFP includes the Provisioning Requirements Statement (PRS) and Provisioning Performance Schedule (PPS) plus any other provisioning requirements or data necessary for competing contractors to make proposals to the government regarding their desire and ability to produce the requested items. The RFP may become the legally binding contract, or some part of it, between the government and the selected contractor.

ACTIVITY 31: PR/MIPR funded by PPCO (794)

DESCRIPTION: The Provisioning Principal Contracting Officer (PPCO) reviews the Purchase Request (PR) or Military Interdepartmental Purchase Request (MIPR) for accuracy and completeness, then affixes the appropriate fund citation authorizing purchasing action. The PR/MIPR is forwarded to the Administrative Contracting Officer (ACO) after a due-in has been established in the computer.

ACTIVITY 32: PIO (326) prepared by IM ALC

DESCRIPTION: The IM ALC/MMIS prepares Provisioned Item Orders (PIOs), AFLC Forms 326, which are used to furnish the Provisioning Principal Contracting Officer (PPCO) with a written request for items to be bought through the provisioning process, or on a production contract. This form, when attached to Standard Form (SF) 30 by the PPCO, sets forth the specific items ordered, the estimated cost, and the required delivery schedule.

ACTIVITY 33: PPLs developed by the contractor & sent to SPM ALC

DESCRIPTION: After the Guidance Conference and receiving screening results from the Defense Logistics Service Center (DLSC), the contractor must prepare all of the information requested by the Air Force to complete the requirements for Provisioning Technical Documentation (PTD). A large portion of the PTD is a variety of Provisioning Parts Lists (PPLs) that, according to MIL-STD-1561, contain all components, assemblies, and support items which can be disassembled, reassembled or replaced, and when combined, constitute and end item. The PPL will contain all tools and test equipment required to maintain the end item, unless an exclusion statement is included in the Provisioning Requirements Statement (PRS). The following lists separate provisioned items into different categories and are a subset of the PPL:

- Common/Bulk Items List (CBIL)
- Long Lead Items List (LLIL)
- Recoverable Item Provisioning Parts List (RIPPL)
- Reparable Items List (RIL)
- Short Form Provisioning Parts List (SFPPL)

PPLs are submitted incrementally, but the completed PPL should be submitted by the contractor at least 30 days in advance of the scheduled Provisioning Conference.

ACTIVITY 34: FSD CDRL to SPM ALC for review

DESCRIPTION: After receiving contractor proposals in response to the Air Force's Request for Proposal (RFP), SPM ALC/MMIS reviews all information received with the Contract Data Requiements List (CDRL) to insure completeness for the upcoming source selection.

ACTIVITY 35: SPM ALC reviews items coded by IM ALCs

DESCRIPTION: The SPM ALC/MMIS reviews all Provisioning Technical Documentation (PTD) provided before, during, and after the Provisioning Conference prior to preparation of Provisioned Item Orders (PIOs) and requests for review of Interchangeables and Substitutes (I & S ) to ensure that all necessary information is properly documented. MMIS also receives all output products from the D169 automated system provisioned item submissions as a result of Supply Support Requests (SSRs) or Nonconsumable Item Material Support Requests (NIMSRs).

ACTIVITY 36: PIO (326) funded by PPCO (30)

DESCRIPTION: The Provisioning Principal Contracting Officer (PPCO) reviews all Provisioned Item Orders (PIOs) on AFLC Forms 326, and assigns the proper fund citatition authorizing release of the PIO to the contractor (through the Administrative Contracting Officer (ACO)). AFLC Forms 326 are the only documents used to authorize the issuance of or to be attached to SF 30, Amendment of Solicitation/Modification of Contract. The PPCO approves the order, prepares SF 30, and forwards the order with the SF 30 to the ACO with a copy of the SF 30 to finance. The PPCO also endorses an AFLC Form 773 or 778 back to the provisioning activity (SPM/IM ALC/MMIS).

ACTIVITY 37: I & S review by CASC (86)

DESCRIPTION: The Cataloging and Standardization Center (CASC) receives Form 86, Request for Cataloging Action, from IM ALCs and search central data files to determine the existence of potential interchangables and substitutes (I&S). CASC coordinates with equipment specialists at the appropriate ALCs to obtain technical information, but they are the ultimate authority for I&S decisions.

ACTIVITY 38: SAIP/LLIL Guidance Conference by contractor

DESCRIPTION: Spares Acquisition Integrated with Production (SAIP) is used to incorporate Air Force orders for spare recoverable assemblies with the prime contractor's order for production installations and will be included in appropriate production and/or modification contracts as an optional item. The Long Lead Items List (LLIL) indicates those items, which due to their complexity of design, complicated manufacturing processes, or limited production, require early ordering to insure adequate delivery schedules. The contractor determines candidates for both SAIP and LLIL, then furnishes Supplementary Provisioning Technical Documentation (SPTD) to SPM ALC/MMIS for review. Efforts are made to insure early Source, Maintenance, and Recoverability (SMR) and other coding to push long lead items through the provisioning process quickly.

ACTIVITY 39: PPL items produced by contractor

DESCRIPTION: After agreeing to the final price and schedule, the contractor actually manufactures the provisioned item(s). The contractor must notify the SPM ALC/MMIS of all design changes by submitting Design Change Notices (DCNs). DCNs can be the result of major changes such as approved Engineering Change Proposals (ECPs) or minor changes, i.e. informational changes.

ACTIVITY 40: Interim release items produced by contractor

DESCRIPTION: The intention to produce interim release items is reflected in the Provisioning Requirements Statement (PRS). To follow this concept in a contract, a funded spare or repair parts contract line item must be in the contract. The interim release concept is intended to permit the contractor to release to production those items which have a production leadtime greater than will permit placing an order for the items after a Provisioning Conference. Provisioning Technical Documentation (PTD) on interim release items from the the Long Lead Items List (LLIL) must be submitted to the SPM ALC/MMIS no later than 30 days after being released for production. Supplementary Provisioning Technical Documentation (SPTD) is also normally required.

ACTIVITY 41: MMIS prepares PTDDSS (1949-1), PRS (1949-2), PPS (718)

DESCRIPTION: Based on the Statement of Work (SOW) provided by AFSC, SPM ALC/MMIS prepares DD Form 1949-1, Provisioning Technical Documentation Data Selection Sheet (PTDDSS); DD Form 1949-2, Provisioning Requirements Statement (PRS); and AFLC Form 718, Provisioning Performance Schedule (PPS), for input to the SPM in preparation of the Request for Proposal (RFP). MMIS also insures that adequate funds are cited for the contractor to get started, i.e. funds for Guidance Conference, preparation of Provisioning Technical Documentation (PTD) and interim release of items during the first six months after contract award.

ACTIVITY 42: SPM ALC sends PRSs to IM ALCs for review

DESCRIPTION: At the time of contract award, or no later than submission of the first Provisioning Technical Documentation (PTD) on the contract, the SPM ALC/MMIS furnishes involved IM ALCs with the Provisioning Requirements Statements (PRSs) and programming checklists to be followed in determining initial support requirements.

ACTIVITY 43: SPM determines agency w/contract responsibility

DESCRIPTION: After appointment of the System Program Manager (SPM) and establishment of the System Program Office (SPO), the SPM must evaluate the contractual needs of the provisioning effort. The SPM then determines the DOD activity (USAF, USN, USA, or DCAS) which will have contracting responsibility for the system/end article involved. The action is documented on the Contract Data Requirements List (CDRL), AF Form 1423.

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# VITA

Captain Robert M. Douglas was born on 22 September 1952 in Peoria, Illinois. He graduated from high school in East Moline, Illinois, in 1970 and attended Black Hawk Junior College where he received the degree of Associate of Arts in Psychology in June 1973. Following a year of attendance at Southern Illinois University, he enlisted in the USAF. While assigned as an administrative specialist to the 436th Transportation Squadron, Dover AFB, Delaware, between 1975 and 1980, he received two Air Force Comendation Medals, and was named the 436th Military Airlift Wing's NCO of the Year for 1979. He received the degree of Bachelor of Science in Industrial Technology from Southern Illinois University in December 1979 and later received a commission in the USAF as a distinguished graduate of OTS in 1980. As a supply officer, his first tour took him to the 48th Supply Squadron, RAF Lakenheath, England. While serving in the Stock Control, Materiel Storage and Distribution, and Supply Systems functions of a base supply operation, he encountered myriad supply and management problems associated with support of the complex F-111F aircraft. Upon tour completion, he received his third Air Force Commendation Medal prior to entering the School of Systems and Logistics, Air Force Institute of Technology, in May 1983.

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# VITA

James E. Mulder was born on June 9, 1950 in Greenville, Ohio. He graduated from Kentucky Military Institute in Lyndon, Kentucky in 1968. In 1969 he enlistd in the USAF where he was trained to be a Russian voice processing specialist. He served in this capacity at Misawa AFB, and Fort Meade Maryland. After his discharge in 1973, he attended Kent State University and Ohio State University, where he graduated in December 1976 with a Bachelor of Science in Natural Resources degree. In 1978, he became employed as a GS-4 biological lab technician for the Aerospace Medical Research Laboratory at WPAFB, Ohio. After taking the Professional Administrative Career Examination (PACE) he was selected for training as a computer programmer, and was assigned to HQ AFLC/LMVTF as a programmer trainee in 1979. In 1980 he received a Master of Arts degree in Management and Supervision from Central Michigan University, after attending classes in Dayton on a part time basis. In 1983 he was reassigned to HQ AFLC/LMTS as a computer systems programmer, where he was selected to attend the School of Systems and Logistics at AFIT, and in October 1983 he was promoted to GS-12.

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Title: DEVELOPMENT OF A NETWORK ANALYSIS OF THE AIR FORCE PROVISIONING PROCESS FOR AN APPLIED COMPUTER SIMULATION EXERCISE

Thesis Chairman: Patrick M. Bresnahan, GM-13, USAF


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thesis
This ~~research~~ set out to produce a ready-to-use package for a computer-aided training exercise to teach a network analysis technique applied to the USAF provisioning process. The starting point for the application of the computer-aided instruction was the existing PROV-MAN-X exercise, but the newly developed exercise can serve either as a module for PROV-MAN-X or as a stand-alone product.

Information was gathered from interviews and prescribing government directives to construct a network model of the USAF provisioning process. Computer programs were designed to present a 64-question programmed text on network analysis and a computerized simulation of the provisioning process, both to be included in a training exercise primarily intended for use by provisioning managers attending courses at the Air Force Institute of Technology.

Summarizing the research objectives, the specific goals of the thesis were to (1) gather information to identify activities, relationships, and times for the USAF provisioning process, (2) design a computerized simulation model of the USAF provisioning process, and (3) develop "user friendly" computer programs to act as the instructional medium for the training exercise.

The remainder of the thesis was organized into the following sections: literature review, model methodology, training exercise methodology, results, conclusions, and a comprehensive set of exercise instructions that includes appendices of: flowcharts, computer coding, exercise manuals, definitions, and the model of the provisioning process developed for the exercise.

Limitations of the research included: the deterministic branching of the provisioning network model, computer coding written specifically for the NOS 2.1 operating system on the CDC Cyber computer (with an available Graphical Evaluation and Review Technique with Queuing (Q-GERT) library), and the exercise has not yet been used in an actual classroom environment.

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