M. Com 2nd (Second) Semester
Operations Research (O.R.)
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Lecture no. 1 Topic - Network Analysis

A. Introduction: Different types of projects like construction of a bridge, highway, power plant; repair and ~~maint~~ maintenance of an oil refinery or an air plane, design, development and marketing of a new product, research and development work etc. in which large number of interrelated activities involved, must be completed in a specified time, according to specific sequence (order) and required resources such as personnel, money, meterial, facilities.

B. Definition: The techniques of O.R. used for planning, scheduling and controling large and complex projects are often referred as network analysis or network planning and scheduling technique.

A network is a graphical (representation) plan consisting of a certain configuration of arrows and nodes for showing the logical sequences of various activities to be performed to achieve projects objectives.

C. Commonly used methodology in project management technique are:

1. Critical path Method (CPM): This technique was developed in connection with a construction and maintenance of project in which duration of each activity was known with certenty.

2. Programme Evaluation and Review Technique (PERT):

It assumes a probability distributation for the duration of each activity. Thus completion time estimates for all of the activities are needed. This method is basically a probabilistic approach where as CPM method is known as deterministic in nature.

D. Steps in PERT/CPM Technique

There are four basic steps involved in network analysis ~~by~~ for CPM/PERT ~~on~~ for any project.

i) Project Planning and construction of network
ii) Scheduling
iii) Allocation of resources
iv) Project Controlling.

i) Project Planning and construction of network:
It is done by splitting the total project into small projects. The smaller projects are again divided into different activities and then analyzed by a department or section. The relationship between the activities are defined properly and made an establishment with the help of a diagram (known as network diagram).

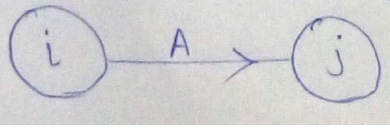
ii) Scheduling: The objective of scheduling is to give the earliest and the latest allowable start and finish time of each activity as well as its relationship with other activities in the project. It must pinpont the critical path ie the time activities which requires specific attention if the project is to be completed in time.

iii) Allocation of resources: Allocation of resources is performed to achieve the desired objective. Resources is a physical variable such as labour, finance, space, equipment etc. Which will impose a limitation for completion of a project.

iv) Controlling: It is the final step of project. After making previous steps as well as identifying the critical path (to be discussed later) the project is controlled by checking progress against the schedue, assigning and scheduling manpower and equipment and analyzing the effects of delays. This is done by progress report from time to time and updating the network continuously. Arrow diagram and time charts are used for making periodic progress reports.

E. Basic Definitions:

a) Activity: Activities in network diagram represents project operations or tasks to be conducted. It requires the expenditure of time and resources for their accomplishment. An arrow is commonly used to represent an activity and its head indicates the actual progress of the activity. Activities are identified by the number of their starting event and ending event (Def given later). An arrow (i,j) between two events: the ~~head~~ tail event i represents the start of an activity and head event j represent the end of the activity and i<j. Let A is an activity (i,j) which starts at event i and finishes at event j. Arrow indicates the direction of progression of activity.



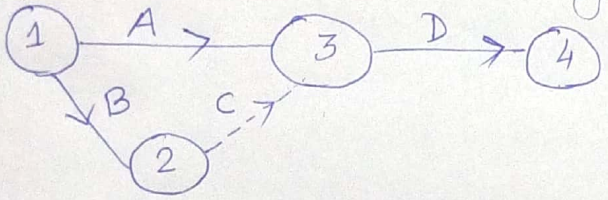
Activities are of three types:

i) Predecessor: Activity that must be completed immediately prior to the start of another activity is called Predecessor activity.

ii) Sucessor: Activity that can not be started until one or more of the other activities are completed but immediately succeed them is sucessor activity.

iii) Dummy: Activity which can not consume any time and resource is known as dummy activity.

A dummy activity in the network is added only to establish the given precedence relationship among the activities of the project and is needed when (a) two or more activities on a project has same head and tail events (b) two or more activities have some of their immediate predecessor activities in common. A dummy activity is depicted by dotted line in the network diagram.



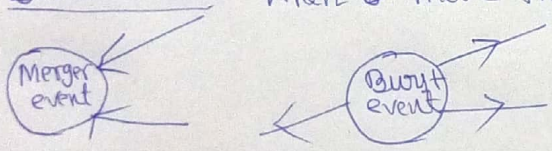
Here A is predecessor, D is succesor and C is dummy activity.

(b) Events: Events in network diagram represents project milestones such as the start or completion of an activity or activities and occur at a particular instant of time at which some specifit part of the project has been or is to be achieved. These are commonly represented by circles, called nodes in network diagram.

Events are of two types:

i) Merger event: It represents the join completion of more than one activites.

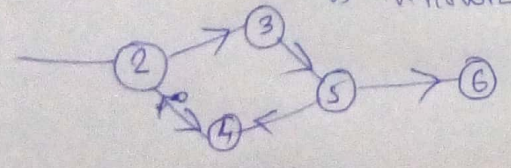
ii) Burst event: When more than one activities leaves an event.



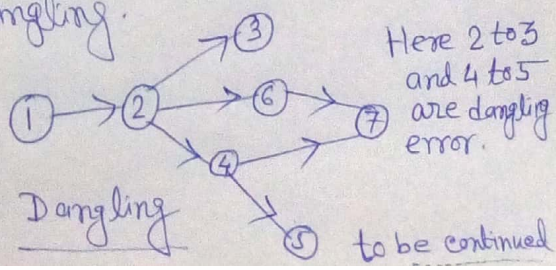
(c) Errors: Sometimes error appers in construction of network diagram. These are: i) Looping ii) Dangling

i) Looping: It is an endless loop in a network diagram which is known as looping. It is a cycling error.

ii) Dangling: To disconnect an activity before the completion of all activities in a project network diagram is known as dangling.



Looping



Here 2 to 3 and 4 to 5 are dangling error.

Dangling

to be continued