Work Breakdown Structure (WBS) and Project Planning Tools

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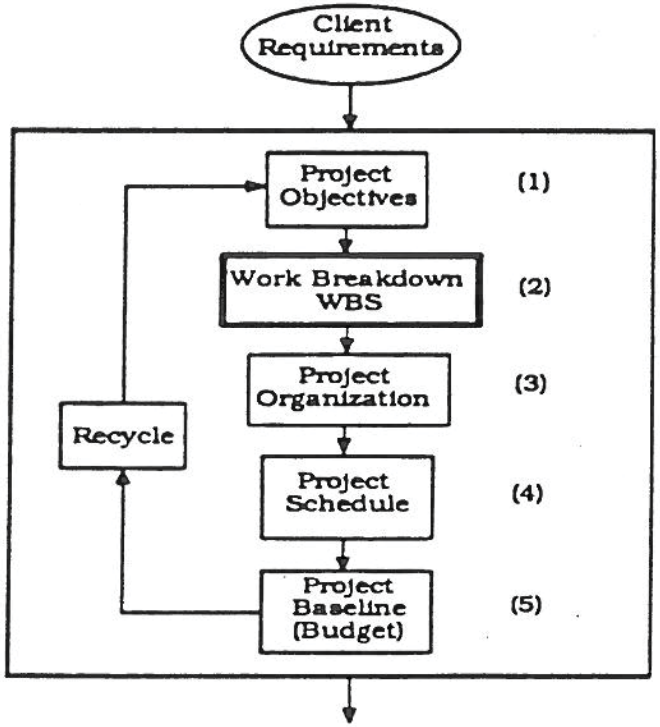
WORK BREAKDOWN STRUCTURE (WBS)

The basic idea of the work breakdown structure is to divide the total work of the project into major groups, then to subdivide these groups into tasks, then to subdivide these tasks into subtasks, and so on.



The work may be subdivided through as many stages as necessary to provide final units of the desired size.

The lowest level of subdivided work would be small enough to permit adequate control and visibility without creating an unwieldy administration burden.

Charles Martin,
Project Management

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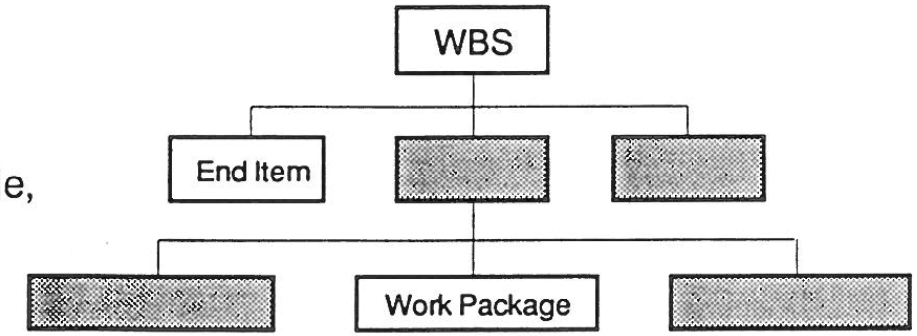
CRITERIA FOR DEVELOPING A WORK BREAKDOWN STRUCTURE

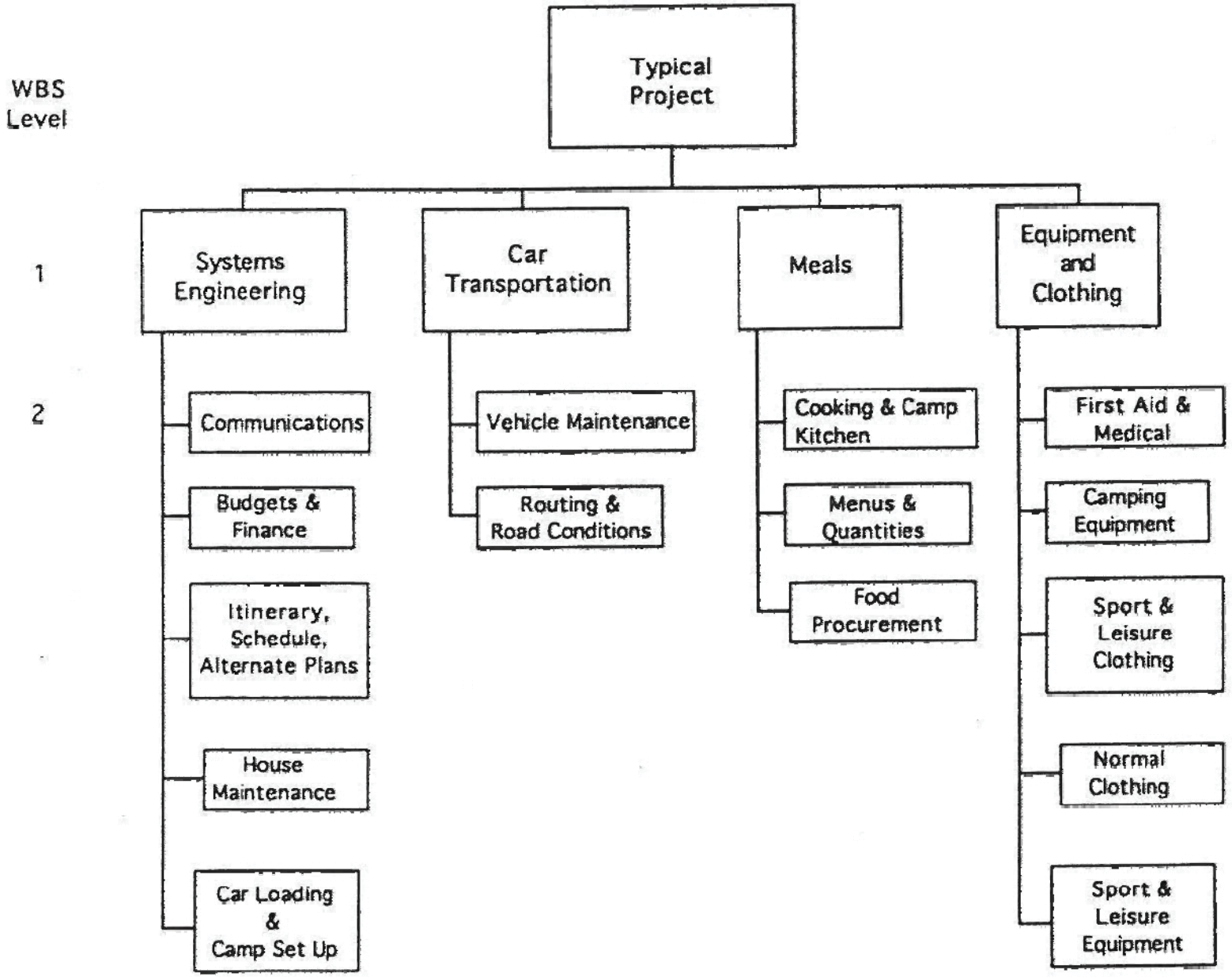
1. The WBS and work description should be easy to understand.
2. No attempt should be made to sub-divide work arbitrarily to the lowest possible level. Lowest level of work should not end up having a ridiculous cost in comparison to other efforts.
3. The WBS can act as a list of discrete measurable, tangible milestones so that everyone will know when the milestones are achieved.



4. Tasks should have clearly defined start and end dates; it should be possible to construct a schedule or a network for a WBS task.
5. No effort should be made to extend the WBS to the same number of levels for all projects.

WORK BREAKDOWN EXAMPLE

Camping Trip



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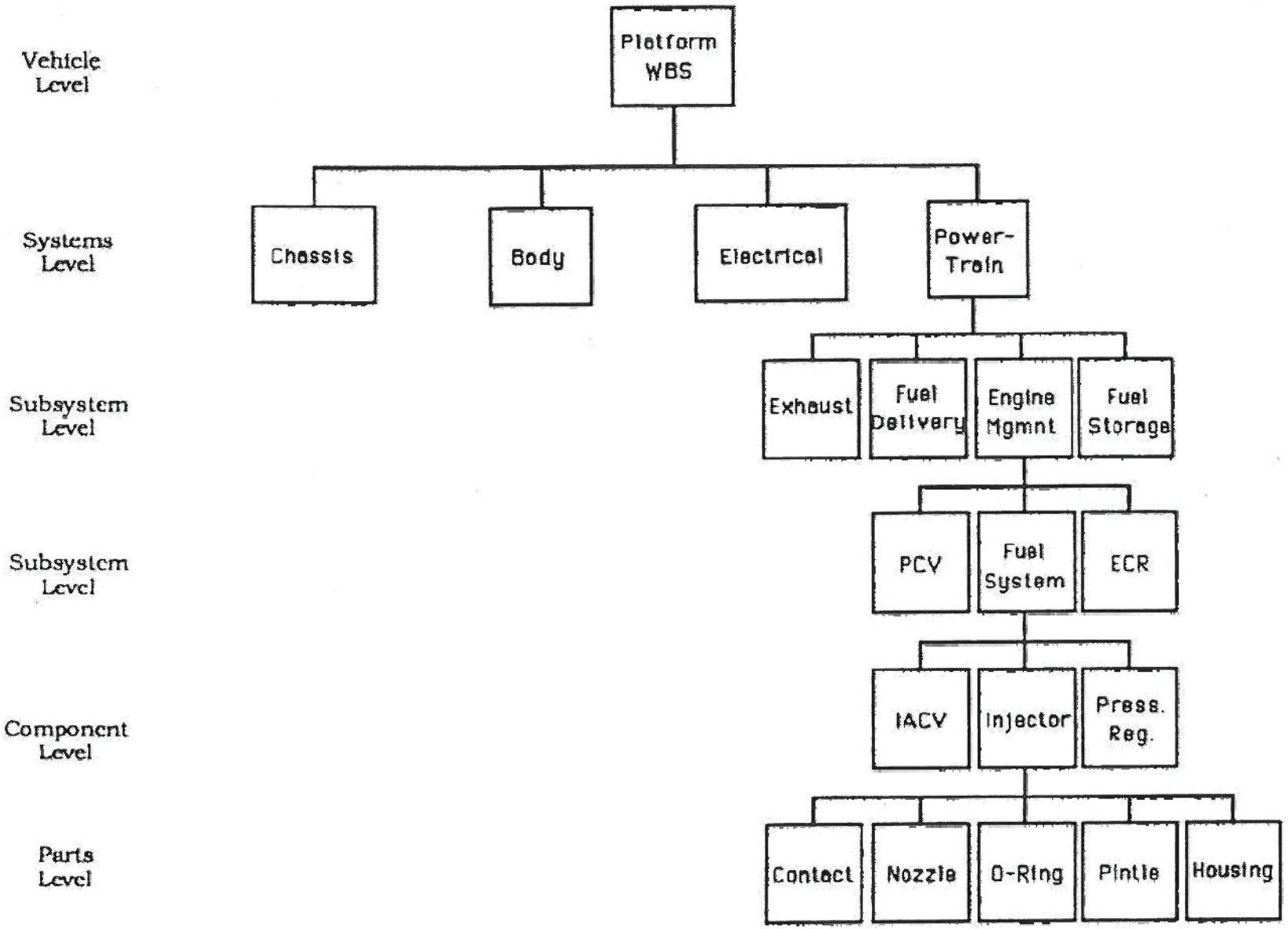
WORK BREAKDOWN EXAMPLE

ACG Automotive System
(General Motors Europe)



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ESTIMATING ACTIVITY TIMES

- **Most optimistic completion time:**
  This time assumes that everything will go according to plan and with minimal amount of difficulties. This should occur approximately 1 percent of the time.

- **Most pessimistic completion time:**
  This time assumes that everything will not go according to plan and that the maximum potential difficulties will develop. This should also occur approximately 1 percent of the time.

- **Most likely completion time:**
  This is the time that, in the mind of the functional manager, would most often occur should this effort be reported over and over again.

- **An Alternate Method Sometimes Used:**
  Ones best estimate becomes the most likely completion time as before; ± 20 percent of the most likely completion time is added or substracted to create the pessimistic and optimistic completion times respectively.

EXPECTED ACTIVITY TIME

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

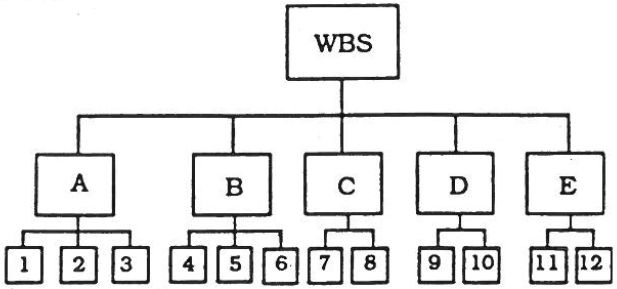
where t_e = expected time
a = most optimistic time
b = most pessimistic time
m = most likely time

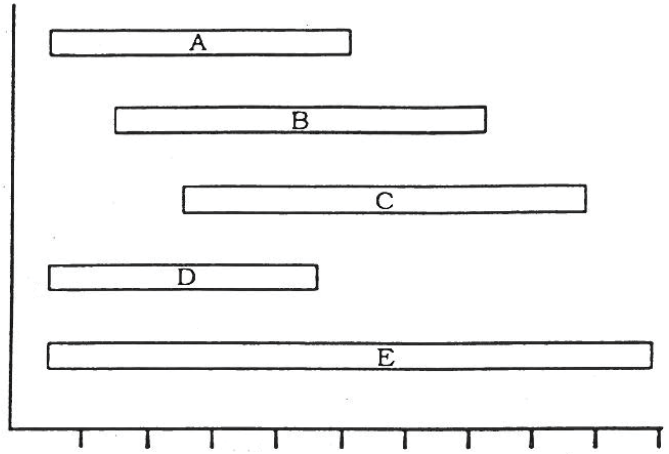
STANDARD DEVIATION OF THE EXPECTED ACTIVITY TIME

$$\sigma_{t_e} = \frac{b - a}{6}$$

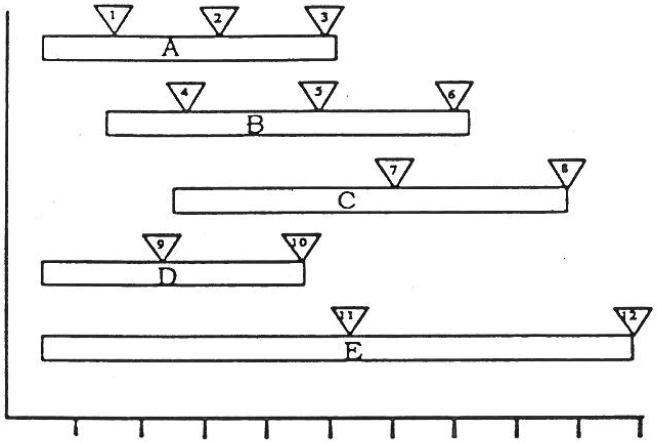
A SIMPLE GANTT CHART and NETWORK DEVELOPMENT PROCESS

All elements of the WBS should be communicated to the project team, the client and management in a *graphic* and most simple way. Remember, the fundamental purpose of scheduling is to communicate. *"Don't let the tools of management obscure our appreciation of the Art."*

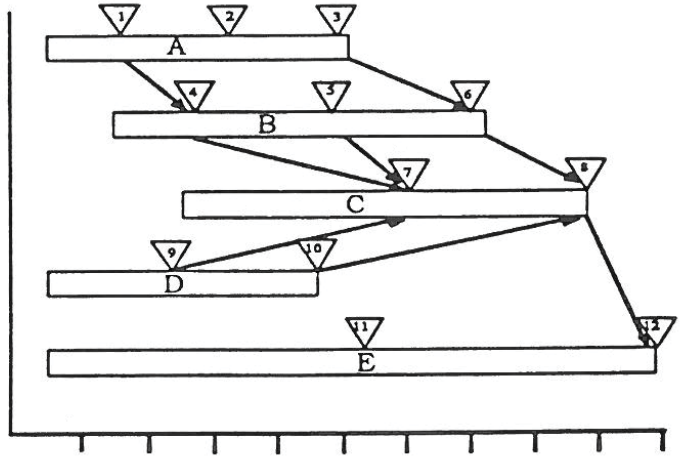




GANTT (Bar) Chart



GANTT Chart with Milestones



GANTT Chart with Milestones and Networks

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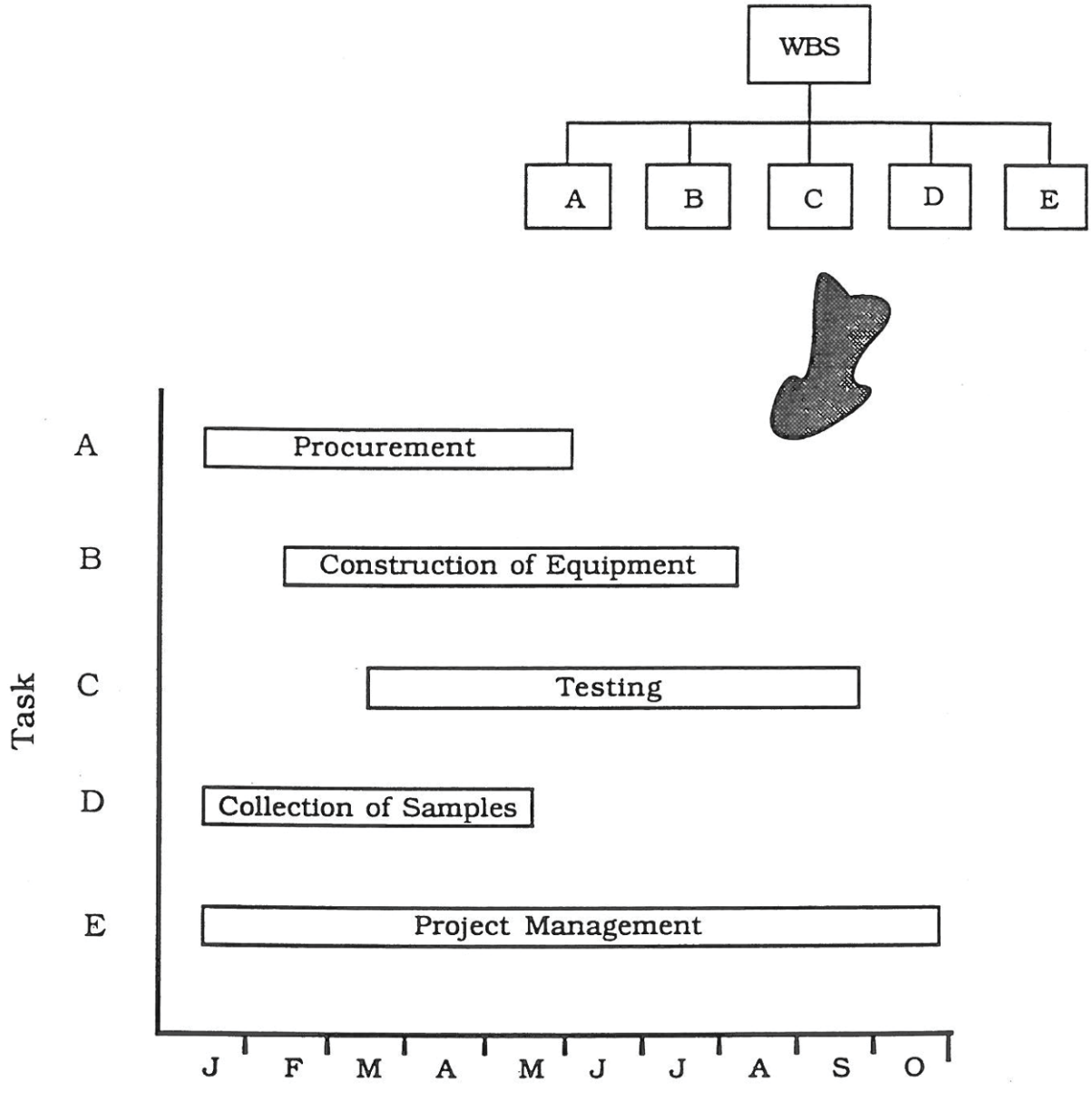
GANTT CHART



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PROGRAM EVALUATION & REVIEW TECHNIQUE (PERT)

and

CRITICAL PATH METHOD (CPM)

PERT and CPM are planning and control instruments for defining the parts of a project and putting them together in a network form so that the person responsible for each element of work knows what is supposed to happen and when in relation to other project activities. The basic difference in PERT and CPM methods is in how the diagrams are drawn. In PERT, the oldest of the techniques, emphasis is placed on points in time (events when something has or is to happen) by placing the events in circles or rectangles. These events are then connected with network lines or arrows, which are the tasks. In CPM, however, emphasis is placed on the tasks by placing them in circles or rectangles. The interconnection of tasks in a CPM diagram is simply the network displaying the interrelationship of tasks.

BASIC REQUIREMENTS FOR PERT AND CPM

1. All of the individual tasks to complete a given project must be visualized in a clear enough manner to be put down in a network, which is comprised of events and activities.

2. Events and activities must be sequenced on the network under a highly logical set of ground rules which allow the determination of important critical and subcritical paths.

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CRITICAL PATH (PERT/CPM) CHARTING

Data Required

- Listing of Activities
- Relationship Between Activities
- Activity Durations

Advantages

- Forces Planning at All Levels
- Shows Relationships/Dependence
- Facilitates Alternative Planning
- Makes Possible Feedforward Control
- Prevents Elements "Falling Thru Crack"

Output Information

- Project Completion Time
- Critical Activities
- Slack Time

Disadvantages

- Complex to Implement
- Extensive Data Requirements
- Expensive to Maintain
- Emphasizes Time Rather than Cost
- Not Useful When Tasks are Nebulous or when Routine and Required

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BASIC ELEMENTS OF PERT AND CPM

- EVENTS - points in time at which something has happened
- ACTIVITIES - clearly definable tasks
- TIMES ESTIMATES - optimistic, pessimistic, most likely
- EXPECTED TIME - mathematical combination of optimistic, pessimistic, and most likely
- SPREAD - degree of uncertainty associated with the expected time
- NETWORK - the interdependencies of the component tasks
- CRITICAL PATHS - the longest time path
- SLACK - how much time to spare on non-critical paths

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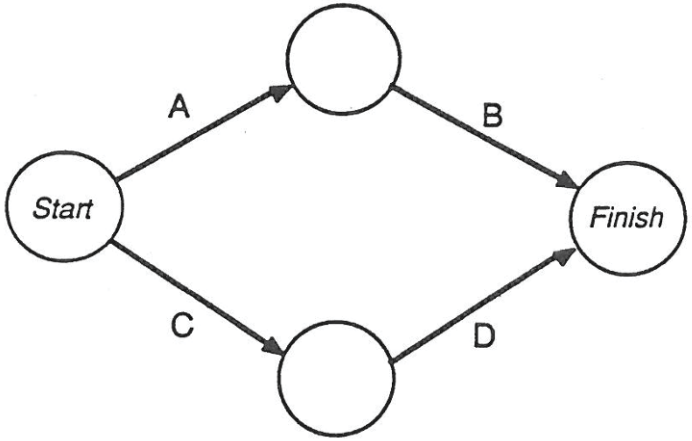
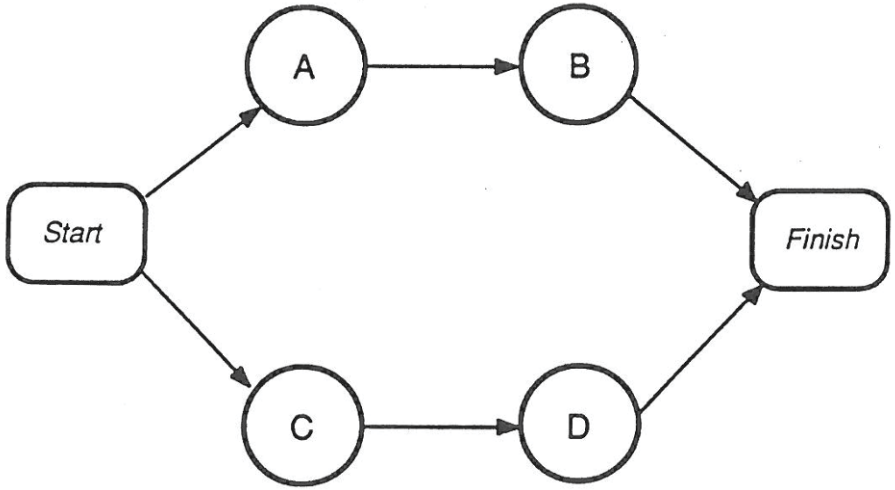
FORMAT DIFFERENCES IN PERT AND CPM NETWORKING METHODS



PERT, Tasks on Arrows



CPM, Tasks in Circles or Boxes

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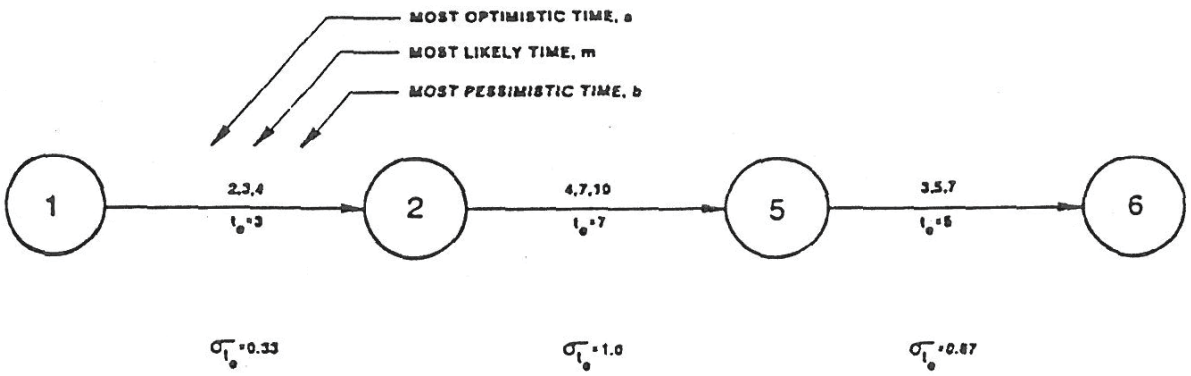
AN EXAMPLE OF STATISTICAL ESTIMATES OF TOTAL CRITICAL PATH PROJECT TIME



TOTAL CRITICAL PATH STANDARD DEVIATION

$$\sigma_{total} = \sqrt{1\text{–}2 + 2\text{–}5 + 5\text{–}6}$$
$$= \sqrt{(0.33)^2 + (1.0)^2 + (0.67)^2}$$
$$= 1.25$$

Statistical Estimates of Total Time (Weeks).

SIGMA LIMIT	PERCENTAGE	EXPRESSION	RANGE
1	68	15 ± 1.25	13.75–16.25
2	95	15 ± 2.50	12.50–17.50
3	99	15 ± 3.75	11.25–18.75

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TREE PROJECT NETWORK

ACTIVITY	DURATION
1 - 2: Dig hole	20 minutes
2 - 3: Position tree	1 minute
3 - 4: Fill in hole	5 minutes