Production Planning & Control

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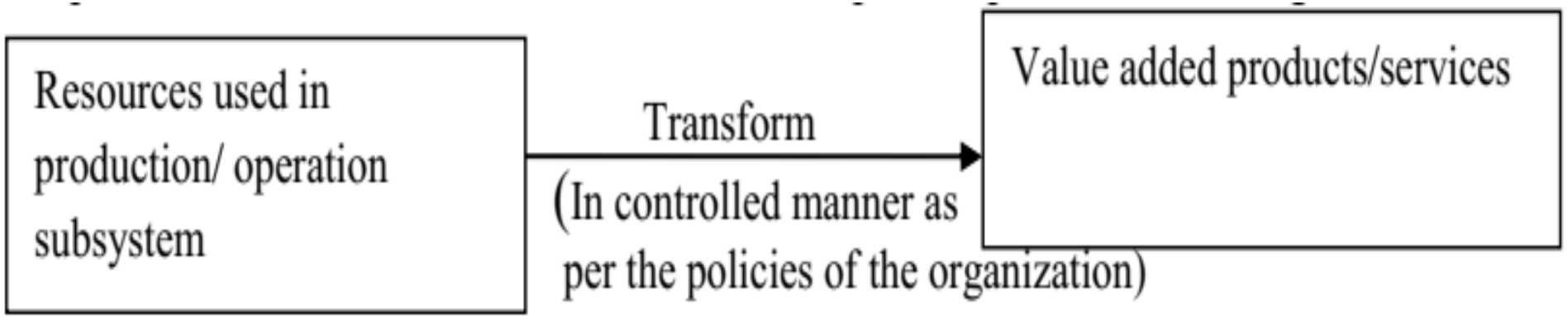
https://github.com/tanmoyie/operations-Management
Ref: Operations Management by Stevension

Introduction to PPC

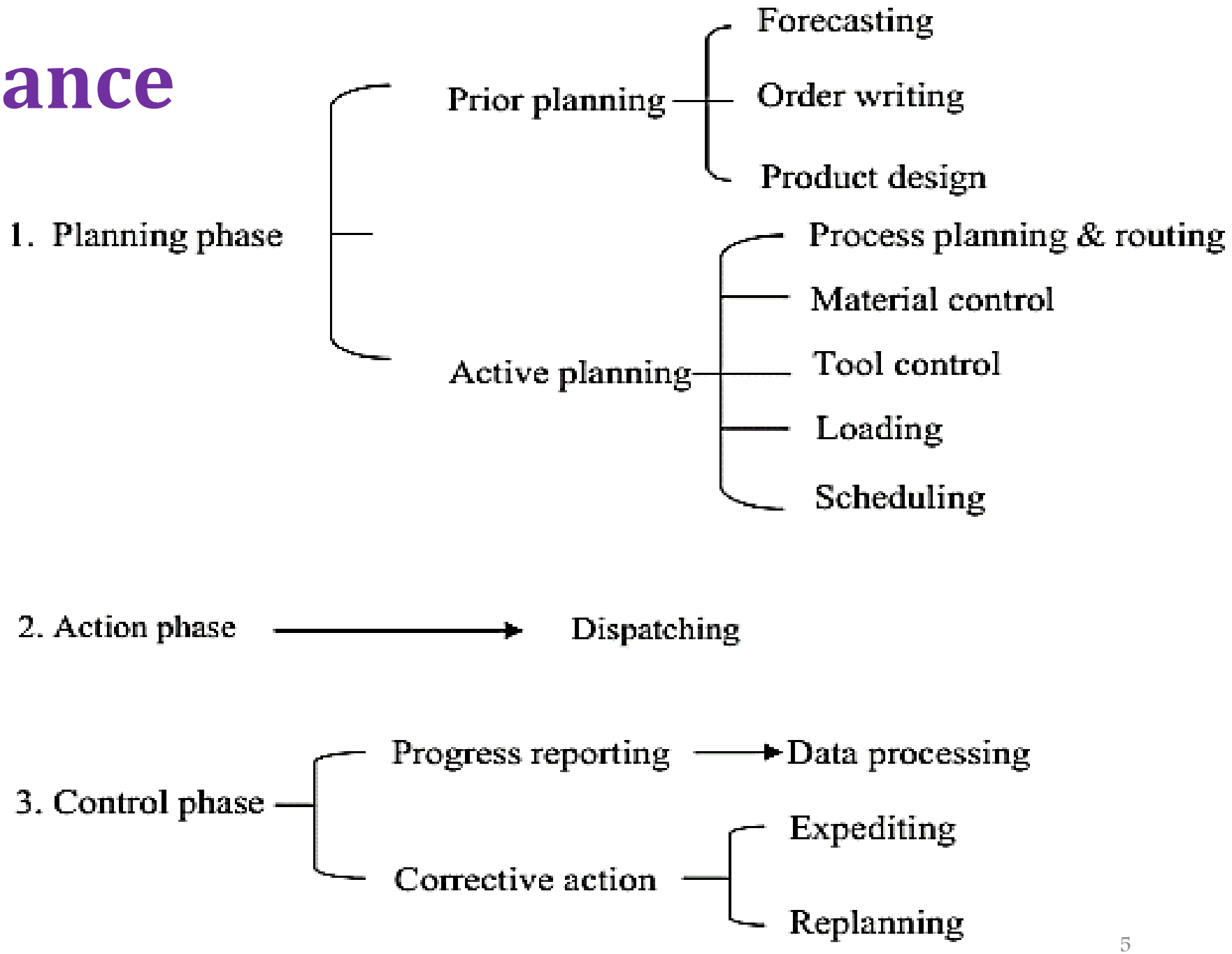
Input – Process - Output



Definition

- **PRODUCTION:** that transformation of raw materials to finished goods.
- **PLANNING:** looks ahead, anticipates possible difficulties and decides in advance as to how the production, best, be carried out.
- **CONTROL:** phase makes sure that the programmed production is constantly maintained

PPC at a glance

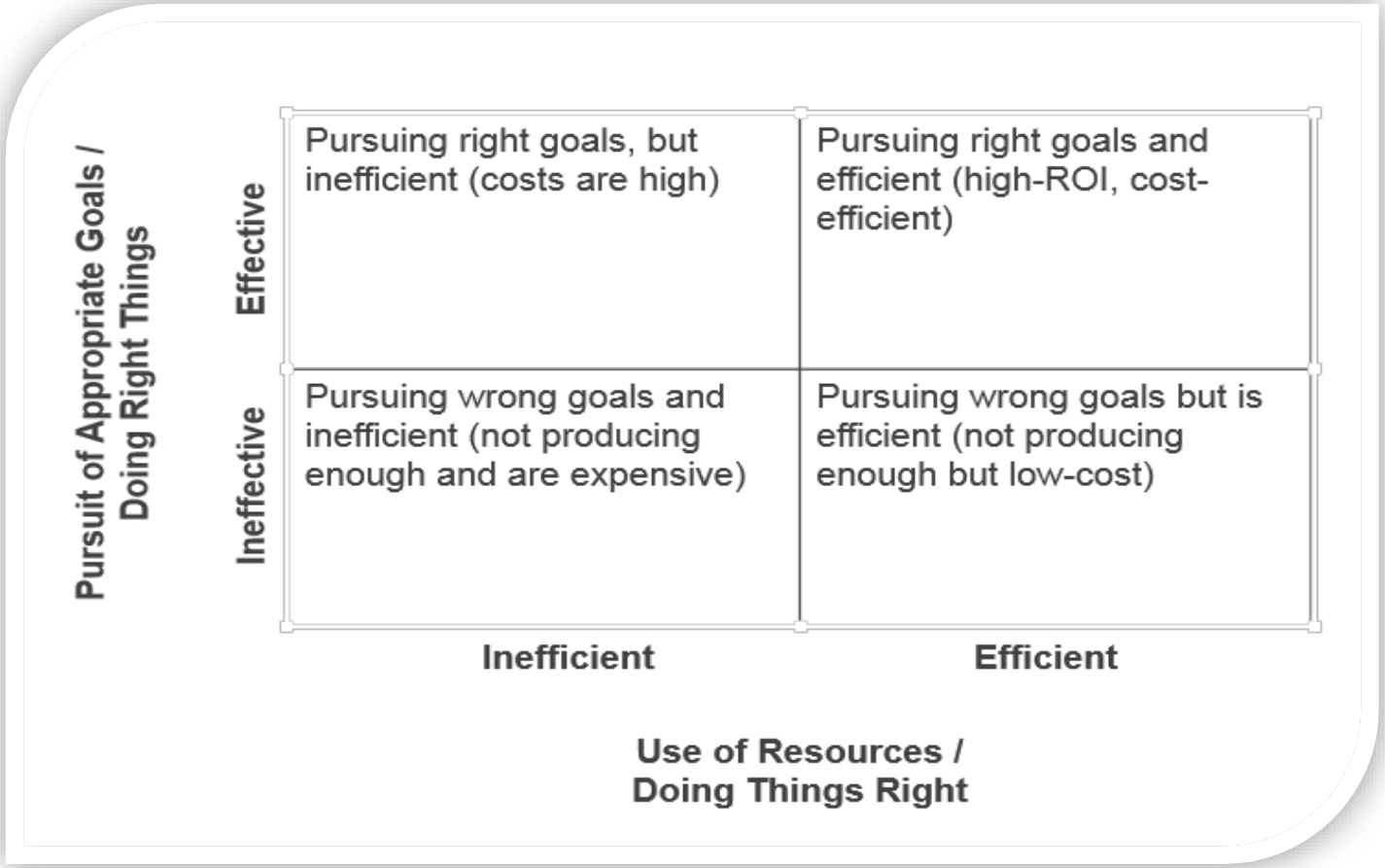


Efficiency & Effectiveness

Efficient – Performing or functioning in the best possible manner with the least waste of time and effort.

Effective - successful in producing a desired or intended result.

Being **effective** is about doing the right things, while being **efficient** is about doing things right.



Productivity

- Production/Operation management is the process which combines and transforms various resources used in the production/operation subsystem of the organization into value added products/services
- **Productivity:**

Productivity is the quantitative relation between what we produce and what we use as a resource to produce them. Productivity can be expressed as:

$$Productivity = \frac{Output}{Input}$$

PDCA cycle

- Plan~Do~Check~Act

80-20 rules

- 20% of the causes contributes to 80% of the effects

How SolidWorks can assist during Planning Stage?

Time Dimension in Planning

 Long Range Planning; is done annually and focus on a planning horizon greater than one year.
 Medium Range Planning; usually covers a period from 6 months to 18 months, with monthly or sometimes quarterly time increments.
 Short Range Planning; covers a period from one day or less to six months, with weekly time increment usually

Production Planning

PLANNING

That may be defined as the technique of foreseeing every step in a long series of separate operations., Each step to be taken at the **right time**, and in the **right place** and each operation to be performed in maximum efficiency.

ROUTING

Under this operations , their path and sequence are established

SCHEDULING

It mainly concerns with time element and priorities of a job.
The pattern of scheduling differs from one job to another which is explained as below:
Production Schedule, Master Schedule, Manufacturing Schedule

LOADING

Defined as the relationship between load and capacity, so as to assign the work for the production

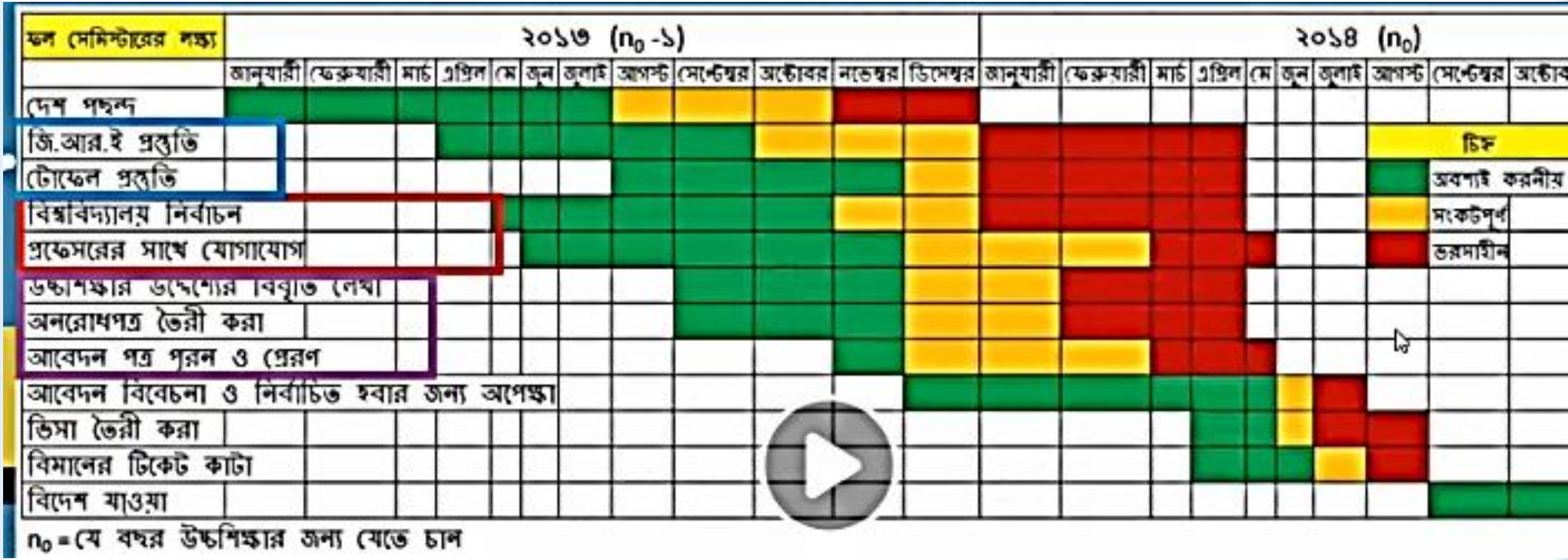
- MRP – Material Requirement Planning
- MPS – Master Production Scheduling
- CPM – Critical Path Method
- PERT – Program Evaluation & Review Technique
- MRP-II – Manufacturing Resource Planning
- JIT – Just in Time

CPM & PERT

The objective of CPM & PERT

1. A graphical display of project activities.
2. An estimate of how long the project will take.
3. An indication of which activities are the most critical to timely project completion.
4. An indication of how long any activity can be delayed without delaying the project

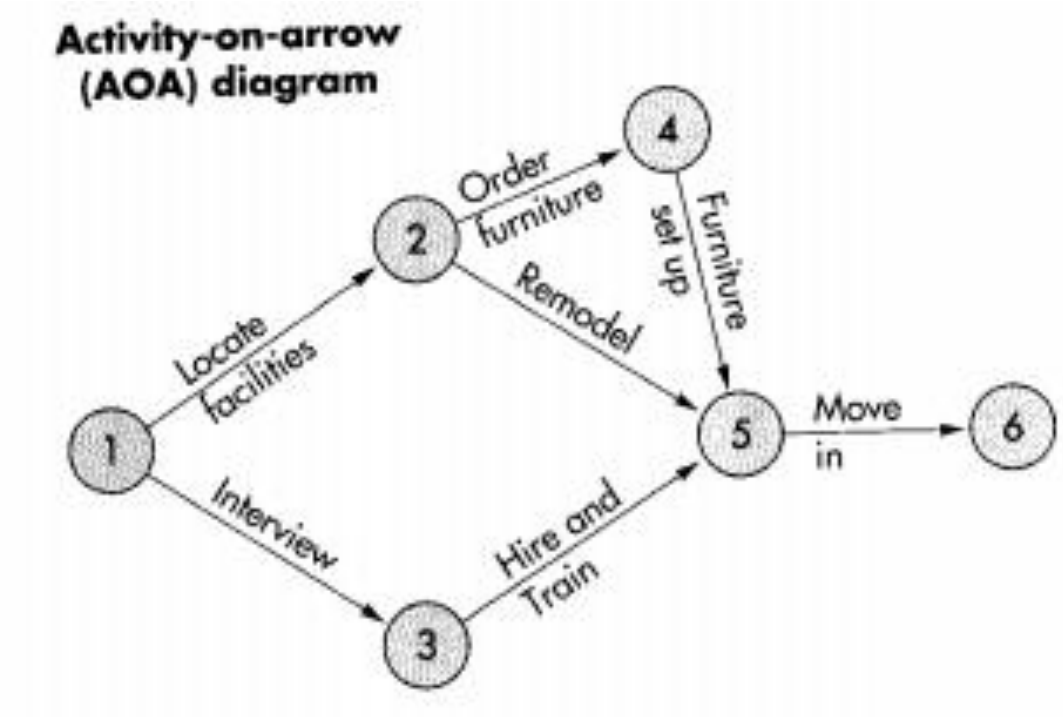
Gantt Chart


ফল সেমিস্টারের লক্ষ্য
২০১৩ (n_0 -১)
২০১৪ (n_0)
জানুয়ারী
ফেব্রুয়ারী
মার্চ
এপ্রিল
মে
জুন
জুলাই
আগস্ট
সেপ্টেম্বর
অক্টোবর
নভেম্বর
ডিসেম্বর
দেশ পছন্দ
জি.আর.ই প্রস্তুতি
টোফেল প্রস্তুতি
বিশ্ববিদ্যালয় নির্বাচন
প্রফেসরের সাথে যোগাযোগ
উচ্চশিক্ষার উদ্দেশ্যের বিস্তৃত লেখা
অনুরোধপত্র তৈরী করা
আবেদন পত্র পূরন ও প্রেরণ
আবেদন বিবেচনা ও নির্বাচিত হবার জন্য অপেক্ষা
ভিসা তৈরী করা
বিমানের টিকেট কাটা
বিদেশ যাওয়া
টিপ
অবশ্যই করনীয়
সংকটপূর্ণ
ভয়দায়ীন
n_0 = যে বছর উচ্চশিক্ষার জন্য যেতে চান

Time estimates include:

1) Total time for completion.
2) ES- Earliest start time: the earliest time at which the activity can start given that its precedent activities must be completed first.
3) EF-Earliest finish time: equals to the earliest start time for the activity plus the time required to complete the activity.
4) LF- Latest finish time: the latest time in which the activity can be completed without delaying the project.
5) LS- Latest start time: equal to the latest finish time minus the time required to complete the activity.

Network Diagram



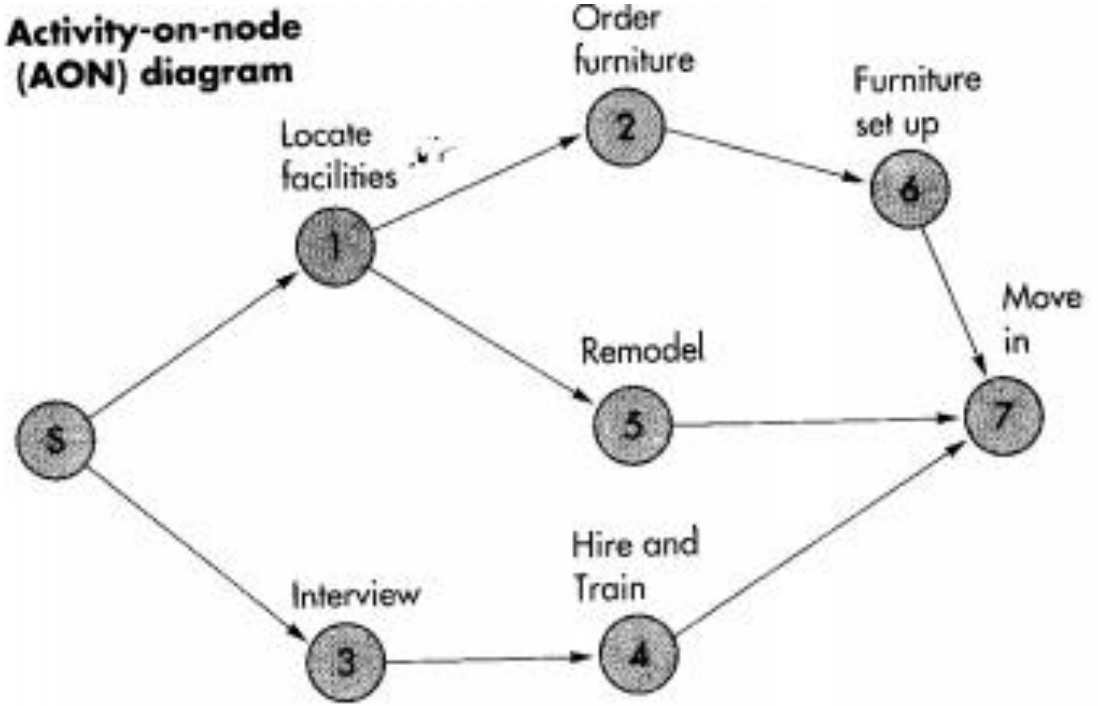
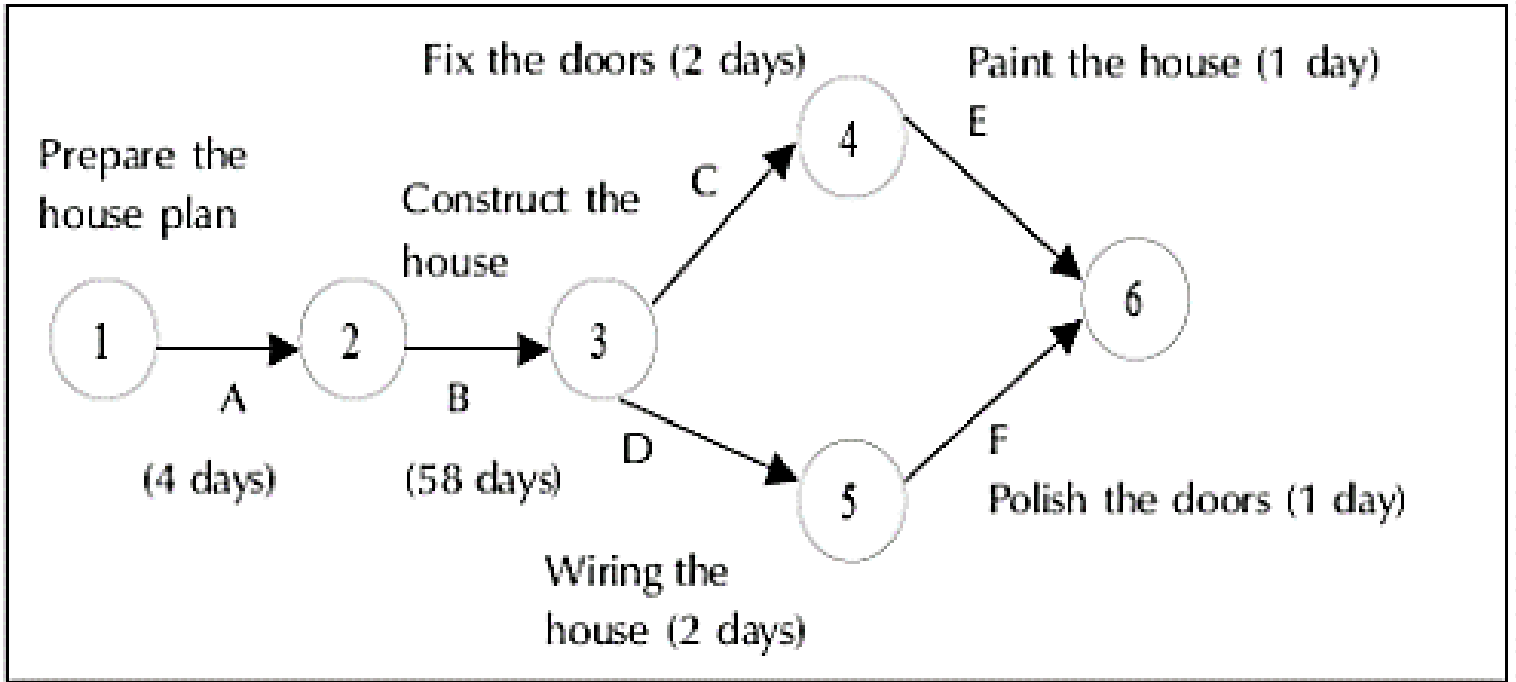


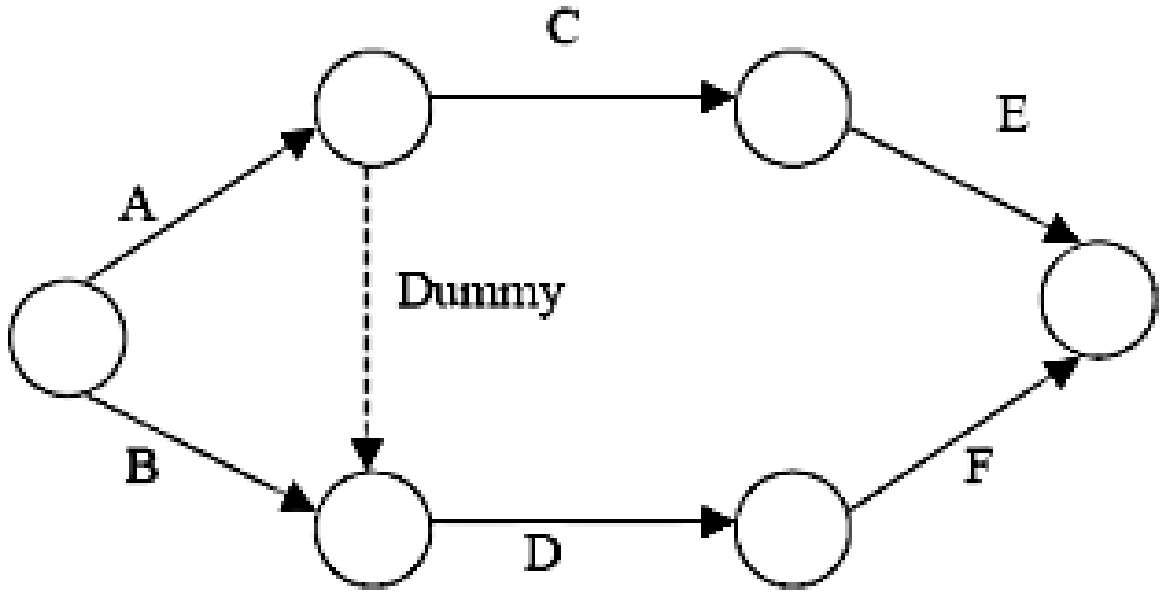
Table 8.1: Sequence of Activities for House Construction Project

Name of the activity	Starting and finishing event	Description of activity	Predecessor	Time duration (days)
A	(1,2)	Prepare the house plan	--	4
B	(2,3)	Construct the house	A	58
C	(3,4)	Fix the door / windows	B	2
D	(3,5)	Wiring the house	B	2
E	(4,6)	Paint the house	C	1
F	(5,6)	Polish the doors / windows	D	1



Network diagram with dummy activities

Activity	Description	Predecessor
A	Purchase of Land	-
B	Preparation of building plan	-
C	Level or clean the land	A
D	Register and get approval	A, B
E	Construct the building	C
F	Paint the building	D



CPM

- Critical path: the longest path; determine the expected project duration
- The (estimated) project duration equals the length of the longest path through the project network. This longest path is called the critical path. (If more than one path tie for the longest, they all are critical paths.)
- The earliest start time of an activity is equal to the largest of the earliest finish times of its immediate predecessors (ES is used in Forward pass). In symbols,

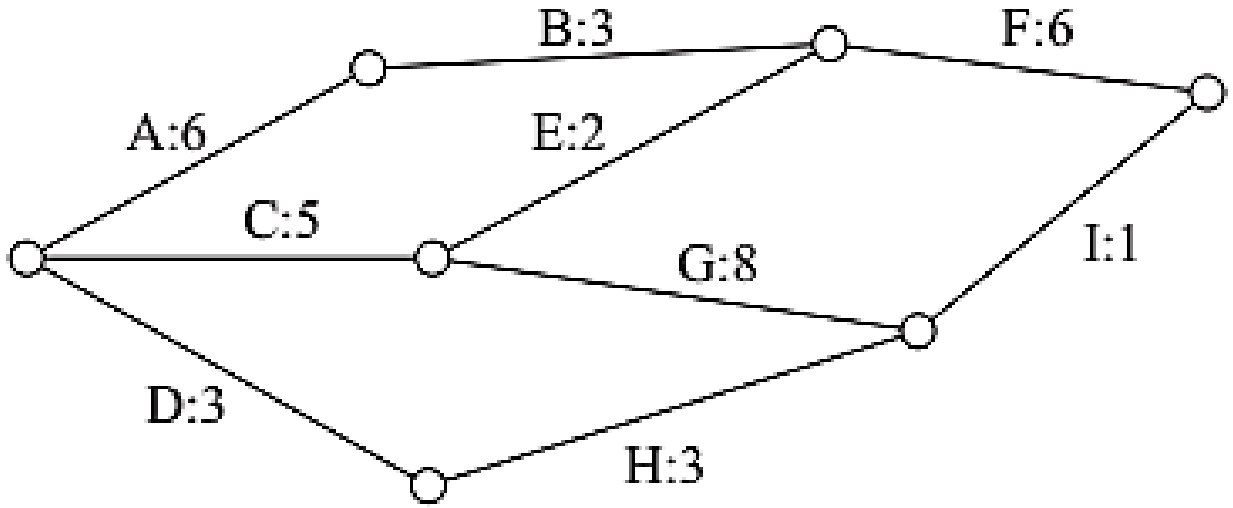
$$EF = \text{largest } EF \text{ of the immediate predecessors.}$$

- The latest finish time of an activity is equal to the smallest of the latest start times of its immediate successors. (LF is used in Backward pass). In symbols,

$$LF = \text{smallest } LS \text{ of the immediate successors.}$$

The project network below shows activity durations in weeks. There is a likelihood that Activity D cannot start until the end of Week 3. In this context, the earliest that the project can be completed is the end of Week:

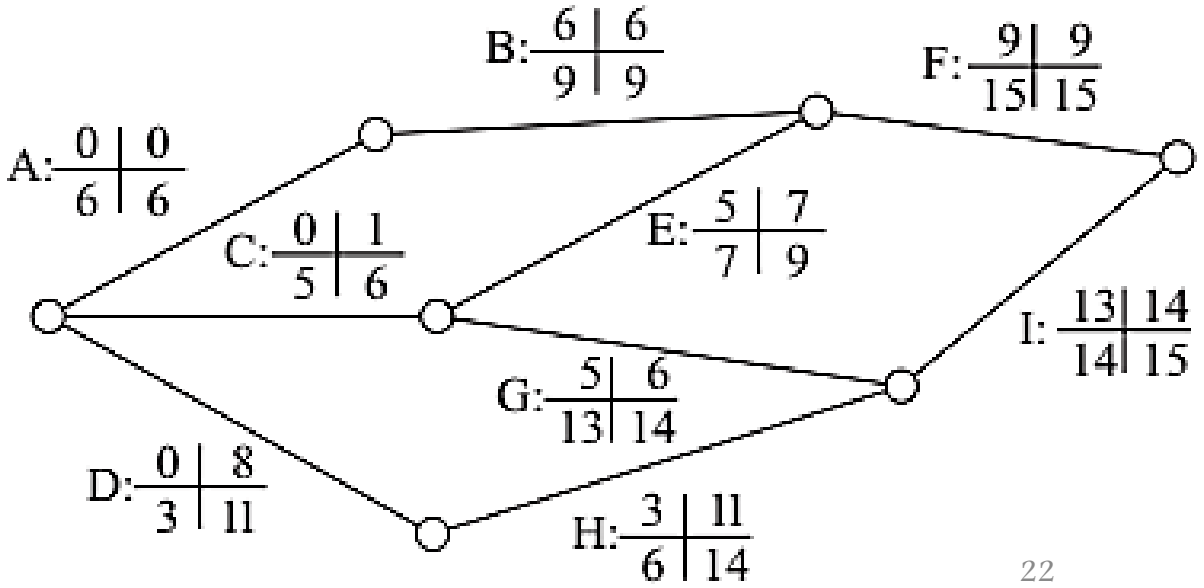
A. 15
B. 17
C. 18
D. 43



The diagram with early start, late start, early finish, and late finish times is as follows:

Activity:
ES: earliest start
EF: earliest finish
LS: latest start
LF: latest finish

ES LS
EF LF



The critical path is A–B–F. Activity D has slack of 8 weeks, so starting Activity D at the end of Week 3 will not affect the completion date. Therefore, A–B–F will still be the critical path with a time of 15 weeks.

PERT

- Optimistic time (to) – It is the shortest time in which the activity can be completed.
- Most likely time (tm) – It is the probable time required to perform the activity.
- Pessimistic time (tp) – It is the longest estimated time required to perform an activity.
- Expected time

$$t_e = \frac{(t_o + 4t_m + t_p)}{6}$$

PERT

(a_{ij}, b_{ij}, c_{ij}) = (optimistic, most likely, pessimistic) durations for activity (i, j)

μ_{ij} = mean duration of activity (i, j)

σ_{ij} = standard deviation of the duration of activity (i, j)

μ = project mean duration

σ = standard deviation of project duration

$$\mu_{ij} = \frac{a_{ij} + 4b_{ij} + c_{ij}}{6}$$

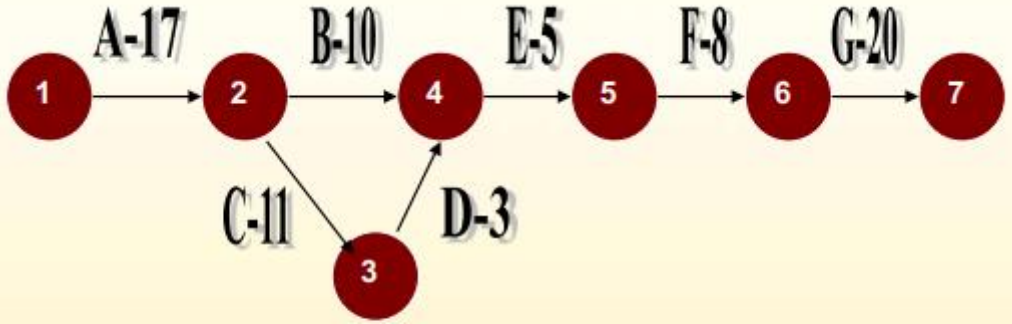
$$\sigma_{ij} = \frac{c_{ij} - a_{ij}}{6}$$

$$\mu = \sum_{(i,j) \in CP} \mu_{ij}$$

$$\sigma^2 = \sum_{(i,j) \in CP} \sigma_{ij}^2$$

Math problem in PERT

- Construct the network diagram
- Determine the CP as well
- Find the project duration



A-B-E-F-G = 60

A-C-D-E-F-G = 64 (CRITICAL PATH)

Activity	Description	Precedence	Optimistic time	Most Likely time	Pessimistic time
A	Initial design	-	12	16	26
B	Survey market	A	6	9	18
C	Build prototype	A	8	10	18
D	Test prototype	C	2	3	4
E	Redesigning	B,D	3	4	11
F	Market testing	E	6	8	10
G	Set up production	F	15	20	25

Line Balancing

Line Balancing

- Line Balancing: the process of assigning tasks to workstations in such a way that the workstations have approximately equal time requirements
- Cycle time: The maximum time allowed at each workstation to perform assigned tasks before the work moves on. The cycle time also establishes the output rate of a line.

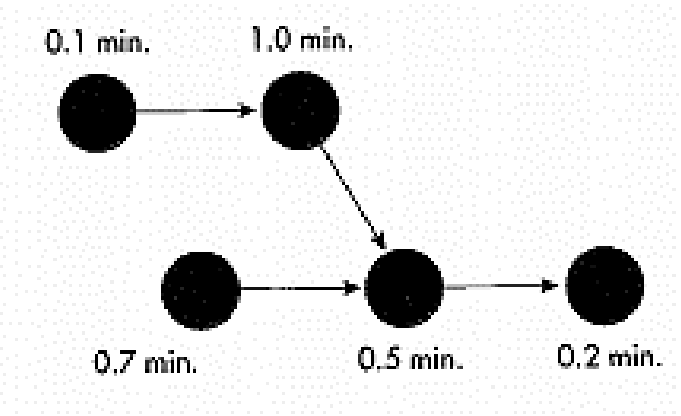
Line Balancing

- $Output = \frac{OT}{CT}$
  - OT = Operating time
  - CT = Cycle time

- The minimum number of workstations needed,

$$N_{min} = \frac{\sum t}{CT}$$

Math problem: Given, CT = 1



Solution:
N_min = (.1+1+.7+.5+.2)/1 = 2.5 stations = 3 stations

Line Balancing

$$N_{\min} = \left(OR \times \sum_i t_i / OT \right)$$

= theoretical minimum number of stations

Idle Time/Station $= CT - ST$

Idle Time/Cycle $= \sum (CT - ST)$

$$\text{Percent Idle Time} = \frac{\text{Idle Time/Cycle}}{N_{\text{actual}} \times CT} \times 100, \text{ where}$$

CT = cycle time (time between units)

OT = operating time/period

OR = output rate/period

ST = station time (time to complete task at each station)

t_i = individual task times

N = number of stations

The *percentage of idle time* of the line. This is sometimes referred to as the **balance delay.** It can be computed as follows:

$$\text{Percentage of idle time} = \frac{\text{Idle time per cycle}}{N_{\text{actual}} \times \text{cycle time}} \times 100$$

where N_{actual} = Actual number of stations.

Workstation	Time Remaining	Eligible	Assign Task	Station Idle Time
1	1.0	a, c	a	
	0.9	c	c	
	0.2	none	—	0.2
2	1.0	b	b	0.0
3	1.0	d	d	
	0.5	e	e	
	0.3	—	—	0.3
				0.5