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# Activity-On-Arrow (A-O-A) Network Planning Technique

## ❖ *What is the A-O-A Network?*

It is a network diagramming technique in which activities are represented by arrows. The start and end of each node or event is connected to an arrow. Between the two nodes lies an arrow that represents the activity.



## ❖ *The Activity Early Start (E.S)*

It is the earliest time that an activity can start with.

## ❖ *The Activity Early Finish (E.F)*

It is the earliest time that an activity can finish with.

$$E.F = E.S + \text{Duration (D)}$$

## ❖ *The Activity Late Finish (L.F)*

It is the latest time that an activity can finish with.

## ❖ *The Activity Late Start (L.S)*

It is the latest time that an activity can start with.

$$L.S = L.F - \text{Duration (D)}$$

## ❖ *The Activity Total Float (T.F)*

The float for an activity is the amount that its duration can slip without causing the project to be delayed. Any activity with a zero float is on the critical path (C.P).

$$T.F = L.F - E.F \quad \text{(or)} \quad = L.S - E.S$$

**Critical path (C.P) is the path that has the longest duration where activities have zero float**
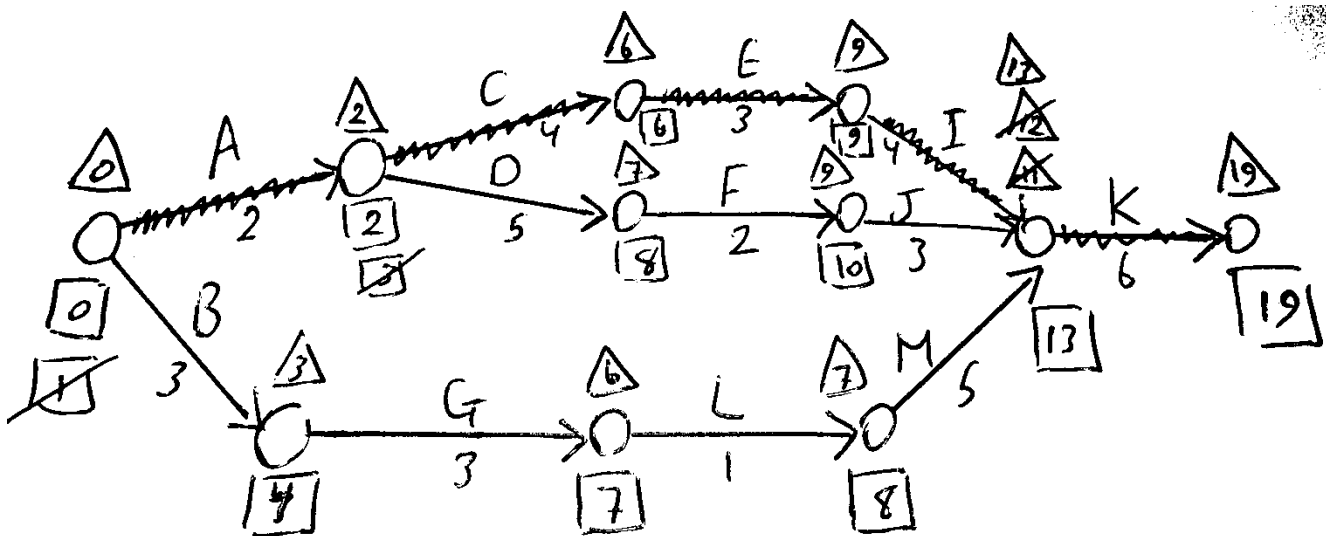
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❖ *Examples of A-O-A Networks*

**Ex-1/ Find the project's total duration. Use the following details to draw the A-O-A Network and build its Table:**

| Activity | A | B | C | D | G | E | F | L | I | J | M | K |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Duration (weeks) | 2 | 3 | 4 | 5 | 3 | 3 | 2 | 1 | 4 | 3 | 5 | 6 |
| Following Activity | C,D | G | E | F | L | I | J | M | K | K | K | --- |

Solution:  (( $\triangle$ = Forward (E.S) ))      (( $\square$ = Backward (L.F) ))



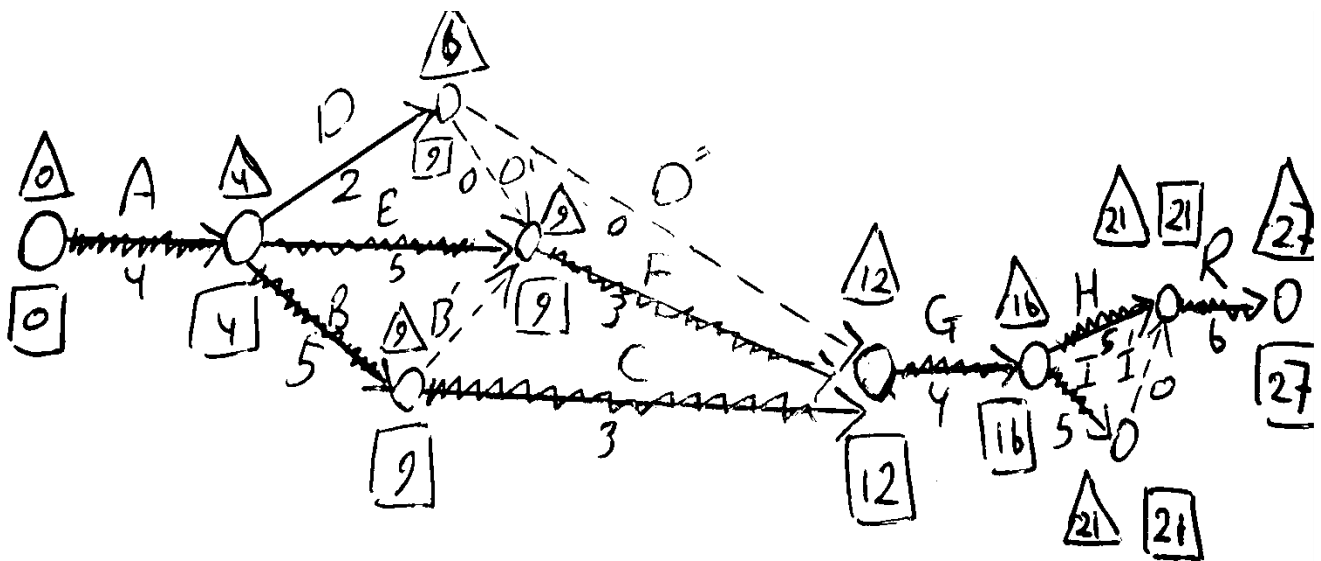| Activity | Duration (weeks) | Early Start (E.S) | Early Finish (E.F=E.S+D) | Late Finish (L.F) | Late Start (L.S=L.F-D) | Total Float (T.F=L.F-E.F) or (L.S-E.S) | Status Of Activity |
|---|---|---|---|---|---|---|---|
| A | 2 | 0 | 2 | 2 | 0 | 0 | Critical |
| B | 3 | 0 | 3 | 4 | 1 | 1 | - |
| C | 4 | 2 | 6 | 6 | 2 | 0 | Critical |
| D | 5 | 2 | 7 | 8 | 3 | 1 | - |
| G | 3 | 3 | 6 | 7 | 4 | 1 | - |
| E | 3 | 6 | 9 | 9 | 6 | 0 | Critical |
| F | 2 | 7 | 9 | 10 | 8 | 1 | - |
| L | 1 | 6 | 7 | 8 | 7 | 1 | - |
| I | 4 | 9 | 13 | 13 | 9 | 0 | Critical |
| J | 3 | 9 | 12 | 13 | 10 | 1 | - |
| M | 5 | 7 | 12 | 13 | 8 | 1 | - |
| K | 6 | 13 | 19 | 19 | 13 | 0 | Critical |

*Project Total Duration is 19 weeks. (C.P= A,C,E,I,K)*

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**Ex-2/ Find the project's total duration and date of completion (assume the project start date is 1/12/2014). Use the following details to draw the A-O-A Network and build its Table:**

| Activity | A | B | C | D | E | F | G | H | I | R |
|---|---|---|---|---|---|---|---|---|---|---|
| Duration (days) | 4 | 5 | 3 | 2 | 5 | 3 | 4 | 5 | 5 | 6 |
| Following Activity | B,D,E | C,F | G | F,G | F | G | H,I | R | R | --- |

**Solution:**



| Activity | Duration (weeks) | Early Start (E.S) | Early Finish (E.F=E.S+D) | Late Finish (L.F) | Late Start (L.S=L.F-D) | Total Float (T.F=L.F-E.F) or (L.S-E.S) | Status Of Activity |
|---|---|---|---|---|---|---|---|
| A | 4 | 0 | 4 | 4 | 0 | 0 | Critical |
| B | 5 | 4 | 9 | 9 | 4 | 0 | Critical |
| C | 3 | 9 | 12 | 12 | 9 | 0 | Critical |
| D | 2 | 4 | 6 | 9 | 7 | 3 | - |
| E | 5 | 4 | 9 | 9 | 4 | 0 | Critical |
| F | 3 | 9 | 12 | 12 | 9 | 0 | Critical |
| G | 4 | 12 | 16 | 16 | 12 | 0 | Critical |
| H | 5 | 16 | 21 | 21 | 16 | 0 | Critical |
| I | 5 | 16 | 21 | 21 | 16 | 0 | Critical |
| R | 6 | 21 | 27 | 27 | 21 | 0 | Critical |

*Project Total Duration is **27 days**. The date of completion is **28/12/2014***
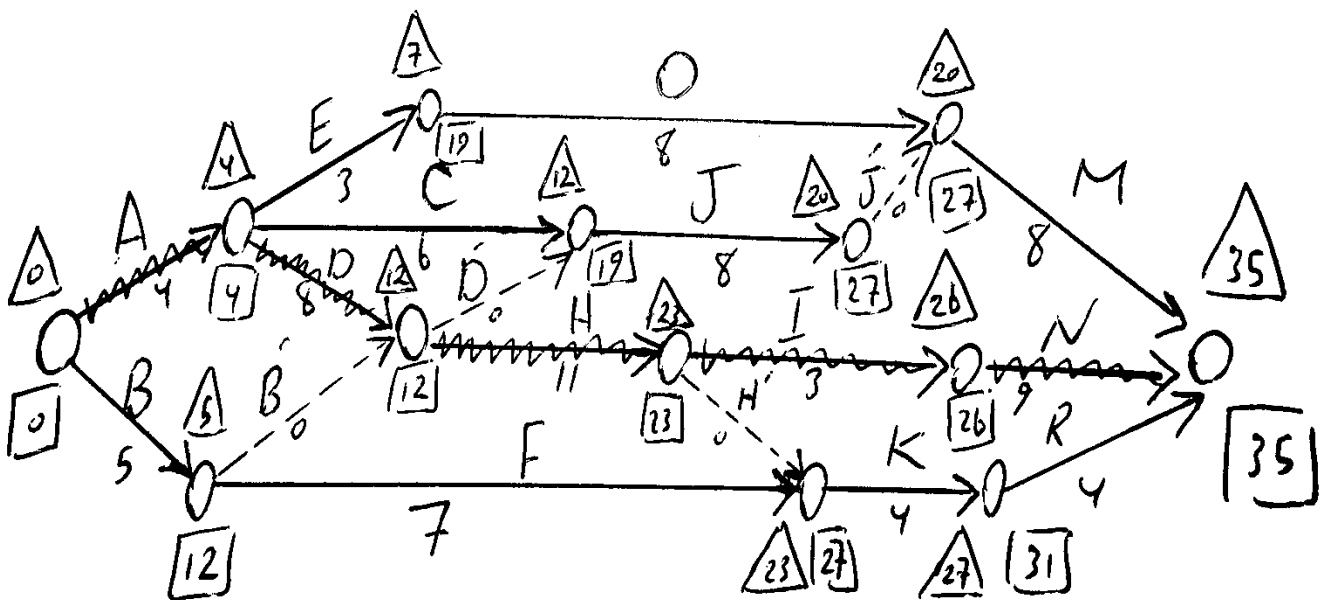*C.P= (A,B,C,G,H,R)   OR   (A,E,F,G,I,R)*

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**Ex-3/ Find the project's total duration and date of completion (assume the project start date is 10<sup>th</sup> of June 2015). Use the following details to construct the A-O-A Network and build its Table:**

| Activity | A | B | C | D | E | F | O | H | I | J | K | M | N | R |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Duration (weeks) | 4 | 5 | 6 | 8 | 3 | 7 | 8 | 11 | 3 | 8 | 4 | 8 | 9 | 4 |
| Following Activity | C,D,E | D,F | J | J,H | O | K | M | I,K | N | M | R | ---- | --- | ---- |

**Solution:**



| Activity | Duration (weeks) | Early Start (E.S) | Early Finish (E.F=E.S+D) | Late Finish (L.F) | Late Start (L.S=L.F-D) | Total Float (T.F=L.F-E.F) or (L.S-E.S) | Status Of Activity |
|---|---|---|---|---|---|---|---|
| A | 4 | 0 | 4 | 4 | 0 | 0 | Critical |
| B | 5 | 0 | 5 | 12 | 7 | 7 | - |
| C | 6 | 4 | 10 | 19 | 13 | 9 | - |
| D | 8 | 4 | 12 | 12 | 4 | 0 | Critical |
| E | 3 | 4 | 7 | 19 | 16 | 12 | - |
| F | 7 | 5 | 12 | 27 | 20 | 15 | - |
| O | 8 | 7 | 15 | 27 | 19 | 12 | - |
| H | 11 | 12 | 23 | 23 | 12 | 0 | Critical |
| I | 3 | 23 | 26 | 26 | 23 | 0 | Critical |
| J | 8 | 12 | 20 | 27 | 19 | 7 | - |
| K | 4 | 23 | 27 | 31 | 27 | 4 | - |
| M | 8 | 20 | 28 | 35 | 27 | 7 | - |
| N | 9 | 26 | 35 | 35 | 26 | 0 | Critical |
| R | 4 | 27 | 31 | 35 | 31 | 4 | - |

*Project Total Duration is <u>35 weeks</u>. The date of completion is <u>1<sup>st</sup> of April 2016</u>*
*<u>(C.P= A,D,H,I,N)</u>*