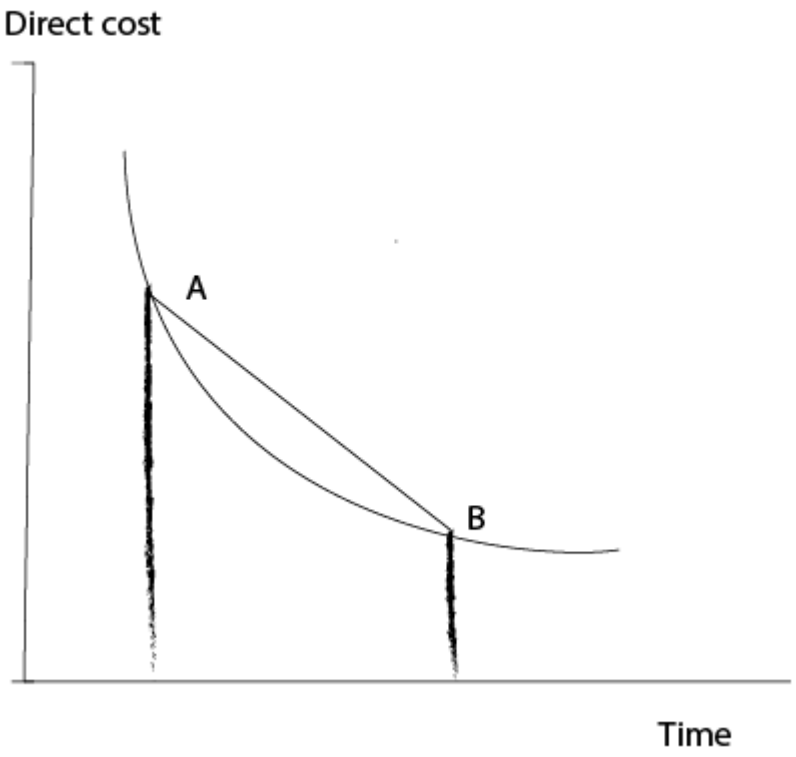
Resource Allocation:- TIME COST TRADE-OFF

Till now, we discussed how to schedule project activities in a logical sequence. The costs of resources consumed by activities were not taken into consideration. . For our analysis, we assume that the resources required for each of the activities of a project and the resource restrictions are known. The project competition time can be reduced by reducing (crashing) the normal completion time of critical activities. If we crash any activity then the resource requirement for completion of activity will increase so cost of activity will increase. Therefore we face the situation in which there is trade off between time and cost. If we reduce time by crashing activities then cost will increase and if we want to keep cost at low level then project duration will increase.

The total cost of project comprises direct and indirect costs. The time cost relationship for the activities may take a variety of forms. For simplicity purpose, the relationship is generally assumed to be linear.

- Direct Cost- the direct costs are associated with the individual activities such as manpower loading, equipment utilized, materials consumed directly etc. in respect of various activities.



The straight line, downward sloping cost relationship gives an idea of the direct cost required to perform an activity over any time from normal to crash completion.

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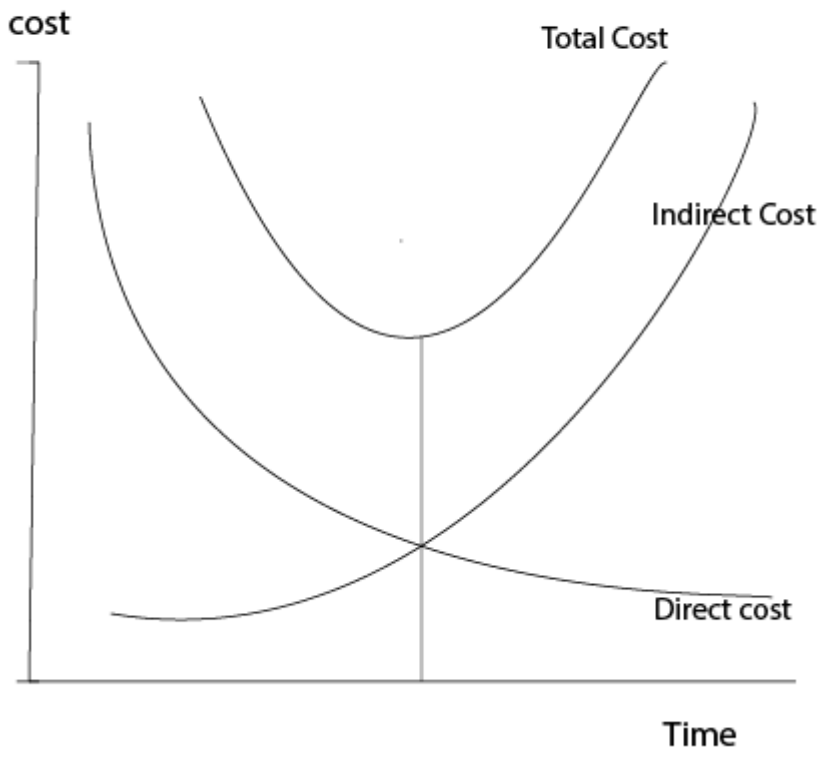
- Indirect cost- Indirect costs are those expenditures which cannot be allocated to individual activities of the project. These may include administration or supervision costs, loss of revenue, fixed overheads and so on.

  While indirect costs allocated to a project goes up with the increase in project duration, direct costs go high as the time for individual activity is reduced.

Crashing the activity- Deliberate reduction of activity times by putting an extra effort is called crashing the activity. The direct cost, indirect cost and total cost can be represented by following diagram.



It is important to note that by crashing the activity, direct cost component of total cost will increase. By crashing the activity, project duration will decrease consequently indirect cost will decrease.

Crash time- the Crash time represents the fully expedited or the minimum activity duration time that is possible, and any attempts to further crash would only raise the activity direct costs without reducing the time. The activity cost corresponding to the crash time is called the crash cost which equals the minimum direct cost required to achieve the crash performance time.

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The normal cost is equal to the absolute minimum of the direct cost required to perform an activity. The corresponding activity duration is known as the normal time.

The cost curve is non-linear and asymptotic but for the sake of simplicity it can be approximated by a straight line with its slope given by

Cost slope = (crash cost – Normal cost)/(Normal time – Crash time)

The cost slope represents the rate of increase in the cost of performing the activity per unit decrease in time and is called cost/time trade off. It varies from activity to activity. Having assessed the direct and indirect project costs, the total costs can be found out. The total project cost is sum of total of the project direct and indirect costs.

Time cost optimisation algorithm

The process of shortening a project is called a crashing and is usually achieved by adding extra resources to an activity. Project crashing involves following steps

1. Schedule a project with all its activities at their normal durations. Identify the critical path and critical activities
2. Calculate the cost slope for the different activities and rank the activities in ascending order of cost slope
3. Crash the activities on the critical path as per the ranking, i.e. activity having lower cost slope would be crashed first to the maximum extent possible.
4. As the critical path duration is reduced by the crashing in step 3, other paths may also become critical i.e. we get parallel critical paths. This means that project duration can be reduced duly by simultaneous crashing of activities in the parallel critical paths.
5. Crashing as per steps 3 and 4, one reaches a point when further crashing is either not possible or does not result in the reduction of crashing of project duration.
6. Compute the total project cost by adding corresponding fixed cost to the direct cost, which is obtained by adding the crashing cost cumulatively to the normal cost.

http://rajkumar2850.weebly.com/, Rajkumar, Assistant Professor, College of Vocational Studies, Delhi. Email- rajkumar_dse@outlook.com