

Summary

This module introduces you to scheduling and resource levelling. In project management these are two essential (inter-related) concepts used to determine a viable plan for a project. This includes the start and finish dates of the activities, as well as the resources assigned at each timestep.

Objectives

At the conclusion of this module you should:

1. Understand the precedence diagram method (PDM)
2. Be able to construct a resource unconstrained schedule using the PDM
3. Understand how resource levelling provides a resource constrained schedule

Further reading

Wilkens, T. T. (2006). Fundamentals of scheduling & resource leveling. Paper presented at PMI® Global Congress 2006—North America, Seattle, WA. Newtown Square, PA: Project Management Institute.

Key Points

A **precedence diagram** is a network map of the project's activities that shows their dependencies.

Each node in the precedence diagram is an activity. The activity's duration, **float**, **early start** (ES), **early finish** (EF), **late start** (LS), and **late finish** (LF) are shown:

ES	A	EF
	float	
LS	dur	LF

The **forward pass** is the process of calculating the ES and EF for each activity.

$ES = \max\{\text{start of the project, } 1 + EF \text{ of the preceding activity}\}$

$EF = ES + \text{duration} - 1$

The **backward pass** works backwards from the project and determines the LS and LF for each activity. If a project deadline isn't specified, the latest EF is used.

$LF = \min\{\text{project finish date, late start of successor} - 1\}$

$LS = LF - \text{duration} + 1$

The **float** is the amount of time that an activity can be delayed before the project is delayed. $\text{Float} = LF - ES - \text{duration} + 1$

The **critical path** is the series of activities with $\text{float} = 0$.

Resource levelling is used to determine a resource constrained schedule. It requires the previous steps to determine the ES and float for each activity. It also requires knowing what resources are needed at

each point during each activity. Resource levelling is an iterative process that requires a software to find the optimal, however the general idea is as follows: For each time step, the activities scheduled by their ES are considered. If all resources are available the activities are scheduled to start then, that is, their **resource start** (RS) = ES. However, if there are not enough resources to conduct all the activities, the activity with the lowest priority (commonly the highest float) are delayed and will be considered again in the next time step.

If the resource levelling results in missing the deadline, managers need to determine whether more resources are brought in, whether the deadline should be extended, or if the work plan needs reconsidering.

Example Problems

Question

Outline the process of resource levelling. That is, what is considered at each timestep by an algorithm?

Question

Explain what the “resource start” (RS) is and how it differs from the “early start” (ES). When would these be equal?

Question

The critical path method is deterministic. Identify and describe a limitation.

Question

Draw the precedence diagram for the following house construction problem and determine the float of each activity.

	Activity	Immediate predecessor	Time (days)
1	Walls and ceiling	2	5
2	Foundation	None	3
3	Roof timbers	1	2
4	Roof sheathing	3	3
5	Electrical Wiring	1	4
6	Roof shingles	4	8
7	Exterior Siding	8	5
8	Windows	1	2
9	Paint	6, 7, 10	2
10	Inside wall board	8, 5	3