



Software Project Management

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Resource Allocation cont ...

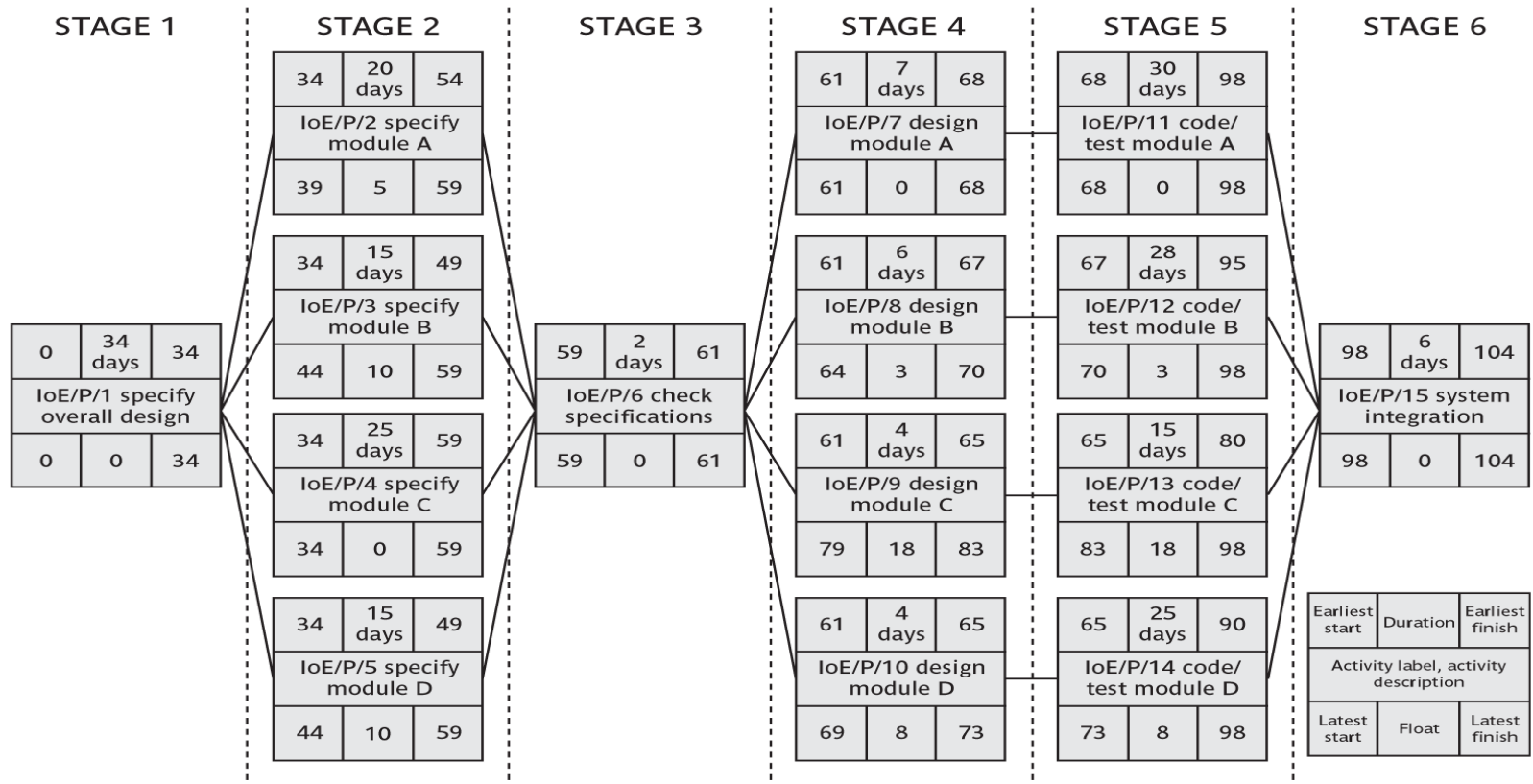
Resource allocation - Steps

- Identify the resources needed for each activity and create a *resource requirement list*
- Identify *resource types* - individuals are interchangeable within the group (e.g. 'VB programmers' as opposed to 'software developers')
- Allocate resource types to activities (scheduling resources) and examine the *resource histogram*

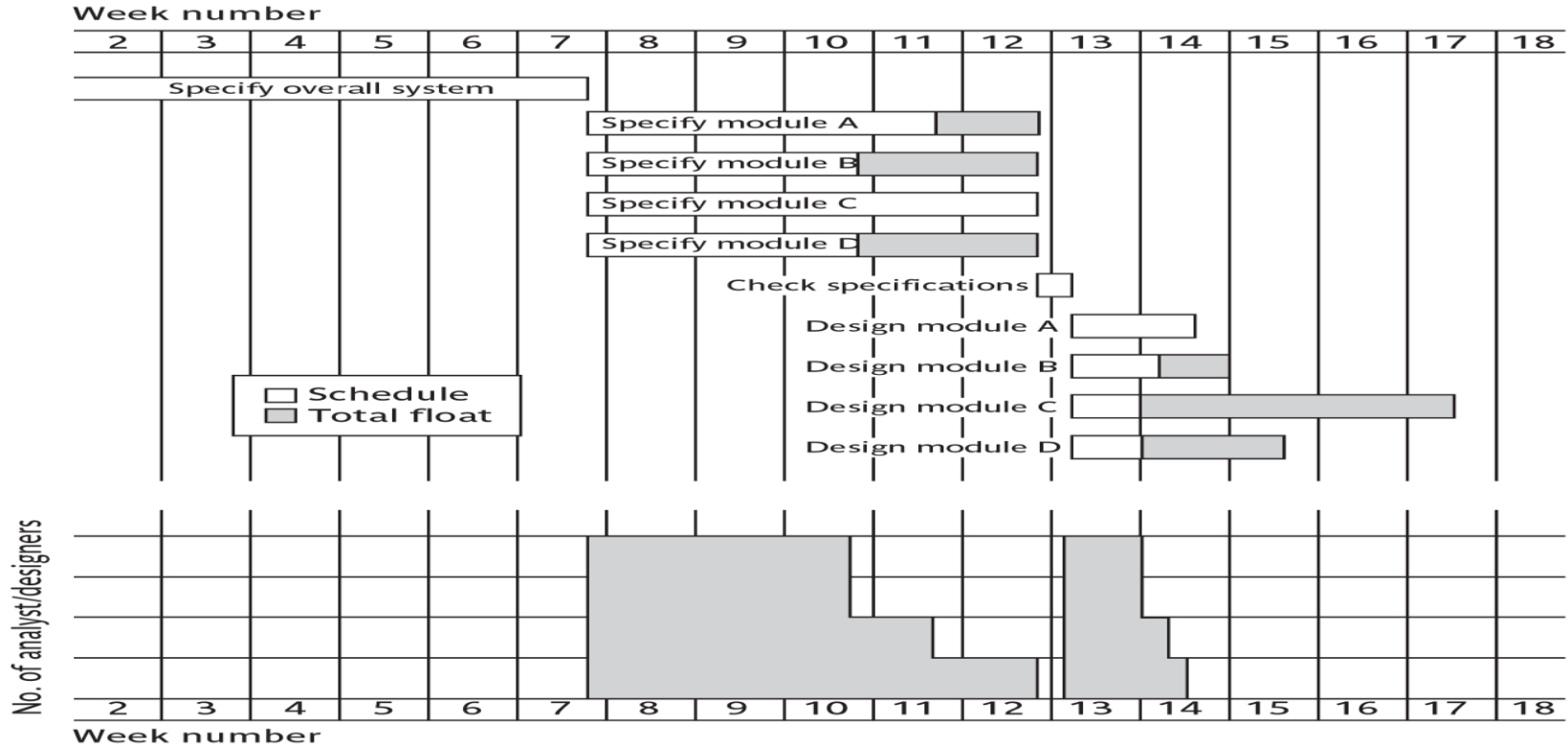
Scheduling resources

- After producing the resource requirements list, the next stage is to map this on to the activity plan to assess the distribution of resources required over the duration of the project.
- This is done by representing the activity plan as a **bar chart** & using this to produce a **resource histogram** for each resource.
- The next figure illustrates the example activity plan as a bar chart and a resource histogram for analyst/designers.
- Each activity has been scheduled to start at its earliest start date. Earliest start date scheduling, frequently creates resource histograms that start with a peak and then tail off.

An Example of Precedence Network



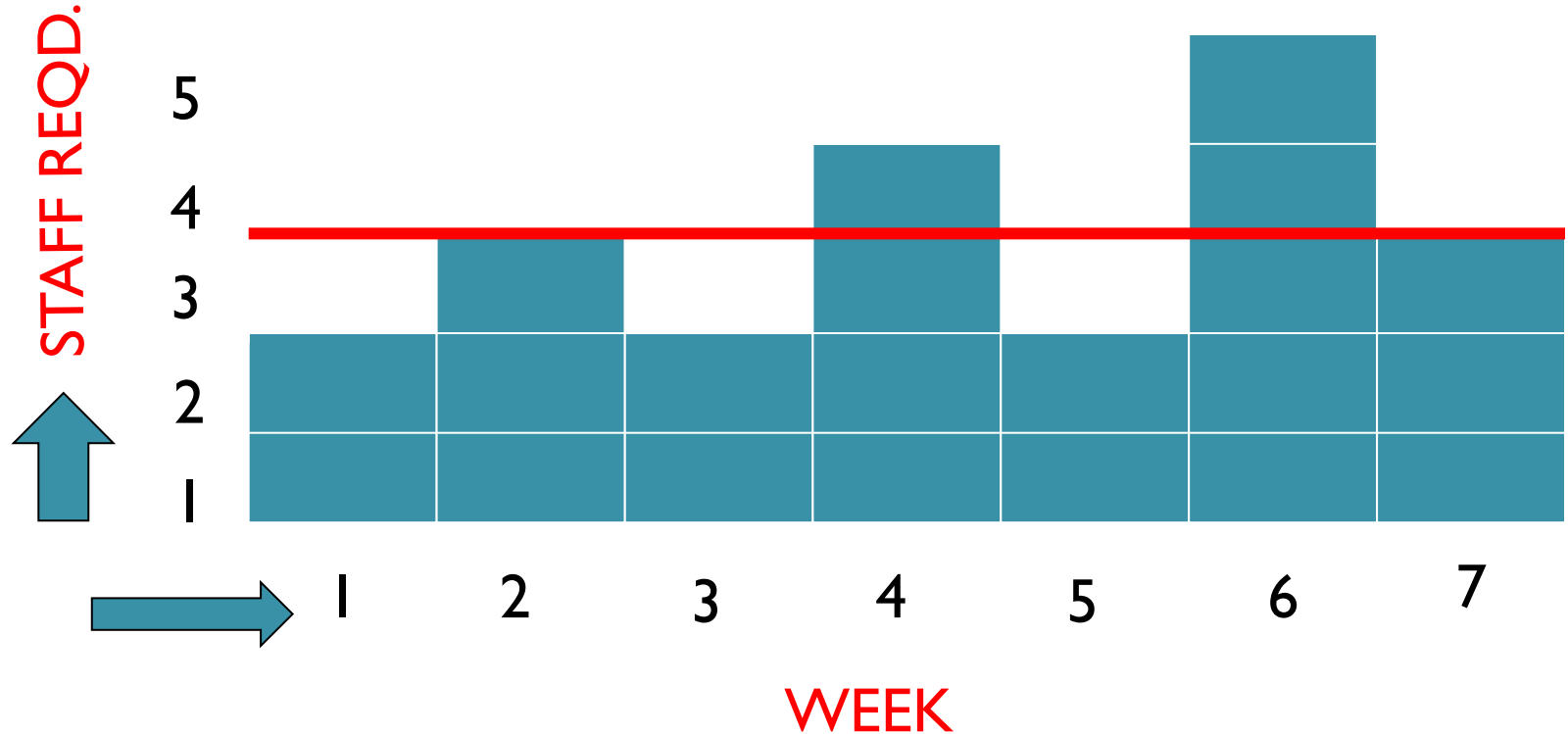
Sample Bar chart and resource histogram for analyst/designers



Scheduling resources cont...

- Changing the level of resources on a project over time, particularly personnel, generally adds to the cost of a project. Recruiting staff has costs and, even where staff are transferred internally, time will be needed for familiarization with the new project environment.
- The resource histogram shown in the previous figure poses some problems. Some analysts/designers may sit idle for some days (e.g. between the specification and design stages of the histogram). It is unlikely that there would have another project requiring their skills for exactly those periods of time.
- This idle time may be charged to the project.
- The **ideal resource histogram** will be **smooth** (even) with an initial build-up and a staged run-down.

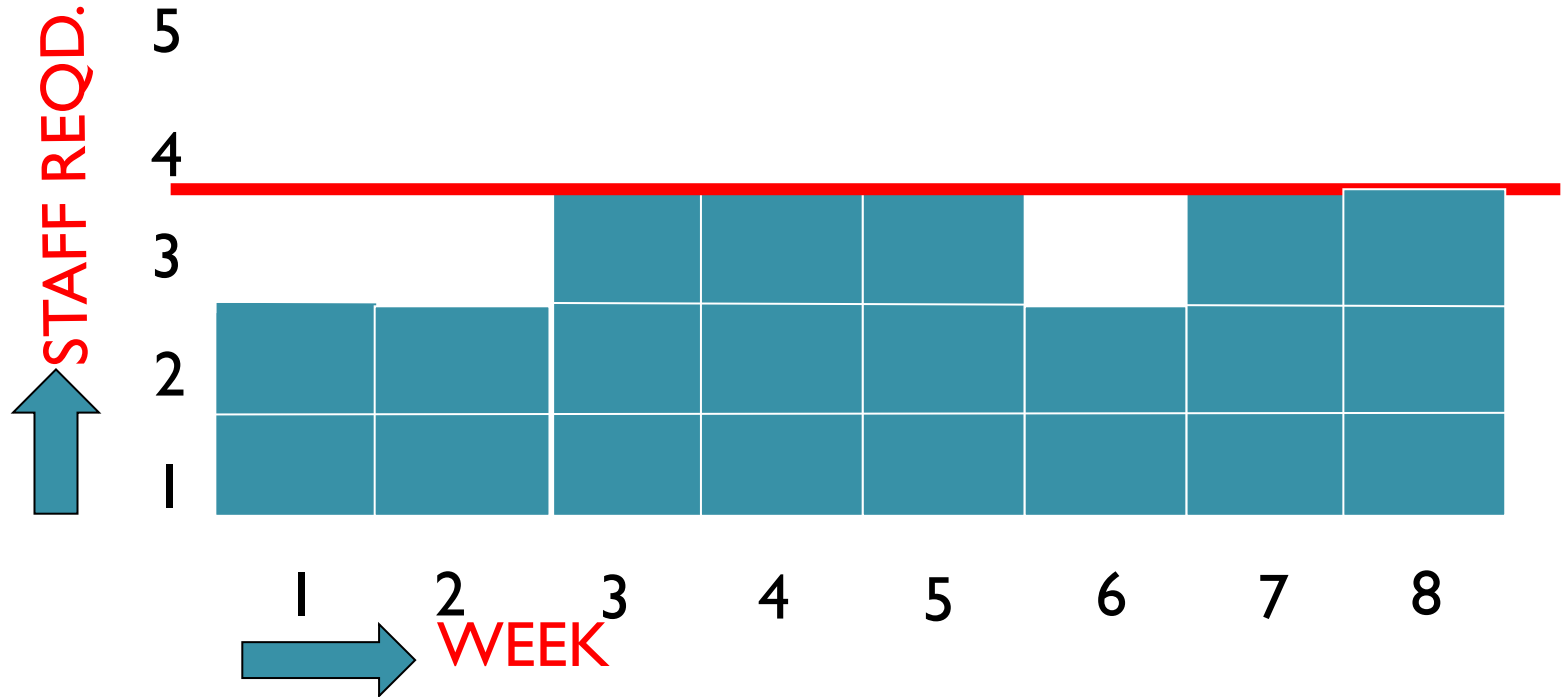
Resource histogram: An Example



Resource smoothing

- It is usually difficult to get specialist staff who will work odd days to fill in gaps – there is a need for staff to learn about application, etc
- Staff often have to be employed for a continuous block of time
- Therefore it is desirable to employ a constant number of staff on a project – who as far as possible are fully employed
- Hence there is a need for **resource smoothing**

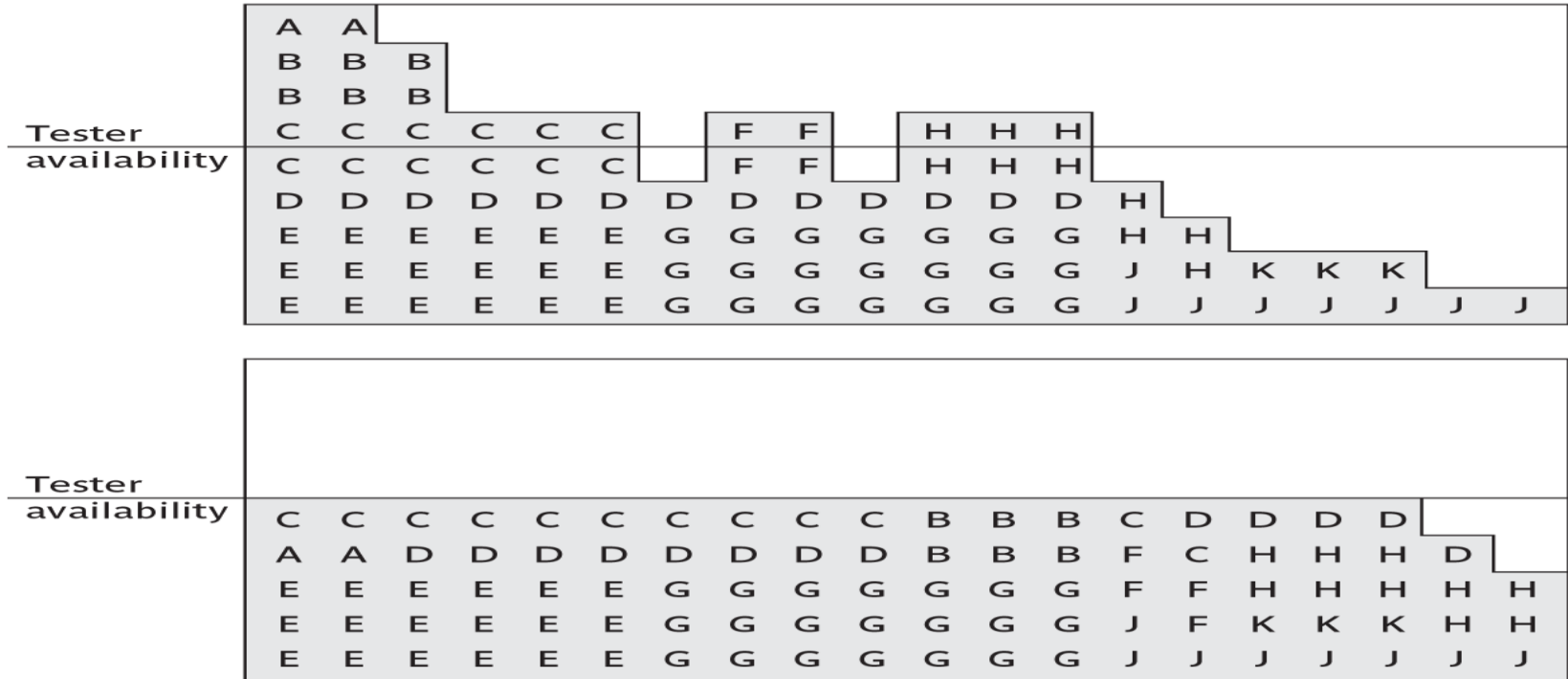
Resource histogram after smoothing



Resource smoothing cont ...

- Another problem with an uneven resource histogram is that it may call for levels of resource beyond those available.
- The next figure illustrates how, by **adjusting the start date** of some activities and **splitting** others, a resource histogram can be **smoothed** to contain resource demand at available levels, subject to constraints such as precedence requirements.
- The different letters in the figure represent **staff working on a series of module testing tasks**, i.e. 1 person working on task A, 2 on tasks B and C etc.

Resource smoothing cont ...



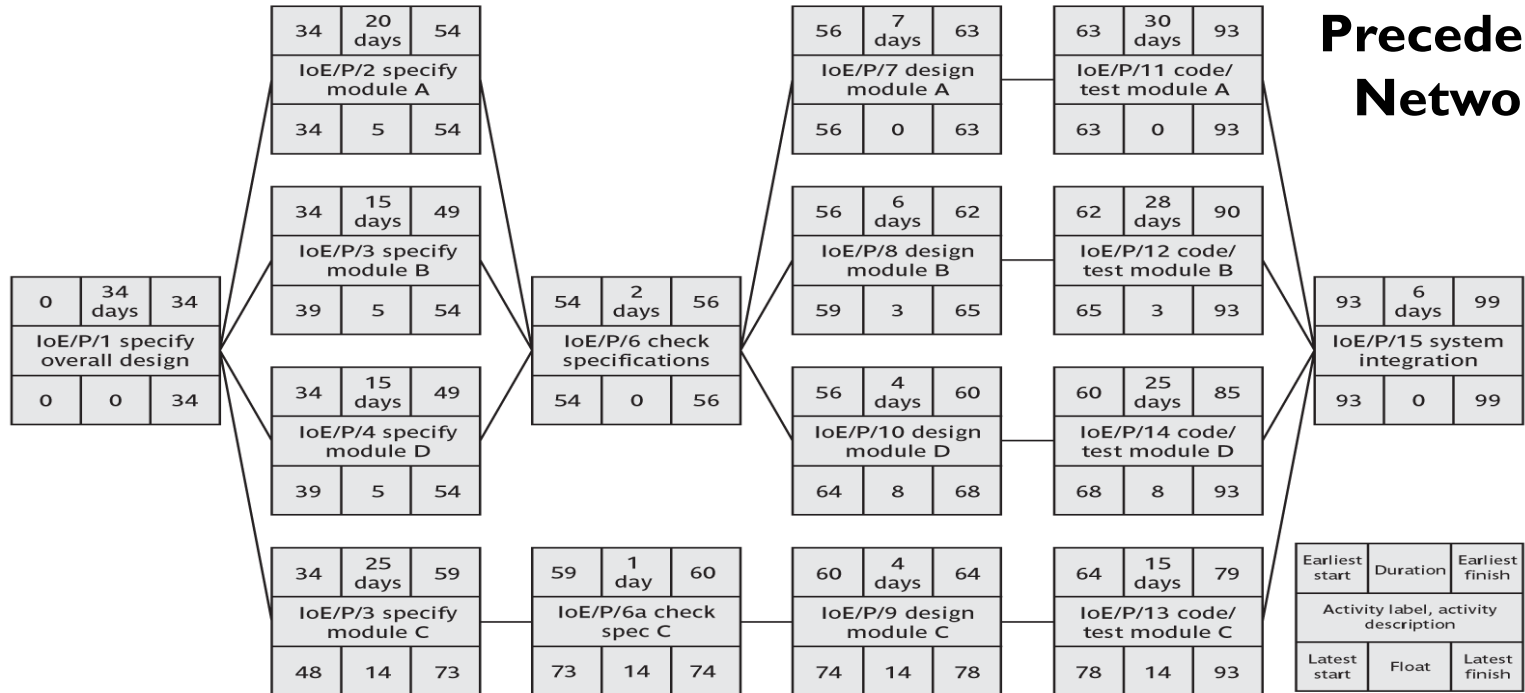
A resource histogram showing demand for staff before and after smoothing

Resource smoothing cont ...

- In this figure, the original histogram was created by scheduling the activities **at their earliest start dates**. The resource histogram shows the typical peaked shape caused by earliest start date scheduling & calls for a total of **9 staff** where only **5 are available** for the project.
- **By delaying the start of some of the activities**, it is possible to **smooth the histogram** and reduce the maximum level of demand for the resource.

Resource smoothing cont ...

Revised Precedence Network



Resource smoothing cont ...

- Notice that some activities, such as C and D, have been split. Where non-critical activities can be split they can provide a useful way of filling troughs in the demand for a resource.
- But, in software projects it is difficult to split tasks without increasing the time they take.
- Some of the activities may call for more than one unit of the resource at a time, e.g. activity F requires 2 programmers, each working for 2 weeks.
- It is possible to reschedule this activity to use one programmer over 4 weeks (although not done here).

Resource clashes

- **Resource clashes:** Where same resource is needed in more than one place (activity) at the same time
- **Can be resolved by:**
 - delaying one of the activities
 - taking advantage of float to change start date
 - delaying start of one activity until finish of the other activity that resource is being used on - *puts back project completion*
 - moving resource from a non-critical activity
 - bringing in additional resource - *increases costs*

Prioritizing activities

- In practice, resources are allocated to a project on an activity-by-activity basis.
- Finding the best allocation is time consuming and difficult.
- Allocating a resource to one activity limits the flexibility for resource allocation and scheduling of other activities.
- So, there is a need to **prioritize the activities** so that resources can be allocated to competing activities in some rational order.
- The priority must almost always be to allocate resources to **critical path activities** and then to those activities that are **most likely to affect others**.
- In this way, lower-priority activities are made to fit around the more critical , already scheduled activities.

Prioritizing activities cont ...

There are two main ways of doing this:

- *Total float priority*
- *Ordered list priority*

Total float priority

- Total Float: It is a measure of how much the start or completion of an activity may be delayed without affecting the end date of the project.
- In this method, activities with the smallest float have the highest priority.
- Activities are allocated resources in ascending order of their floats.
- As scheduling proceeds, activities may be delayed (if resources are not available at their earliest start dates) and total floats will be reduced.
- So, it is desirable to recalculate the floats (and hence reorder the list) each time an activity is delayed.

Ordered list priority

- In this method, activities that can proceed at the same time are ordered according to a set of simple criteria.
- Example: **Burman's priority list**
- This method takes account of the **duration of the activity** as well as **the float**.

Burman's priority list

Give priority to the activities as in the following order:

1. Shortest critical activities
2. Other critical activities
3. Shortest non-critical activities
4. Non-critical activities with least float
5. Non-critical activities

Alternatives to resource smoothing

- Resource smoothing is not always possible
 - Deferring activities to smooth out resource peaks often puts back project completion.
- In this case the project manager need to consider alternative ways, such as
 - Increasing the available resource levels
 - Altering working methods such as doing overtime work, working in holidays etc.

Resource usage

- Project manager needs to maximize %usage of resources i.e. to reduce the idle periods between tasks
- There is a need to balance costs against early completion date
- There is a need to allow for contingency



Creating critical path

- Scheduling resources can create new critical paths.
- Delaying the start of an activity because of lack of resources will cause that activity to become critical if this uses of its float.
- Further, a delay in completing one activity can delay the availability of a resource required for a later activity.
- If the later one is already critical, than the earlier one might now have been made critical by linking their resources.

Creating critical path cont ...

- Scheduling resources can create new dependencies between activities.
- It is better not to add dependencies to the activity network to reflect resource constraints
 - Makes network very messy
 - A resource constraint may disappear during the project, but link remains on network
- Rather, amend dates on **schedule** to reflect resource constraints



Summary

- Discussed the scheduling of resources
- Presented what is a resource histogram?
- Explained the concept of resource smoothing
- Described fundamentals of resource clashes
- Discussed the methods for prioritizing activities

References :

- I. B. Hughes, M. Cotterell, R. Mall, *Software Project Management*, Sixth Edition, McGraw Hill Education (India) Pvt. Ltd., 2018.



Thank you