# Resource Allocation

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# Introducing resources in planning

- Plans discussed so far somehow assumed that resources where not limited and no constraints on their usage are considered

## Resources

A resource is any item or person required for the execution of the project

When considered in planning (resource allocation) they result in the definition of a number of scheduling:

- activity schedule
- resource schedule
- cost schedule

Some resources will be required for the duration of the project others are acquired and released possibly more than once.

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# Typical resources

Resources can refer to:

- Labour to perform project activities - full assignment vs. partial assignment to the project
- Equipment to be used to permit the work of labour (desks, workstations ...)
- Materials to be consumed during the project
- Space in particular if additional personnel units have to be recruited
- Services to be used during the project (e.g. confcall services)
- Time
- Money resource needed to retrieve other resources

# Resource requirements

The first required step is "resource identification". To do this we need to consider each single activity in the plan and define which are the needed resources

| Stage | Activity | Resource | Days | Quantity | Notes |
|---|---|---|---|---|---|
| 1 | | Project Manager | 65 F/T | | |
| | All | Workstation | | 17 | Check for OS licenses |
| 2 | Planning | Senior Analyst | 7 F/T | | |
| ... | ... | ... | ... | ... | ... |

# Scheduling resources

After having identified the resources we use a bar chart to derive timewise the real needs . . . we need to do it wisely

**Week number**

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

System specification

2 1 1 1 1 1 1

Design subsystem A

2 2 2 1 1 1 1 1

Design subsystem B

1 1 1 1 1 1 1 1

Design subsystem C

2 2 1 1 1 1 1 1 1 1

Implement A, B

2 2 1

Implement C

2 2 1

Test system

|   | A | A |   |   |   |   |   | B | B |   |
| B | B | A |   |   |   |   |   | C | C |   |
| C | C | B | A |   |   |   |   | D | D |   |
| D | D | C | B | A | A | A |   | D | D |   |
| A | E | E | D | C | B | B | B | A | E | E |
| B | A | F | F | E | D | C | C | C | B | F | F | F |

0 0 0 0 0 2 1 6 6 5 4 3 3 3 2 5 5 2 0 0 0 0 0 0 0 0 0 0 0 0 0 0

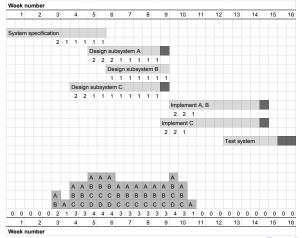| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

System specification

2  1  1  1  1  1  1

Design subsystem A

2  2  2  1  1  1  1  1

Design subsystem B

1  1  1  1  1  1  1

Design subsystem C

2  2  1  1  1  1  1  1  1  1

Implement A, B

2  2  1

Implement C

2  2  1

Test system

| | | | | | A | A | A | | | | A | | | | | |

| | | | A | A | B | B | B | A | A | A | A | A | B | A | | |

| | | A | B | B | C | C | C | B | B | B | B | B | C | B | | |

| | | B | A | C | C | D | D | D | C | C | C | C | C | D | C | A |

| 0 | 0 | 0 | 0 | 0 | 2 | 1 | 3 | 3 | 4 | 4 | 4 | 3 | 3 | 3 | 3 | 3 | 4 | 3 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

| | 1 | | 2 | | 3 | | 4 | | 5 | | 6 | | 7 | | 8 | | 9 | | 10 | | 11 | | 12 | | 13 | | 14 | | 15 | | 16 |

**Week number**

# Scheduling resources

In scheduling the engagement personnel it is worth to consider

- Recruiting staff has a cost
- "familiarisation" has a cost
- idle time of personnel could be charged on the project budget
- at a certain stage assigned personnel will have a "first and last name"

# Optimisations

Finding the best allocation is difficult and time consuming

- Reduce maximum number of resource usage
- Reduce idle time for resources
- Reduce context switch for resources

Possible optimisation strategies suggest to:

- Move activities within their float
- Split activities

Additional constraints are introduced if allocation has to be based on individuals

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# Allocating strategies

It is useful to prioritize activites so that resources can be allocated on competing activites in some rational order

## Rule of thumb

Priority must almost always be to allocate resources to critical path activities and then to those activities that are most likely to affect others

General strategies

- Total float priority: activities are ordered according to their total float, those with the smallest total float having the highest priority. As scheduling proceeds, activities will be delayed if resources are not available and the total float is reduced accordingly

- Ordered list priority: activities that can proceed at the same time are ordered according to a set of simple criteria (e.g. Burman proposal):
  - shortest critical activity
  - critical activities
  - shortest non-critical activities
  - non-critical activity with least float
  - non-critical activity

# Generation of new critical activities

Scheduling resources can create new critical paths:

- delaying an activity using all the available float
- resource allocation can transform an activity into critical as consequence of resource release related to a critical activity

# Allocating individuals

Often individuals are not considered the same "as resources". Skill and experience are generally important factors considered in resource allocation

- Availability: check departmental work plan and act wisely
- Criticality: more experienced on critical path
- Risk: more experienced on more complex and risky activities
- Training: junior staff on non critical activities permits to foresee training activities
- Team building: the team makes the project, allocation of people should consider this aspect

# Cost schedules

After having allocated the resources to activities and having defined a schedule it is possible to derive the cost schedule for the project on a weekly or monthly bases:

- Staff costs
- Overheads
- Usage charges

Scheduling decisions affect costs so it can be the case that it is necessary to revise it in order to optimize costs and the corresponding cash flow

Consider now a project in which the foreseen activities and dependencies are the ones specified in the able below, where the duration is expressed in weeks:

| Activity | Activity Durations (days) | | | | | | |
|---|---|---|---|---|---|---|---|
| (Precedents) | Optimistic (a) | Most likely (m) | Pessimistic (b) | Expected te | Standard deviation (s) | te+comfort z. (0,95 prob.) | Comfort zones |
| T1.1 | 1 | 2 | 4 | 2,5 | 0,5 | 3,5 | 1 |
| T1.2 | 1 | 2 | 4 | 2,5 | 0,5 | 3,5 | 1 |
| T1.3 (T1.1) | 4 | 8 | 13 | 8,5 | 1,5 | 11,5 | 3 |
| T1.4 (T1.2,T1.3) | 8 | 12 | 17 | 12,5 | 1,5 | 15,5 | 3 |
| T1.5 (T3.3) | 6 | 10 | 12 | 10 | 1 | 12 | 2 |
| T2.1 (T1.1,T1.2) | 3 | 4 | 5 | 4 | 0,33 | 5 | 1 |
| T2.2 (T2.1) | 3 | 4 | 4,5 | 4 | 0,25 | 4,5 | 0,5 |
| T2.3 (T1.1,T1.2,T2.2) | 2 | 4 | 6 | 4 | 0,66 | 5,5 | 1,5 |
| T3.1 (T1.2,T1.3) | 2 | 4 | 7 | 4,5 | 0,83 | 6 | 1,5 |
| T3.2 (T3.1) | 7 | 8 | 9 | 8 | 0,33 | 9 | 1 |
| T3.3 (T2.2,T3.2) | 8 | 12 | 13 | 11,5 | 0,83 | 13 | 1,5 |
| T3.4 (T1.4,T1.5) | 5 | 7 | 10 | 7,5 | 0,83 | 9 | 1,5 |
| T4.1 (T2.3) | 3 | 4 | 5 | 4 | 0,33 | 5 | 1 |
| T4.2 (T1.4,T1.5) | 3 | 4 | 5 | 4 | 0,33 | 5 | 1 |
| T4.3 (T4.1,T4.2) | 6 | 8 | 11 | 8,5 | 0,83 | 10 | 1,5 |

- Apply the Critical Chain method to derive a plan according to a comfort zone corresponding to a 0,95 probability
- Use the 0,5 probability to derive a CPM network

With respect to the previous plan consider the effort expressed in the following table in terms of needed Senior Developers (SD - 500$/d) and Junior Developers (JD - 300$/d) :

| Activity | Senior Dev. (days) | Junior Dev. (days) | Notes |
|---|---|---|---|
| T1.1 | 5 | 7,5 | Contemporary not less than 2 and not more than 4 |
| T1.2 | 2,5 | 0 | Uniform distribution |
| T1.3 | 0 | 8,5 | Uniform distribution |
| T1.4 | 25 | 12,5 | Uniform distribution |
| T1.5 | 10 | 10 | Uniform distribution |
| T2.1 | 8 | 2 | Uniform distribution SD - Only last days JD with UD |
| T2.2 | 4 | 4 | Uniform distribution |
| T2.3 | 0 | 12 | Uniform distribution |
| T3.1 | 4,5 | 0 | Uniform distribution |
| T3.2 | 8 | 8 | Uniform distribution (JD after SD) |
| T3.3 | 0 | 11,5 | Uniform distribution |
| T3.4 | 7,5 | 0 | Uniform distribution |
| T4.1 | 8 | 12 | Uniform distribution |
| T4.2 | 8 | 12 | Uniform distribution |
| T4.3 | 8,5 | 17 | Uniform distribution |

- Provide a possible allocation of resources respecting the following constraints:
  - only activity T2.1 can be split in subactivities
  - the company does not have more than x Senior Developers and y Junior Developers, and no recruiting is foreseen
- Compute the total cost for the project as well as the weekly and cumulative cash flow

Are there any possible issue of "pick-release" for resources?

# Resources

Study material can be found here:

📕 Bob Hughes and Mike Cotterell
*Software Project Management, 5th Ed.*
McGraw-Hill, 2009

- Chapter 7 - Resource Allocation