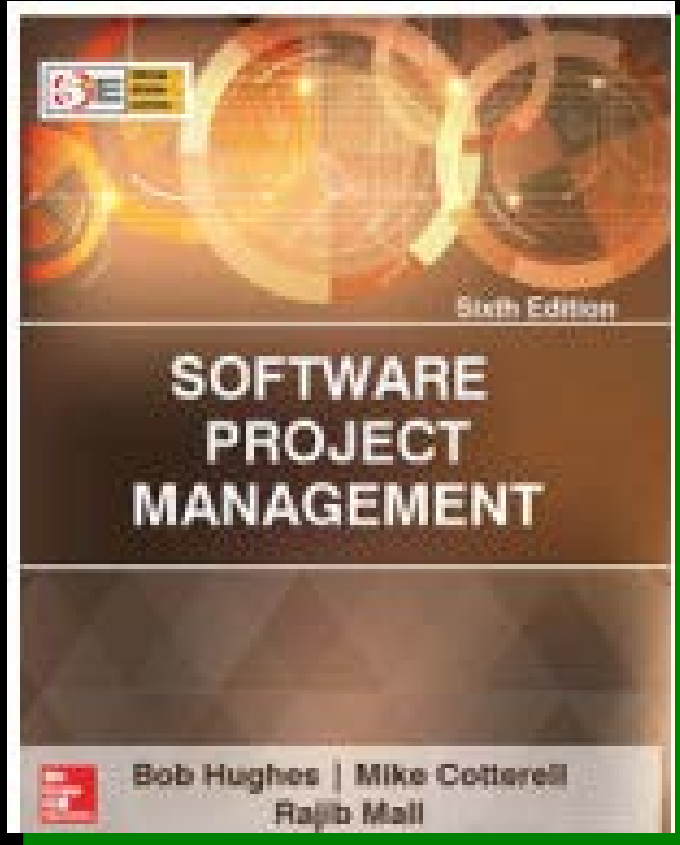# Software Project Management

Chapter Seven

Risk management

Risk management

This lecture will touch upon:

- Definition of 'risk' and 'risk management'

- Some ways of categorizing risk

- Risk management

  - Risk identification – what are the risks to a project?

  - Risk analysis – which ones are really serious?

  - Risk planning – what shall we do?

  - Risk monitoring – has the planning worked?

- We will also look at PERT risk and critical chains

Some definitions of risk

'the chance of exposure to the adverse consequences of future events' PRINCE2

'an uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives' PM-BOK

- Risks relate to **possible future** problems, not current ones

- They involve a possible cause and its effect(s) e.g. developer leaves > task delayed

Categories of risk
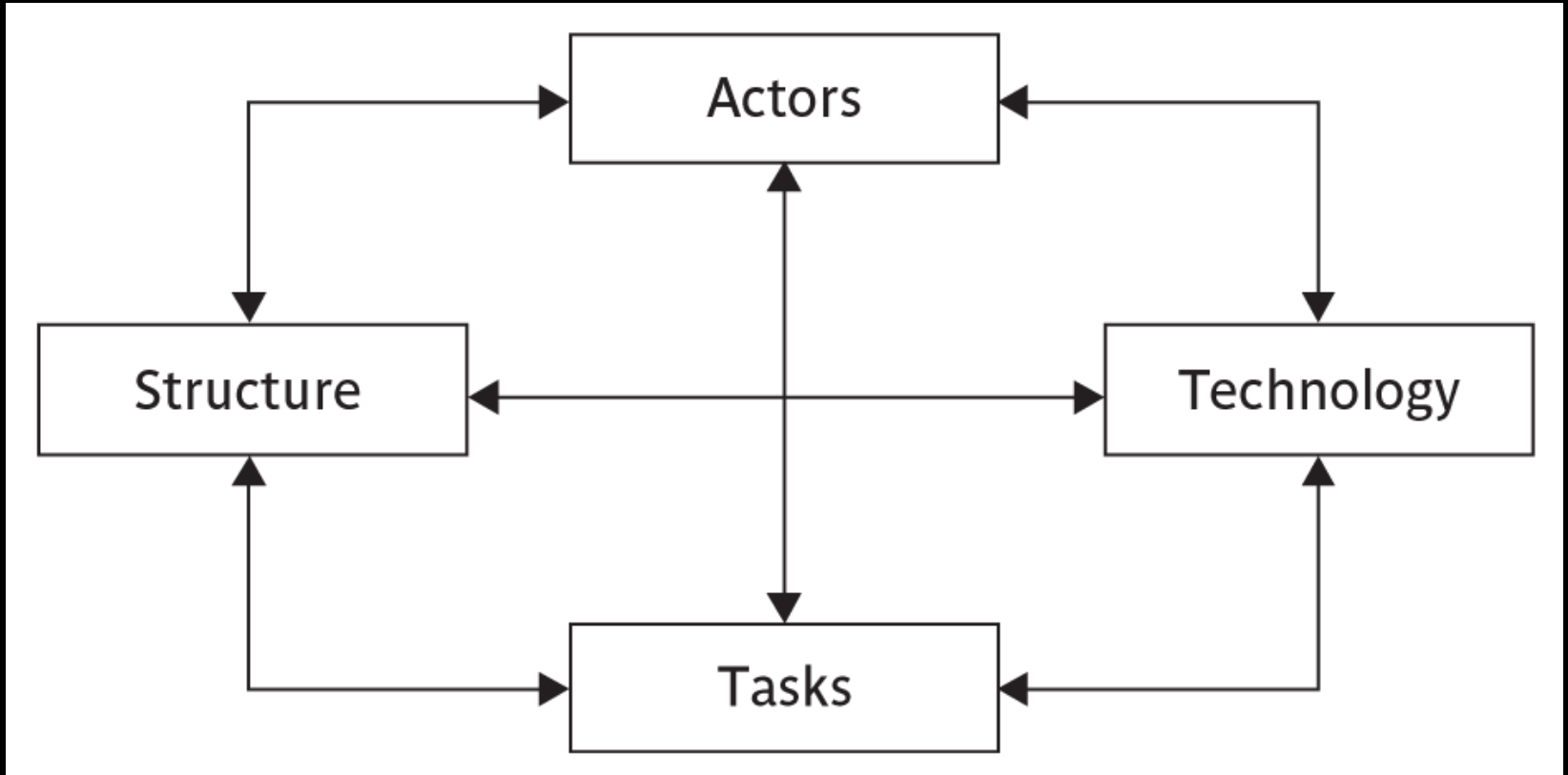
Risk Management Approaches

- Proactive:
  - The proactive approaches try to anticipate the possible risks that the project is susceptible to.
  - After identifying the possible risks, actions are taken to eliminate the risks.
- Reactive:
  - Reactive approaches take no action until an unfavourable event occurs.
  - Once an unfavourable event occurs, these approaches try to contain the adverse effects associated with the risk and take steps to prevent future occurrence of the same risk events.

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A framework for dealing with risk

The planning for risk includes these steps:

- Risk identification – what risks might there be?

- Risk analysis and prioritization – which are the most serious risks?

- Risk planning – what are we going to do about them?

- Risk monitoring – what is the current state of the risk?

Risk identification

Approaches to identifying risks include:

- Use of checklists – usually based on the experience of past projects

- Brainstorming – getting knowledgeable stakeholders together to pool concerns

- Causal mapping – identifying possible chains of cause and effect

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Boehm's top 10 development risks

Risk	Risk reduction techniques
Personnel shortfalls	Staffing with top talent; job matching; teambuilding; training and career development; early scheduling of key personnel
Unrealistic time and cost estimates	Multiple estimation techniques; design to cost; incremental development; recording and analysis of past projects; standardization of methods
Developing the wrong software functions	Improved software evaluation; formal specification methods; user surveys; prototyping; early user manuals
Developing the wrong user interface	Prototyping; task analysis; user involvement

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Boehm's top ten risk - continued

Gold plating	Requirements scrubbing, prototyping, design to cost
Late changes to requirements	Change control, incremental development
Shortfalls in externally supplied components	Benchmarking, inspections, formal specifications, contractual agreements, quality controls
Shortfalls in externally performed tasks	Quality assurance procedures, competitive design etc
Real time performance problems	Simulation, prototyping, tuning
Development technically too difficult	Technical analysis, cost-benefit analysis, prototyping , training

Risk prioritization

Risk exposure (RE)

 = (potential damage) x (probability of occurrence)

Ideally

Potential damage: a money value e.g. a flood would cause £0.5 millions of damage

Probability 0.00 (absolutely no chance) to 1.00 (absolutely certain) e.g. 0.01 (one in hundred chance)

RE = £0.5m x 0.01 = £5,000

Crudely analogous to the amount needed for an insurance premium

Risk probability: qualitative descriptors

Probability level	Range
High	Greater than 50% chance of happening
Significant	30–50% chance of happening
Moderate	10–29% chance of happening
Low	Less than 10% chance of happening

Qualitative descriptors of impact on cost and associated range values

Impact level	Range
High	Greater than 30% above budgeted expenditure
Significant	20 to 29% above budgeted expenditure
Moderate	10 to 19% above budgeted expenditure
Low	Within 10% of budgeted expenditure.

Probability impact matrix
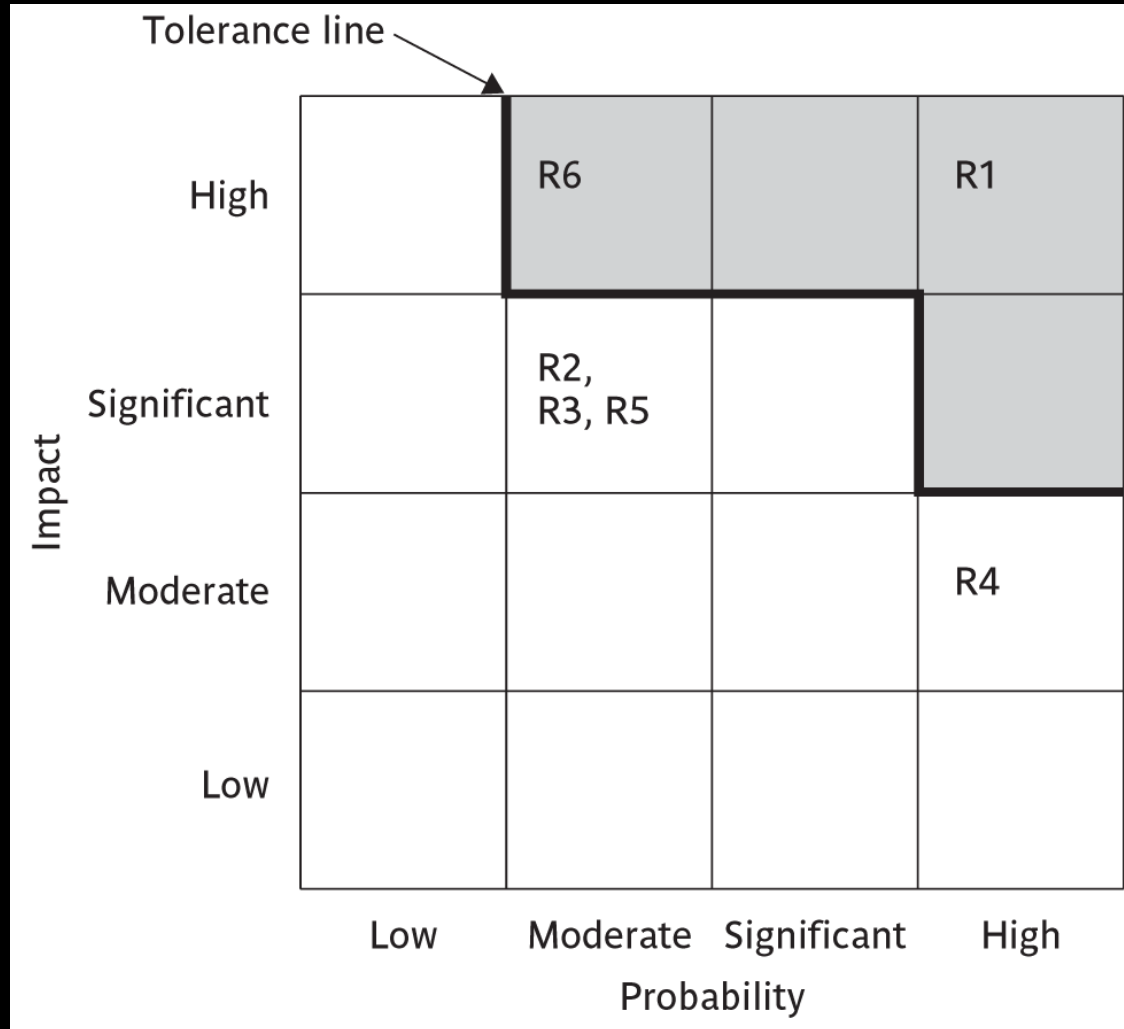
Risk planning

Risks can be dealt with by:

- Risk acceptance

- Risk avoidance

- Risk reduction

- Risk transfer

- Risk mitigation/contingency measures

Risk reduction leverage

Risk reduction leverage =

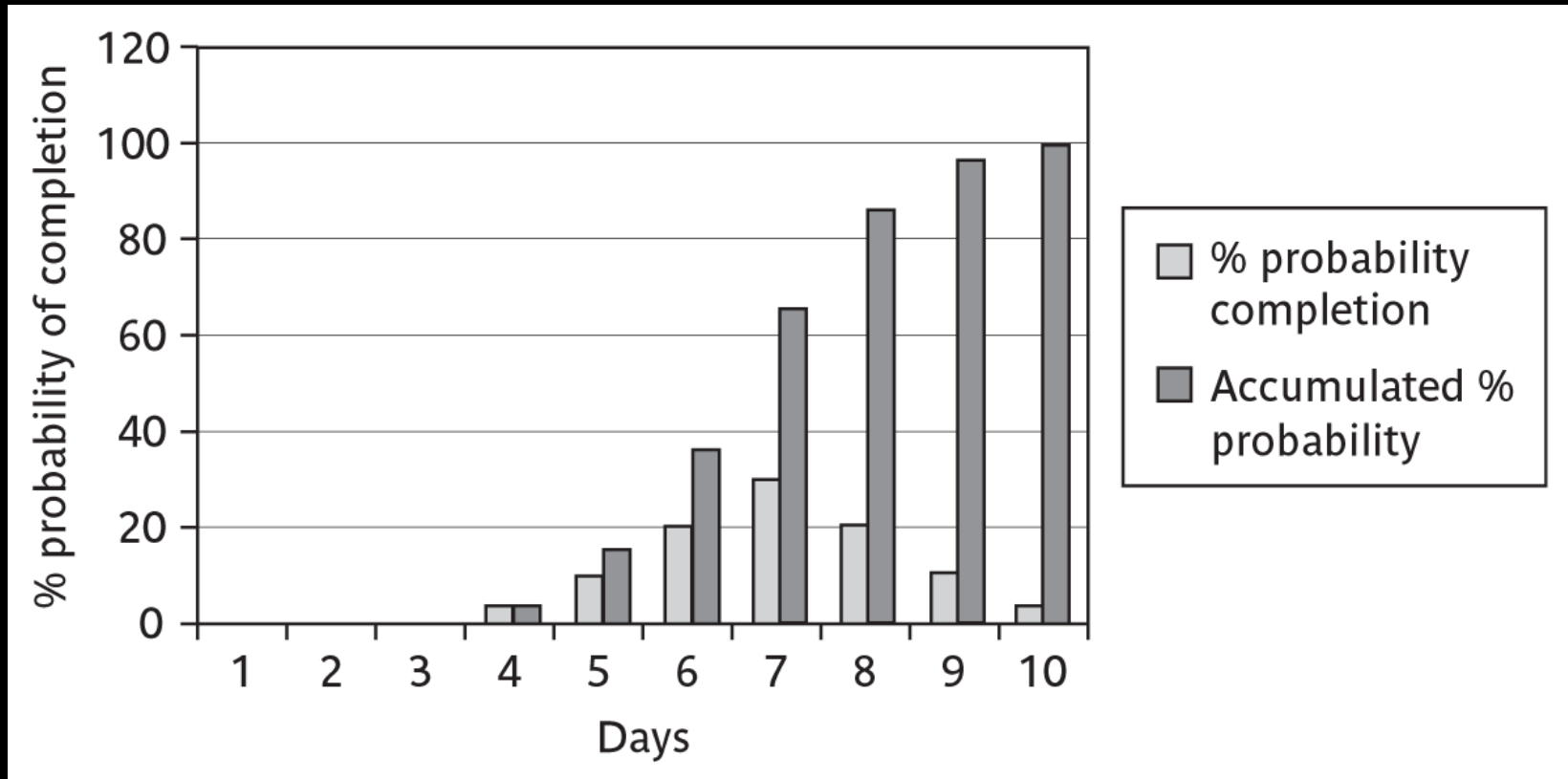$(RE_{before} - RE_{after})$/ (cost of risk reduction)

RE_{before} is risk exposure before risk reduction e.g. 1% chance of a fire causing £200k damage

RE_{after} is risk exposure after risk reduction e.g. fire alarm costing £500 reduces probability of fire damage to 0.5%

RRL = (1% of £200k)-(0.5% of £200k)/£500 = 2

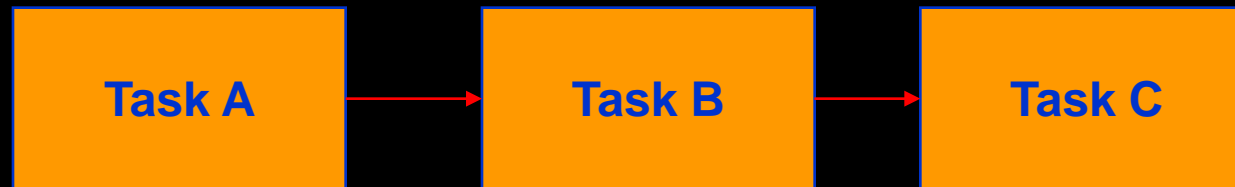RRL > 1.00 therefore worth doing

Probability chart

Using PERT to evaluate the effects of uncertainty

Three estimates are produced for each activity

- *Most likely time (m)*

- *Optimistic time (a)*

- *Pessimistic (b)*

- 'expected time' $t_e = (a + 4m + b) / 6$

- 'activity standard deviation' $S = (b-a)/6$

A chain of activities

| Task	a	m	b	t_e	s
A	10	12	16	?	?
B	8	10	14	?	?
C	20	24	38	?	?

A chain of activities

- What would be the expected duration of the chain A + B + C?

- Answer: 12.66 + 10.33 + 25.66 i.e. 48.65

- What would be the standard deviation for A + B+ C?

- Answer: square root of $(1^2 + 1^2 + 3^2)$ i.e.

  3.32

Assessing the likelihood of meeting a target

- Say the target for completing A+B+C was 52 days (T)
- Calculate the z value thus
  $$z = (T - t_e)/s$$
- In this example z = (52-48.33)/3.32 i.e. 1.01
- Look up in table of z values – see next overhead

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Graph of z values
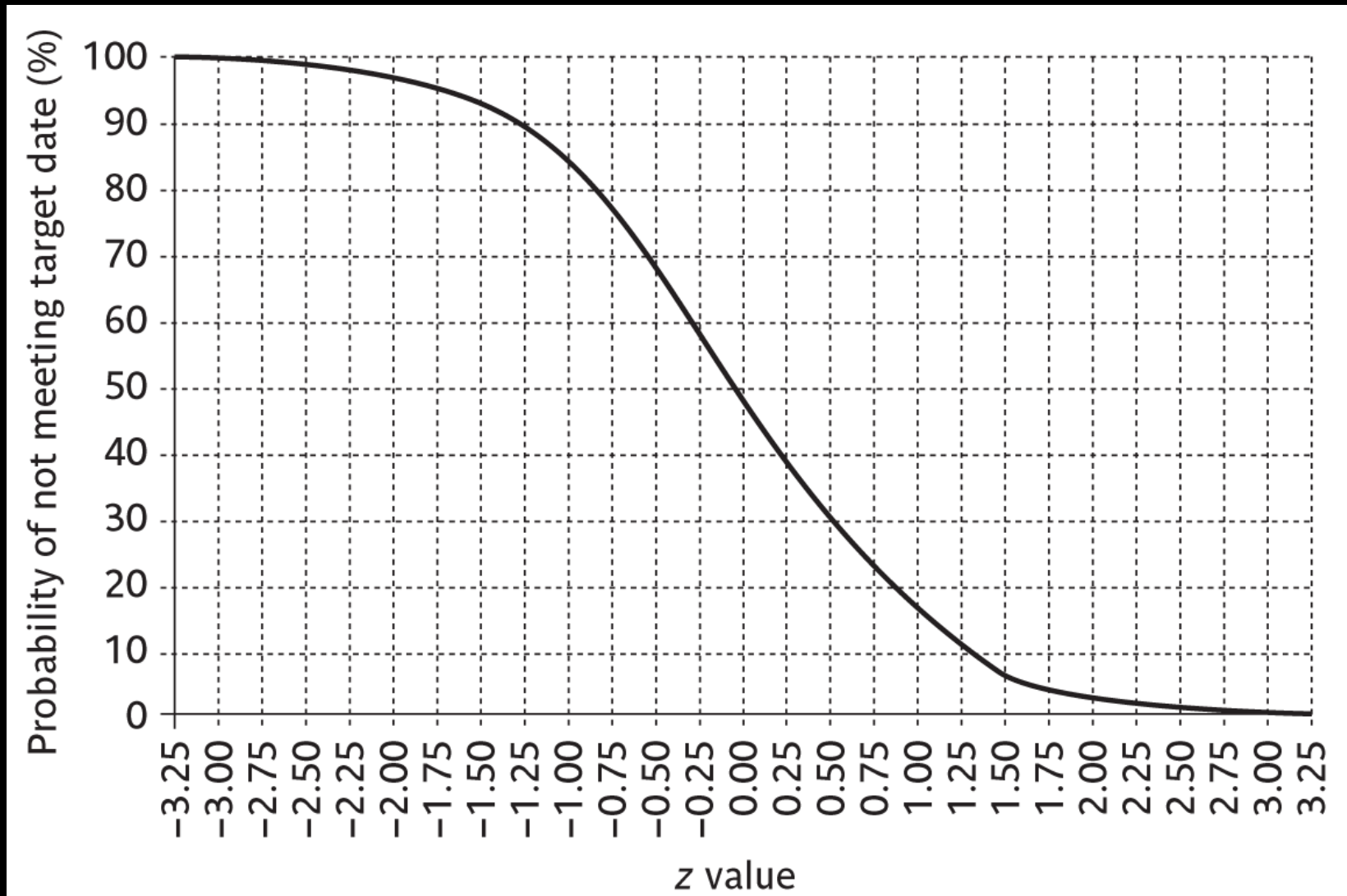
Monte Carlo Simulation

- An alternative to PERT.

- A class of general analysis techniques:

    - Valuable to solve any problem that is complex, nonlinear, or involves more than just a couple of uncertain parameters.

- Monte Carlo simulations involve repeated random sampling to compute the results.

- Gives more realistic results as compared to manual approaches.

Steps of a Monte Carlo Analysis

1. Assess the range for the variables being considered.

2. Determine the probability distribution of each variable.

3. For each variable, select a random value based on the probability distribution.

4. Run a deterministic analysis or one pass through the model.

5. Repeat steps 3 and 4 many times to obtain the probability distribution of the model's results.

Critical chain concept

Traditional planning approach
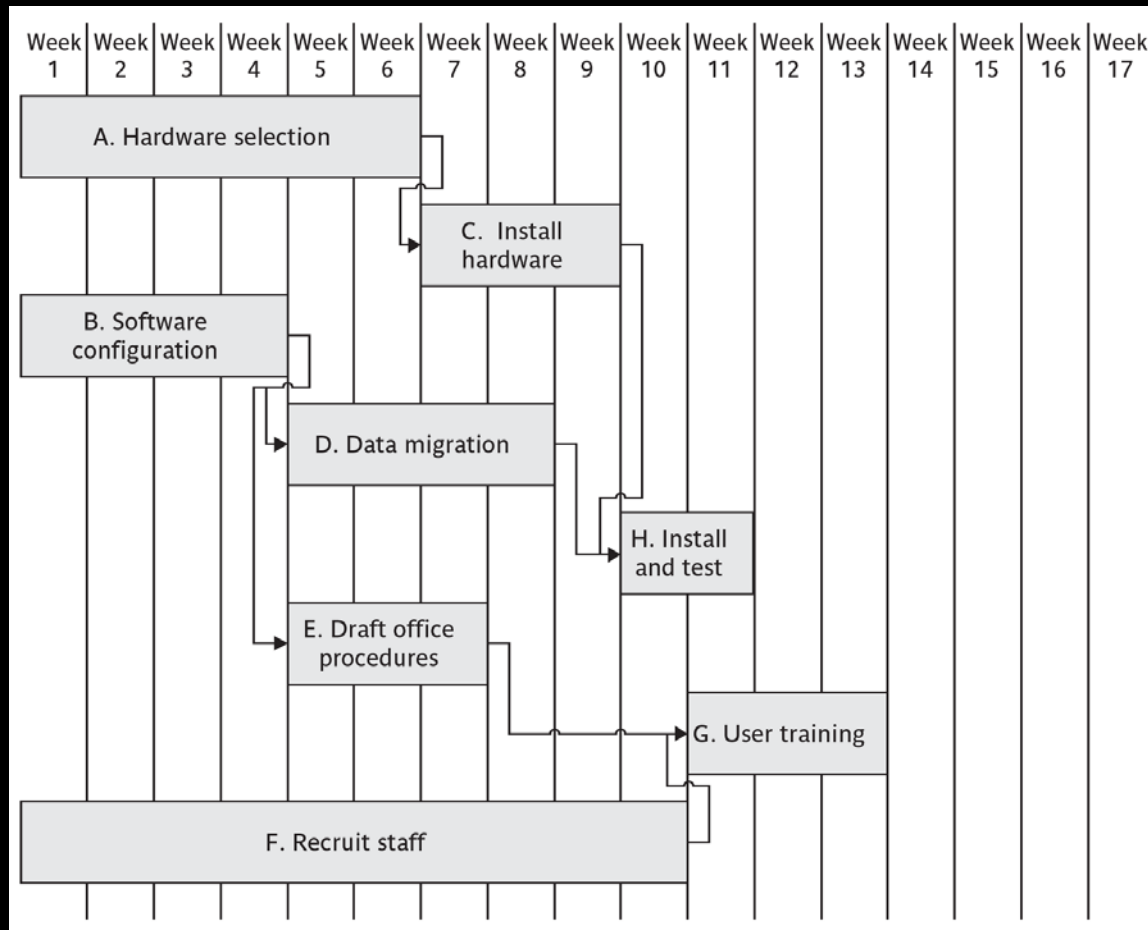
Critical chain approach

One problem with estimates of task duration:

- Estimators add a safety zone to estimate to take account of possible difficulties

- Developers work to the estimate + safety zone, so time is lost

- No advantage is taken of opportunities where tasks can finish early – and provide a buffer for later activities

Critical chain approach

One answer to this:

1. Ask the estimators for two estimates

   ◆ Most likely duration: 50% chance of meeting this

   ◆ Comfort zone: additional time needed to have 95% chance

2. Schedule all activities using most likely values and starting all activities on latest start dates

Most likely and comfort zone estimates

Activity	Most likely	Plus comfort zone	Comfort zone
A	6	8	2
B	4	5	1
C	3	3	0
D	4	5	1
E	3	4	1
F	10	15	5
G	3	4	1
H	2	2.5	0.5

TABLE 7.8 Most likely and comfort zone estimates (days)

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Critical chain - continued

3. Identify the critical chain – same a critical path but resource constraints also taken into account

4. Put a project buffer at the end of the critical chain with duration 50% of sum of comfort zones of the activities on the critical chain.

Critical chain -continued

5. Where subsidiary chains of activities feed into critical chain, add feeding buffer

6. Duration of feeding buffer 50% of sum of comfort zones of activities in the feeding chain

7. Where there are parallel chains, take the longest and sum those activities

Plan employing critical chain concepts
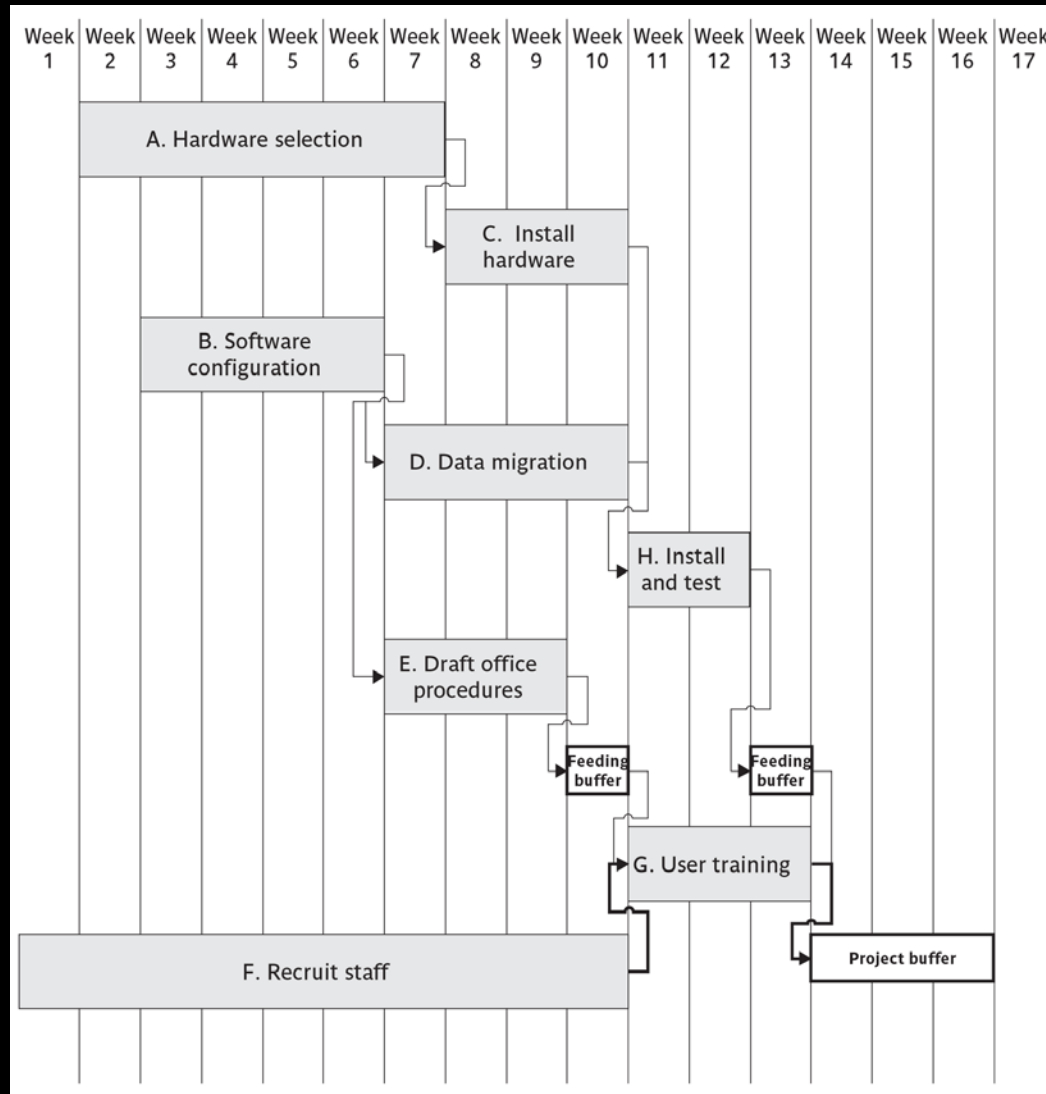
Executing the critical chain-based plan

- No **chain** of tasks is started earlier than scheduled, but once it has started is finished as soon as possible

- This means the activity following the current one starts as soon as the current one is completed, even if this is early – the relay race principle

Executing the critical chain-based plan

Buffers are divided into three zones:

- Green: the first 33%. No action required
- Amber : the next 33%. Plan is formulated
- Red : last 33%. Plan is executed.