Software Project Management
Lecture-7

By: Usama Musharaf

Contents of Lecture-7

Risk Management

A Framework for Dealing with Risk

- risk identification;
- risk analysis and prioritization;
- risk planning;
- risk monitoring.

PERT Technique

Risk Management

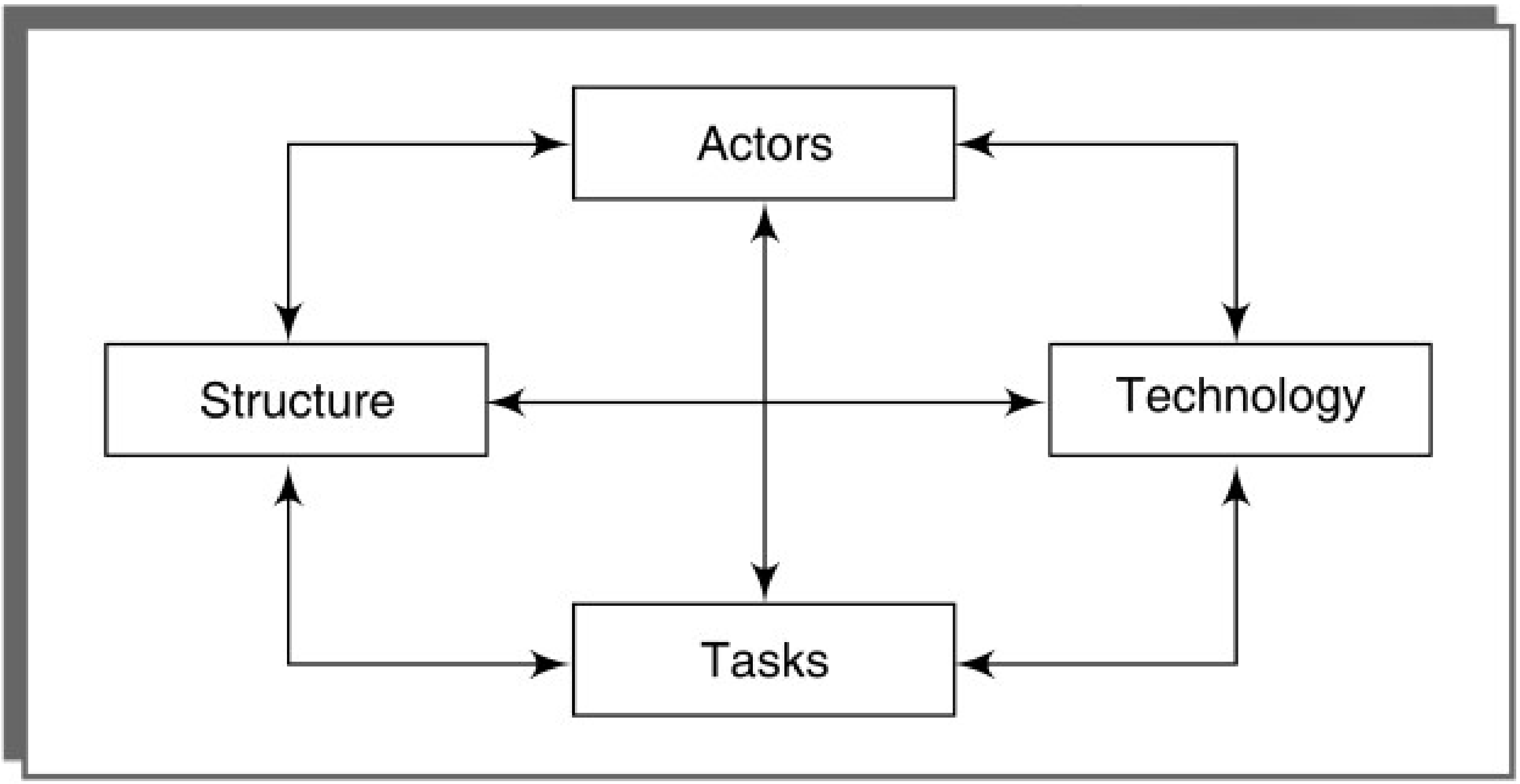
Risk Management

An uncertain event or condition that, if it occurs, has a positive or negative effect on a project's objectives.

The key elements of a risk follow.

- It relates to the future.
- The future is inherently uncertain.
- Some things which seem obvious when a project is over, for example that the costs were under estimated or that a new technology was overly difficult to use, might not have been so obvious during planning.

Risk Framework



Risk Management

Structure describes the management structures and systems, including those affecting planning and control.

For example, the implementation might need user participation in some tasks, but the responsibility for managing the users' contribution might not be clearly allocated.

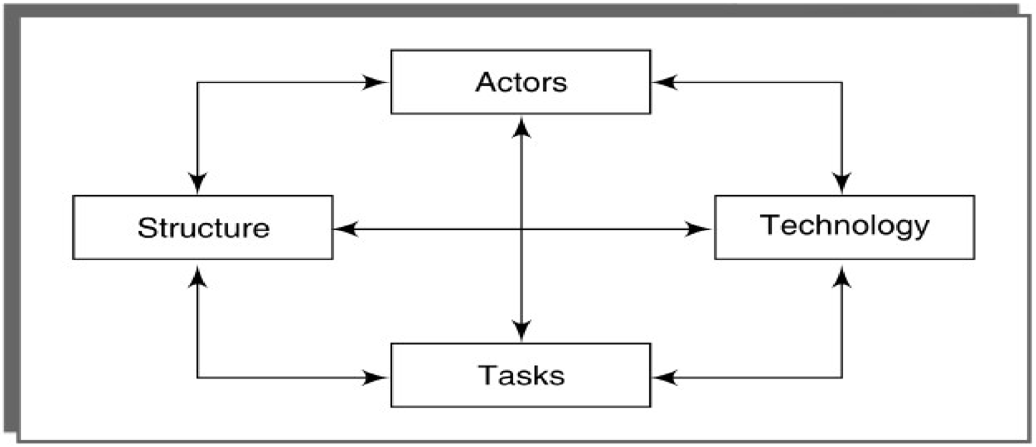
Tasks' relates to the work planned. For instance, the complexity of the work might lead to delays because of the additional time required integrate the large number of components.

Risk Management

Risks often arise from the relationships between factors.

– for example between technology and people.

If a development technology is novel then the developers might not be experienced in its use and delay results.



Risk Management Framework

Risk Management Framework

Planning for risk includes these steps:

(i) risk identification;

(ii) risk analysis and prioritization;

(iii) risk planning;

(iv) risk monitoring.

Risk Management Framework

(i) Risk Identification:

The two main approaches to the identification of risks are the use of ***checklists*** and ***brainstorming.***

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
Gold plating	Requirements scrubbing; prototyping; cost–benefit analysis; design to cost

Risk Management Framework

Late changes to requirements	Stringent change control procedures; high change threshold; incremental development (deferring changes)
Shortfalls in externally supplied components	Benchmarking; inspections; formal specifications; contractual agreements; quality assurance procedures and certification
Shortfalls in externally performed tasks	Quality assurance procedures; competitive design or prototyping; contract incentives
Real-time performance shortfalls	Simulation; benchmarking; prototyping; tuning; technical analysis
Development technically too difficult	Technical analysis; cost–benefit analysis; prototyping; staff training and development

Risk Management Framework

(ii) Risk Assessment

A common problem with risk identification is that a list of risks is potentially endless. A way is needed of distinguishing the damaging and likely risks.

This can be done by estimating the risk exposure for each risk using the formula:

risk exposure = (potential damage) * (probability of occurrence)

Risk Management Framework

Example:

A project depended on a data center vulnerable to fire.

It might be estimated that if a fire occurred a new computer configuration could be established for £500,000.

It might also be estimated that where the computer is located there is a 1 in 1000 chance of a fire actually happening, that is a probability of 0.001.

The risk exposure in this case would be:

$$£500,000 * 0.001 = £500$$

Risk Management Framework

Justification:

A way of understanding this value is as the minimum sum an insurance company would require as a premium.

If 1000 companies, all in the same position, each contributed £500 to a fund then, when the 1 in 1000 chance of the fire actually occurred, there would be enough money to cover the cost of recovery.

Risk Management Framework

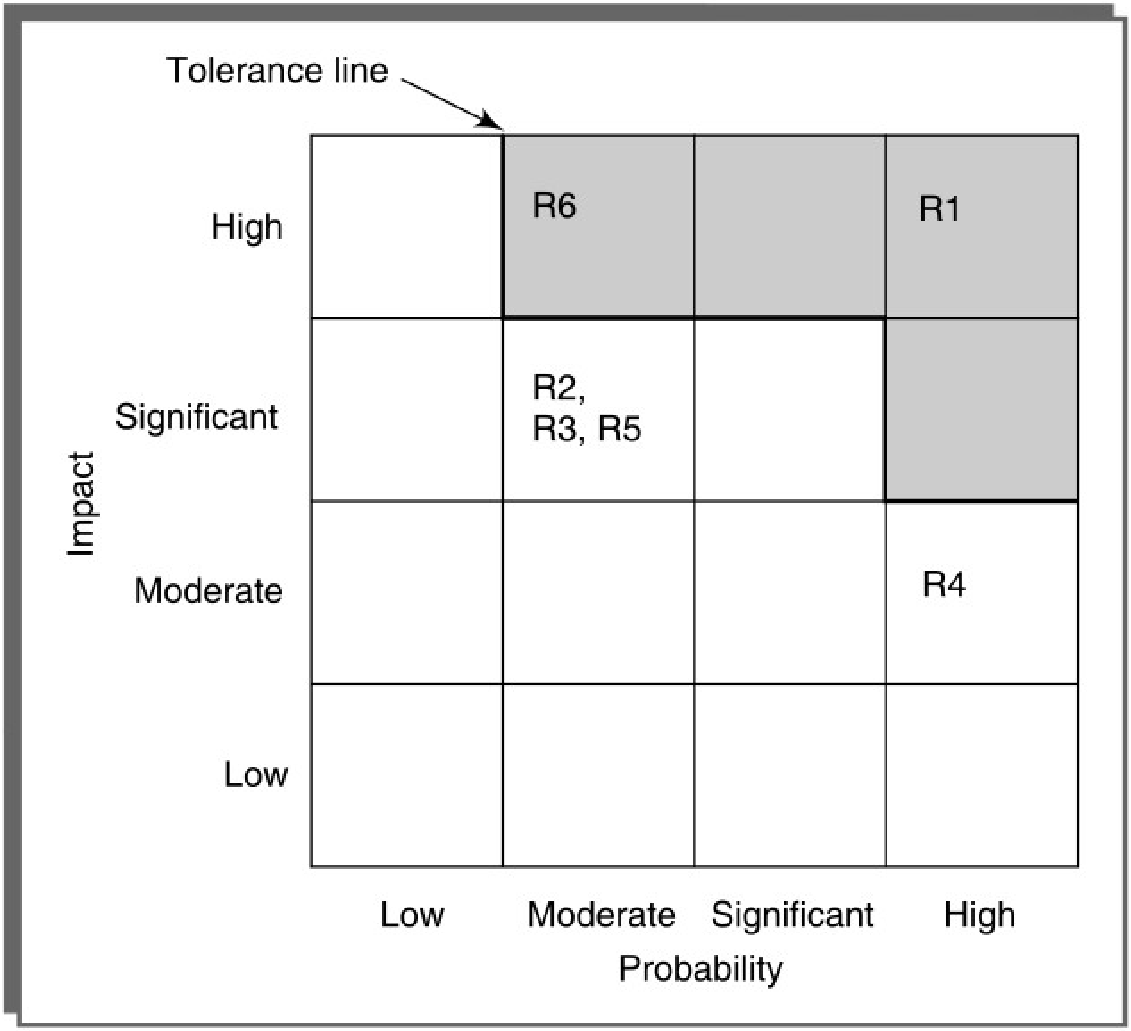
Ref	Hazard	Likelihood	Impact	Risk
R1	Changes to requirements specification during coding	8	8	64
R2	Specification takes longer than expected	3	7	21
R3	Significant staff sickness affecting critical path activities	5	7	35
R4	Significant staff sickness affecting non-critical activities	10	3	30
R5	Module coding takes longer than expected	4	5	20
R6	Module testing demonstrates errors or deficiencies in design	4	8	32

Risk Management Framework

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

Impact level	Range
High	More 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.

Risk Management Framework



Cost Benefit Analysis

Example:

BuyRight, a software house, is considering developing a payroll application for use in academic institutions and is currently engaged in a cost–benefit analysis.

Study of the market has shown that, if BuyRight can target it efficiently and no competing products become available, it will obtain a high level of sales generating an annual income of £800,000. It estimates that there is a 1 in 10 chances of this happening.

However, a competitor might launch a competing application before its own launch date and then sales might generate only £100,000 per year. It estimates that there is a 30% chance of this happening.

The most likely outcome, it believes, is somewhere in between these two extremes – it will gain a market lead by launching before any competing product becomes available and achieve an annual income of £650,000.

Cost Benefit Analysis

Sales	Annual sales income (£)	Probability	Expected value (£)
	i	p	$i \times p$
High	800,000	0.1	80,000
Medium	650,000	0.6	390,000
Low	100,000	0.3	30,000
Expected Income			500,000

Risk Profile Analysis

An approach which attempts to overcome some of the objections to cost–benefit averaging is the construction of risk profiles using sensitivity analysis.

This involves varying each of the parameters that affect the project's cost or benefits to as certain how sensitive the project's profitability is to each factor.

We might, for example, vary one of our original estimates by plus or minus 5% and recalculate the expected costs and benefits for the project.

Risk Profile Analysis

By repeating this exercise for each of our estimates in turn we can evaluate the sensitivity of the project to each factor.

By studying the results of a sensitivity analysis we can identify those factors that are most important to the success of the project.

We then need to decide whether we can exercise greater control over them or otherwise mitigate their effects. If neither is the case, then we must live with the risk or abandon the project.

Risk Profile Analysis Using Decision Trees

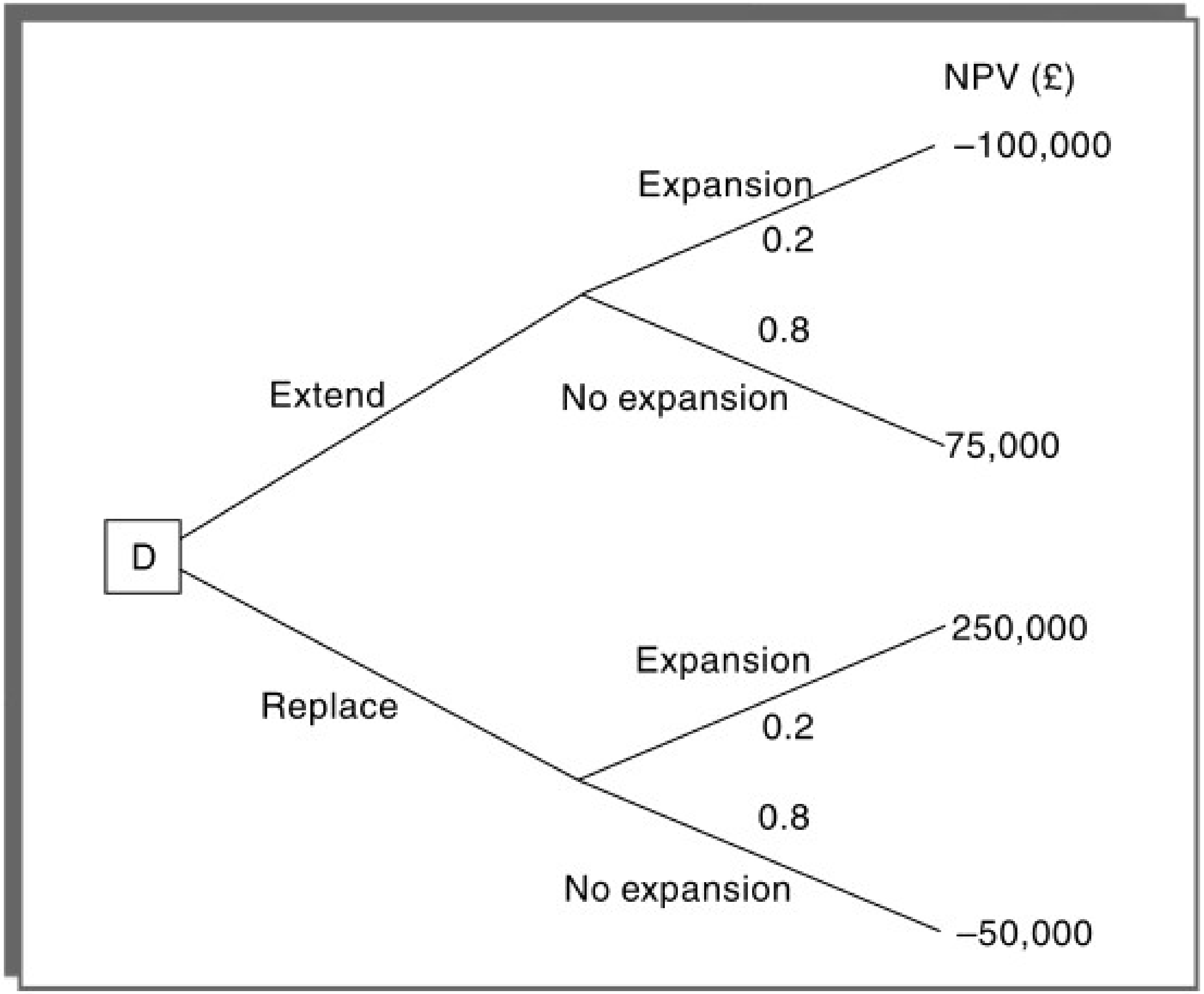
A company "xyz" is considering when to replace its sales order processing system.

The decision largely rests upon the rate at which its business expands – if its market share significantly increases (which it believes will happen if rumours of a competitor's imminent bankruptcy are fulfilled) the existing system might need to be replaced within two years.

Not replacing the system in time could be an expensive option as it could lead to lost revenue if it cannot cope with increased sales.

Replacing the system immediately will, however, be expensive as it will mean deferring other projects already scheduled.

Risk Profile Analysis Using Decision Trees



Risk Profile Analysis Using Decision Trees

The expected value of each path is the sum of the value of each possible outcome multiplied by its probability of occurrence.

The expected value of extending the system is therefore
£40,000 (75,000 * 0.8 – 100,000 * 0.2)

and the expected value of replacing the system
£10,000 (250,000 * 0.2 – 50,000 * 0.8).

The company should therefore choose the option of extending the existing system.

Risk Management Framework

(iii) Risk Planing:

- risk acceptance;
- risk avoidance;

  (For example, given all the problems with developing software solutions from scratch, managers might decide to retain existing clerical methods, or to buy an off-the-shelf solution.)
- risk reduction and mitigation;

  (For example, taking regular back-ups of data storage would reduce the impact of data corruption)
- risk transfer;

  (outsource project/ activity)

Risk Management Framework

RISK RECORD

Risk id		Risk title			
Owner		Date raised		Status	

Risk description

Impact description

Recommended risk mitigation

Probability/impact values

	Probability	Impact		
		Cost	Duration	Quality
Pre-mitigation				
Post-mitigation				

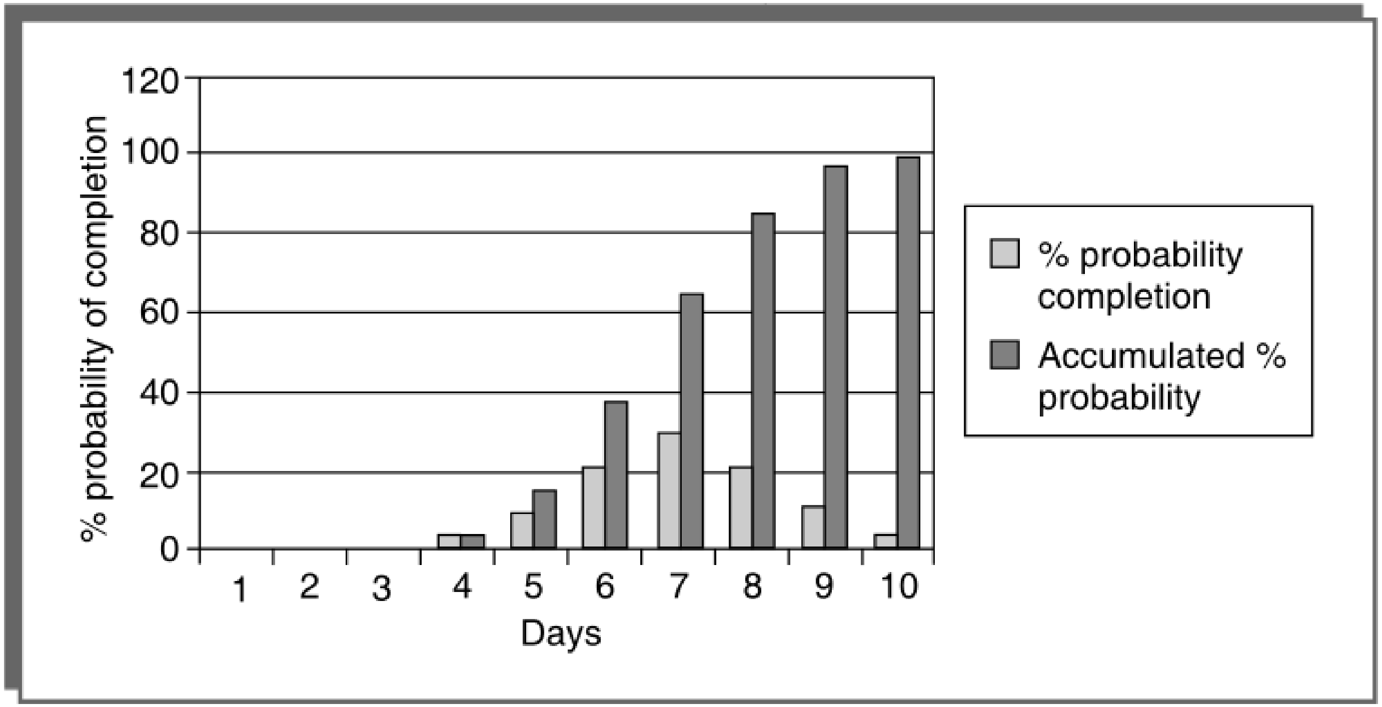
Incident/action history

Date	Incident/action	Actor	Outcome/comment

Risk Management Framework

PERT (Program Evaluation Review Technique)

- To evaluate the effects of uncertainty.



Risk Management Framework

PERT (Program Evaluation Review Technique)

PERT requires three estimates:

Most likely time:

The time we would expect the task to take under normal circumstances. We shall identify this by the letter m.

Optimistic time:

The shortest time in which we could expect to complete the activity, barring outright miracles. We shall use the letter a for this.

Pessimistic time:

The worst possible time, allowing for all reasonable eventualities.

We shall call this b.

Risk Management Framework

PERT (Program Evaluation Review Technique)

PERT then combines these three estimates to form a single expected duration, t_e , using the formula

$$t_e = \frac{a + 4\,m + b}{6}$$

Risk Management Framework

PERT (Program Evaluation Review Technique)

$$t_e = \frac{a + 4m + b}{6}$$

Activity	Activity durations (weeks)			
	Optimistic (a)	Most likely (m)	Pessimistic (b)	Expected (t_e)
A	5	6	8	6.17
B	3	4	5	4.00
C	2	3	3	2.83
D	3.5	4	5	4.08
E	1	3	4	2.83
F	8	10	15	10.50
G	2	3	4	3.00
H	2	2	2.5	2.08

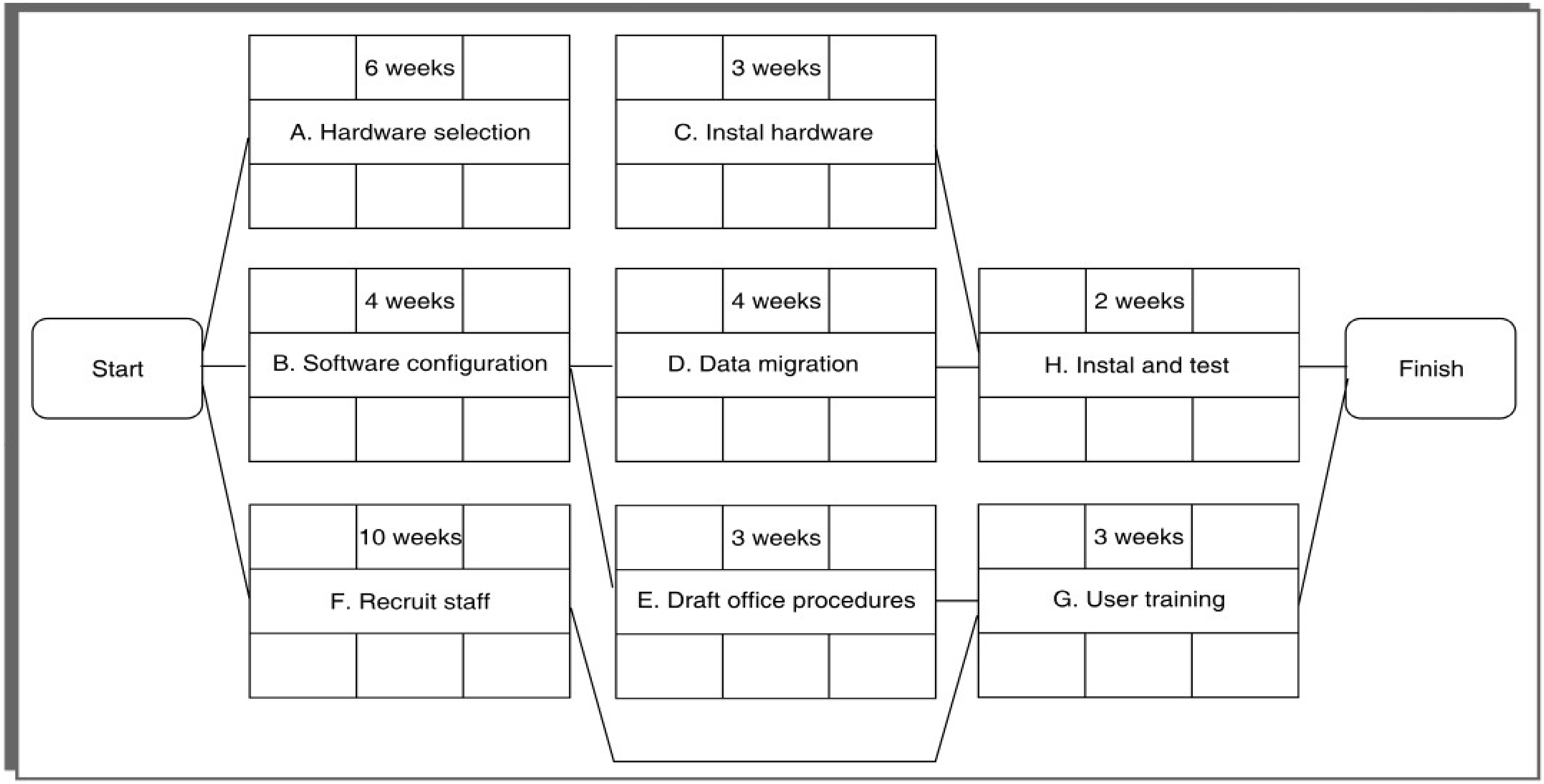
Risk Management Framework

PERT (Program Evaluation Review Technique)

Activity		Duration (weeks)	Precedents
A	Hardware selection	6	
B	System configuration	4	
C	Instal hardware	3	A
D	Data migration	4	B
E	Draft office procedures	3	B
F	Recruit staff	10	
G	User training	3	E, F
H	Instal and test system	2	C, D

Risk Management Framework

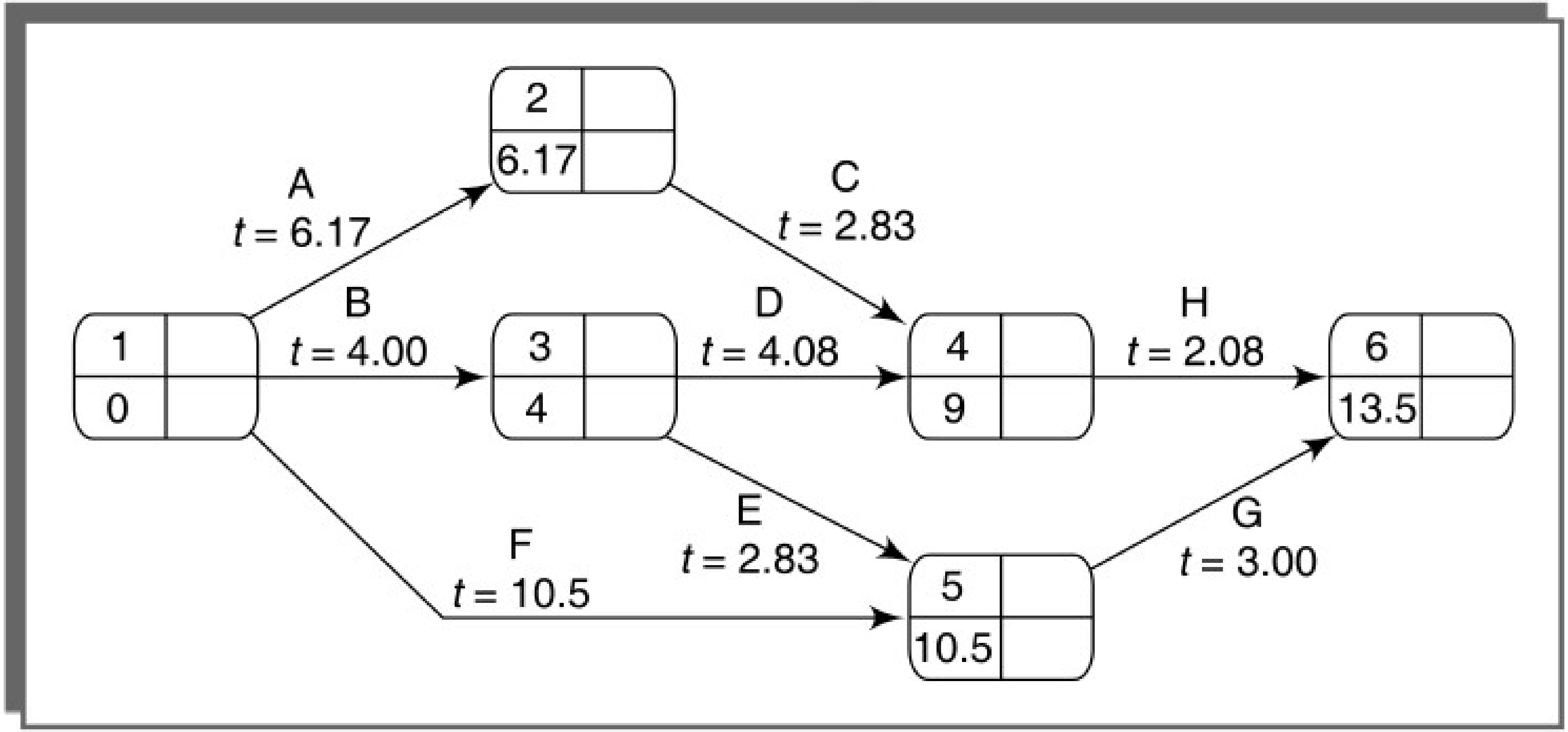
PERT (Program Evaluation Review Technique)



Risk Management Framework

PERT (Program Evaluation Review Technique)

Forward pass:



Risk Management Framework

PERT (Program Evaluation Review Technique)

Activity standard deviation: The activity standard deviation is proportional to the difference between the optimistic and pessimistic estimates, and can be used as a ranking measure of the degree of uncertainty or risk for each activity.

$$s = \frac{b - a}{6}$$

Risk Management Framework

PERT (Program Evaluation Review Technique)

Activity standard deviation:

$$s = \frac{b - a}{6}$$

Activity	Activity durations (weeks)				
	Optimistic (a)	Most likely (m)	Pessimistic (b)	Expected (t_e)	Standard deviation (s)
A	5	6	8	6.17	0.50
B	3	4	5	4.00	0.33
C	2	3	3	2.83	0.17
D	3.5	4	5	4.08	0.25
E	1	3	4	2.83	0.50
F	8	10	15	10.50	1.17
G	2	3	4	3.00	0.33
H	2	2	2.5	2.08	0.08

Risk Management Framework

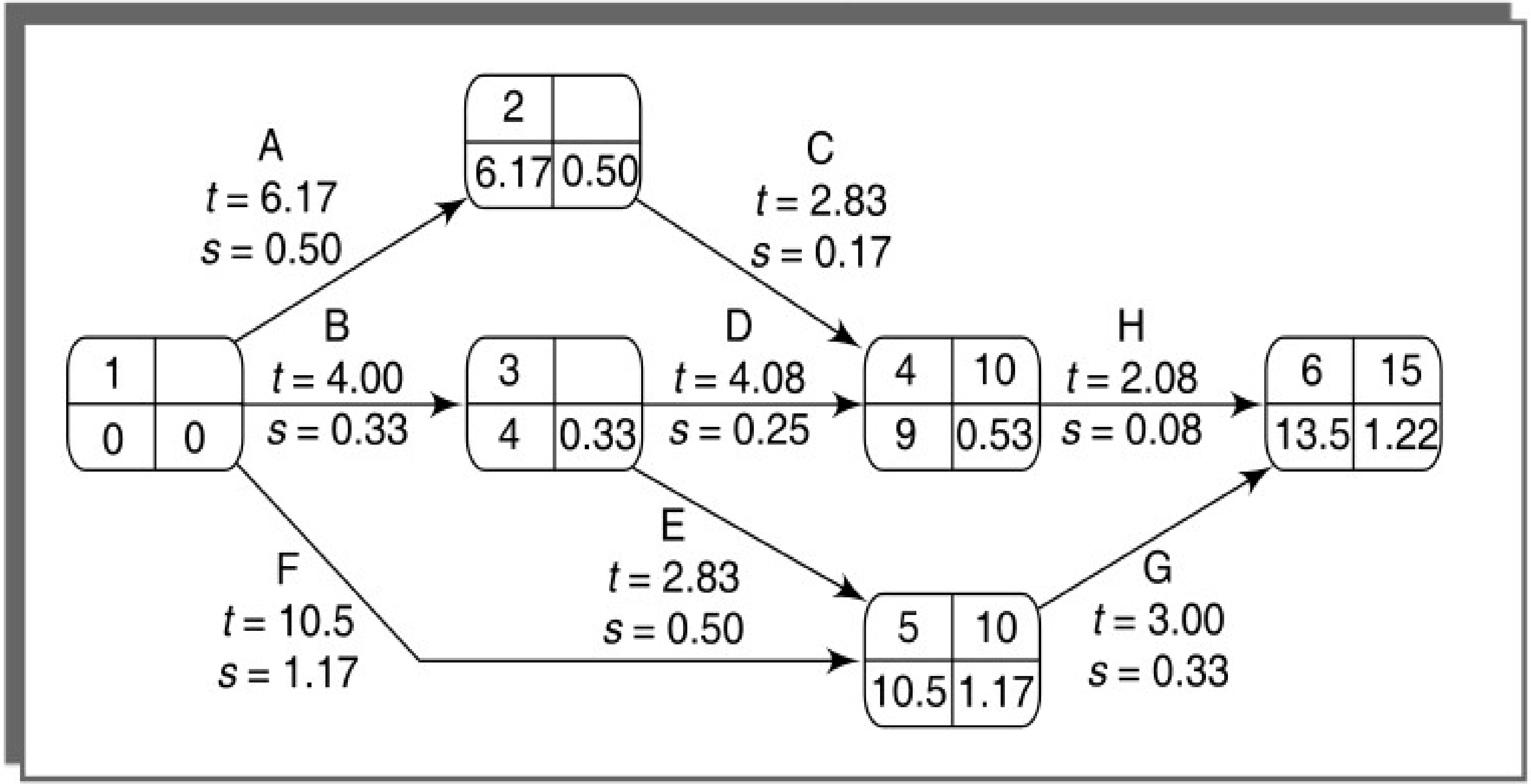
PERT (Program Evaluation Review Technique)

The PERT technique uses the following three-step method for calculating the probability of meeting or missing a target date:

- calculate the standard deviation of each project event;
- calculate the z value for each event that has a target date;
- convert z values to a probabilities

Risk Management Framework

PERT (Program Evaluation Review Technique)



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PERT (Program Evaluation Review Technique)

Calculate the standard deviation of each project event;

The standard deviation for event 3 depends solely on that of activity B. The standard deviation for event 3 is therefore 0.33.

For event 5:

There are two possible paths, B + E or F. The total standard deviation for path B + E is $\sqrt{(0.33^2 + 0.50^2)} = 0.6$ and that for path F is 1.17; the standard deviation for event 5 is therefore the greater of the two, 1.17.

Risk Management Framework

PERT (Program Evaluation Review Technique)

Standard deviation:

For Event 4:

Path A + C has a standard deviation of $\sqrt{(0.50^2 + 0.17^2)} = 0.53$

Path B + D has a standard deviation of $\sqrt{(0.33^2 + 0.25^2)} = 0.41$

For Event 6:

Path 4 + H has a standard deviation of $\sqrt{(0.53^2 + 0.08^2)} = 0.54$

Path 5 + G has a standard deviation of $\sqrt{(1.17^2 + 0.33^2)} = 1.22$

Node 6 therefore has a standard deviation of 1.22.

PERT (Program Evaluation Review Technique)

Calculate Z values;

The z value is calculated for each node that has a target date. It is equivalent to the number of standard deviations between the node's expected and target dates. It is calculated using the formula

$$Z = \frac{T - t_e}{s}$$

where t e is the expected date and T the target date.

The z value for **event 5** is $\frac{10 - 10.5}{1.17} = -0.43$

The z value for **event 6** is $\frac{15 - 13.5}{1.22} = 1.23$

Risk Management Framework

PERT (Program Evaluation Review Technique)

Obtaining Probabilities:

Event 4: The z value is 1.89 which equates to a probability of approximately 3%. There is therefore only a 3% chance that we will not achieve this event by the target date of the end of week 10.

Event 5: The z value is −0.43 which equates to a probability of approximately 67%. There is therefore a 67% chance that we will not achieve this event by the target date of the end of week 10.

Risk Management Framework