Unit-3 ACTIVITY PLANNING AND RISK MANAGEMENT

THE OBJECTIVES OF ACTIVITY PLANNING

Feasibility assessment

Is the project possible within required timescales and resource constraints? It is not until we have constructed a detailed plan that we can forecast a completion date with any reasonable knowledge of its achievability.

Resource allocation

What are the most effective ways of allocating resources to the project. When should the resources be available? The project plan allows us to investigate the relationship between timescales and resource availability

Detailed costing

How much will the project cost and when is that expenditure likely to take place? After producing an activity plan and allocating specific resources, we can obtain more detailed estimates of costs and their timing.

Motivation

Providing targets and being seen to monitor achievement against targets is an effective way of motivating staff, particularly where they have been involved in setting those targets in the first place.

Co-ordination

When do the staff in different departments need to be available to work on a particular project and when do staff need to be transferred between projects? The project plan, particularly with large projects involving more than a single project team, provides an effective vehicle for communication and coordination among teams.

PROJECT SCHEDULE

A stage of a larger project, the project plan must be developed to the level of showing dates when each activity should start and finish and when and how much of each resource will be required. Once the plan has been refined to this level of detail *we* call it a project schedule

Creating a project schedule comprises four main stages.

First step

The first step in producing the plan is to decide what activities need to be carried out and in what order they are to be done_ From this *we* can construct an ideal activity plan — that is, a plan of when each activity would ideally be undertaken were resources not a constraint

Second step

The ideal activity plan will then **be** the subject of an activity risk analysis, aimed at identifying potential problems. This might suggest alterations **to** the ideal activity plan and will almost certainly have implications for resource allocation.

Third step

The third step is resource allocation. The expected availability of resources might place constraints on when certain activities can be carried out

Fourth step

The final step is schedule production. Once resources have been allocated to each activity, we will be in a position to draw up and publish a project schedule which indicates planned start and completion dates.

PROJECTS AND ACTIVITIES

Defining projects

- A project is composed of a number of interrelated activities.
- A project may start when at least one of its activities is ready to start.
- A project will be completed when all of the activities it encompasses have been completed.

Defining activities

- If an activity must have a clearly defined start and a clearly defined end-point, normally marked by the production of a tangible deliverable.
- An activity requires a resource (as most do) then that resource requirement must be forecast able and is assumed to be required at a constant level throughout the duration of the activity.
- The duration of an activity must be forecastable — assuming normal circumstances, and the reasonable availability of resources.
- Some activities might require that others are completed before they can begin these are known as precedence requirements).

Identifying activities

Essentially there are three approaches to identifying the activities or tasks that make up a project

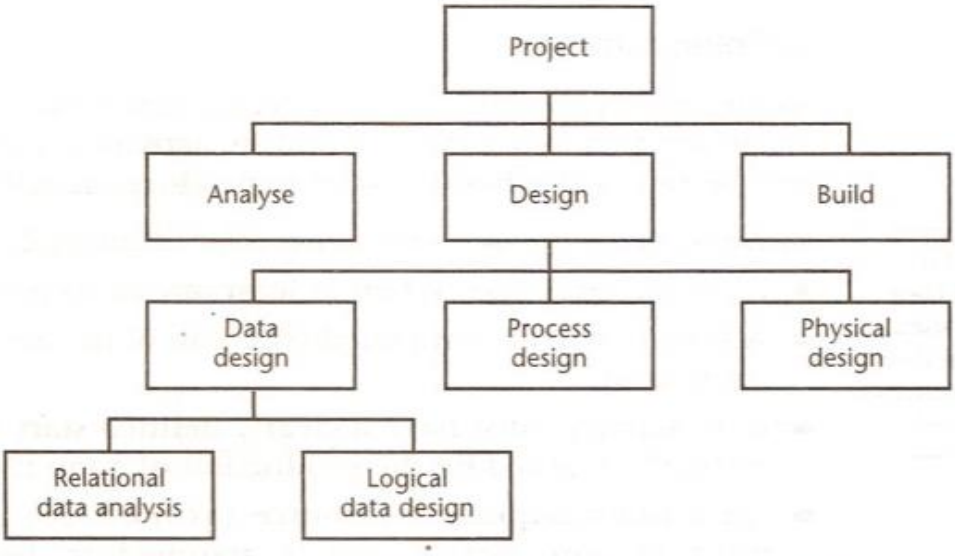
- the activity-based approach,
- the product-based approach
- the hybrid approach.

The activity-based approach

- The activity-based approach consists of creating a list of all the activities that the project is thought to involve.
- This might involve a brainstorming session involving the whole project team or it might stern from an analysis of similar past projects.
- When listing activities, particularly for a large project, it might be helpful to subdivide the project into the main life-style stages and consider each of these separately. Generating a task list is to create a **Work Breakdown Structure** (WBS).

  WBS involves
  - identifying the main tasks
  - break each main task down into subtasks

    - The subtasks can further be broken down into lower level tasks.
- Activities are added to a branch in the structure if they directly contribute to the task immediately above — if they do not contribute to the parent task, then they should not be added to that branch.
- The tasks at each level in any branch should include everything that is required to complete the task at the higher level — if they are not a comprehensive definition of the parent task, then something is missing. When preparing a WBS, consideration must be given to the final level of detail



igure 6.2 A fragment of an activity-based Work Breakdown Structure

Advantages

- More likely to obtain a task catalogue that is complete and is composed of non-overlapping tasks
- WBS represents a structure that can be refined as the project proceeds
- The structure already suggests the dependencies among the activities

Disadvantage

- Very likely to miss some activities if an unstructured activity list is used

The product-based approach

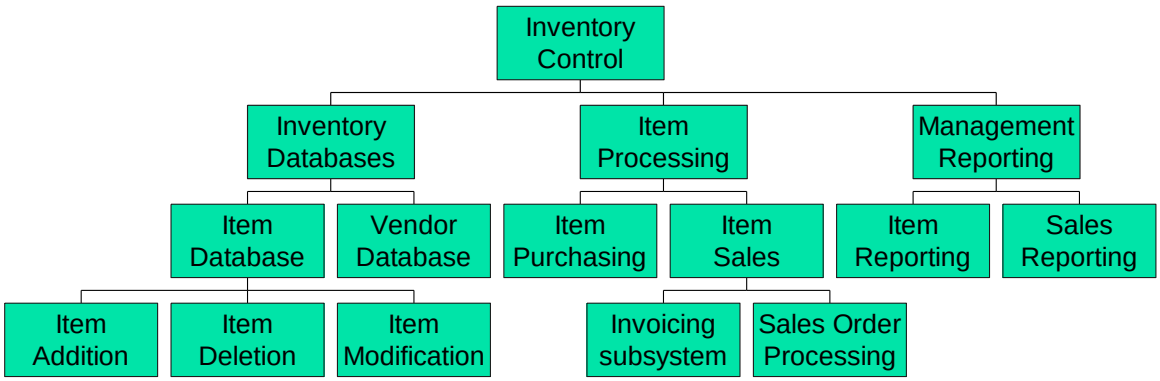
Product Breakdown Structure (PBS)

To show how a system can be broken down into different products for development

Product Flow Diagram (PFD)

To indicate, for each product, which products are required as 'inputs'

A Product Breakdown Structure (an extract)

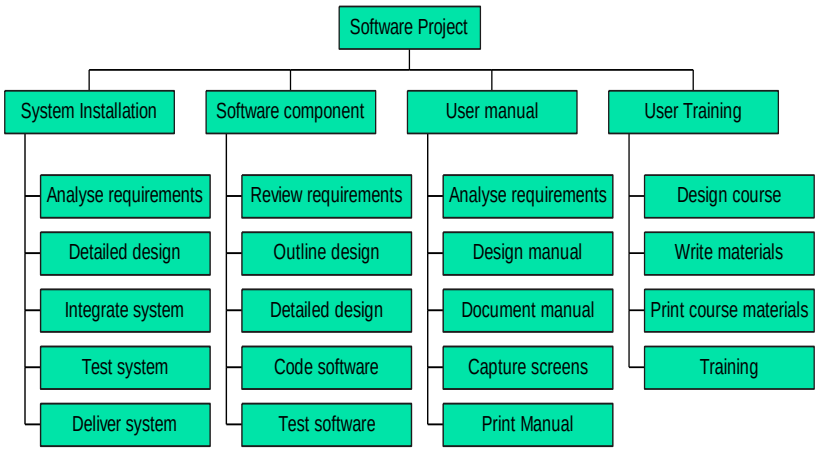


Advantages

Less likely to miss a product unexpectedly from a PBS

The hybrid approach

- A mix of the activity-based approach and the product-based approach
- More commonly used approach
- The WBS consists of
  - A list of the products of the project; and
  - A list of activities for each product



- IBM in its MITP methodology suggests 5 levels
  - Level 1: Project
  - Level 2: Deliverables (software, manuals etc)
  - Level 3: Components
  - Level 4: Work-packages
  - Level 5: Tasks (individual responsibility)

SEQUENCING AND SCHEDULING ACTIVITIES

- Throughout a project, we will require a schedule that clearly indicates when each of the project's activities is planned to occur and what resources it will need.
- The chart shown has been drawn up taking account of the nature of the development process that is. certain tasks must be completed before others may start) and the resources that are available (for example, activity C follows activity B because Andy cannot work on both tasks at the same time).
- In drawing up the chart, we have therefore done two things — we have sequenced the tasks (that is, identified the dependencies among activities dictated by the development process) and scheduled them (that is, specified when they should take place).
- The scheduling has had to take account of the availability of staff and the ways in which the activities have been allocated to them.
- The schedule might look quite different were there a different number of staff or were *we* to allocate the activities differently.
- In the case of small projects. this combined sequencing—scheduling approach might be quite suitable, particularly where we wish to allocate individuals to particular tasks at an early planning stage.
- However, on larger projects it is better to separate out these two activities: to sequence the tasks according to their logical relationships and then to schedule them taking into account resources and other factors.
- Approaches to scheduling that achieve this separation between the logical an the physical use networks to model the project and it is these approaches that will consider in subsequent sections of this chapter.

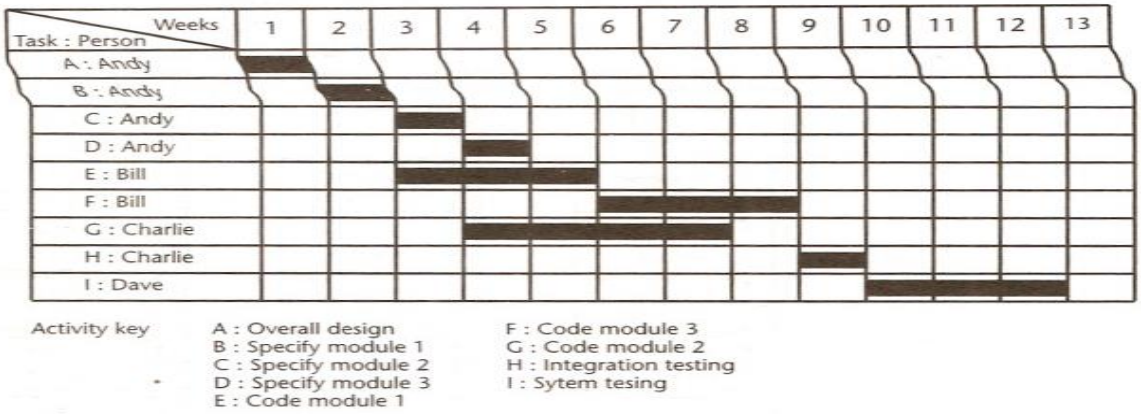


Figure 6.6 A project plan as a bar chart

NETWORK PLANNING MODEL

Formulating a network model

The first stage in creating a network model is to represent the activities and their relationships as a graph. In activity-on-node we do this by representing **activities as nodes** in the graph-**the lines** between nodes represent **dependencies.**

Constructing precedence networks:

- A project network should have only one start node.
- A project network should have only one end node.
- A node has duration.
- Links normally have no duration.
- Precedents are the immediate preceding activities**.(Fig)**

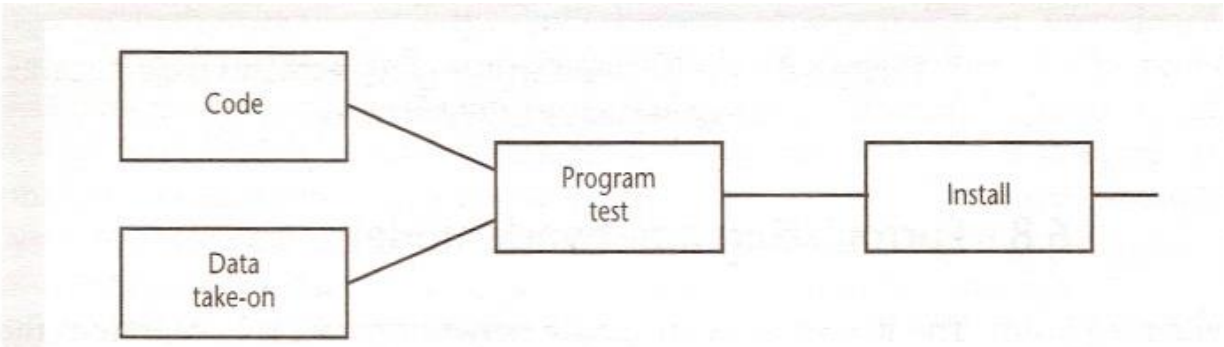


Figure 6.9 Fragment of a precedence network

- Times moves from left to right
- A network may not contain loops.**(Fig)**

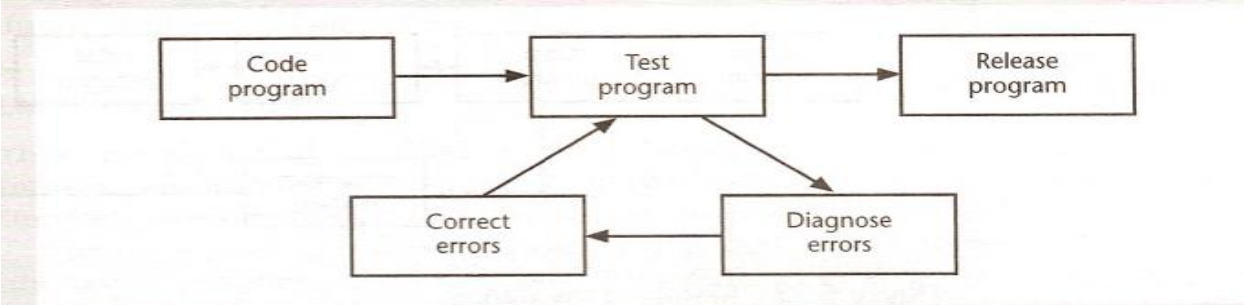


Figure 6.10 A loop represents an impossible sequence

- A network should not contain dangles**.(Fig)**

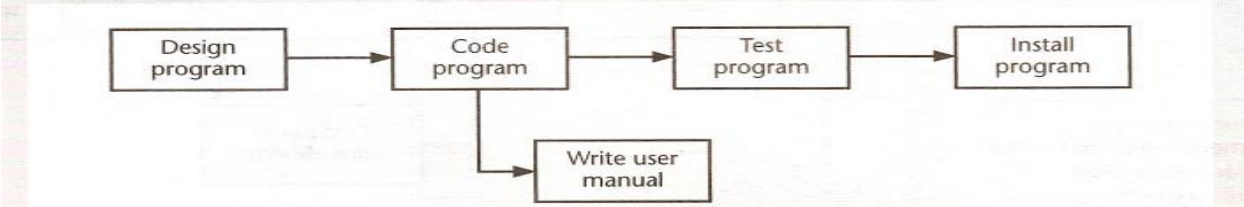


Figure 6.11 A dangle

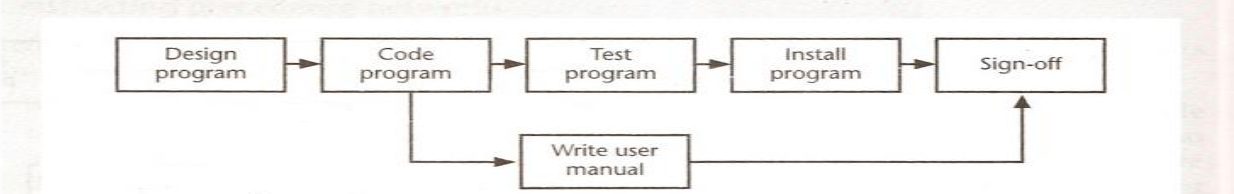


Figure 6.12 Resolving the dangle

Representing lagged activities:

We might come across situations where we wished to undertake two activities in parallel so long as there is a lag between the two. We might wish to document amendments to a program as it was being tested - particularly if evaluating a prototype. Where activities can occur in parallel with a time lag between them we represent the lag with duration on the linking arrow as shown in Figure 6.13. This indicates that documenting amendments can start one day after the start of prototype testing and will be completed two days after prototype testing is completed.

Hammock activities:

A hammock activity (also hammock task) is a schedule or project planning term for a grouping of tasks that "hang" between two end dates it is tied to. A hammock activity can group tasks which are not related in the hierarchical sense of a Work Breakdown Structure, or are not related in a logical sense of a task dependency where one task must wait for another.

Labeling conventions:

Earliest Start	Estimated Duration	Earliest Finish
Activity Label, Activity Description		
Latest Start	Float	Latest Finish

Forward pass

The forward pass is carried out to calculate the earliest dates on which each activity may be started and completed.

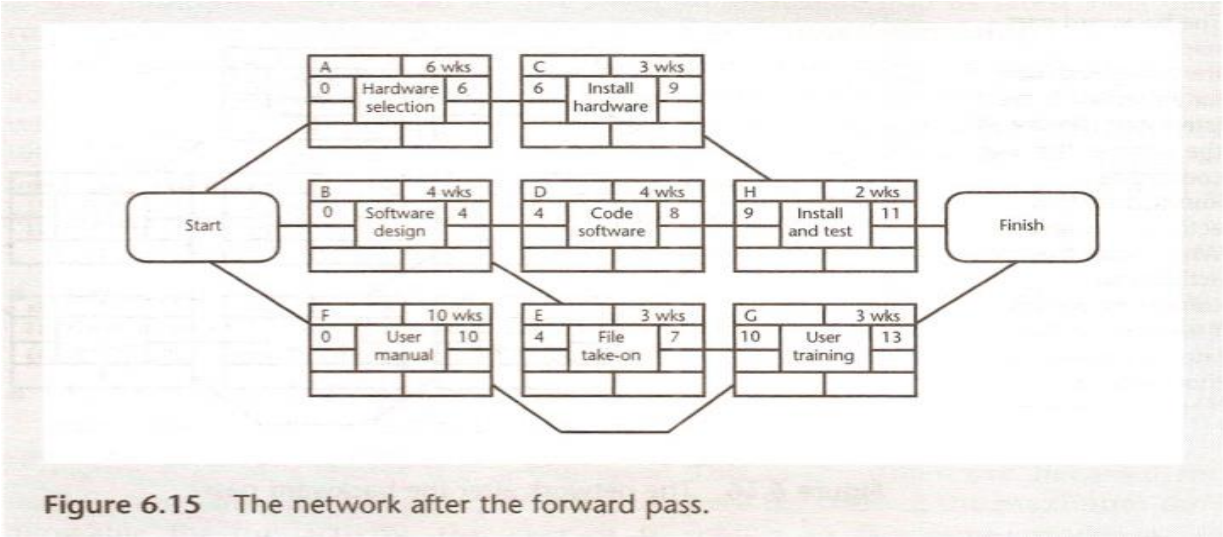


Figure 6.15 The network after the forward pass.

The forward pass and the calculation of earliest start dates is calculated according to the following reasoning.

- Activities A, B and F may start immediately, so the earliest date for their start is zero.
- Activity A will take 6 weeks, so the earliest it can finish is week 6.
- Activity B will take 4 weeks, so the earliest it can finish is week 4.
- Activity F will take 10 weeks, so the earliest it can finish is week 10.
- Activity C can start as soon as A has finished so its earliest start date is week 6. It will take 3 weeks so the earliest it can finish is week 9.
- Activities D and E can start as soon as B is complete so the earliest they can each start is week 4. Activity D, which will take 4 weeks, can therefore finish by week 8 and activity E, which will take 3 weeks, can therefore finish by week 7.
- Activity G cannot start until both E and F have been completed. It cannot therefore start until week 10 — the later of weeks 7 (for activity E) and 10 (for activity F). It takes 3 weeks and finishes in week 13.

- Similarly, Activity H cannot start until week 9 — the later of the two earliest finished dates for the preceding activities C and a
- The project will be complete when both activities H and G have been completed. Thus the earliest project completion date will be the later of weeks 11 and 13— that is, week 13.
- The results of the forward pass are shown in Figure 6.15.

Backward pass

The second stage in the analysis of a critical path network is to carry out a backward pass to calculate the latest date at which each activity may be started and finished without delaying the end date of the project. In calculating the latest dates, we assume that the latest finish date for the project is the same as the earliest finish date — that is, we wish to complete the project as early as possible.

Figure 6.16 illustrates our network alter carrying out the backward pass.

The latest activity dates are calculated as follows.

- The latest completion date for activities G and 1-1 is assumed to be week 13.
- Activity H must therefore start at week 11 at the latest (13-2) and the latest start date for activity G is week 10 (13-3).
- The latest completion date for activities C and D is the latest date at which activity H must start — that is. Week 11. They therefore have latest start dates of week 8 (11-3) and week 7 (11-4) respectively.
- Activities E and F must be completed by week 10 so their earliest start dates are weeks 7 (10-3) and 0 (10-10 respectively.
- Activity B must be completed by week 7 the latest start date for both activities D and El so its latest start is week 3 (7-4).
- Activity A must be completed by week 8 (the latest start date for activity C) so its latest start is week 2 (8-6).
- The latest start date for the project start is the earliest of the latest start dates for activities A. B and F. This is week zero. This is, of course, not very surprising since it tells vi that if the project does not start on time it won't finish on time.

Activity float

The difference between an activity's earliest start date and its latest start date (or difference between an activity's earliest and latest finish dates) is known as the activity's float-it is measure of how much the start or completion of an activity may be delayed without affecting the end date of the project. Any activity with a float of zero is critical (any delay in carrying out the activity delay the completion date of the project as a whole.

Although the total float is shown for each activity, it really 'belongs' to a path through the network. Activities A and C in Figure 6.16 each have 2 weeks' total float. If,

however, activity A uses up its float (that is, it is not completed until week 8) then activity B will have zero float (it will have become critical). In such circumstances it may be misleading and detrimental to the project's success to publicize total float!

There are a number of other measures of activity float, including the following:

- Free float: the time by which an activity may be delayed without affecting any subsequent activity. It is calculated as the difference between the earliest completion date for the activity and the earliest start date of the succeeding activity. This might be considered a more satisfactory measure of float for publicizing to the staff involved in undertaking the activities.
- Interfering float: the difference between total float and free float. This is quite commonly used, particularly in association with the free float. Once the free float has been used (or if it is zero), the interfering float tells us by how much the activity may be delayed without delaying the project end date - even though it will delay the start of subsequent activities.

Identifying critical path

There will be at least one path through the network that defines the duration of the project. This is known as critical path. Any delay to any activity on this critical path will delay the completion of the project.

Significance of critical path

- In managing the project, we must pay particular attention to monitoring activities on the critical path so that the effects of any delay or resource unavailability are detected at the earliest opportunities.
- In planning the project, it is the critical path that we must shorten if we are to reduce the overall duration of the project.

SOME DEFINITIONS OF RISK

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

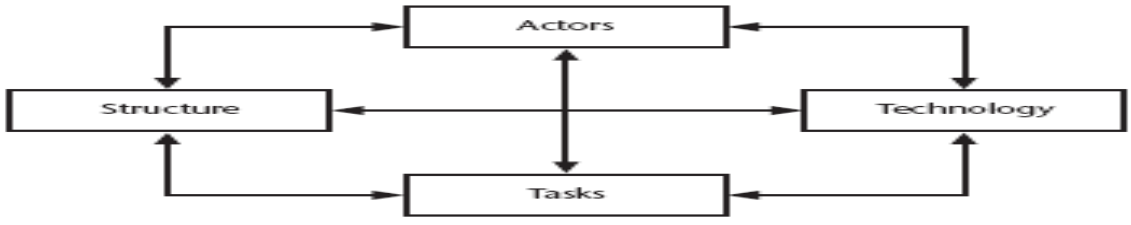
2. The chance of exposure to the adverse consequences of future events'

- Project plans have to be based on assumptions
- Risk is the possibility that an assumption is wrong
- When the risk happens it becomes a problem or an issue

Key elements of risks

- It relates to the future
- It involves cause and effect

CATEGORIES OF RISKS:



Tasks: the types of task to be undertaken
Structure: the communication systems, management structures, work flows etc
Actor: the people involved in the project
Technology: the methods, techniques and tools to be used

Brief notes on various types of risks;
Financial risk is the loss of key resources like funding, etc. In this case the company will not have adequate cash flow to meet financial obligations. Credit risk, liquidity risk, market risk, operational risk are different types of financial risks.
When the borrower becomes default and was unable to make payments as promised it is said to be **Credit risk**, also called default risk.
Investment risk was associated with this where the investor losses his principal and interest too.
Sometimes due to lack of liquidity in the market an asset cannot be sold to make the profit or to prevent a loss this is what called as **Liquidity risk**.
Due to the change in value of the market risk factors value of investment portfolio or the value of a trading portfolio will decrease. Foreign exchange rates, stock prices, interest rates, and commodity prices are the standard **Market risk** factors.
A risk arising from execution of an organisation's business functions is **Operational risk**. Risks arising from the people, systems and processes through which an organisation operates. Fraud risks, legal risks, physical or environmental risks are other categories included under this.
Risky business processes that could lead to project failure are **Process risks**.
Those risks that are often associated with damage to the reputation of an organisation or its brand are **Intangible risks**.
Risks which often involve things connected to time are **Time risks**.
Loss of critical employees or knowledge which are connected to man power are **Human risks**.
Losses include government regulations and the same having an impact on the operations of the company are **Legal Risks**.
Physical risks are those lose of physical resources such as equipment, buildings, land, etc due to natural disasters or manmade.
Risk management process begins when somebody asks what kind of events can damage the business and how much damage can be done. Identifying and measuring the potential loss exposures, choosing the most efficient methods of controlling and financing loss exposure and implementing them and finally Monitoring all the out comes are the main steps involved in Risk Management.

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

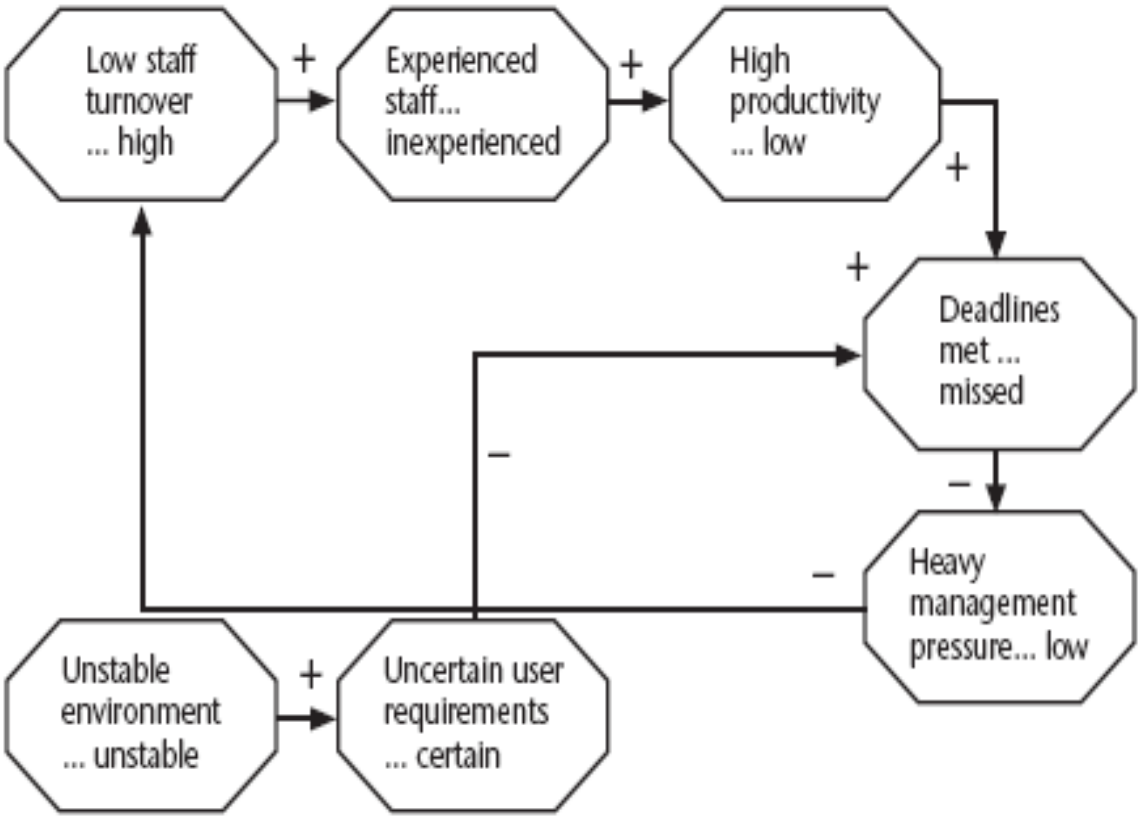
Approaches to identifying risks include:

- 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

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
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

Causal mapping



Risk Analysis

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

Table 7.1 *Part of Amanda's risk exposure assessment*

	Hazard	*Likelihood*	*Impact*	*Risk exposure*
R1	Changes to requirements specification during coding	1	8	8
R2	Specification takes longer than expected	3	7	21
R3	Staff sickness affecting critical path activities	5	7	35
R4	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	1	10	10

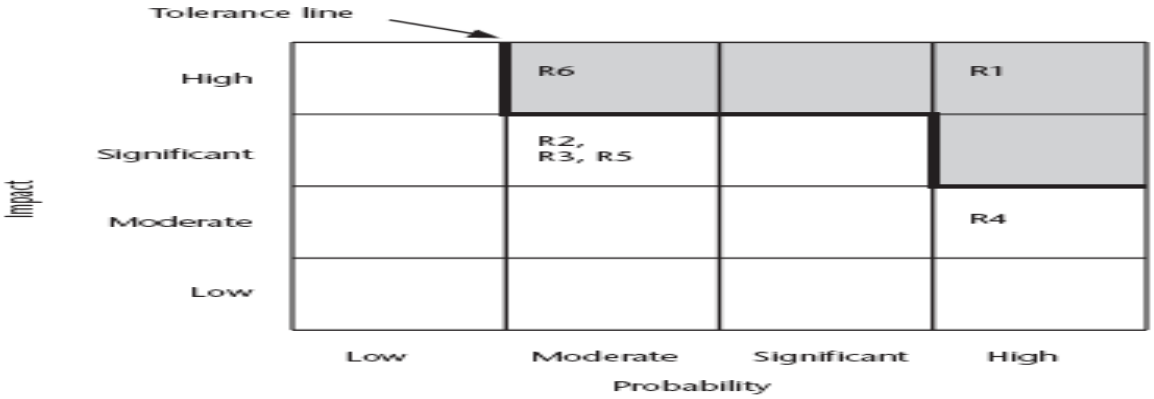
Risk probability: qualitative descriptors

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.

Risk planning consists of drawing up contingency plans and where appropriate, adding these to the project's task structure. With small projects, risk planning is likely to be the responsibility of the project manager, but medium or large projects will benefit from the appointments of a full-time risk manager.

Risk Acceptance: This is deciding to do nothing about the risk. This means you will accept its consequences. In order to concentrate on the more likely or damaging risks. The damage that those risks could cause would be less than the costs needed to act towards reducing their probability of occurrence.

Risk Avoidance: Some activities are so prone to accident that it is best to avoid them altogether.
Example to avoid all the problems associated with developing software solutions from scratch, a solution could be to: Buy an off-the-shelf product.

Risk Reduction and Mitigation:

Risk Reduction: attempts to reduce the likelihood of the risk occurring. For example, **consider the following risk:** developers leaving a company in the middle of a project for a better paid job. In order to reduce the probability of such a risk occurring: the developers could be promised to be paid generous bonuses on successful completion of the project.

Risk Mitigation: is the action taken to ensure that the impact of the risk is reduced when it occurs. Taking regular backups of data storage, is it a risk mitigation measure or a risk reduction measure. Since it would reduce the impact of data corruption not its likelihood of happening, in this sense it is a data mitigation measure.

Risk Transfer: In this case the risk is transferred to another person or organization. For Example, a software development task is outsourced for a fixed fee. Another example is when you buy insurance

Risk reduction leverage

Risk reduction leverage =

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

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

PERT Technique

Project Evaluation and Review Technique (PERT) is a project management tool used to schedule, organize, and coordinate tasks within a project. It estimation considers three values: the most optimistic estimate (O), a most likely estimate (M), and a pessimistic estimate (least likely estimate (L)).

Evaluate the pert techniques:

Three estimates are produced for each activity ϖ Most likely time (m)

Optimistic time (a)

Pessimistic (b)

Expected time' te = (a + 4m +b) / 6 Activity standard deviation'

S = (b-a)/6

ϖExpected time: Helps to carry out a forward pass through a network similar to CPM

Activity standard deviation: Used as ranking measure of the degree of uncertainty or risk for each activity

Advantages of PERT Technique.

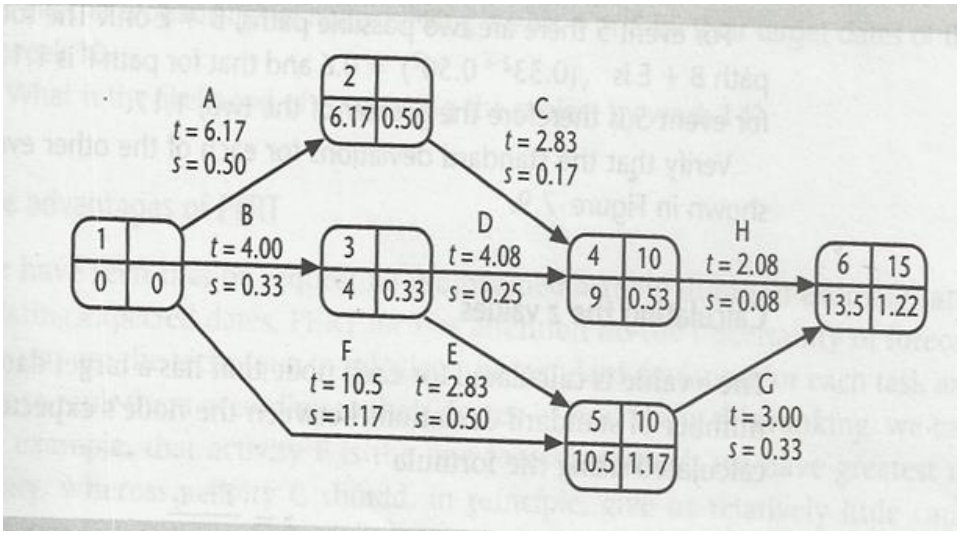
- ✓ Useful at many stages of project management
- ✓ Mathematically simple
- ✓ Give critical path and slack time
- ✓ Provide project documentation
- ✓ Useful in monitoring costs

Pert Labeling Convention

Event Number	Target Date
Expected Date	Standard deviation

Activity	Description	Precedents	Optimistic (a)	Most likely (m)	Pessimistic(b)
A	Hardware Selection		5	6	8
B	Software Design		3	4	5
C	Install Hardware	A	2	3	3
D	Code & test software	B	3.5	4	5
E	File take-on	B	1	3	4
F	Write user manuals		8	10	15
G	User training	E, F	2	3	4
H	Install and test	C,D	2	2	2.5

Activity	Optimistic (a)	Most likely (m)	Pessimistic(b)	Expected te	Standard deviation s
A	5	6	8	6.17	0.5
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	0.5
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



Monte Carlo Simulation

A Monte Carlo method is a technique that involves using random numbers and probability to solve problems. Monte Carlo simulation is a method for iteratively evaluating a deterministic model using sets of random numbers as inputs. This method is often used when the model is complex, nonlinear, or involves more than just a couple uncertain parameters. A simulation can typically involve over 10,000 evaluations of the model, a task which in the past was only practical using super computers.

The Monte Carlo method is just one of many methods for analyzing uncertainty propagation, where the goal is to determine how random variation, lack of knowledge, or error affects the sensitivity, performance, or reliability of the system that is being modeled.

Monte Carlo simulation is categorized as a sampling method because the inputs are randomly generated from probability distributions to simulate the process of sampling from an actual population. So, we try to choose a distribution for the inputs that most closely matches data we already have, or best represents our current state of knowledge.

The data generated from the simulation can be represented as probability distributions (or histograms) or converted to error bars, reliability predictions, tolerance zones, and confidence intervals.

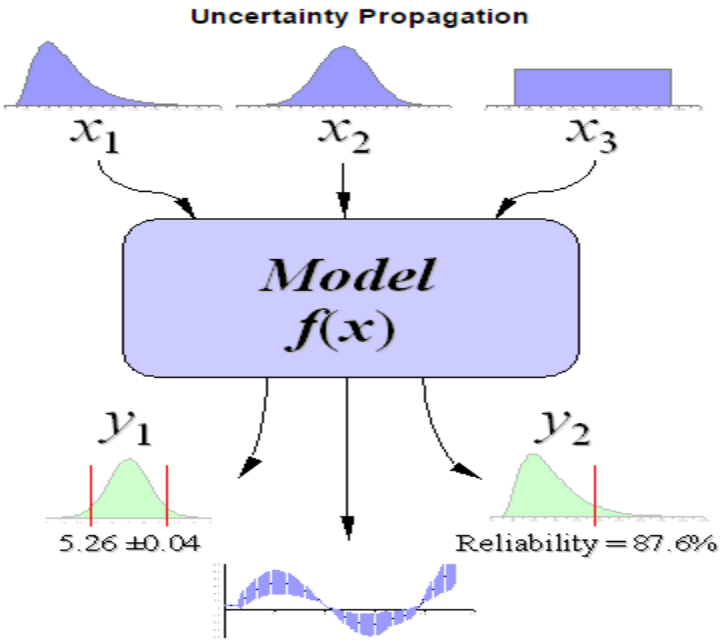


Figure 2: Schematic showing the principal of stochastic uncertainty propagation. (The basic principle behind Monte Carlo simulation.)

The steps in Monte Carlo simulation corresponding to the uncertainty propagation shown in Figure 2 are fairly simple, and can be easily implemented in Excel for simple models. All we need to do is follow the five simple steps listed below:

Step 1: Create a parametric model, $y = f(x_1, x_2, ..., x_q)$.

Step 2: Generate a set of random inputs, $x_{i1}, x_{i2}, ..., x_{iq}$.

Step 3: Evaluate the model and store the results as y_i.

Step 4: Repeat steps 2 and 3 for i = 1 to n.

Step 5: Analyze the results using histograms, summary statistics, confidence intervals, etc.

Resource Allocation

Resource allocation is the assignment of available resources to various uses. In the context of an entire economy, resources can be allocated by various means, such as markets or central planning. In project management, resource allocation or resource management is the scheduling of activities and the resources required by those activities while taking into consideration both the resource availability and the project time.

Nature of Resources

- Labour – Members of the project team
- Equipment – Workstations and other communicating and office equipments
- Material – Items that are consumed
- Space – Office space

- Services – Some specialist services telecommunicating
- Time – Offset against the other primary resource

Identifying Resource Requirements

- What resources are required along with the expected level of demand
- Consider each activity
- Identify required resources.
-

Scheduling Resources

Allocating resources for one activity limits flexibility for resource allocation and scheduling of other activities

Priorities resource allocation

- ❖ Total float priority

Activities are ordered according to their total float .Those with the smallest float are assigned the highest priority

Ordered list priority

- Ordered according to predefined criteria
- Shortest critical path – Critical activities
- Shortest non-critical activity
- Non-critical activity with least float
- Non-critical activities
- Map on activity plan to assess the distribution of resources required over the duration of the project Recruiting staff has cost
- Smooth the histogram by delaying the start of some activities.

Cost Schedules

Calculating cost is straightforward where organization has standard cost figures for staff and other resources. Staff costs includes not just salary, but also social security contributions by the employer, holiday pay etc.

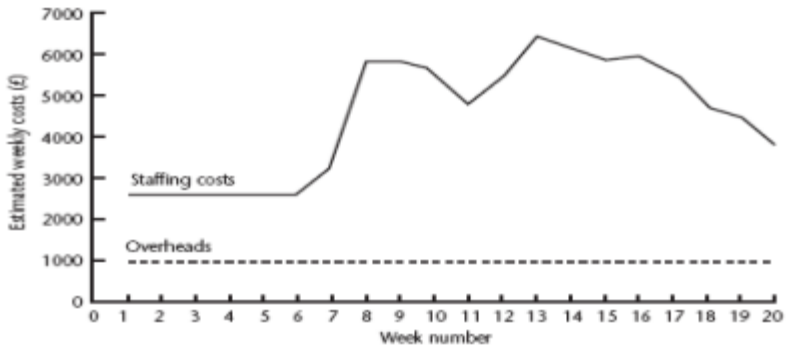
Timesheets are often used to record actual hours spent on each project by an individual. One issue can be how time when a staff member is allocated and available to the project, but is not actually working on the project, is dealt with. Overheads e.g. space rental, service charges etc. Some overheads might be directly attributable to the project, in other cases a percentage of departmental overheads may be allocated to project costs. Usage charges are some charges can be on a 'pay as you go' basis e.g. telephone charges, postage, car mileage – at the planning stage an estimate of these may have to be made.

Cost can be categorized :

- Staff Costs-include staff salaries as well as the other direct costs of employment such as the employer's contribution to social security funds, pension scheme contributions, holiday pay and sickness benefit.

- Overheads-represents expenditure that an organization
- Usage Charges-projects are charged directly for use of resources such as computer time.
-

Cost profile



This shows how much is going to be spent in each week. This could be important where an organization allocates project budgets by financial year or quarter and the project straddles more than one of these financial periods

Balancing concerns

Successful project scheduling is not a simple sequence. Because of the inter-linking of different concerns project planning will need to be iterative. The consequences of decisions will need to carefully assessed and plans adjusted accordingly.