

Project Management¹

1 WHAT IS A PROJECT?

1.1 A project is any sort of planned undertaking

All of us have been involved in projects, whether they be our personal projects or in business and industry. Examples of typical projects are for example:

- Personal projects:
 - obtain an MBA
 - write a report
 - plan a wedding
 - plant a garden
 - build a house extension
- Industrial projects:
 - construct a building
 - provide a gas supply to an industrial estate
 - build a motorway
 - design a new car
- Business projects:
 - develop a new course
 - develop a new course
 - develop a computer system
 - introduce a new product
 - prepare an annual report
 - set up a new office

Projects can be of any size and duration. They can be simple, like planning a party, or complex like launching a space shuttle.

Generally projects are made up of:

- a defined beginning,
- multiple activities which are performed to a plan,
- a defined end.

Therefore a project may be defined as a means of moving from a problem to a solution via a series of planned activities.

- A project is a means of moving from a problem to a solution via a series of planned activities.
- A project has a definite beginning and end.
- Projects consist of several activities.

Two essential features are present in every project no matter how simple or complicated they are. In the first place, all projects must be *planned* out in advance if they are to be successfully executed. Secondly, the execution of the project must be *controlled* to ensure that the desired results are achieved.

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On most projects it is possible to carry out multiple activities simultaneously. Usually it is possible to perform several activities at the same time, however there will be activities which cannot begin until a preceding activity has been completed. Such relationships are referred to as dependencies or precedencies, and when planning a project it is important to establish the order of precedence of dependent activities, and to establish those activities which can be performed in parallel with other activities.

Regardless of the nature or size of your project a successful outcome can only be achieved by using sound project management techniques. The most widely used and popular methods of project management are Gantt Charts, Critical Path Method (CPM) and Programme Evaluation and Review Technique (PERT). However, it is important to remember that projects are carried out by people, and the human aspects of project management are critical for the project success.

1.2 Terminology and Definitions

A *project* is an interrelated set of activities that has a definite starting and ending point and results in the accomplishment of a unique, often major outcome. "Project management" is, therefore, the planning and control of events that, together, comprise the project. Project management aims to ensure the effective use of resources and delivery of the project objectives on time and within cost constraints.

An *activity* or task is the smallest unit of work effort within the project and consumes both time and resources which are under the control of the project manager. A project is a sequence of activities that has a definite start and finish, an identifiable goal and an integrated system of complex but interdependent relationships.

A *schedule* allocates resources to accomplish the activities within a timeframe. The schedule sets priorities, start times and finish times.

Project management is:

the adept use of techniques and skills (hard and soft) in planning and controlling tasks and resources needed for the project, from both inside and outside of organisation, to achieve results.

The purpose of project management is to achieve successful project completion with the resources available. A successful project is one which:

- has been finished on time
- is within its cost budget
- performs to a technical/performance standard which satisfies the end user.

1.3 The Attributes of Successful Project Management

The effectiveness of project management is critical in assuring the success of any substantial undertaking. Areas of responsibility for the project manager include planning, control and implementation. A project should be initiated with a feasibility study, where a clear definition of the goals and ultimate benefits need to be established. Senior managers' support for projects is important so as to ensure authority and direction throughout the project's progress and, also to ensure that the goals of the organization are effectively achieved within this process. The particular form of support given can influence the degree of resistance the project encounters.

Knowledge, skills, goals and personalities are all factors that need to be considered within project management. The project manager and his/her team should collectively possess the necessary and requisite interpersonal and technical skills to facilitate control over the various activities within the project.

The stages of implementation must be articulated at the project planning phase. Disaggregating the stages at its early point assists in the successful development of the project by providing a number of milestones that need to be accomplished for completion. In addition to planning, the control of the evolving project is also prerequisite to success. Control requires adequate monitoring and feedback mechanisms by which senior and project managers can compare progress against initial projections at each stage of the project. Monitoring and feedback also enables the project manager to anticipate problems (e.g.: the knock-on effects of late start or finish times) and therefore take pre-emptive corrective measures for the benefit of the project overall.

Projects normally involve the introduction of a new system of some kind and, in almost all cases, new methods and ways of doing things. This impacts upon the work of others: the "users". User consultation is an important factor in the success of projects and, indeed, the degree of user involvement can influence the extent of support for the project or its implementation plan. A essential quality of the project manager is that of being a good communicator, not just within the project team itself, but with the rest of the organization and outside bodies as well (the users may be internal or external).

1.3.1 Features of projects

- Projects are often carried out by a team of people who have been assembled for that specific purpose. The activities of this team may be co-ordinated by a project manager.
- Project teams may consist of people from different backgrounds and different parts of the organisation. In some cases project teams may consist of people from different organisations.
- Project teams may be inter-disciplinary groups and are likely to lie outside the normal organisation hierarchies.
- The project team will be responsible for delivery of the project end product to some sponsor within or outside the organisation. The full benefit of any project will not become available until the project as been completed.

In recent years more and more activities have been tackled on a project basis. Project teams and a project management approach have become common in most organisations. The basic approaches to project management remain the same regardless of the type of project being

considered. You may find it useful to consider projects in relation to a number of major classifications:

a) **Engineering and construction**

The projects are concerned with producing a clear physical output, such as roads, bridges or buildings. The requirements of a project team are well defined in terms of skills and background, as are the main procedures that have to be undergone. Most of the problems which may confront the project team are likely to have occurred before and therefore their solution may be based upon past experiences.

b) **Introduction of new systems**

These projects would include computerisation projects and the introduction of new systems and procedures including financial systems. The nature and constitution of a project team may vary with the subject of the project, as different skills may be required and different end-users may be involved. Major projects involving a systems analysis approach may incorporate clearly defined procedures within an organisation.

c) **Responding to deadlines and change**

An example of responding to a deadline is the preparation of an annual report by a specified date. An increasing number of projects are concerned with designing organisational or environmental changes, involving developing new products and services.

Activity

Consider this last category. Can you think of any examples where your organisation needs to respond to change and a project management approach may be valid?

1.4 Responsibilities of the Project Manager

1. To plan thoroughly all aspects of the project, soliciting the active involvement of all functional areas involved, in order to obtain and maintain a realistic plan that satisfies their commitment for performance.
2. To control the organization of manpower needed by the project.
3. To control the basic technical definition of the project, ensuring that "technical" versus "cost" trade-offs determine the specific areas where optimisation is necessary.
4. To lead the people and organizations assigned to the project at any given point in time. Strong positive leadership must be exercised in order to keep the many disparate elements moving in the same direction in a co-operative.
5. To monitor performance, costs and efficiency of all elements of the project and the project as a whole, exercising judgement and leadership in determining the causes of problems and facilitating solutions.
6. To complete the project on schedule and within costs, these being the overall standard by which performance of the project manager is evaluated.

1.4.1 Why do projects go wrong?

There can be many reasons why projects go wrong. The most common reasons are as follows:

- a) Project goals are not clearly defined
- b) There can be constraints on the completion of projects arising from the different objectives of:
 - Short time scale
 - Resource availability
 - Quality factors
 - Human factors

1.4.2 Problems with Project Goals

- The project sponsor or client has an inadequate idea of what the project is about at the start.
- There may be a failure of communication between the client and the project manager. This may be due to a lack of technical knowledge on the part of the client or an overuse of jargon by the project manager.
- Specifications may be subject to constant change. This may be due to problems with individual clients, decision making processes at the client end, or environmental changes. For example the government may change the basic "rules of the game" before the completion of the project.
- The project goals may be unrealistic and unachievable, and it may be that this is only realised once the project is under way.
- The client may become carried away with the idea of the project and may be unable to see clearly what can be achieved.
- Projects may be highly complex and may have a number of objectives that actually contradict each other.

There are perhaps two stages which can help in ensuring that goals are properly defined and achievable:

- a) Ensuring that the client specification is clear and understandable. To do this you must first of all establish the objectives of the project. It would help to ask the following questions:
 - What is it that the organisation is setting out to achieve or is being asked to achieve?
 - Will the suggested project fulfil these objectives?
 - Have all the alternatives been considered and is the chosen option the best one available?
 - Have the full effects of the project, both inside and outside the organisation, been considered?
- b) Preparation of a Project overview (Project brief). The brief should take the objectives set out in the previous exercise and translate them into targets and goals. Any key constraints should also be identified and stated at this stage. This brief should be agreed by the sponsor/client and communicated to the project manager. Any ambiguities or queries should be sorted out as soon as possible.

A good way forward would be through the establishment of **success criteria** for the project. If you want the project to succeed (and who doesn't?), then you have to know when you have succeeded.

Success criteria can be described as being **hard** or **soft**:

- **Hard criteria** are often the most obvious criteria that are tangible and measurable and can be expressed in quantitative terms. They tend to pose the question "what?", that is "what should be achieved?"
- **Soft criteria** are usually less obvious, but not necessarily less important. They are often intangible and qualitative. Consequently they may be difficult to measure. They would tend to ask the question "how?"

a) **Hard criteria**

- Performance specifications: these may be set out in terms of the ability to deal with certain demands. For example, this could be throughput of traffic, number of patients, volume of transactions processed or the number of enquiries dealt with.
- Specific quality standards: this could relate to technical standards and tolerance, or may be the achievement of a favourable report from an outside inspection agency.
- Meeting deadlines: this is probably the most obvious one of them all where projects need to be completed within a given time scale. For example, a new system may need to be implemented ready for the start of the financial year, or a new development may have to meet time requirements as laid down in contract specifications.
- Cost of budget constraints: an important criterion may be to complete the project within a cost limit or budget which has been determined. Additionally there may be requirements in terms of the ongoing cost of the completed project. For example, a new system may be required to make savings for the organisation on a continuing basis.
- Resource constraints: there may be other resource constraints such as making use of existing premises or labour force.

As you can see, the above criteria are relatively easy to establish and should also be quite easy to specify in a project brief.

b) **Soft criteria**

- Demonstrative co-operation: this would be about showing that the project team could work together effectively and without a degree of conflict. It could be an important consideration to develop and implement solutions for the organisation which have a wide element of consensus and stem from a co-operative attitude.
- Presenting a positive image: this may also be important but obviously can be difficult or impossible to quantify.
- Achieving a total quality approach: this would be more about the adoption of a philosophy of continuous improvement than the achievement of specific performance targets on quality.
- Gaining total project commitment: this is again about how the project is managed and the attitude of the project team to it.
- Ensuring that ethical standards are maintained: it can be very important to ensure that no corners have been cut that should not have been and that professional standards of ethics have not been breached.
 - Showing an appreciation of risk: this would ensure that no unacceptable risks were taken in the pursuit of other project objectives. Again this is about how the project is developed rather than the end product itself.

1.4.3 **Constraints on the completion of projects**

a) **Time**

Our definition of a project stated that it was an activity which had a defined beginning and ending point. Most projects will be close-ended in terms of there being a requirement for completion by a certain point in time. This point may be the result of an external factor such as new legislation, or may be derived from organisational requirements. It may also be partly determined by other constraints. There is likely to be some relationship between the time taken for a project and its cost. A trade-off between the two constraining factors may then be necessary.

b) **Resource Availability**

There is likely to be a budget for the project and this will clearly be a major constraint. Cost constraints may be set in a number of ways, for example as an overall cash limit or as a detailed budget broken down over a number of expenditure headings. Labour resources in particular may be a limiting factor on the completion of the project. In the short run it is likely that labour will be fixed in supply. Whilst the overall resource available may in theory be sufficient to complete the project, there may be difficulties arising out of the way in which the project has been scheduled. That is, there may be a number of activities scheduled to take place at the same time and this may not be possible given the amount of resources available.

c) **Quality factors**

Whether the project delivers the goods to the right quality.

There are techniques which can be used to overcome the problems referred to above. These include:

- **Budgeting**, and the corresponding control of the project budget through budgetary control procedures.
- **Project planning** and **control** techniques such as Gantt charts and network analysis.

An important point to note at this stage is how the various constraints on project completion are likely to be interlinked with each other. For example, problems with time constraints or resource constraints may be overcome by spending more through working overtime, employing more people or purchasing better machines. Budget problems may have a knock-on effect on the achievement of deadlines.

It is important to remember that while project management techniques are important, they tend to understate the importance of the key resource: people. In a fact changing environment where tasks are often difficult, controversial with uncertain outcomes, "people management" skills are called for.

Summary

A project should possess identifiable goals and a definite starting and finishing point.

Project goals must be defined clearly. A useful checklist can be developed in relation to success criteria. Criteria may be hard and concerned with what the project should achieve, or soft when they will cover how the project should proceed.

The major constraints on the completion of projects are Time, Resource Availability and the need to achieve the required standard of performance for the project.

2 THE PROCESS OF PROJECT MANAGEMENT

2.1 Project Planning

A major decision at the outset of any project is to decide upon the organization and composition of the project team. In so doing, it is worth remembering that many members

will have dual responsibilities of involvement in the project in addition to a commitment to other projects or management of a functional area on a day-to-day basis. It is at this stage that a project manager should be appointed and responsibilities made explicit for all members of the team.

The selection of the team will be dependent upon the skill requirements of the project, and upon the matching of those skills to those possessed by individual members of the team. There may be a conflict here with hierarchical status.

The project management team will, therefore, begin its task in advance of project proper so that a plan can be developed. An important first step is to set the objectives and then define the project, breaking it down into a set of activities and related costs. It is probably too early to determine exact resource implications at this stage, but expected requirements for people, supplies and equipment should at least be estimated during the planning stage.

2.2 Project Scheduling

This phase is primarily concerned with attaching a timescale and sequence to the activities to be conducted within the project. Materials and people needed at each stage of the project are determined and the time each is to take will be set.

A popular and easy to use technique for scheduling is the use of Gantt charts. Gantt charts reflect time estimates and can be easily understood. Horizontal bars are drawn against a time scale for each project activity, the length of which represent the time taken to complete. Letters or symbols can also be added to the left of each bar to show which other activities need to be completed before that one can begin.

2.2.1 Gantt Charts

A Gantt Chart is a simple technique that can be used to attach a time scale and sequence to a project.

A Gantt Chart is a form of horizontal bar chart and horizontal bars are drawn against a time scale for each project activity, the length of which represents the time taken to complete. To construct a Gantt Chart the following steps are necessary:

- 1) Use the horizontal axis to represent time
- 2) Use the vertical axis to represent activities
- 3) Represent each activity by a horizontal bar of appropriate length
- 4) Take activity procedures into account by starting each activity bar to an appropriate point along the time axis after its preceding activities. Normally the start point for an activity is the earliest time that it could start after its preceding activities had finished.

It is possible to enhance the Gantt Chart in several ways. For instance the number of staff required to do a task can be entered into the bar on the diagram.

Gantt charts, also commonly known as milestone plans, are a low cost means of assisting the project manager at the initial stages of scheduling. They ensure that:

1. all activities are planned for,
2. the sequence of activities is accounted for,
3. the activity time estimates are recorded; and
4. the overall project time is recorded.

They are therefore a simple, rough and ready means of planning a project and assessing progress and are sufficient for most simple projects.

However, where projects become complex, it becomes difficult to see relationships between activities by using a Gantt Chart. For more complex projects Network Analysis techniques are used.

Gantt charts also provide a summary of the project as a whole and can be used as a rough and ready means of assessing progress at the project control phase. At any date, the project manager can draw a dateline through the Gantt chart and see which activities are on-time, which are behind schedule and generally record project status against plan.

Gantt charts, named after Henry L. Gantt, one of the pioneers of scientific management, are a useful means of representing a schedule of activities comprising a project and enable the operations manager to know exactly what activities should be performed at a given time and, more importantly, to monitor daily progress of a project so that corrective action may be taken when necessary.

To construct a Gantt chart, the various activities are listed on a vertical axis and the horizontal axis is used to represent time. Activity precedencies are taken into account by starting a horizontal bar to represent the next activity at an appropriate point after its preceding activities, i.e. those activities which must take place before the next activity can start, have taken place. Normally this would be at the earliest time that it could start after its preceding activities had finished.

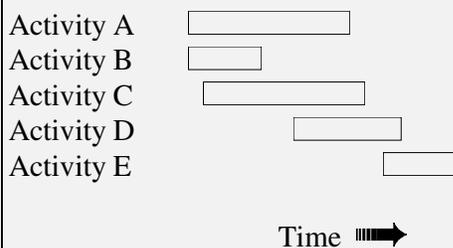
Example:

Suppose a project comprises five activities: A,B,C,D, and E. A and B have no preceding activities, but activity C requires that activity B must be completed before it can begin. Activity D cannot start until both activities A and B are complete. Activity E requires activities A and C to be completed before it can start. If the activity times are A: 9 days; B: 3 days; C: 9 days; D: 5 days; and E: 4 days,

- i) determine the shortest time necessary to complete this project.
- ii) identify those activities which are critical in terms of completing the project in the shortest possible time.

Solution:

The figure below indicates the form that a Gantt chart would take from the above information.



The above chart shows that activities A and B have no preceding activities and so can start right away. Activity C requires Activity B to have been completed before it can begin. The

chart is then completed using such precedence relationships as listed in the question, with each horizontal bar being proportional in length to the activity time that it represents.

Looking at the chart it is apparent that the project ends when activity E has been completed. Working back in time from activity E the "steps" which are crucial or critical in order to ensure that the project duration does not extend beyond the planned length are: E,C and B. The shortest time in which the project could be completed from the given information is therefore 16 days. The set of activities B,C and E which together determine the project duration are referred to as the **critical path** through the chart.

Those activities forming the critical path can be highlighted on the Gantt chart to help the operations manager to give priority to them if lack of resources mean that such decisions have to be made.

It is important to realize though that activities not on the critical path can become so if they are allowed to drift too far. How far could activities A and D drift before they affected the duration of the project?

Provided the project is not too complex in its activity relationships or simply too big to be mapped on reasonably sized graph paper, Gantt charts can be very useful tools for the project manager and are graphically superior to the network analysis methods of CPM and PERT. They allow the critical activities to be found, i.e. those activities which must be performed on time if the project duration is not to increase, and any "slack" or "float" in the sequence of activities can easily be shown.

3 NETWORK ANALYSIS

3.1 Introduction to PERT and CPM

The two most common and widely used project management techniques that can be classified under the title of Network Analysis are Programme Evaluation and review Technique (PERT) and Critical Path Method (CPM). Both were developed in the 1950's to help managers schedule, monitor and control large and complex projects. CPM was first used in 1957 to assist in the development and building of chemical plants within the DuPont corporation. Independently developed, PERT was introduced in 1958 following research within the Special Projects Office of the US Navy. It was initially used to plan and control the Polaris missile programme which involved the coordination of thousands of contractors. The use of PERT in this case was reported to have cut eighteen months off the overall time to completion.

3.2 The PERT/CPM Procedure

There are six stages common to both PERT and CPM:

1. Define the project and specify all activities or tasks.
2. Develop the relationships amongst activities. Decide upon precedences.
3. Draw network to connect all activities.
4. Assign time and/or costs to each activity.
5. Calculate the longest time path through the network: this is the "critical path".
6. Use network to plan, monitor and control the project.

Finding the critical path (step 5) is a major in controlling a project. Activities on the critical path represent tasks which, if performed behind schedule, will delay the whole project. Managers can derive flexibility by identifying the non-critical activities and replanning, rescheduling and reallocating resources such as manpower and finances within identified boundaries.

PERT and CPM differ slightly in their terminology and in network construction. However their objectives are the same and, furthermore, their project analysis techniques are very similar. The major difference is that PERT employs three time estimates for each activity. Probabilities are attached to each of these times which, in turn, is used for computing expected values and potential variations for activity times. CPM, on the other hand, assumes activity times are known and fixed, so only one time estimate is given and used for each activity. Given the similarities between PERT and CPM, their methods will be discussed together. The student will then be able to use either, deciding whether to employ variable (PERT) or fixed (CPM) time estimates within the network.

PERT and CPM can help to answer the following questions for projects with thousands of activities and events, both at the beginning of the project and once it is underway:

- When will the project be completed?
- What are the critical activities (i.e.: the tasks which, if delayed, will effect time for overall completion)?
- Which activities are non-critical and can run late without delaying project completion time?
- What is the probability of the project being completed by a specific date?
- At any particular time, is the project on schedule?
- At any particular time, is the money spent equal to, less than or greater than the budgeted amount?
- Are there enough resources left to complete the project on time?
- If the project is to be completed in a shorter time, what is the least cost means to accomplish this and what are the cost consequences?

3.3 Critical Path Analysis

The objective of critical path analysis is to determine times for the following:

- **ES = Earliest Start Time.** This is the earliest time an activity can be started, allowing for the fact that all preceding activities have been completed.
- **LS = Latest Start Time.** This is the latest time an activity can be started without delaying the start of following activities which would put the entire project behind schedule.
- **EF = Earliest Finish Time.** The earliest time an activity can be finished.
- **LF = Latest Finish Time.** The latest time that an activity can finish for the project to remain on schedule.
- **S = Activity Slack Time.** The amount of slippage in activity start or duration time which can be tolerated without delaying the project as a whole.

If ES and LS for any activity is known, then one can calculate values for the other three times as follows:

$$EF = ES + t$$
$$LF = LS + t$$

$$S = LS - ES \text{ or } S = LF - EF$$

Analysis of the project normally involves:

1. Determining the Critical Path. The critical path is the group of activities in the project that have a slack time of zero. This path of activities is critical because a delay in any activity along it would delay the project as a whole.
2. Calculating the total project completion time, T. This is done by adding the activity times of those activities on the critical path.

The steps in critical path analysis are as follows:

- a) Determine ES and EF values for all activities in the project: the Forward Pass through the network.
- b) Calculate LS and LF values for all activities by conducting a Backward Pass through the network.
- c) Identify the critical path which will be those activities with zero slack (i.e.: ES=LS and EF=LF).
- d) Calculate total project completion time.

3.4 PERT and Activity Time Estimation

The major distinguishing difference between PERT and CPM is the use of three time estimates for each activity in the PERT technique, with CPM using only one time for each activity using CPM.

The three time estimates specified for each activity in PERT are:

- i) the optimistic time;
- ii) the most probable time; and
- iii) the pessimistic time.

The optimistic, most likely and pessimistic time estimates are used to calculate an expected activity completion time which, because of the skewed nature of the beta distribution, is marginally greater than the most likely time estimate. In addition, the three time estimates can be used to calculate the variance for each activity. The formulae used are as follows:

$$t = \frac{o + 4m + p}{6}$$

$$v = \left(\frac{p - o}{6} \right)^2$$

Where:

- o, m, p - optimistic, most likely, and pessimistic times
- t - expected completion time for task
- v - variance of task completion time

Knowing the details of a project, its network and values for its activity times (t) and their variances (v) a complete PERT analysis can be carried out. This includes the determination of the ES, EF, LS, LF and S for each activity as well as identifying the critical path, the project completion time (T) and the variance (V) for the entire project.

Normally when using PERT, the expected times (t) are calculated first from the three values of activity time estimates, and it is these values of t that are then used exactly as before in CPM. The variance values are calculated for the various activity times and the variance of the total project completion time (i.e. the sum of the activity expected times of those activities on the critical path) is the sum of the variances of the activities lying on that critical path.

4 MANAGEMENT OF PROJECTS

Gantt charts, PERT, CPM and other scheduling techniques have proven to be valuable tools in the management of large and complex projects. A wide variety of software packages is available for project managers, for use on micro- or larger computers, to assist in the handling of complex network problems. PERT and CPM, however, cannot ever purport to be able to solve all project scheduling and management problems in service or manufacturing industries. Good management practices, clear responsibilities for tasks, and accurate and timely reporting systems are the most essential qualities for successful project completions. The watchword is that useful as these techniques are, they are only tools to assist the manager in making better, more calculated decisions in the process of conducting large scale projects.

4.1 The Process of Project Management

Traditional approaches to project management have emphasised the procedures involved. This reflects an idea of project management which has emphasised physical resources and the use of analytical techniques such as network analysis. Another approach which has been found to be effective is much more people and organisation oriented and can be broken down into a series of steps:

- a) Clarifying the nature of the project
- b) Defining goals and objectives
- c) Feasibility studies
- d) Detailed organisation of the project:
 - Project definition
 - Planning and scheduling
- e) Project implementation and control

We can have a look at these in turn.

4.1.1 Clarifying the nature of the project

The following need to be established at the planning stage of the project:

- Resourcing,
- management support,
- nature of team working; the balance, for example, between creativity and implementation skills,
- clarity of objectives.

4.1.2 Defining goals and objectives

The success criteria for the project need to be defined. We have already seen that there could be hard or soft.

4.1.3 Feasibility Studies

The basic questions to be asked are:

- Is the project feasible?
- How feasible are the alternatives under consideration?

The aim of the study would be to carry out a preliminary investigation which should help to determine whether the project should proceed further and how it should proceed.

The relevance of this approach will vary with the nature of the project itself. The more concrete the project is, the more likely that there will be established procedures in relation to feasibility. At the other end of the scale there will be less need for a feasibility study for an open project.

The project manager responsible for conducting the feasibility study would normally consider:

- Cost:** is this within the budget set by the organisation or within the capabilities of the organisation to finance it? How do the alternatives compare?
- Timing:** are there specific constraints on timing and is it possible to complete the project within these constraints?
- Performance:** will the project satisfy performance criteria which have been determined? Basically this means will it do the job it is designed to do?
- Effect on the organisation:** is it feasible in the context of the organisation and the effect which it will have upon it?

We should have a look at these factors in a little more detail.

- Cost** factors will be looked at through a financial appraisal. This should be related to financial criteria which have been determined. You need to consider whether the following criteria are relevant.
 - Capital expenditure implications:
 - What are the costs of the project?
 - If there are alternatives, what are the relative figures?
 - What effect will this have upon the organisation's finances particularly the capital budget?
 - How will it fit with controls imposed upon the organisation by central government.
 - How will the expenditure be financed? What are the alternatives?
 - Revenue implications:
 - How much will this cost both in the current year and in subsequent years?
 - What are the likely gains in terms of income?
 - What effect will this have upon the revenue budget?

The answers to these questions will determine the financial criteria upon which the feasibility will be judged.
- Timing:** the project schedule may need to comply with specific criteria which have been laid down. Timing can be important:
 - to comply with legal or governmental requirements. For example, new legislation or new requirements may need to be implemented by a certain date;

- for operational reasons. A new system may be required as a matter of organisational policy or to fit in with existing procedures and deadlines;
 - to assist with financing arrangements. Grants or borrowing approvals may need to be spent within a specific period;
 - to give the organisation an edge over its competitors.
- c) **Performance specifications:** these may be:
- technical
 - service based
 - resulting from external regulations
 - required by clients and customers
- d) **Organisational context:**
- What is the policy of the organisation?
 - Organisational culture; does the project fit in with the general values and beliefs of the organisation?
 - How will it affect resourcing? (Are the skills, technology and physical space available?)
 - How will the project fit in with existing procedures? What effect will it have upon systems?

The actual questions asked and the shape of the study and the consequent report will depend upon the type of project being investigated.

Activity

Examine a live project in your own organisation. Make a list of questions that should be asked in relation to feasibility.

4.1.3.1 Feasibility Report

The project manager will be responsible for reporting on feasibility to the sponsoring decision makers or stakeholders.

This may be done in a variety of ways and with different degrees of formality. Typical contents would include:

- project definition covering goals and objectives
- general background and introduction with an outline description of the options
- a clear definition of success criteria or feasibility criteria
- findings of the feasibility study
- financial appraisal
- preliminary compliance
- organisational suitability
- the plan for the management of the project including implementation

Summary

Feasibility is principally concerned with:

- cost
- timing

4.1.4 Detailed Organisation of the Project

4.1.4.1 Project Definition

This begins once the project has received formal approval to proceed. Its purpose is to formally document the objectives of the project and decide how the work will be undertaken. The Project Manager will carry out this work, in consultation with the Project Sponsor, and Sub-Project Manager where there are sub-projects.

Large projects may be divided into sub-projects, with each sub-project requiring its own sub-project definition.

1. **Ensure that Prerequisites are in place.** Before definition can begin you should have:

- a Project Brief signed off by all parties involved in the project
- authority to proceed
- a Project Sponsor
- a Project Manager

1. **Clarify Objectives.**

Objectives must be achievable by the project alone, and must be measurable.

2. **Determine Project Scope.**

Determining the scope of the project helps to clarify objectives and set the boundaries of the project. It is often useful to state limitations i.e. what the project will not cover.

3. **Determine Work Structure.**

Large projects can be better controlled, and are therefore more likely to be successful, if they can be divided into smaller units of work (sub-projects).

Identify tasks which can be arranged into logical groups to form sub-projects. Grouping could be on the basis of (for example):

- tasks relating to one functional area,
- tasks to be performed by staff in one geographic location,
- tasks relating to a particular deliverable,
- tasks to be performed by team members belonging to the same Division or Department.

5. **Identify the Major Project Milestones**

Milestones are significant events in the life of the project, such as installation of hardware or completion of training. They are used in tracking project progress.

Dates will be added to these during Planning.

6. **Ensure Project Structure and Responsibilities are Established**

Assign Sub-project Managers where appropriate. Clarify composition and responsibilities of Project Steering Group, and responsibilities of Project Sponsor and Project Manager.

Produce a project organisation structure to show reporting lines.

7. **Determine Management Systems**

These will vary according to the size and nature of the project but should always include:

- a progress control system for recording planned and actual times. This could be an automated system or a manual one,
- acceptance procedures for formal review and agreement of each project deliverable
- scheduled management checkpoints

If the project is divided into sub-projects it is important that consistent management systems are used across them all.

8. **Document the Project Definition**

The results of Project Definition must be documented and distributed for agreement to:

- Project Sponsor
- Steering Group members (if applicable)
- Sub-project managers
- Line managers who are contributing significant resource to the project

The precise format of the document is left to the discretion of the Project Manager. However the following topics should be covered:

- **Goals and Objectives**
State the business goals and the project objectives.
- **Work Structure and Scope**
A high level description of the work to be performed including:
 - a brief statement of the current business situation and the changes which the project is intended to bring about
 - a list and brief description of each sub-project
 - key events in the project i.e. the Major Milestones
- **Organisation and Responsibilities**
Include an organisation chart, names and responsibilities.
Highlight any functions or responsibilities peculiar to this project.
- **Risks and Assumptions**
List and briefly describe each identified risk. Give an indication of its severity i.e. the probability of its occurrence and the impact on the project if it does occur.
- **Management Systems**
Outline the systems to be used for tracking and control of the work.
- **Potential Problems**
List any other outstanding issues which might affect the project, and any actions being taken to resolve them. Include details of who is responsible for the action and the completion date.
- **Appendices**
The Project Definition document will first be issued as a draft. Once the Sub-Project Managers have completed Sub-project Definition their reports can be added as appendices. The Sub-project Definition should include Objectives, Work Structure and Scope and Organisation.

The whole document will normally be only a few pages. For very large projects, where the document exceeds about a dozen pages, it may be helpful to include a Management Summary as the first section.

4.1.4.2 Project Planning and Scheduling

Project Planning begins as soon as Definition allows. The process involves planning sub-projects first and hence Definition must at least have identified the sub-projects and the major tasks involved in them.

From this point, Planning and Definition tend to continue in parallel as a series of iterations, gradually refining and hardening both Definition and Plans.

The purpose of the Project Plan at this stage, is to provide detailed realistic estimates of time, duration, resource and cost, and planning should be carried out only in sufficient detail to allow this to be achieved. Detailed planning for allocation of tasks to individuals is carried out progressively as the work proceeds.

Where there are sub-projects these should be planned first and then combined to produce the overall project plan. Produce a plan for each sub-project, or for the total project if there are no sub-projects as follows:

1. Identify Major Activities

Break the work down into activities of the order of 20-50 days of effort, ensuring that milestones correspond to completion of one or more of these. In practice the achievement of a milestone is usually a good basis for identifying an activity e.g. 'prepare and perform user training'.

2. Identify and Chart Dependencies

Produce a network chart for the sub-project showing dependencies between the major activities and dependencies on other sub-projects or external events.

3. Estimate Effort and Duration

Estimate effort and duration of each major activity.

4. Provide Contingency

At this stage estimates are likely to be 'soft' and probably expressed in ranges, because precise details of the work are not settled. Contingency needs to be allowed both on the estimated effort and elapsed time because of:

- the likelihood of unforeseen work arising,
- the likelihood that tasks will take longer than expected,
- the likelihood of changes to requirements or plans before publication. (Subsequent changes should be processed through Change Control).

Contingency provision should remain evident in plans (probably as one or more contingency 'tasks'). This provision should then progressively be removed from plans during Tracking and Control as a result of either:

- being used up by e.g. tasks taking longer than planned,
- or reaching a point where uncertainty is reduced such that a part of contingency provision can safely be deleted. This usually means the deletion of contingency allowed, but not used, on tasks now completed.

5. Schedule Major Activities

Determine start and end dates for each major activity and produce a bar chart or other diagram, showing relationships between activities.

6. Calculate Resource Requirements
Calculate requirements for each time period. Identify needs for each resource type (e.g. systems analyst, user staff) and identify needs for special skills or scarce resources.
7. Calculate Costs
Calculate costs for the sub-project. This should include 'hardening up' items such as cabling, training etc., for which an order of costs had been produced previously.
8. Determine Overall Costs and Benefits of the Project
The cost/benefit justification should have already been stated in the feasibility study. This stage provides the opportunity to review the case in the light of more detailed information.
9. Document the Project Plan
Once a viable plan has emerged (i.e. conflicts have been resolved, resource availability has been confirmed etc.) the Project Manager should produce the Project Plan covering:
 - Project Schedule. This should show major activities by sub-project on a bar chart or other diagram. The chart should also show project milestones and target dates. Show contingency as a single provision at the end. Include an overall project network showing the critical path. Narrative explanation may be included for clarification.
 - Major Checkpoints and Reviews. List the dates of Checkpoint Reports, Checkpoint Meetings, Steering Group Meeting and the Post-Implementation Review.
 - Deliverables. List the major products of the project with delivery dates and acceptance procedures.
 - Resources. Summarise the resource needs from the sub-project plans.
 - Costs and Benefits figures. Revise and refine as a result of completion of Definition and Planning.
 - Potential Problems. List any risks, problems or assumptions which may jeopardise the Plan, together with actions needed to correct the situation.
 - Appendices. Any useful supporting information including Sub-project Plans may be included.
10. Ensure Management Systems are in place.

4.1.5 Project Implementation and Control

The role of the project manager falls into three areas:

- i) Management of stakeholders
- ii) Management of the project life cycle
- iii) Management of performance

An approach needs to be developed for each of these. Control and monitoring procedures need to be put in place and appropriate information systems developed.

The procedures which are put into place can only be successful if:

- there is satisfactory information to enable the team to manage the project effectively;
- they are simple and easy to operate and understand;

- they have the full support of the project team.

How should this relate to the three categories referred to above?

i) Management of stakeholders:

Stakeholders' interest must be monitored to ensure that:

- their interest and support is maintained;
- their views and ideas are being adequately reflected in the project development;
- their personal success criteria are being pursued and achieved;
- environmental change is fully taken into account.

ii) Management of the project life cycle:

This is probably the most conventional view of project control. Feedback systems need to be set up to monitor key areas.

Activity

For a project that is already underway in your organisation, identify the key areas requiring monitoring and suggest the kind of information and procedures that would be involved.

Suggested Answer

The key areas would be as follows:

- The project timetable, with particular reference to critical event times and potential bottlenecks. There should be feedback on activity times achieved and their effect on the whole project. If network analysis is used, then it is vital that the network is reworked and updated to take into account the actual performance achieved.
- The project budget; budgetary control procedures can be used as in respect of any other form of budget.
- Quality and performance standards; these need to be monitored against the original project specification subject to changes agreed with stakeholders in the course of project development.

Where possible this should all be done through positive reporting which will required action to be taken.

iii) Management of performance:

This is the least tangible but possibly the most important of the three categories. How it is tackled will depend upon what kind of project is being carried out.

It is unlikely that the project team will spend all of their working time together in close proximity and under the direct supervision of the project manager. It is much more likely that they will work apart most of the time, only meeting up occasionally and only meeting with the project manager from time to time. Control issues that need to be considered therefore would be:

- How to get the best out of the team when they are together. If you are holding meetings then they should be purposeful and effective. They should not simply be part of the

routine. Having said that, they may be an important element in binding the team together and in developing a team approach to planning and monitoring of performance.

- Ensuring people work when the team is apart. You need to set people realistic deadlines and ensure that they see the importance of their contribution and that their contribution is fully valued.
- Communications are important in terms of disseminating information and keeping everyone informed. There are views that team members should be given information on a need to know basis but this approach can cause problems.
- Ensuring continuing commitment by the team and adherence to the values and beliefs being pursued by the team.
- Change, in particular, needs to be communicated to team members quickly and effectively.

It is important to stress once again the need to look at the team and also for the project leader to look inwards at his or her own performance.

4.2 Funding the Project

This will be determined by:

- a) The nature of the project
- b) The nature of the organisation

4.2.1 The nature of the Project

A major capital scheme will call for a large injection of new finance into the organisation. A management project can often be managed by using existing staffing resources. However it should not be forgotten that there is an opportunity cost to this.

4.2.2 The nature of the organisation

Companies can use a variety of resources for capital projects.

- Share issues
- Long term loans
- Leasing

The ability of companies to raise finance will depend upon the perceptions of lenders of money. Public Sector organisations are often restricted in their sources of finance by government regulations.

5 HUMAN FACTORS

Gantt charts, PERT, CPM and other scheduling techniques have proven to be valuable tools in the management of large and complex projects. A wide variety of software packages is available for project managers, for use on micro- or larger computers, to assist in the handling of complex network problems. PERT and CPM, however, cannot ever purport to be able to solve all project scheduling and management problems in service or manufacturing industries. Good management practices, clear responsibilities for tasks, and accurate and timely reporting

systems are the most essential qualities for successful project completions. The watchword is that useful as these techniques are, they are only tools to assist the manager in making better, more calculated decisions in the process of conducting large scale projects.

So far little mention has been made of the human issues involved in the management of projects. These issues will now be addressed.

Group Discussion:

- Discuss the qualities you would look for in appointing a project manager.
- What factors would you take into account when selecting members of a project team, and how would you motivate them if you were the project manager?
- Discuss any project with which you have been involved from the point of view of the projects objectives and constraints, its management and implementation including the use of planning, scheduling and controlling techniques, any problems encountered and how they were dealt with.

5.1 Human Factors in Project Management

Dinsmore uses the following definitions for projects and project management:

- A project is a unique venture with a beginning and an end, conducted by people to meet established goals within parameters of cost, time and quality.
- Project management is the combination of people, systems, and techniques required to coordinate the resources needed to complete projects within established goals.

It is all too easy to form the view that project management and network techniques such as CPM and PERT are one and the same thing. Because networks are valuable tools for graphically showing relationships between project activities, pinpointing critical activities and for estimating the probability of project completion by a certain date, some managers believe that they constitute the only important management tool in the planning, scheduling and controlling phases of a project. No project is managed effectively without a good Gantt/CPM/PERT approach but equally there are other management tools and practices required for effective management of projects.

Group discussion point:

Outline the difference between Project Management and Operational or Functional Management.

5.2 Motivation

Human motivation is a complex issue and a great deal of research has been done on how best to motivate employees of an organisation to achieve good performance.

The term "Motive" has a dictionary definition of: "causing motion: concerned with the initiation of action", and "Motivate" has the definition: "to provide with a motive, to induce."

Various managerial strategies have been adopted to motivate people within an organization, and they are often categorised under the headings:

- Paternalistic,
- Scientific,
- Participative.

Paternalistic strategy assumes that simply by belonging to an organization with whose aims and objectives an employee can identify, that employee will be sufficiently motivated to perform well for the organization.

Scientific management, as championed by F. W. Taylor, is of the carrot and stick variety and is based upon the assumption that motivation can be directly linked to reward for good performance and a lack of reward for a poor performance. The reward is tangible and in the form of increased payment.

Participative management is based upon the theory that if an employee is given an objective then he or she should be left to sort out the best method of achieving that objective without being told what to do by "the boss". [See also the Introduction to Vroom Vroom & Deci, Management and Motivation, Penguin, 1989].

Group discussion:

From your experiences at your company or organization, which of the above characterisations best represents its management style?

Whatever strategy adopted, they are all based upon the premise that “**performance = ability times motivation**”, i.e. that more competent and the more motivated an employee the greater will be his/her performance.

5.3 Motivation Theory

To motivate is rather more than giving a reason for doing something. It is the creation of a keen enthusiasm or desire in a person for the achievement of a particular objective or set of objectives. Because human beings have free-will and have a great many other influences acting upon them, it is not surprising that motivation is a complex issue.

One very important quality needed by a project manager is the ability to motivate the project team. Different people respond to various techniques of persuasion in sometimes very different ways, and it is necessary to know how to approach a particular individual, or group of individuals, in order to optimise your likelihood of success in motivating them into appropriate action.

5.4 Maslow

One field of psychology that considers human motivation theory is that of EXISTENTIAL PSYCHOLOGY or HUMANISTIC PSYCHOLOGY, and one of its best known proponents is Abraham Harold Maslow (US. Psychologist (1908-1970)).

Existential psychology emphasises that each individual is constantly making choices, great and small, which cumulatively determine the kind of person he/she becomes. It is concerned with the individual's attempts to discover a satisfying sense of personal identity and to give meaning to his/her life. As well as Maslow you may wish to look at the work of Rollo May, and Carl Rogers.

Humanistic psychology is another term for existential psychology and which is critical of those schools of psychology which are preoccupied with "Statistics, white rats and computers" preferring instead to concentrate upon the individual from an existential viewpoint. [Further reading: F. T. Severin (Ed.), *Humanist Viewpoints in Psychology*, New York, (1965)].

5.4.1 Maslow's Theory of Human Motivation

Maslow's theory is based on the idea that there is a hierarchy of basic human needs. He organised these into five categories:

- physiological needs
- safety needs
- love
- esteem
- self actualisation.

These are sometimes represented in the literature as a pyramid with the more basic needs at the bottom.

Maslow uses the work **prepotent** to indicate those needs which prevail over the others. So the more basic the unfulfilled need, the more prepotent it is as a motivator, and so on.

For example a person dying from hunger or thirst is unlikely to be highly motivated by the need for the esteem or respect of his colleagues.

Maslow makes the point that only needs which are unsatisfied are motivating factors. Satisfied needs are not.

Discussion point:

What relevance, if any, does Maslow's approach have for the management of projects within your organization?

5.5 Project teams

As we have seen, the management of a project involves rather more than just the mastery of Gantt charts, network analysis and other mathematical techniques. It includes the creation and management of a team of people who are given the task of handling the project from its inception to successful completion.

The benefits of effective teamwork are clear to those who have experienced the synergy created by a team who work together well, who cooperate with each other, and who are all committed to the project.

Synergy is the state in which the team 'takes off', working together as a whole to achieve far more than the individuals, working separately, could have done.

The opposite of such a synergistic grouping is sometimes called dysfunctional conflict - the unpleasant state when everyone seems to be wilfully at cross purposes with everyone else, and the group achieves much less than the individuals working separately, could have done.

An effective team is more dependent upon the chemistry between the members of the group than a strict matching of the various roles suggested by Belbin et al. to the attributes of those group members. Mutual trust is an effective lubricant to the effectiveness of team work.

Teamwork depends upon being able to persuade people to work together, to cooperate, and to be committed to the project. By their very nature, projects are usually one-off situations and the project team will usually be an ad-hoc matrix of individuals chosen for their specialist skills and who may not be used to working together. The role of the project manager is particularly challenging under these conditions.

Group Discussion:

Drawing upon your own experiences within your organization, discuss one example of teamwork which you consider to have been successful, and one example which might have been more successful than it was.

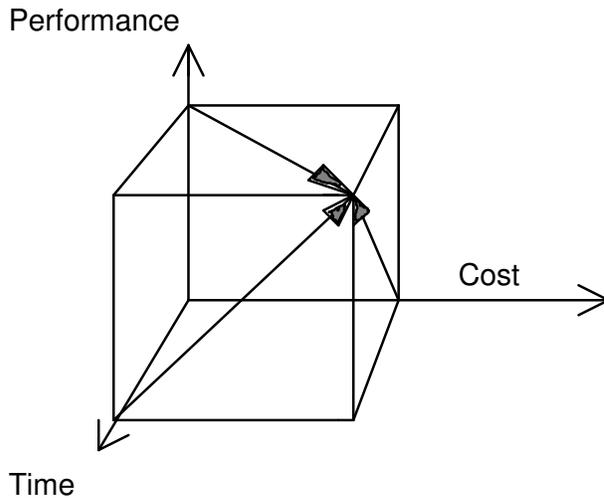
Group discussion:

In the previous discussion point can you separate out those factors which might be thought of as internal ones, and those which might be considered external factors.

6 THE PROJECT MANAGER

Source: Project Management - A Managerial Approach, Jack Meredith and Samuel Mantel, Wiley, 1995.

The prime objectives of project management are performance, cost and time [Meredith, 1995]. Clearly there is a relationship between these three objectives, and there may be trade-offs between them to be managed by the PM.



"...the PM is expected to integrate all aspects of the project, to ensure that the proper knowledge and resources are available when and where needed, and above all to ensure that the expected results are produced in a timely, cost-effective manner" [Meredith, 1995, p.4].

Chapter 3 of [Meredith, 1995] is concerned with the Project Manager and they discuss in section 3.1 the differences between a functional manager and a project manager. A functional manager being defined as a person in charge of a functional department such as marketing, engineering, finance etc., within an organization.

They argue that the functional manager is likely to be a specialist in the area being managed, and as such they are **analytically oriented**, so that when a technically difficult task is encountered they know how to analyse and tackle it.

"As functional managers they are administratively responsible for how something will be done, who will do it, and what resources will be devoted to accomplish the task."

By contrast, the PM is more likely to be a generalist, or non-specialist, with a wide background of both experience and knowledge, and who is required to manage a number of diverse functional areas, each comprising a group of specialists in their own fields. The PM's task then is to bring together all the bits of the project together to form a coherent whole - i.e. the PM must be more skilled in **synthesis**, whereas the functional manager must be more skilled in **analysis**. The authors argue that the functional manager uses an analytical approach whereas the PM uses a **systems approach**.

The analytical approach would break a system down into smaller and smaller parts, but the systems approach is one which attempts to understand the links between the components, as

well as the components themselves, on the basis that the links between components are as important in determining the systems performance as the components themselves. In order to understand the system better, it is necessary to understand the environment (or larger system) of which it is a part.

The authors maintain that the adoption of the systems approach is crucial for project management, with an understanding of the organisational programme of which the project is a part, and the organization in which the programme exists, as well as the environment within which the organization operates.

On page 111, the authors suggest another difference between the functional and project managers. The functional manager is a direct, technical supervisor, whereas the PM is a *facilitator*. The facilitation of co-operation between those who have various kinds of specialised knowledge and those who need it.

Three questions face the PM at the outset of a project:

- What needs to be done?
- When must it be done?
- How are the resources needed by the project to be obtained?

It will have occurred to you that the PM will often be reliant upon functional managers for answers to these questions, and for other specialist inputs and it is often the case that the functional managers will make some of the fundamental and critical project decisions. For example they may select the people who will be responsible for carrying out the project, and may develop the technological plan detailing how to accomplish the project's goals, as well as frequently influencing the precise deployment of the project's resources. It is this separation of powers between functional and project management that on the one hand makes for a successful outcome to the project, but on the other is a source of *discomfort* for both.

"Note that the PM is responsible for organising, staffing, budgeting, directing, planning, and controlling the project. In other words, the PM manages the project, but the functional managers may affect the choice of technology to be used within the project and the specific individuals who will do the work." [Meredith, 1995, p.111-112.]

Clearly a good project manager will attempt to influence by negotiation or other means the choice of specific individuals making up the project team, and the PM cannot allow the functional manager to usurp control of the project, since if this happens the project is likely to become secondary to the work of that functional group and consequently the project is likely to suffer. Equally the functional manager cannot allow the PM to usurp his/her authority when it comes to making technical decisions in the functional area, or indeed to the assignment of duties to personnel within that functional department or section.

Another very real problem faced by the project manager is that of *micromanagement*. This is the unhappy state of affairs created by the PM's line manager *taking over the PM's job by exercising extremely close supervision over every action the PM takes, or will tell the PM precisely what to do*. See box below for quote from page 112 of Meredith and Mantel:

At times, a senior manager (the PM's immediate superior) will, in effect, take over the PM's job by exercising extremely close supervision over every action the PM takes, or will actually tell the PM precisely what to do. All of the powers normally delegated to the PM are withdrawn and the PM's boss runs the project. This condition is known as *micromanagement*. It stamps out any creativity or initiative from the PM or project workers, frustrates almost everyone connected with the project, and generally ensures mediocre performance, if not failure. The senior rationalises the need for control with such statements as: "After all, the project is *my* responsibility," *or* "You must understand how important this project is to the firm," *or* "Superboss expects me to keep my eye on everything that goes on around here."

Such nonsense sounds logical until subjected to analysis. The first comment denies the virtue of delegation. The second assumes that everyone except the speaker is stupid. The third is an indication of the self-importance of the superior. To be frank we do not know how to cure or prevent micromanagement. It is practised by individuals who have so little trust in their co-workers that they must control everything. Micromanagers are rarely likeable enough for anyone to try to help them. Our considered advice to PMs who are micromanaged is to request a transfer. [Meredith, 1995, p. 112]

Guidelines for Managing Projects

- Set a clear Goal
- Determine the Objectives
- Establish Checkpoints, Activities, Relationships, and Time estimates
- Create a Schedule
- Develop people individually and as a team
- Reinforce the commitment and excitement of people
- Inform everyone connected with the project
- Vitalise people by building agreements
- Empower yourself and others
- Risk approaching problems creatively

Source: Randolph and Posner, *Getting the Job Done! Managing Project Teams and Task Forces for Success*, Prentice-Hall, 1992