Project Management is something all of us unconsciously use, but in an informal and subconscious way. In achieving major objectives of significant complexity however, it is not practical to do it in our heads. A more formalized and documented approach is needed to handle the complexity and detail of large projects.

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PROJECT MANGEMENT

What is a project?

A project is a temporary endeavour undertaken to create a unique product or service. Temporary means that every project has a definite ending point. Unique means that the product or service is different in some distinguishing way from all similar products or services (PMBOK 1997)

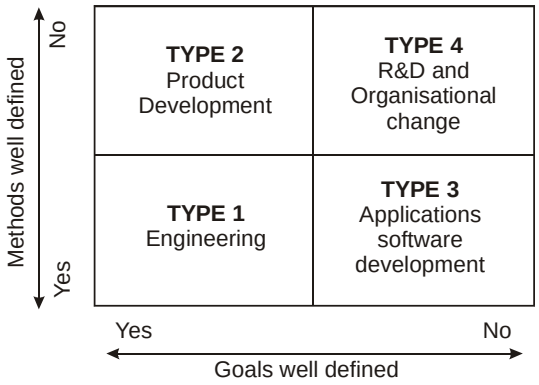
A project is an activity with:

- Finite duration (A specific starting and end point)
- It has a well-defined goal
- It is unique
- It is not repetitive
- It is constrained by time, cost and quality
- It often cuts across organisational and functional lines
- Always involves change

Types of Projects

Almost all projects can be considered to fir into at least one of four generic types of projects:

Type 1: Both goals and methods are well defined at the outset (e.g.: Engineering projects)
Type 2: Goals are initially well defined, but methods of achieving them are not (e.g.: Product Development)
Type 3: Goals are not initially well defined, but methods are known (e.g.: some software development projects)
Type 4: Neither the goals nor the methods are well defined (e.g.: many R&D projects, organisational change projects)



Turner & Cochrane's Goals-and-Methods Matrix

What is Project Management?

Project Management is integration of project activity through the project life-cycle to achieve the delivery of a defined product or service within the prescribed constraints of time, budget, scope and quality.

Project Management is normally viewed as having 9 primary components, with Integration having a further 3 elements:

- Integration Management
  - Project Planning and control
  - Project context
  - Project life cycle
- Scope Management
- Time Management
- Cost Management
- Quality Management
- Human Resource Management
- Communication Management
- Risk Management
- Procurement Management

Integration:

Project Planning

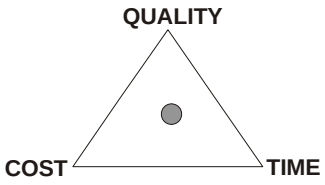
Project planning involves the planning of all the project management functions, and their integration into a cohesive whole.

Typically, planning starts with defining the project **scope**, in which the desired **quality** of the final product is embedded. A Product Breakdown Structure (PBS) is then developed, followed by a Work Breakdown Structure (WBS), which establishes the basic work packages for executing the project. The Work packages are then further broken down into activities, which form the basis for time, resource and cost planning.

Time planning involves establishing the sequencing and relationships of all activities (typically be developing a project network), estimating how long each activity will take (which depends on resources available and allocated), and thence developing a project schedule. This then forms the basis for controlling project time.

Cost plans/ estimates are primarily calculated from pricing the resources allocated to the scheduled project activities for their estimated durations. These form the basis for detailed cost control

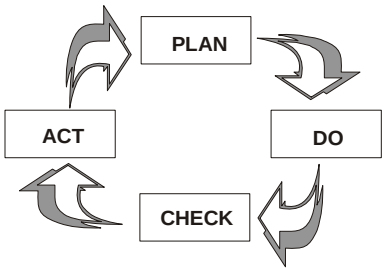
Typically there is tension between scope, quality, time and cost objectives. This can best be represented as a triangle. The marker in the centre shows that each objective is equally important. However, at different points of the project the relative importance that each objective has may change, which can be indicated by moving the marker within the triangle to indicate the current priority in achieving the objectives.



Resource plans are part of the time and cost plans, and include **human resource** plans, which are often represented by an Organisational Breakdown Structure (OBS) and responsibility matrices/ charts. These in turn form part of **communications** planning. **Risk** assessment and **procurement** planning are normally undertaken early in the project.

Project Control

Planning and control are completely intertwined. Planning without subsequent control processes wastes much of the planning. Control without prior planning is a contradiction in terms.
The 'Deming wheel' represents the planning and control cycle in an easily understandable diagram using few words.



Project context

Project context includes both internal and external environments
Internal environments may include:

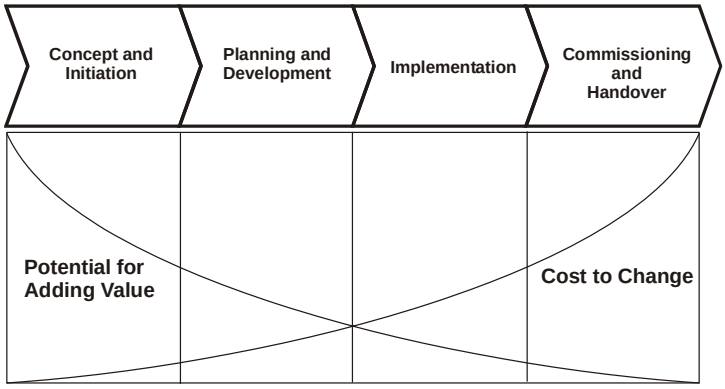
- Physical location of the project
- Layout of project personnel and equipment
- Personal working conditions (physical and emotional)
- Team and interpersonal dynamics
- Identity and differentiation of the project within the larger environment

External environment may include:

- The parent organisation, enterprise, industry
- Employee representative groups (unions, associations, etc)
- Political, social and societal influences
- Public and media interest
- The physical environment (geography, ecology, sensitivity)
- External stakeholder expectations

Project Life Cycle

Following is a commonly used generic 4-phase model used to describe a project:

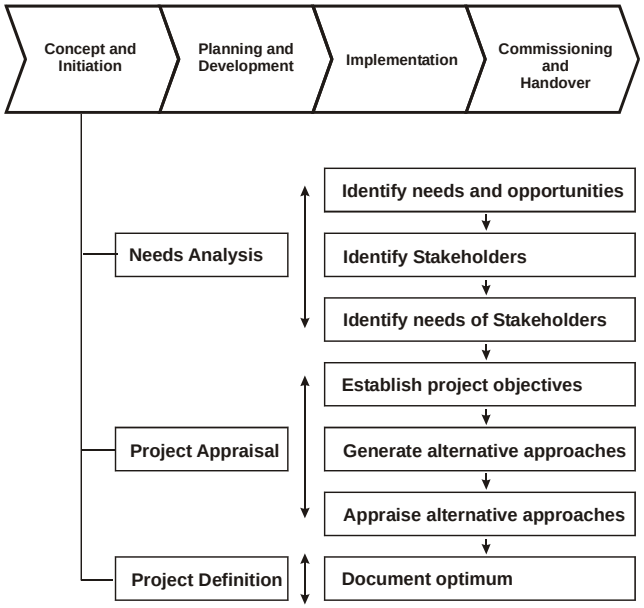


Phase 1: Initiation and Concept

Phase 1 is concerned with determining/ confirming the business (or equivalent) needs of the client and key stakeholders, and thence the requirements of the project "product" which will satisfy those needs.
This is followed by the task of identifying the project objectives, examining alternative ways of achieving those objectives, developing an optimum project solution (via feasibility studies), and obtaining approval and commitment to "run with" that solution. The resultant Project Definition Report documents and consolidates the work to date, and extends it to developing preliminary strategies and plans for implementing the recommended solution.

The phase involves:

- Setting the project up right from the start
- Doing the groundwork to ensure that it is the right project, in the right place, and the right time, and for the right client/customer/stakeholders.
- Defining and agreeing what is really required
- Deciding if it really is required.



The outcomes of this phase should include
- **A GO / NO GO decision for the project**
- **A Project Definition Report, or Terms of Reference**

The Project Definition Report
A project Definition Report communicates the outcomes of the Initiation and Concept phase to the project sponsors.
A project definition report should typically include the following key elements:
- Authority and project sponsor (delegation)
- Purpose (need)
- Project scope / Deliverables
- Project objectives

It should describe:
- The client needs
- Options explored and reasons for rejection of options not analysed
- Marketing and costing data
- Scope, cost and time plans
- Evaluation criteria
- Cash flows
- Financial performance indicators
- Sensitivity of project outcomes to risk
- Recommendations on viability of the project and conditions under which the viability will be retained
- Risk management strategies that may need to be adopted

The **project purpose** or need should be clearly and precisely stated and should contain both quantitative and qualitative measures. It should eb a statement of the business need to be achieved by the project. It may be:
- A problem to be solved
- An opportunity to be exploited
- Elimination of an efficiency
- Derived from strategic objectives of the organisation

The **project scope** should be an initial high level description of the way in which the purpose will be satisfied. Statements of scope should include:
- What work is included in the project
- What work is outside the gambit of the project

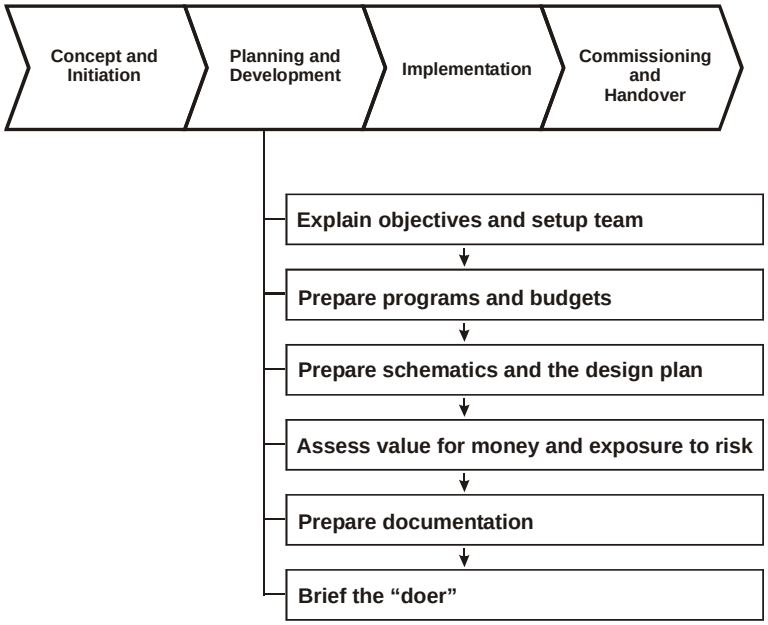
The project objectives are what the ultimate success of a project are usually judged by. It is therefore important to get these right from the start. These will act as the guidelines for decision making throughout the project and for the achievement of the end result.
It should also be remembered that different clients/ customers/ stakeholders/ participants/ constituencies will identify different objectives in a project.

The project objectives should:
- Be aligned with business objectives
- Be measurable in terms of quality, quantity, time, cost and defined end product
- Be achievable
- Be consistent
- Be readily understandable
- Have the full support and commitment of senior management, project sponsor and users.

Phase 2: Planning and Development

Phase 2 is concerned with developing and refining (i.e.: progressively elaborating) the project solution developed in Phase 1 to the point that implementation of the agreed concept can be undertaken in an orderly and controlled way.

Generally the project team will be expanded to include the expertise necessary to fully plan and develop the project. The Project Manager will also start putting in place the major systems and controls necessary to manage the project to completion.



Typically, tenders are called for supply or procurement at the end of this stage.

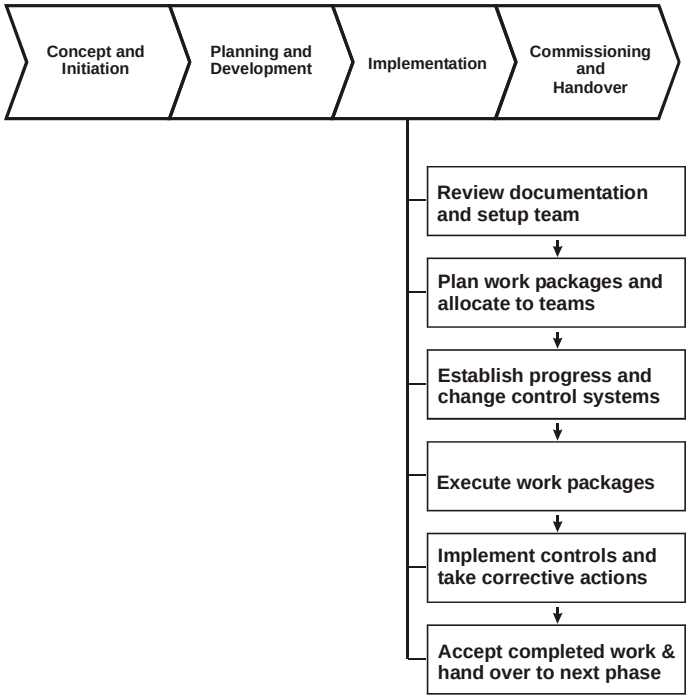
Outputs of this phase should include:

- **Detailed plans**
- **Detailed designs**
- **Detailed costings**
- **Detailed programs and networks.**

Phase 3: Implementation

Phase 3 is basically a delivery process. It is concerned with ensuring that the approved scope of the project (design, specification, etc. elaborated in Phase 2) is converted into the agreed product (scope), and that the other key objectives for the project in terms of time and quality are achieved within the agreed cost limits.

It is the commencement of a stage where the client cannot make major changes, as significant resources are now committed to executing the project. It is also a stage during which highly formalised contractual relationships are established to protect the parties. Often the major tasks will be undertaken by contractors and/or consultants outside the organisation, in which case the setting up and management of contracts for procurement and production will be a major role for the project team.

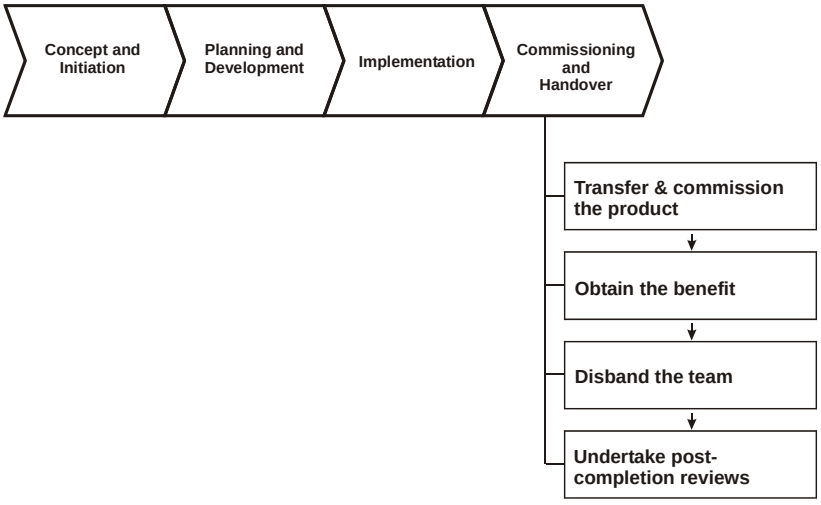


The outputs of this stage could include a new product launched on the market, and operational building, a new computer or accounting system, or a multitude of other products of the project.

Phase 4: Commissioning and Hand-over

This phase is fundamental to the success of a project. The objective of Phase 4 is to integrate the project's outcome into the client organisations normal and on-going operations. This may include:

- Testing of systems, facilities or products
- Procedures, manuals, and guidelines
- Resourcing and training the on-going operation.



The phase concludes with a thorough review and evaluation of both the product, and the management systems that were used to produce it.

The Work Breakdown Structure

The Military Standard (MIL-HDBK-881) defines the Work Breakdown Structure as follows:

"A work breakdown structure is a product-oriented family tree composed of hardware, software, services, data and facilities .... [it] displays and defines the product(s) to be developed and/or produced and relates the elements of work to be accomplished to each other and to the end product(s)."

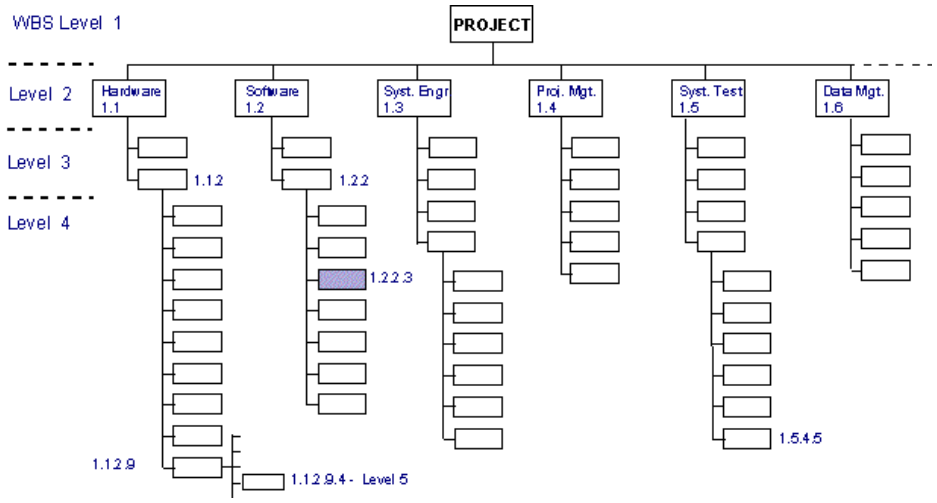
What it all means
A $10,000,000 project can usually be regarded as a lot of smaller $10,000 projects joined together. The larger a project is, the more difficult it can be to comprehend all it's complexities. Projects are therefore organized and broken down into progressively smaller pieces, thus making them easier to comprehend. The Work Breakdown Structure is used to provide a framework to tie all these project elements together. The clustering of end products, project elements and project tasks helps to divide the overall project work into manageable pieces. The resulting structure can then serve as the basis for communication, scheduling, cost management, estimating resource requirements, etc

The WBS is used to graphically break up a project into manageable elements reflecting all products to be delivered and services to be performed by the project. It relates the elements of work to be accomplished to each other and to the end product. It is a product-oriented family tree composed of hardware, software, services, data, and facilities.

Though some project management environments have rather rigid conventions for grouping items in a WBS (witness the MIL-HDBK-881, which very precisely defines items that can be included in the WBS and excludes certain others), a more effective method is to have a WBS that is tailored to the particular project environment it is being used in. The WBS design should specifically try to achieve certain goals.

- It should be compatible with how the work will be done and how costs and schedules will be managed.
- It should help to identify and give visibility to important or risky work elements.
- It should ultimately act as a map of all requirements, plans, testing, and deliverables.
- As it is primarily a communication tool, it should foster clear ownership by managers and task leaders.
- It should provide data for performance measurement and historical databases that can be used on future projects.
- And possibly most importantly, it must make sense to the workers, accountants and all others involved in the project.

A sample of a standard WBS is shown in the figure below:



A WBS for a large project may have multiple levels of detail, and the lowest WBS element will be linked to functional area cost accounts that are made up of individual work packages. Irrespective of how many levels the WBS has, work packages should add up through each WBS level to form the total project deliverable.

Many project management software packages (such as MS-Project) often display the WBS as a vertical list with indents to show structure, thus making them compatible with the Gantt chart type data views.

WBS Element

A WBS element is an individual, discrete portion of the WBS representing an identifiable component item such as an engine, or software routine, a set of data such as training documentation, or a service such as integration and assembly. WBS elements are organized into a hierarchy of levels beginning with Level One items. Level Two WBS elements are major components that make up their corresponding Level 1 items. Level Three items are elements subordinate to the respective Level Two elements, and so on... The WBS should include as many levels as necessary to fully define the work at hand.

Numbering and WBS Index

WBS elements are usually numbered, and the numbering system should be arranged in the way that makes the most sense to the project team. One of the more conventional numbering systems is used in the above figure (and is the standard required for the US military use of WBSs). The shaded box shown in the above figure could be numbered 1.2.2.3, which would tell you it was in the second box in level 2, the second box in level 3, and the third box in level 4.

TIME MANAGEMENT

Time management or planning is traditionally the function most strongly identified with Project Management. Time management involves establishing the sequencing and relationships of all activities (typically by developing a project network), estimating how long each activity will take (which depends on resources available and allocated), and thence developing a project schedule.

Activity Definition

Before one can sequence activities, they first need to be defined. An activity is any identifiable task that must be performed within the project. These activity definitions most commonly come from the Work Breakdown Structure.

Activity Sequencing

At its very simplest, this is simply a list of activities, and the order in which it is planned they will be executed. More commonly however, this can be done in the form of network scheduling. There are many methods for developing networks, but 4 of them are prevalent:

Critical Path Methods (CPM), Arrow Diagramming:

Arrow diagrams (also known as activity-on-arrow networks) were first publicised in 1959, and became the de facto standard for several years. The benefits of using Precedence Diagramming Method (PDM) however slowly but surely came to be recognised, and this method overtook Arrow Diagramming as the new de facto standard.

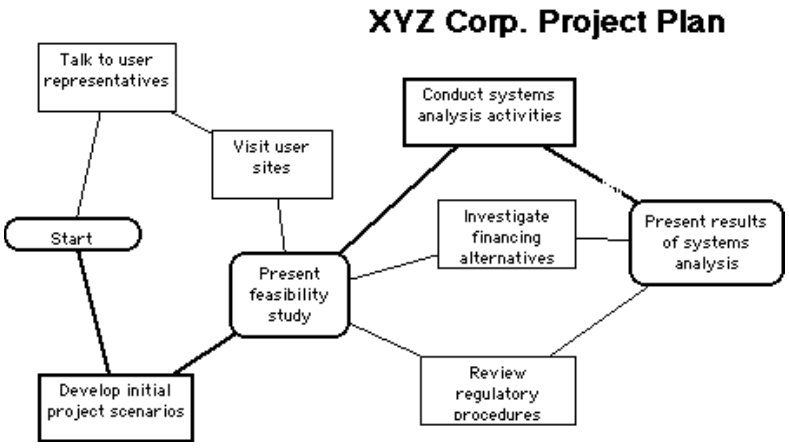
Precedence Diagramming Method (PDM)

Precedence Diagramming (also known as activity-on-node networks) is now the de facto standard for CPM networking.

Program Evaluation Review Technique (PERT) networks

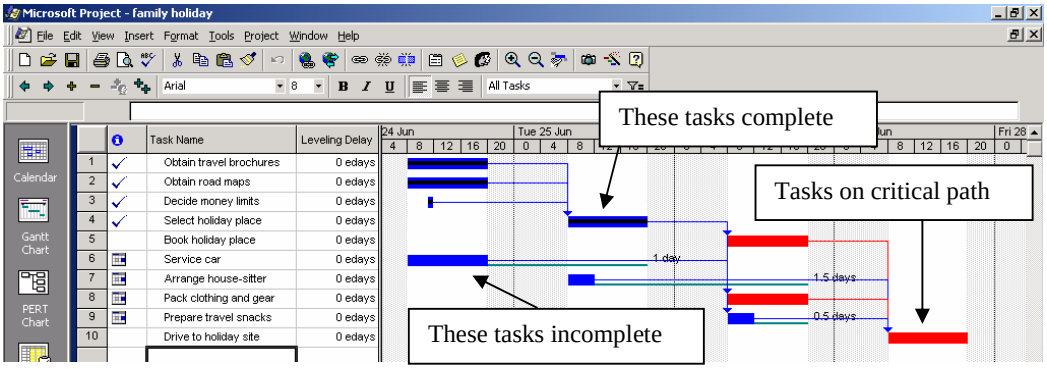
PERT is an acronym that stands for **P**rogram **E**valuation **R**eview **T**echnique. It was originally developed in the late 1950s - early 1960s as a management tool for the U.S. Navy's Polaris submarine project; Booz Allen (the consulting firm), Lockheed Aircraft, and the Navy are generally credited with developing the concept. PERT charts have been used widely in industry and government projects since then; many people now refer to them as activity diagrams.

In a PERT chart, each rectangular box represents a *task* or an *activity* (i.e., a recognizable chunk of work that needs to be done). The boxes with rounded corners are known as milestones, and they have an obvious meaning within the context of a typical project. The lines connecting the boxes show *dependencies*; that is, they show which activities must be finished prior to the commencement of some other activity. The heaviest, dark lines that form a contiguous path from the beginning to the end of the project represent the critical path, those activities whose delay would force a delay in the overall project (activities not on the critical path have “slack time” available; they can be started later than the scheduled date up to the amount of slack time available, if desirable, without affecting the overall project).



Gantt Charts

A Gantt chart represents the activity information as a bar graph, but has the added advantage that the length of each bar represents the duration of each task (so analogous to marking out the tasks on a calendar). It therefore has the advantage of graphically showing the duration of the project. Most modern project management computer programs such as Microsoft Project have become extremely easy to use, and can show Gantt charts with or without the critical path, and they can also be displayed as 'tacking' Gantt charts in which our current progress is indicated on the chart.

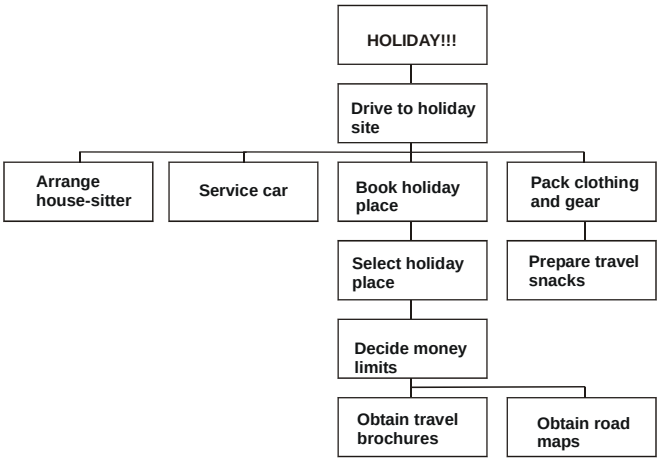


The Gantt chart is probably now one of the most commonly used methods of displaying a network. One of the reasons for this recent change is the emergence of very easy to use software packages such as MS Project. Gantt charts are also commonly printed and displayed on the project office wall where the entire team can then instantly be aware of the project tasks, and their progress.

The easiest way of understanding the various techniques is through an example:

"Holiday Time"
You and 3 of your friends (Tom, Dick and Harry) have decided to go on holiday . The holiday will officially start on the Monday after the end of first semester exams. After preparing and packing you will drive to the holiday place. The problem is to select a location and take all the necessary steps to successfully get to the holiday place in a minimum of time after the holiday officially starts.

If you were to generate a Work breakdown Structure for this project, it might look something like this:



The first step is to generate a list of ***Activities*** (things to be achieved) from the WBS and decide on the sequence of execution. This is achieved through a ***Precedence List*** that may be in the form of a table or a simple list. It might typically appear as shown below:

Number	Activity	Precedence
1	Obtain travel brochures	Must precede 4
2	Obtain road maps	Must precede 4
3	Decide money limits	Must precede 4
4	Select holiday place	Must precede 5,8,9
5	Book holiday place	Must precede 10
6	Service car	Must precede 8
7	Arrange house-sitter	Must precede 10
8	Pack clothing and gear	Must precede 10
9	Prepare travel snacks	Must precede 10
10	Drive to holiday site	

At this point, we can also define the time needed to execute each activity. We will leave the start/finish times undefined at the moment although these could be filled in. The target start date is however the Monday after exams.

Number	Activity	Earliest start Time	Latest Finish Time	Time Required (days)
1	Obtain travel brochures			1.0
2	Obtain road maps			1.0
3	Decide money limits			0.1
4	Select holiday place			1.0
5	Book holiday place			1.0
6	Service car			1.0
7	Arrange house-sitter			0.5
8	Pack clothing and gear			1.0
9	Prepare travel snacks			0.5
10	Drive to holiday site			1.0

Note that the above lists, though extremely useful, are difficult to instantly comprehend. This is because the brain does not handle large quantities of information well. On the other hand, the brain does deal very well with images. This is the main reason that network diagrams are worth developing and so commonly used. They present a graphical view of the project that we can very easily comprehend.

If we wanted to graphically show all this information, we could construct and **Activity-on-Arrow** network diagram:

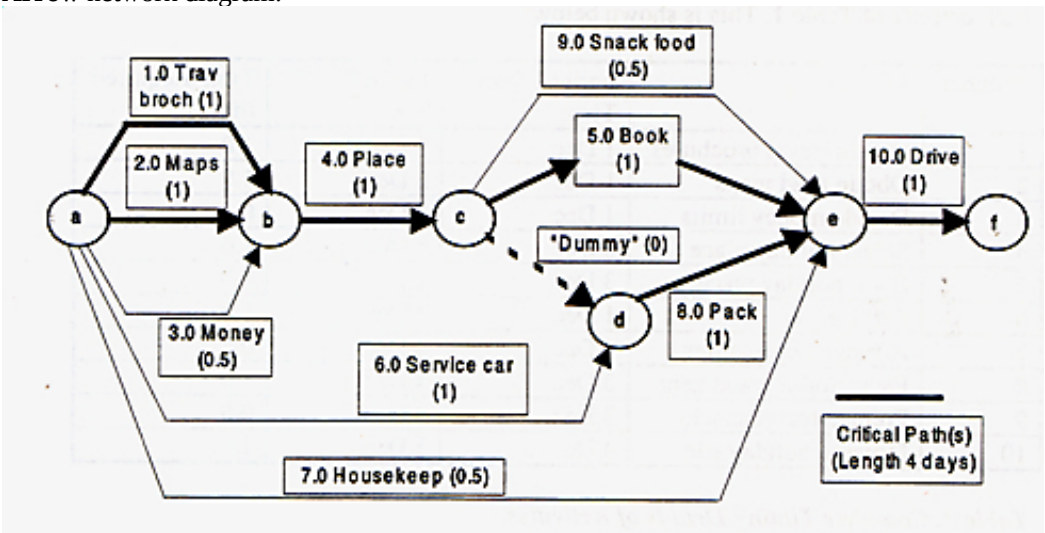


Diagram 1. Critical Path Method, Activity on Arrow Network Diagram (hours in brackets)

In this type of diagram, each activity is represented by an arrow. The circles at the beginning and end of each arrow are called 'events' or 'nodes'. These are just points in time that have no duration. Each arrow, however, does have duration, which is most commonly written in brackets beneath the activity. Work always flows in the direction of the arrows.

Notice the dotted arrow between 'c' and 'd'. This is called a **dummy arrow**. Dummy arrows are used to transfer logic from one event node to another in the network. They are represented by broken arrows. A dummy arrow has zero duration and does not represent an activity. These symbols are used to represent the relation ships among the activities.

Or, the diagram can be redrawn as an **Activity-on Node** Diagram as shown below

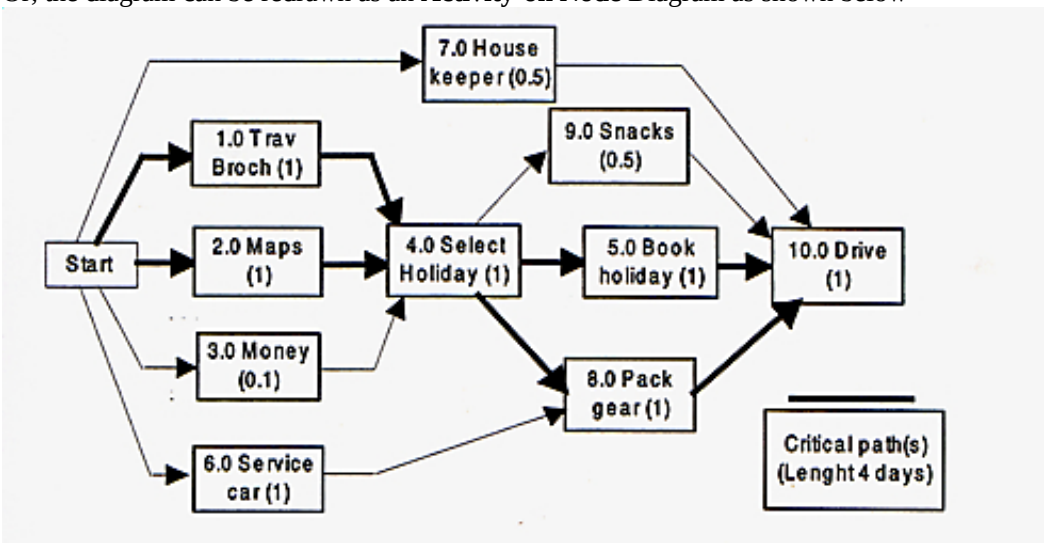


Diagram 2. Precedence Diagramming Method, Activity on Node Network Diagram

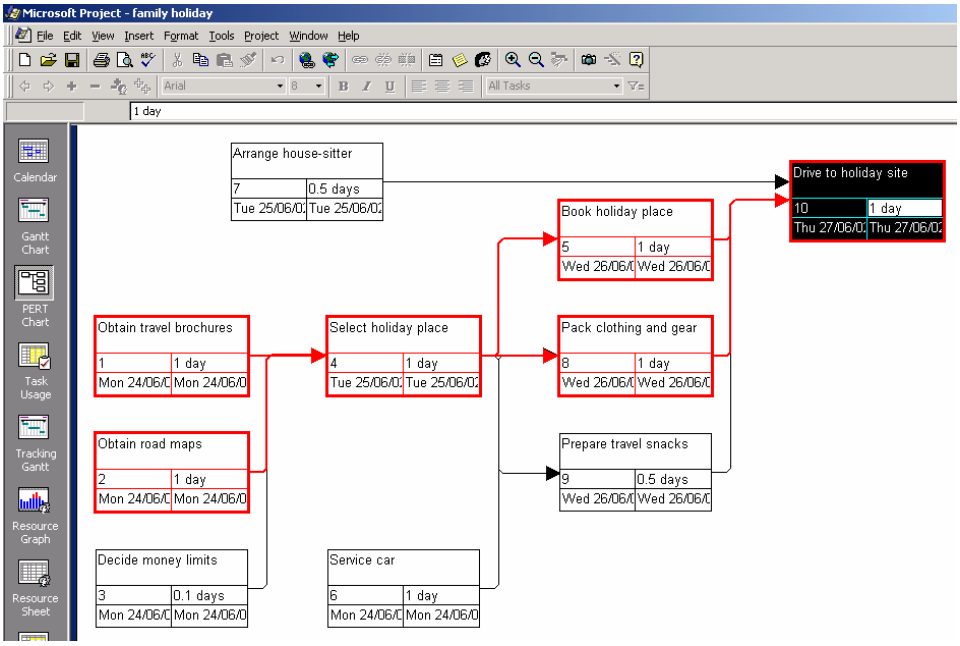
Notice that there is no need for the dummy arrow in this diagram.

Network diagrams 1 and 2, make it quite easy to see the "dates" after each activity. This is particularly easy with Diagram 1. Taking "a" as day 0, therefore, b is +1, c is +2, d is +2, e is +3 and f is +4. Notice that the LONGEST time between each node is taken as the required time between nodes. It is now a simple matter to fill in the earliest start dates and the latest finish dates for each activity of Table 1. This is shown below:

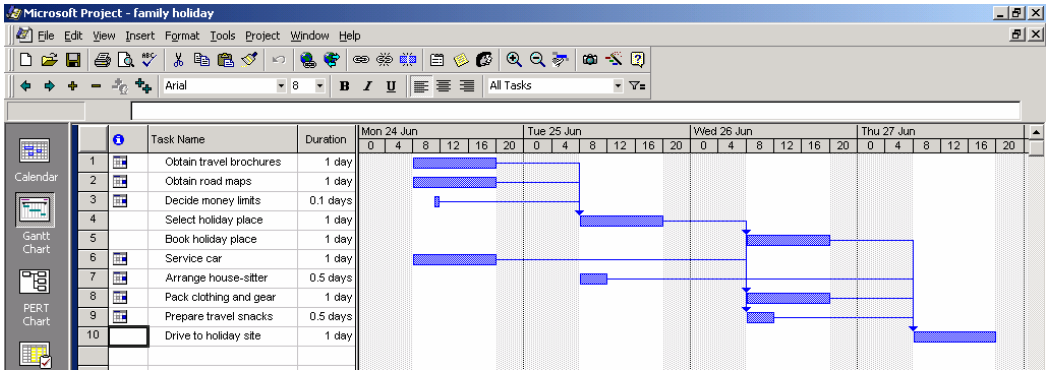
Table 3. Complete Timing Details of Activities

Number	Activity	Earliest Start Time	Latest Finish Time	Time Required (Days)
1	Obtain travel brochures	Mon	Tue	1.0
2	Obtain road maps	Mon	Tue	1.0
3	Decide money limits	Mon	Tue	0.1
4	Select holiday place	Tue	Wed	1.0
5	Book holiday place	Wed	Thurs	1.0
6	Service car	Mon	Wed	1.0
7	Arrange house sitter	Mon	Thurs	0.5
8	Pack clothing and gear	Wed	Thurs	1.0
9	Prepare travel snacks	Wed	Thurs	0.5
10	Drive to holiday site	Thurs	Fri	1.0

Another method of showing this network is using the Program Evaluation Review Technique (PERT).



All of the above types of networks can be considered to be only a semi graphical way of depicting the activities (tasks) as they give no graphical indication of time. Times are indicated in brackets beneath the activities, or in the lower parts of the boxes for PERT, but they need to be manually calculated to arrive at a total.
This is an area where the Gantt chart comes in handy.



The various arrows in the above chart indicate that certain tasks cannot begin until the preceding ones are finished.
Note that certain other tasks have blank space to the right or left of them. If a bar in the Gantt chart is shorter than the actual time needed for the task, then the activity is said to possess ***Slack*** or ***Float***. This means that those activities can be started a bit earlier or later without affecting the final date of the project.

The critical path, on the other hand, has **no slack in any of its activities.** It is possible for there to be several critical paths.

It is common practice to start tasks with float as early as possible, as this then leaves float for later in the project to handle unforeseen occurrences.

It should be noted that each diagramming method has certain advantages, depending on what you are trying to show. Many projects may develop more than one type of network diagram to make everything as simple as possible to understand. This is an other area that makes most software packages useful, as most of them can automatically generate different network views.

If you are using Microsoft Project, for example, then the Gant chart can also be displayed with its Critical path (detailed Gantt), or as a PERT diagram, etc.

The Gantt chart is an excellent communication tool, not only for management, but also for those involved in the project. It is something that may go up on the wall or be used in a presentation to give a quick and easily understood chart of project sequence.

RESOURCE MANAGEMENT

A problem so far not mentioned, is that of resources.

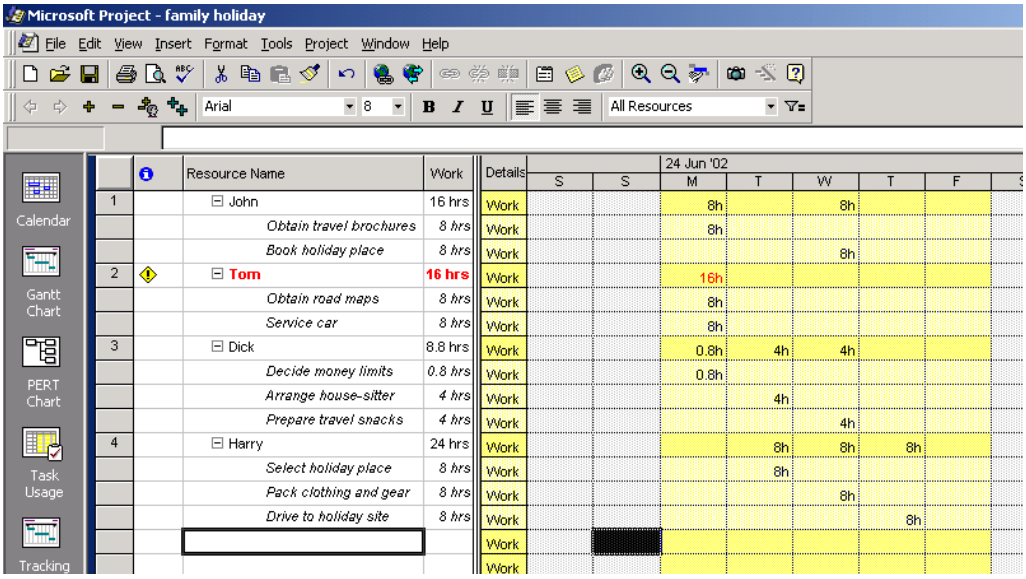
In the above holiday example, it is assumed that Tom, Dick, and Harry are helping out and doing their fair share of the organising. But what happens if you are doing all the organising on your own?

In the holiday planning, it takes a day to obtain the maps, and another day to obtain the brochures. In project planning, time is almost always given as man/hours, or man/days, etc. This means that the one day given for obtaining the brochures represents one persons full-time working day (usually assumed to be 8 hours per day, for example).

In all the above networks, we are however running these two tasks in parallel, which means that at least 2 people are needed to do these two tasks.

If only Harry has a valid drivers license, and will therefore be the one doing all the driving, would it be fair for Tom, Dick and Yourself to do some extra work on the planning tasks?

In the above example, we have randomly allocated tasks to everyone as follows:



As can easily be seen with our current set-up (indicated by the exclamation mark sign), Tom has been over-allocated, as he is working 16 hours on the Monday and his tasks are to obtain the roadmaps, and get the car serviced.
This can be fixed in one of 2 ways. Either we need to assign someone else who is not working on the Monday (Harry, for example) to service the car, or we need to delay the car servicing (remember that this task has some float, so is not on the critical path) until Tuesday when Tom is not scheduled to work.
Note also that Dick is working less than everyone else, so it may be fairer to redistribute the labour somewhat. We could for example take one of Harry's tasks and assign it to Dick. That way, everyone would be working around 16 hours for the holiday.

The above example is perhaps over-simplified. It should be remembered that in real projects, resources are often affected by factors such as areas of expertise, etc. If for example there is only one registered electrician available, then he must do all the electrical tasks, and may therefore be a scarce resource.

Resource planning is essentially a balancing act in which we try to use the resources we have in the most effective manner.

If a person or facility was, for example, working 12 hours a day for one week, and working four hours a day for the next because of lack of work, it might be advantageous to reschedule the project activities to even out the load. This process is called **Resource Levelling** and is of prime importance in big projects.

Remember too that cost plays a major part in resource planning. If the stakeholders decide that cost is no object, it may be possible to hire extra people/ equipment and thus get the job-finished earlier. Adding extra resources however does not always help. There often comes a point where no matter how many extra people you put on the job, it still cannot get completed any earlier. This point is often referred to as the 'crash-point'

Potential Problem Analysis (threats or hazards) must be considered in any substantial program. What if someone gets sick on the holiday? What if a tyre blows?
What if the family's credit cards are stolen?

If such problems are anticipated, their consequences can be minimised. In a big expensive project, failure to anticipate potential problems can cause the project to-fail or people to go broke. For example, what happens if the unions go on strike? What happens if the parts don't arrive on time, or can't be obtained?

Similarly, anticipation of opportunities can have major payoff. What happens if the laying of the building foundations is finished a week early? Can we move the rest of the schedule up?

EFFECTIVE TEAMS, LEADERSHIP & MOTIVATION

Forming an Effective Team
It is recognized that we are all different and that we all have a wide range of different skills. A truly effective team has members with a range of different personalities and skills so that all these skills and personalities compliment each other, thus forming a well balanced team.

Belbin conducted some extensive research into team personalities and classified personality types into 9 different categories. Through that research she created a personality test that is widely recognised as giving an accurate assessment of team role types, and is therefore of great use in putting together a well balanced team.

Each of the different roles have their own unique strengths and weaknesses that they bring to team work. Understanding these strengths and weaknesses can assist you in developing a well-balanced team of people. It will also assist with the recognition of potential problems that may arise. Understanding the roles that people naturally tend to take will help you decide the responsibilities of each team member. Therefore, if you know which role each team member enjoys fulfilling, it can assist you in providing your team members with motivating tasks.

The roles recognised by Belbin are:

- **Shaper:** Shapers attempt to apply a shape to the team and are very focused on taking positive action.
- **Plant:** Plants are individuals who originate new ideas and provide unique solutions to problems.
- **Co-ordinator:** Co-ordinators like to consult with their colleagues when making decisions and encourage co-operative teamwork.
- **Monitor Evaluator:** Monitor Evaluators identify the pros and cons of each decision and like to ensure that they have all the facts before making decisions.
- **Resource Investigator:** Resource Investigators are very good at finding the necessary information required for a decision. They also are very good at networking with other teams and organisations.
- **Implementer:** Implementers are focused on practical solutions and will do what is required to achieve the desired outcome.
- **Team Worker:** Team Workers are the team diplomats. They encourage team unity and attempt to diffuse potentially damaging interpersonal conflicts.
- **Specialist:** Specialists provide in depth knowledge about a service or product. They are often technically minded individuals.
- **Completer-Finisher:** Completer-Finishers ensure that tasks are completed. They pay attention to detail and are very good at organising meetings and keeping the team on schedule.

Belbin's research indicates that all roles, except the specialist, are needed in successful teams. Care needs to be taken regarding the co-ordinator and shaper roles. Both of these roles are leadership roles so their formal positions within the team need to be well defined. The people who play these roles need to work closely together to ensure the team does not split into factions. To avoid leadership disputes it is best to have only a single co-ordinator and shaper in a team. In some situations it may be best to have only a co-ordinator or a shaper and not both, if the available people who play these roles are likely to cause conflict if on the same team. It is most advantageous to have multiple implementers and team workers in a team

Leadership
Leadership is one of the key skills for any enterprise that involves a group, because we need to make use of the abilities of the group to achieve a common objective. Leadership pulls together the group so that they can reach agreement on what is the objective and how best to achieve it, using the resources available or to be obtained.

The first requirement of leadership is acknowledgement from the individuals that will form a group that they will need and be guided by a leader. Usually because we join an existing activity, leaders and leaders of sub-groups are already in place and we have to become a part of an existing work pattern. Although we accept such patterns as a part of the job, nevertheless we should aim to understand how the structure operates so that we can increase our efforts towards the common goal. Structures will inevitably change with time and most structures could be improved if only to react to new situations. We all operate inside structures both in business and in our leisure life; however, we often accept situations without thinking through what are the interactions.

Good or weak leadership is something we all quickly recognise but to understand what causes the difference we must be more specific in studying the situation. A business leader must, before starting, have a view of the following:

- Understand the market that the business serves
- Understand the finance of the business, balancing investment, running cost and sales income
- Understand the capabilities of the group
- Make a draft plan for the business

A leader must then at the start of a project ensure the following happens:

- Collaborate with his staff to agree on a plan
- Ensure the group is committed (motivated) to support this plan
- Agree with the individuals in the group on their contributions to the plan and delegate resources to meet their agreed responsibilities

During a project, a leader must:

- Monitor the situation versus the plan to ensure that both the customer's and business interests will be satisfied
- Ensure that all new issues, problems and opportunities are recognised and if appropriate addressed as they emerge
- Ensure that all staff have adequate feedback so that they are aware of the overall progress being made and of their individual contributions

Theories have been proposed to help us understand what is happening. **McGregor**, in 1960, described two types of management called **type X** and **type Y**. (Note the careful choice of neutral labels). X managers believe the workforce is lazy and not interested in the work, only in the wage and therefore work must be driven. Y managers believe that staff want to be involved and must be drawn into all decision-making and that work can flow by its own momentum so that the manager’s job is to control the direction.
Ouchi later proposed type Z that came between the other two extremes.

Fiedler proposed the more realistic Contingency Theory that recognised that the best solution depends on the current situation and the manager must chose the best route for immediate response. Thus if the house is burning down, don’t start a type Y discussion, either give commands or accept someone else's orders. However, if a new concept is on the horizon, the manager will want to draw all his best brains into a discussion on the options and issuing orders will not achieve a breakthrough so type Y is essential and X would be unhelpful. A leader must be flexible in approach while being steadfast in his personal attitudes, because the situation facing him will produce varying demands.

Motivation
Motivation is a key factor in the link between receipt of a proposal or stimulus and the human response and has been studied extensively. **Maslow** identified five ascending levels of human needs that we should aim to satisfy in sequence if we are to feel fulfilled.

- At the lowest level where we have basic needs of being fed and clothed. Until these are satisfied we cannot function as people.
- Once these are met we then need to feel safe and secure before we can give time to any other problems.
- Once we feel secure, most people want to be a part of a family or club or team and we are comfortable if we can be accepted.
- At a higher level we will wish to be accepted as a useful leader for some topics and recognised as worth supporting.
- At the highest level we then must meet our own standards where we usually are our own toughest critic: by meeting our own standards we can be confident that we are being fully utilised and contributing to society.

This concept of hierarchy is worth studying because it helps us to assess our own interests. Note this is not a steady state but rather we are continually shifting levels according to the stresses on us. While we might start a day feeling on top of the situation and of the world, if things go wrong at work we might need the support of the group. If we work late and go home in the dark and the car breaks down, we might feel a concern for safety. Then if redundancy threatens we might worry about basic pressures of mortgages and housekeeping expenses. Being able to recognise the pressures on you at any time and being able to put them into categories of need is a major factor in deciding our personal priorities and hence how we should respond.

Hertzberg in his study *Work and the Nature of Man* took this idea a stage further by listing a larger set of needs then grouping these needs as either making staff satisfied, (*motivator* factors) or dissatisfied, (*hygiene* factors).
While pay is usually a prime consideration for staff, Hertzberg found that it was not a major motivator in practice. Your own experience probably shows that expenditure usually rises to match any pay rise within three months, so the recipient soon feels the same pressures good or bad, as before and any extra 'feel good' factor is soon dissipated. The key factors in making staff feel welcome and appreciated were found in his survey to be:

- A sense of growth
- A sense of achievement
- Recognition of a job well done
- Self-acknowledgement that one has done one's best.

Lawler and **Porter** extended this to recognise the importance of perception. It is vital to note that we can only respond to our understanding of a situation and this is limited to what we think we have read or heard and what we think are other people's views. There is little value in asserting a particular view in a discussion if the people we are addressing have a different view of the facts since obviously we are not on the same wavelength. Thus in any meeting of minds it is always important to find out where every one is coming from, what they think the real situation is. By reviewing the facts and agreeing or identifying differences and addressing them, we can build a consensus on which we can progress. At all times we should remind ourselves, we and everyone else respond to our perception, our understanding of the facts. Perceptions may well be different from the true facts, especially our opinion of what others think and therefore we must always check our understanding and if necessary search for facts before jumping to conclusions.

Delegation

Delegation is an important factor in any activity because as already discussed, most of our tasks are too large for us to usefully undertake on our own. We must seek help from others. Delegation is the passing on of responsibility for a future achievement from one person to another. In the past this usually involved delegation 'downwards' to a junior person but with the present reduction in departmental structure this can often be delegation 'sideways' or the related action of 'referral' upwards where you feel your manager must be asked to make a contribution.

It is important for successful delegation to identify what is taking or is intended to take place.

- Firstly the task must be clearly defined with a clear or an understood timescale
- Secondly the outcome expected must be clear
- Thirdly the resources to do the task must be made available by whoever has them
- Fourthly and most importantly the delegator and delegatee must be in agreement on what is taking place

Glossary of Project Management terms

Activity: An activity is an individual task needed for the completion of a project. It is the smallest discrete block of time and resources typically handled by PM software. It is a single task that needs to be done in a project. Multiple activities are related to each other by identifying their immediate predecessors. Solitary activities, which have no predecessors or successors, are allowed. Most PM software packages are precedence-based systems which analyse schedules based on the activity relationships that are specified. Activities can also be called work packages, tasks, or deliverables.

Activity Duration: Activity duration specifies the length of time (hours, days, weeks, months) that it takes to complete an activity. This information is optional in the data entry of an activity. Workflow (predecessor relationships) can be defined before durations are assigned. Activities with zero durations are considered milestones (milestone value of 1 to 94) or hammocks (milestone value of 95 to 99).

Actual Dates: Actual dates are entered as the project progresses. These are the dates that activities really started and finished as opposed to planned or projected dates.

Baseline Schedule: The baseline schedule is a fixed project schedule. It is the standard by which project performance is measured. The current schedule is copied into the baseline schedule that remains frozen until it is reset. Resetting the baseline is done when the scope of the project has been changed significantly. At that point, the original or current baseline becomes invalid and should not be compared with the current schedule.

Calendars: A project calendar lists time intervals in which activities or resources can or cannot be scheduled. A project usually has one default calendar for the normal work week (Monday through Friday), but may have other calendars as well. Each calendar can be customized with its own holidays and extra workdays. Resources and activities can be attached to any of the calendars that are defined.

Control: Control is the process of comparing actual performance with planned performance, analysing the differences, and taking the appropriate corrective action.

Critical Activity: A critical activity has zero or negative float. This activity has no allowance for work slippage. It must be finished on time or the whole project will fall behind schedule. (Non-critical activities have float or slack time and are not in the critical path. Super-critical activities have negative float.)

Calculate Schedule: The Critical Path Method (Calculate Schedule) is a modelling process that defines all the project's critical activities which must be completed on time. The Calc tool bar button on the Gantt and PERT (found in most GUI-based PM software) windows calculates the start and finish dates of activities in the project in two passes. The first pass calculates early start and finish dates from the earliest start date forward. The second pass calculates the late start and finish activities from the latest finish date backwards. The difference between the pairs of start and finish dates for each task is the float or slack time for the task (see FLOAT). Slack is the amount of time a task can be delayed without delaying the project completion date. A great advantage of this method is the fine-tuning that can be done to accelerate the project. Shorten various critical path activities, then check the schedule to see how it is affected by the changes. By experimenting in this manner, the optimal project schedule can be determined.

Critical Path: There may be several paths within one project. The critical path is the path (sequence) of activities that represent the longest total time required to complete the project. A delay in any activity in the critical path causes a delay in the completion of the project. There may be more than one critical path depending on durations and workflow logic.

Duration: Duration is the length of time needed to complete an activity. The time length can be determined by user input or resource usage. Activities with no duration are called Milestones which act as markers (see MILESTONES). Estimating durations for future

activities is very difficult. It is recommended that the largest duration possible be used to account for possible delays.

Early Finish: The Early Finish date is defined as the earliest calculated date on which an activity can end. It is based on the activity's Early Start that depends on the finish of predecessor activities and the activity's duration. (See EARLY START) Most PM software calculates early dates with a forward pass from the beginning of the project to the end. This is done by selecting ANALYZE & PROCESS REPORTS from the Report pull-down menu.

Early Start: The Early Start date is defined as the earliest calculated date on which an activity can begin. It is dependent on when all predecessor activities finish. Most PM software calculates early dates with a forward pass from the beginning of the project to the end.

Elapsed Time: Elapsed time is the total number of calendar days (excluding non-work days such as weekends or holidays) that is needed to complete an activity. It gives a "real world view" of how long an activity is scheduled to take for completion.

Finish Float: Finish float is the amount of excess time an activity has at its finish before a successor activity must start. This is the difference between the start date of the predecessor and the finish date of the current activity, using the early or late schedule. (Early and Late dates are not mixed.) This may be referred to as slack time. All floats are calculated when a project has its schedule computed.

Finishing Activity: A finishing activity is the last activity that must be completed before a project can be considered finished. This activity is not a predecessor to any other activity -- it has no successors. Many PM software packages allow for multiple finish activities.

Finish-To-Finish Lag: The finish-to-finish lag is the minimum amount of time that must pass between the finish of one activity and the finish of its successor(s). If the predecessor's finish is delayed, the successor activity may have to be slowed or halted to allow the specified time period to pass. All lags are calculated when a project has its schedule computed. Finish-to Finish lags are often used with Start-to-Start lags.

Finish-To-Start Lag: The finish-to-start lag is the minimum amount of time that must pass between the finish of one activity and the start of its successor(s). The default finish-to-start lag is zero. If the predecessor's finish is delayed, the successor activity's start will have to be delayed. All lags are calculated when a project has its schedule computed. In most cases, Finish-to-Start lags are not used with other lag types.

Float: Float is the amount of time that an activity can slip past its duration without delaying the rest of the project. The calculation depends on the float type. See START FLOAT, FINISH FLOAT, POSITIVE FLOAT, and NEGATIVE FLOAT. All float is calculated when a project has its schedule computed.

Forced Analysis: Most PM software can force schedule analysis where a project is re-analysed even if no new data has been entered. The feature is used for an analysis on the project by itself after it has been analysed with other projects in multi-project processing (or vice versa). A levelled schedule may also be removed by forcing schedule analysis.

Free Float: Free float is the excess time available before the start of the following activity, assuming that both activities start on their early start date. Free float is calculated in the following way: FREE FLOAT = EARLIEST START OF FOLLOWING ACTIVITY - EARLIEST START OF PRESENT ACTIVITY - DURATION OF PRESENT ACTIVITY On the activity's calendar, free float is the length of time from the end of the activity to the earliest Early Start date from among all of its successors. If the activity has no successors, the project finish date is used. Since free float is meaningless for hammocks, it is set to zero. For the common case where all lags are finish-to-start lags of zero, the free float represents the number of work days that an activity can be delayed before it affects any other activity in the project.

Example: The current activity has an Early Start of March 1st and a duration of 3 days. The succeeding activity has an Early Start of March 7th. Assuming everyday is a work day, then:

FREE FLOAT = March 7 - March 1 - 3 days = 6 days - 3 days = 3 days Free float can be thought of as the amount of time an activity can expand without affecting the following activity. If the current activity takes longer to complete than its projected duration and free float combined, the following activity will be unable to begin by its earliest start date.

Gantt (Bar) Chart: A Gantt chart is a graphic display of activity durations. It is also referred to as a bar chart. Activities are listed with other tabular information on the left side with time intervals over the bars. Activity durations are shown in the form of horizontal bars.

Histogram: A histogram is a graphic display of resource usage over a period of time. It allows the detection of overused or underused resources. The resource usage is displayed in coloured vertical bars.

The ideal level for a resource on the screen is indicated by another colour (typically red). The vertical height is produced by the value specified in the maximum usage field of the Resource Label window. (The printed histogram uses a horizontal line to display the maximum usage set in the Resource Label window.) If the resource bar extends beyond the red area for any given day, resources need to be levelled (or spread out) for proper allocation. The resource histograms should be checked after resources are assigned to the project activities.

Lag: Lag is the time delay between the start or finish of an activity and the start or finish of its successor(s). See FINISH-TO-FINISH LAG, FINISH-TO-START LAG, and START-TO-START LAG.

Late Finish: Late Finish dates are defined as the latest dates by which an activity can finish to avoid causing delays in the project. Many PM software packages calculate late dates with a backward pass from the end of the project to the beginning. This is done by selecting ANALYZE & PROCESS REPORTS from the Report pull-down menu.

Late Start: Late Start dates are defined as the latest dates by which an activity can start to avoid causing delays in the project. Many PM software packages calculate late dates with a backward pass from the end of the project to the beginning.

Micro-Scheduling: Micro-scheduling is the scheduling of activities with duration less than one day (in hours or fractional days).

Milestones: A milestone is an activity with zero duration (usually marking the end of a period).

Multi-Project Analysis: Multi-project analysis is used to analyse the impact and interaction of activities and resources whose progress affects the progress of a group of projects or for projects with shared resources or both. Multi-project analysis can also be used for composite reporting on projects having no dependencies or resources in common.

Negative Float: Negative float indicates activities must start before their predecessors finish in order to meet a Target Finish date. All float is calculated when a project has its schedule computed. Negative float occurs when the difference between the late dates and the early dates (start or finish) of an activity are negative. In this situation, the late dates are earlier than the early dates. This can happen when constraints (Activity Target dates or a Project Target Finish date) are added to a project.

Network Analysis: Network analysis is the process of identifying early and late start and finish dates for project activities. This is done with a forward and backward pass through the project. Many PM software tools will check for loops in the network and issue an error message if one is found. The error message will identify the loop and all activities within it.

Network Diagram: A network diagram is a graphic representation of activity sequence and relationships. Activity boxes are connected together with one-way arrows to indicate precedence. The first activity is placed on the left side of the diagram with the last activity on the right side. Activity boxes are usually placed at different levels (not in a single row) to accommodate activities that are done simultaneously.

Parallel Activities: Parallel activities are two or more activities than can be done at the same time. This allows a project to be completed faster than if the activities were arranged serially in a straight line.

Path: A path is a series of connected activities. Refer to CRITICAL PATH METHOD for information on critical and non-critical paths.

Positive Float: Positive float is defined as the amount of time that an activity's start can be delayed without affecting the project completion date. An activity with positive float is not on the critical path and is called a non-critical activity. Most software packages calculate float time during schedule analysis. The difference between early and late dates (start or finish) determines the amount of float.

Float time is shown at the end or the beginning of non-critical activities when a bar chart reflects both early and late schedules. Float is shown on many of the tabular reports.

Precedence Notation: Precedence notation is a means of describing project work flow. It is sometimes called activity-on-node notation. Each activity is assigned a unique identifier. Work-flow direction is indicated by showing each of the activity's predecessors and their lag relationships. Graphically, precedence networks are represented by using descriptive boxes and connecting arrows to denote the flow of work.

Predecessor: An activity that must be completed (or be partially completed) before a specified activity can begin is called a predecessor. The combination of all predecessors and successors (see SUCCESSOR) relationships among the project activities forms a network. This network can be analysed to determine the critical path and other project scheduling implications.

Program Evaluation and Review Technique (PERT): PERT is a project management technique for determining how much time a project needs before it is completed. Each activity is assigned a best, worst, and most probable completion time estimate. These estimates are used to determine the average completion time. The average times are used to figure the critical path and the standard deviation of completion times for the entire project.

Project: A project is a one-time effort to accomplish an explicit objective by a specific time. Each project is unique although similar projects may exist. Like the individual activity, the project has a distinguishable start and finish and a time frame for completion. Each activity in the project will be monitored and controlled to determine its impact on other activities and projects.

Rescheduling: Rescheduling is a feature of most PM software that recalculates the start and finish dates of all uncompleted activities based upon progress as of a specified date.

Resource: A resource is anything that is assigned to an activity or needed to complete an activity. This may include equipment, people, buildings, etc.

Resource Based Duration: Resource based duration provides the option to determine activity duration, remaining duration, and percent complete through resource usage. The resource requiring the greatest time to complete the specified amount of work on the activity will determine its duration. You may change the duration mode for an activity at any time. This feature may not be used without values in the Resource Usage fields.

Resource Levelling: Resource levelling provides the capability to adjust project schedules in order to minimize the peaks in daily resource usages. This is usually done when resources are over-allocated. Activities are moved within their available float to produce a new schedule.

Resources and projects may have levelling priorities. Some activities may not have any rescheduling flexibility due to lack of float. Either resource-constrained or schedule-constrained levelling may be selected.

Scheduling: Scheduling is the process of determining when project activities will take place depending on defined durations and precedent activities. Schedule constraints specify when

an activity should start or end based on duration, predecessors, external predecessor relationships, resource availability, or target dates.

Sequence: Sequence is the order in which activities will occur with respect to one another. This establishes the priority and dependencies between activities. Successor and predecessor relationships are developed in a network format. This allows those involved in the project to visualize the work flow.

Slippage: Slippage is the amount of slack or float time used up by the current activity due to a delayed start. If an activity without float is delayed, the entire project will slip.

Start Float: Start float is the amount of excess time an activity has between its Early Start and Late Start dates.

Start-To-Start Lag: Start-to-start lag is the minimum amount of time that must pass between the start of one activity and the start of its successor(s).

Starting Activity: A starting activity has no predecessors. It does not have to wait for any other activity to start. Many PM software packages permit multiple start activities if needed.

Sub-Critical Activity: A sub-critical activity has a float threshold value assigned to it by the project manager. When the activity reaches its float threshold, it is identified as being critical. Since this type of criticality is artificial, it normally does not impact the project's end date.

Subproject: A subproject is a distinct group of activities that comprise their own project which in turn is a part of a larger project. Subprojects are summarized into a single activity to hide the detail.

Successor: A successor is an activity whose start or finish depends on the start or finish of a predecessor activity. Refer to PREDECESSOR for related information.

Super-Critical Activity: An activity that is behind schedule is considered to be super-critical. It has been delayed to a point where its float to calculated to be a negative value. The negative float is representative of the number of units an activity is behind schedule.

Target Finish -- Activity: Target Finish is the user's imposed finish date for an activity. A Target Finish date is used if there are pre-defined commitment dates. Most PM software will not schedule a Late Finish date later than the Target Finish date. Your favorite PM software may alert you to negative float which occurs when a Late Finish date is later than a Target Finish date. This is caused by the duration of predecessors which makes it impossible to meet the Target Finish date. The negative float can be eliminated by reducing the duration of predecessors or extending the Target Finish date.

Target Finish -- Project: A user's Target Finish date can be imposed on a project as a whole. A Target Finish date is used if there is a pre-defined completion date. Most PM software will not schedule any Late Finish date later than the Target Finish date. See TARGET FINISH ACTIVITY on how to deal with negative float.

Target Start -- Activity: Target Start is an imposed starting date on an activity. Most PM software will not schedule an Early Start date earlier than the Target Start date.

Total Float: Total float is the excess time available for an activity to be expanded or delayed without affecting the rest of the project -- assuming it begins at its earliest time. It is calculated using the following formula: TOTAL FLOAT = LATEST FINISH - EARLIEST START - DURATION

Work Breakdown Structure (WBS): A product-oriented listing, in family tree order, of the hardware, software, services and other work tasks that completely defines a product or program. The listing results from project engineering during the development and production of a materiel item. A WBS relates the elements of work to be accomplished to each other and to the end product.

The subdivision continues until the lowest required level of detail is established. These end units of the WBS become the activities in a project. Once implemented, the WBS facilitates summary reporting at a variety of levels.

Work Flow: Work flow is the relationship of the activities in a project from start to finish. Work flow takes into consideration all types of activity relationships.

Work Load: Work load is the amount of work units assigned to a resource over a period of time.

Work Units: Work units is the measurement of resources. For example, people as a resource can be measured by the number of hours they work.

Zero Float: Zero float is a condition where there is no excess time between activities. An activity with zero float is considered a critical activity. If the duration of any critical activity is increased (the activity slips), the project finish date will slip.

Recommended Reading

PMI (Project Management Institute), PMBOK, Project Management Body of Knowledge, 1996 version of guide available online at
http://www.projectability.co.uk/downloads/pmbok.pdf

J. Rodney Turner	The Handbook of Project Based Management
Eliyahu M. Goldratt	The Goal, It's not luck, Critical Chain
Lawrence P. Leach	Critical Chain Project Management
R Wysocki, R Beck, D Crane	Effective Project Management

Appendix 1: Belbin test for team role assessment