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# Project Management in a Commercial Environment

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## *Abstract*

*Projects are proposed as a result of creative ideas and as responses to problems and planning. While relatively small projects can be managed on an informal basis, complex projects require formal project management in order to achieve specific objectives, obtain and allocate resources in an efficient and effective manner, meet allocated budgets, and ensure that critical time schedules are met. This paper examines the principal elements of project management by analysing the key roles which Project Managers play, the roles with which the Project Manager must interact, the methods available for the definition, monitoring, control and closure of the project activities. Risk management is examined in terms of risk identification, evaluation and management. Mechanisms for project monitoring, control and quality assurance are discussed. Finally, current project management methodologies are outlined.*

## Introduction

Projects exists to provide defined benefits to the organisation and a significant aspect of the project management task is to generate realistic goals, adequately estimate the time and cost required to achieve these goals, and to manage the project in a way which produces the desired outcome while expending as little resource as is practicable within the constraint of realising the overall goals (TPi 1999).

This paper introduces project management in terms of what tasks need to be done and how they should be organised to ensure successful project completion. Section 2 gives an overview of a project and outlines the need for project management. The main project participants and their roles are identified. These are project champions, sponsors, stakeholders, customers/suppliers, the steering group and the project manager. Section 3 looks at project development in terms of the project scope, goals, objectives and the project plan which outlines the who, what, how and when questions that must be answered when a company is undergoing change of any kind. Section 4 considers risk identification, evaluation and management. Section 5 evaluates project control and monitoring mechanisms. Finally, Section 6 reviews the main project management methodologies currently used in commercial projects.

## *Project Management*

### Need for Project Management

A **Project** has been defined as a '*temporary endeavour undertaken to create a unique product or service*' (PMBOK 1983). This definition was further refined by Wysocki as '*A project is a sequence of unique, complex and connected activities having one goal or purpose and that must be completed by a specific time, within budget and according to specification*' (Wysocki *et al* 1995) . In general, projects have seven characteristics (i) a one time focus, (ii) a specific purpose and desired results, (iii) a start and a finish, (iv) a time frame for completion, (v) the involvement of a cross-functional group of people, (vi) a limited set of resources and (vii) a logical sequence of interdependent activities (Randolph and Posner 1992).

No project can run efficiently without some sort of management. In any project, someone has to plan what has to be done and keep track of how things are going in relation to the plan (Britton 1997). The definition of **Project Management** by the PMBOK is *'the application of knowledge, skills, tools and techniques to project activities in order to meet or exceed stakeholder needs and expectations from a project*' (PMBOK 1996). More recently, this definition has been expanded as *'project management is the process of defining, planning, directing, monitoring and controlling the development of an acceptable system at minimum cost within a specified timeframe*' (Whitten & Bentley 1998).

In order to decide which projects should be pursued, an organisation must evaluate the costs, benefits and risks associated with each one. Overall an organisation should give highest priority to projects that promise significant benefits and a manageable level of risk (Donaldson Dewitz 1996). Effective Project Management works under the triple constraints of ‘getting work done, within budget, to specification’ (Davidson Frame,2000).

The Project Management Book of Knowledge (PMBOK) Guide describes the progression of activities that occur within a project as initiating, planning, executing, controling and closing. Movement from one phase of the project to another is based on established milestones that must be accomplished (PMI 1996).

A successful project is one where the product is delivered, customers perceived requirements are met, the supplier is able to continue further production and the customer is willing to use the supplier again (Norris *et al* 1993). More importantly, the project has been completed on time, within budget and to performance requirements (Markland *et al* 1995).

## *Project Participants*

### Champions, Sponsor, Stakeholders. Customers/Suppliers

**Project Champions** are individuals who take an idea for a new product or service and do all they can within their power to ensure its success (Schön 1963, Afuah & Tucci 2000). By actively promoting the idea and communicating and inspiring others they can help the organisation reach its potential (Howell & Higgins 1990). The project champion is the person who sells the project to management (Whitten & Bentley 1998).

**Sponsors** A project originates in the sponsors belief in it's need (Davis 1994). A sponsor is usually a senior level manager , whose protection sends a signal to political foes that they are dealing with a senior executive and who's support reassures the Champion and other key individuals involved in the project (Roberts & Fusfeld 1980). The sponsor is usually the person / department that underwrites the cost of the project (Whitten & Bentley 1998). Sponsors facilitate the initiating of the project by communicating the vision, providing resources and establishing project boundaries (Grauf 1995).

**Stakeholders** are the people and groups with an interest in the project and who can affect its outcome even if they are neither its participants or its customers (Alter 1999). Key issues for project management include the identification of any stakeholders, pressure groups and interested parties (Boddy & Buchanan 1992) and the evaluation of their impact on the project (Laudon & Laudon 2000).

**Customers** and **Suppliers** might be the same corporate body or may be independent of one another. The customer specifies the desired outcome of the project, makes use of the outcome and probably pays for the project, while suppliers provide the resources and skills to create that outcome (CCTA 1999).

### Steering Group

A link between the project group and the sponsor/ owners is made by means of the steering group which meet regularly and provide guidance on the directions and priorities of the work, monitor progress and discuss difficulties particularly where external relationships are concerned. This group will generally bring together representatives of different organisations or departments involved in sponsorship of the project (Friend & Hickling 1997).

### The Project Manager

Managers in any organisation formulate action plans to solve organisational problems, allocate the human and financial resources to achieve strategy and co-ordinate the work (Laudon & Laudon 2000). Projects are seen as separate and distinct from the normal organisational activities and the project managers role is seen as that of managing change, often facing the triple constraints of time, money and the specification (Boddy & Buchanan 1992).

The project manager has to collect information about what exactly needs to be done and how it is to be organised, how much it will cost and how long it will take and then look at the interdependencies of various tasks, skills and other resources (Morris 1994).

Project managers typically need to get things done with the co-operation of groups or functions over whom they have no formal authority. They have to engage in structured communication processes in order to ensure that all project members understand the goal and objectives of the project, each persons role within the project, reporting requirements and the quality standards to be met (Boddy & Buchanan 1992).

Once the project has begun the project manager directs the project activities and evaluates progress (Whitten & Bentley 1998). Boddy & Buchanan (1992) have proposed that project managers need to manage in four directions :

1. *Managing Up*

   Project Managers have to influence the attitudes and actions of senior managers in the processes of shaping goals, negotiating for adequate resources or seeking other forms of commitment and support. Senior managers, in turn, need help from project managers to articulate their vision of what the project can do and what realistic expectations might be ((Boddy & Buchanan 1992).

2. *Managing Across*

   Most projects depend on co-operation of other departments or external organisations to provide expert support, to advise on functional operations, to provide members of the project team or to change the way they operate as changes are brought in. Conflicts and disagreements among the key stakeholders may need negotiation to a solution and continuing effort is generally needed to maintain a sense of commitment to the project (Boddy & Buchanan 1992).

3. *Managing the Team*

   The temporary nature of project teams, the varying knowledge and interest of the members and the competing demands on each individuals loyalty makes this task difficult for the project manager (Boddy & Buchanan 1992). Project teams need to meet regularly to discuss and monitor progress (Whitten & Bentley 1998). Management of Project Teams is increasingly a specialised field of knowledge with a defined and growing set of principles, tools, metrics and procedures (Adler 2000). Members of the project team need to understand their own individual roles and responsibilities as well as their reporting relationship to the project manager (Whitten & Bentley 1998). Randolph and Posner (1992) have put forward a set of rules for successfully leading a project team summarised by the acronym DRIVER which stands for

   **D**evelop the people individually and as a team

   **R**einforce the commitment and excitement of people

   **I**nform everyone connected with the project

   **V**italise people by building agreements

**E**mpower yourself and others

**R**isk approaching problems creatively.

Developing people is essential to a successful project, project managers must be just as concerned with team members' emotions and attitudes as they with budgets and deadlines (Markland *et al* 1995).

4. *Managing the Staff*

Project managers need to ensure the commitment of a wide range of staff, on whom the success of the project ultimately depends. Some need to change their way of working or cope with additional work, others may be called on to help the project team design solutions (Boddy & Buchanan 1992). Boehm (1981) found that capabilities of personnel were more than twice as important as any other factor in the management of successful software projects.

The project managers most difficult and important function is managing the project, monitoring tasks, schedules, costs and expectations in order to control those elements (Whitten & Bentley 1998).

## *Project Development*

### Scope

Project scope specifies what is or is not included in the study, it limits the functions and business areas addressed by the project and ensures that the project is focused (Donaldson Dewitz 1996). When describing what is to be achieved, it is sensible to state explicitly anything excluded from the project that some parties might have otherwise have expected to be included (Field 1995).

Project assumptions and constraints define those factors that cannot change, these might include absolute deadlines, available resources, current and expected technological advances (Whitten & Bentley 1998). Project constraints limit the resources allocated which include time, money and personnel, all of which are limited for any organisation. Other constraints may impose user requirements that the system must satisfy, for example, the system must be easy to learn and use. Any incompatibilities between objectives and constraints need to be recognised as early in the project as possible (Donaldson Dewitz 1996).

The scope statement is a narrative document which provides a basis for (i) a contract between the project team and the customer, (ii) confirming a common understanding of the project scope, (ii)) change control and (iv) making future project decisions (Thomas 2000).

## *Goals*

Effective project management requires clear, measurable goals and a definition of the benefits which the business will obtain by developing the system (Donaldson Dewitz 1996). Every project should have

one overriding goal (Whitten & Bentley 1998). Clearly defined goals are necessary to make the proper trade-offs in time, schedule and performance during the project (Markland *et al* 1995).

## *Objectives*

Objectives are dated and measurable actions, results or conditions that are directed toward achievement of the project goal. They can be considered as a yardstick which ultimately measures the success or failure of the project (Whitten & Bentley 1998). The completion of the projects objectives will achieve the project goals (Markland *et al* 1995). Deliverables are tangible work products whose specification at each project step is a way of ensuring that the work is progressing - they provide a running history of what was done, when it was done and why it was done (Alter 1999).

## *The Project Plan*

A project plan outlines initial answers to the *who, what, how* and *when* questions that must be answered when a company is undergoing change of any kind. The project plan is a summary of a project that divides it into sub-projects with start and completion times and identifies staffing, resource requirements and dependencies between project steps (Alter 1999). Having a plan helps in identifying unanticipated and organisational problems as they arise and in evaluating their impact (Alter 1999).
Delivering a high quality information system is not sufficient, the system must be delivered on time, within budget and with a high level of user commitment. Hence, how the development process is managed is as important as the quality of the product delivered (Donaldson Dewitz 1996). Randolph and Posner (1992) have developed an acronym for successfully reaching the finish line of a project known as GO-CARTS which stands for :

Set a clear **G**oal
Determine the **O**bjectives
Establish **C**heckpoints, **A**ctivities, **R**elationships and **T**ime estimates
Create a **S**chedule.

## *Task Definition*

An estimate is a document setting out a proposed budget for the project. You cannot estimate accurately how much a project, or part of a project will cost to implement until you know what it involves. Estimating a project involves determining what tasks have to be done in terms of the time and resources each task will take and the order in which the tasks must be carried out in order to optimise the effective use of the available resources (Keller 1995).

## Work Breakdown Structures

The work breakdown structure (WBS) is a hierarchical decomposition of the project into phases, activities and tasks (Whitten & Bentley 1998). The National Aeronautics and Space Administration's *Handbook for Preparation of Work Breakdown Structures (1975)* defines the WBS as '*..a family tree subdivision of effort required to achieve an objective. The WBS is developed by starting with the end*

*objective required and successfully subdividing it into manageable components in terms of size and complexity. It should be task or product orientated and should include all the necessary effort which must be undertaken to achieve the end objective*'.

The work is specified in ever finer detail until a task list emerges, equivalent to the statement of work that describes in detail the work one individual or a very small team will carry out (Rook 1991). It should be possible to test whether a package of work is complete and the work elements should be well-defined tasks that can be completed in a reasonable period of time (Keller 1995).

A method for depicting the WBS includes an outline format as shown in Figure 1

```
1.      Phase 1 of the Project
   1.1 Activity 1 of Phase 1
       1.1.1   Task 1 of Activity 1.1
           1.1.1.1                 Step 1 of 1.1.1
           1.1.1.2                 Step 2 of Task 1.1.1
           1.1.1.3                 . . . .
       1.1.2   Task 2 of Activity 1
       1.1.3   . . . .
   1.2 Activity 2 of Phase 1
2.      Phase 2 of the project
```

**Figure 1** : Outline WBS for a project (Whitten & Bentley 1998).

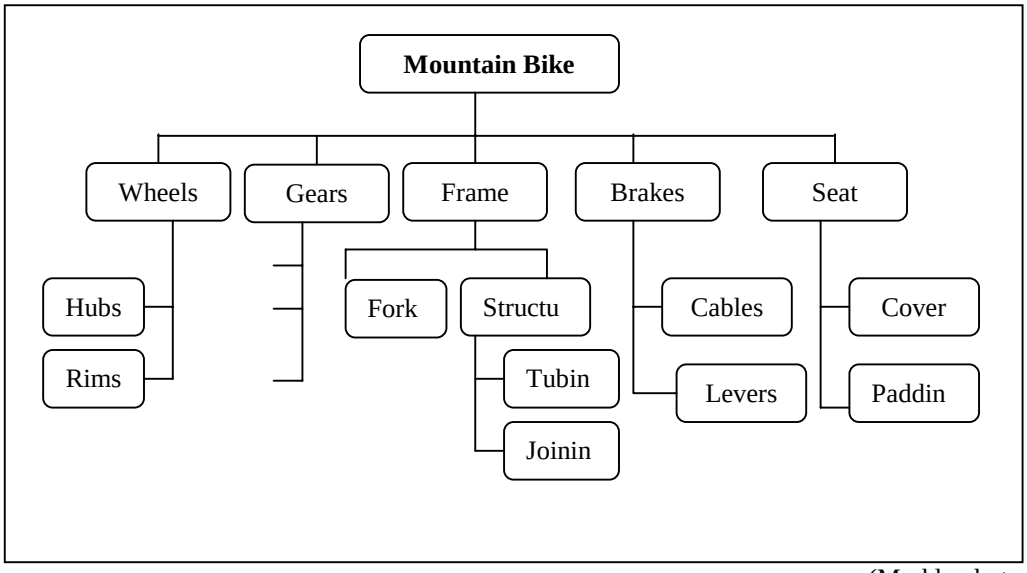
The WBS is not concerned with the order in which the tasks are done, how long they might take or how many people are needed (Markland *et al 1995).* At the lowest level of the structure, each task list item becomes a specific statement of the task to be done known as a Work Package (Keller 1995). Work Packages (WPs) are defined in BS 6046 Part 1 (1992) as '.. *related products and functions brought together ... [to form] parcels of work which can be individually planned, resourced and costed which can be used to produce a project budget and to monitor performance against this. They are not restricted by date boundaries or by project phases* '.

A WP Document specifies a statement of work (SOW) for the work to be done for each package described in the WBS and determines what is to be done, who is responsible, start and completion dates, deliverables and milestones for the package. The SOW will include details of the supplies, materials, components and parts that will be required for each WP (Keller 1995). A milestone is an event that signifies major accomplishments or events during a project such as the completion of a phase or the production of a deliverable (Whitten & Bentley 1998). Inadequate development of the work breakdown structures (WBS) will likely cause a future effect of an incorrectly developed schedule (Bailey 2000).

## Product Breakdown Structures

In some projects, it may be necessary to use a product breakdown structure (PBS) which deals with machinery, equipment and software which consists of components that need to be estimated separately. This will allow comparisons to be made between elements from different suppliers in order to determine optimum choice and to estimate costs (Keller 1995).

**Figure 2** : An example of part of a PBS diagram for designing a mountain bike.




(Markland *et al 1995)*

## Cost Breakdown Structures

The cost breakdown structure (CBS) shows details of all the cost categories for a project and will include information garnered from the WBS, WP definitions and SOWs, PBSs if they have been required. Other cost items, including labour costs, expenses and overheads will also be included (Keller 1995).

## *The Project Schedule*

The essence of project management is controlling tasks that occur in a particular sequence and have an expected duration. Dividing the project into steps clarifies what need to be done and helps the people doing the project understand what they have to do and where it fits into the overall project (Alter 1999). Many projects must be completed within a deadline around which the project schedule must be built (Whitten & Bentley 1998). The project schedule is a terse project description identifying the timing of major steps and who will do the work (Alter 1999). The project schedule should be developed with an understanding of task time requirements, personnel assignments and inter-task dependencies.

## Milestones

The first step in drawing up a schedule is to divide the work into main phases. A baseline is used to represent the status of the project at the end of significant phases of work (Field 1995). Milestones are events that signify major accomplishments or events during a project phase (Whitten & Bentley 1998). The characteristic of a good milestone is that there should be no room for doubt about whether it has been passed or not (Field 1995). Managers can put a date to a milestone and use it to monitor development of the project (Britton, 1997).

## Project Timing

The work breakdown structure (WBS) discussed in Section 3.5.1 does not address the timing of individual work elements (Markland *et al* 1995). A **Gantt chart** is a simple horizontal bar that depicts project tasks against a calendar.

Each bar represents a named project task, the tasks are listed vertically using a horizontal time scale (Whitten & Bentley 1998). Each activity in the Gantt chart is an element in the WBS structure, so a cross reference can be made to the WBS to show information about that activity. Figure 3 shows a typical Gantt chart.

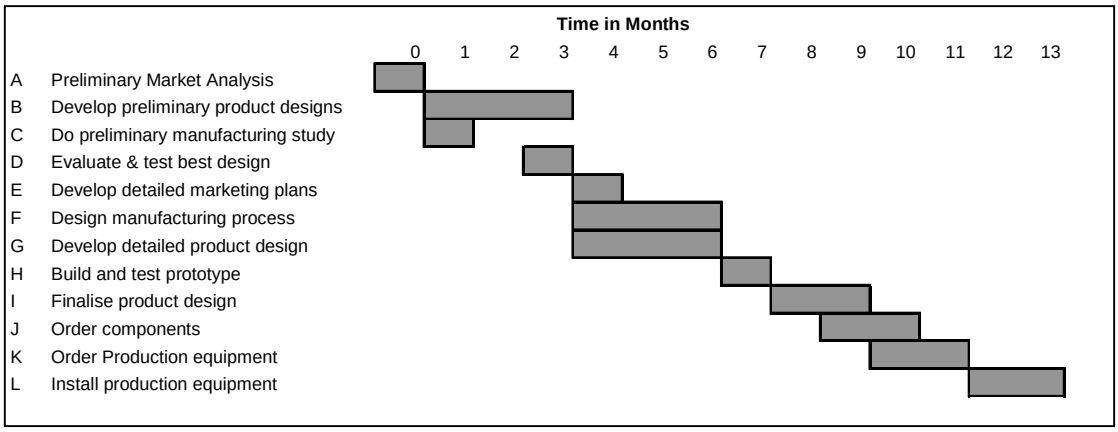



**Figure 3 :** Gantt Chart for Mountain Bike Development Project (Markland 1995)

There are a number of variations on the simple Gantt chart which convey more information, colour may be used to show activities that are the responsibility of a particular department or to indicate progress on a particular activity (Field 1995).

However, Gantt charts do not explicitly express the precedence relationships of activities (Markland *et al* 1995) except by inference (Field 1995).

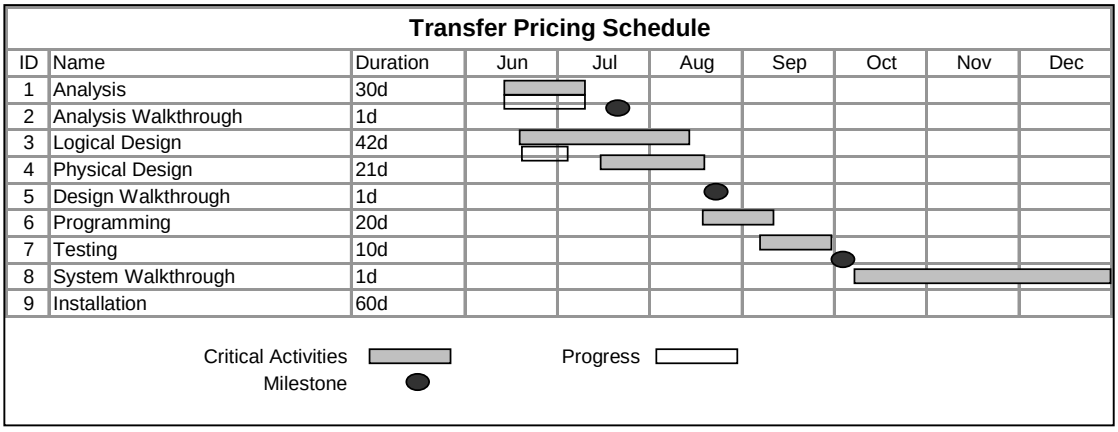



**Figure 4** : Gantt Chart for Planned Sequence and Timing of the Different Steps in an Information System Project (Alter 1999)

## Network Techniques

These are used to portray graphically the interrelationships of the elements of a project and to show the order in which the activities must be performed (Markland *et al* 1995). To develop a network, the planner has to be able to answer two questions for each activity (i) what must be done before this activity can start? and (ii) what can be done once this activity finishes? Activities that can overlap in time can then be ascertained (Field 1995). One of two methods - *activity-on-arrow* or *activity-on-node* is used to construct project networks (Markland *et al* 1995).

## Activity-on-Arrow

An activity-on-arrow diagram is shown in Figure 5. Each activity is represented by an arrow which starts and finishes at a node which represents an event, a point of zero time duration, which signifies the completion of *all* the activities leading to that node.

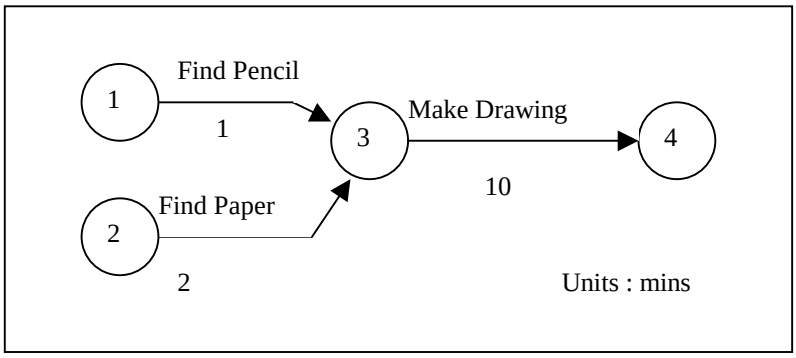



**Figure 5 :** Activity-on-arrow Network (Field 1995)

In Figure 5, the activity *Find Pencil* is independent of *Find Paper* but only when both have been completed is Event 3 reached and the activity *Make Drawing* be started.

## Critical Path

Given the estimated duration of each activity, the minimum time necessary for the whole project can be calculated - the time taken from the longest path from the beginning to end which is known as the Critical Path (Whitten & Bentley 1998). There may be more than one critical path in a network if there are several paths of the same length and the activities are usually referenced back to the WBS references (Field 1995). Given the activity durations from the project network, the minimum completion time for the project can be determined by adding the critical path activity time-spans (Makeland *et al* 1995). Therefore, it is possible to determine whether the project will fit into the time allowed for it (Fields 1995).

## Analysing the Network

Since each activity in the Network diagram has been given an estimated duration, the earliest time at which each node can be reached can be found (in Figure 5, the earliest time node 3 could be reached is 2 minutes). Most projects will have a required completion date, so the latest time by which each node must be reached can be calculated backwards in order to meet this requirement. Figure 6 shows how the activity-on-arrow diagram would be drawn if the completion time for the project in Figure 5 was 15 minutes.

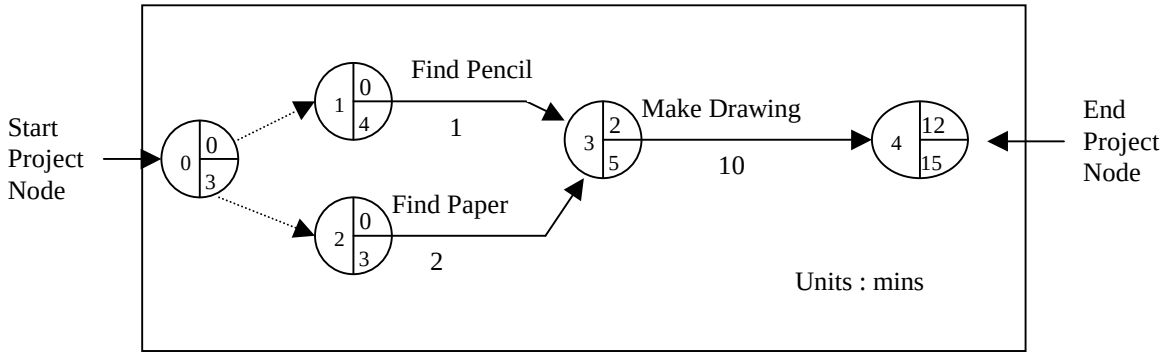



**Figure 6** : The Drawing Project Analysed (Field 1995)

The convention shown in Figure 6 is the British Standard System where 3 is the Node Identifier, 2 is the earliest event time and 5 is the latest event time (BS6046 1992).

Some activities could increase in duration while still enabling the project to be completed by the required date, such activities exhibit **Float**, which is the excess time available for an activity in addition to its estimated duration without delaying the project (Markland *et al* 1995).

## Program Evaluation and Review Technique *(PERT)*

In the Activity-on-node network, the roles of the node and arrow are reversed. The large compartment in the middle can be used to contain the event description, the top corners show the earliest start (EST) and finishing times (EFT) as calculated for the activity-on-arrow network. The bottom row shows the latest start (LST) and finishing (LFT) times and the total float (BS 6046). The redundant information given in the nodes has the advantage of displaying all the data on an activity without requiring further calculation (Field 1995).

| | | |
|---|---|---|
| EST | Duration | EFT |
| Activity Identifier | | |
| LST | Float | LFT |

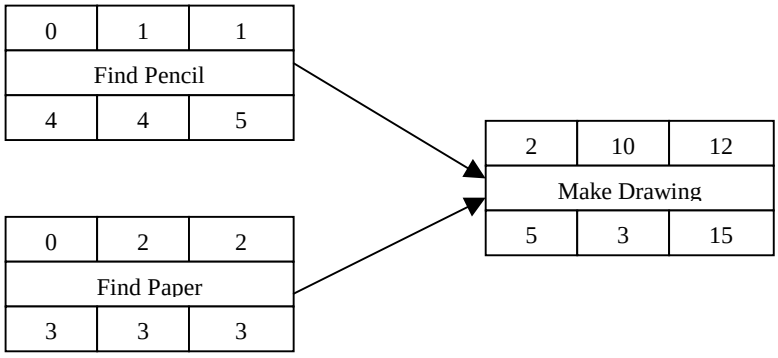



**Figure 7** : The activity-on-node Network Diagram for the Drawing Project (Field 1995)

PERT diagrams can be easily used to represent relationships between activities other than the normal finish-to-start relationships, these relationships might also include a lapse of time - **lag** - between two activities. Figure 8 shows and example of a situation where there is four week lag between starting the design and beginning the manufacture of a component regardless of the duration of the design activity (Field 1995)

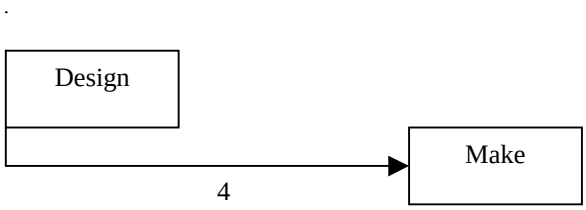



**Figure 8 :** Start -to Start Lag (Field 1995)

The network diagram of the activities and their dependence on each other need not change significantly even when the estimated duration for activities is altered (Field 1995).

Project Management software allows the best feature of PERT - the critical path analysis - to be incorporated into Gantt Charts. As activities, their duration and dependencies are entered, Gantt Charts are scheduled to take into consideration the dependencies with the critical path highlighted in bold facing or colour (Whitten & Bentley 1998). As the project proceeds, the chart can be updated with actual progress allowing a clear view of whether the project is on schedule be easily seen (TPi 1999). There are a number of computer based software packages available including MS Project, SuperProject which carry out these functions.

## *Resources and Scheduling*

The task of managing a project involves deploying resources to achieve a specific result. Resources are usually limited and they can have a significant effect on the ability to complete a project on time and within budget (Markland *et al* 1995). There are two extreme situations, the first the case of unlimited resources within a fixed time project and the case of limited resources within a flexible project time. When unlimited resources are available, the objective of time scheduling is to profile the resource usage as economically as possible (Field 1995). When resources are limited, the project manager must utilise available resources to optimise the smooth running of the project, by prioritising the tasks according to the critical path through the project (Field 1995).

## Estimation

As a project moves forward, there is a planning wave that rolls ahead of activity execution and elaborates the detail of the work about to be done (Harrison 1992). Similarly, organising and staffing are continuing activities (Field 1995). Project estimation can be described as the process of assembling and predicting costs of a project over its life cycle, forecasting is the process of developing future trends along with the assessment of future probabilities, uncertainties, and inflation that could occur in the project (Thomas 2000). Estimating a project will require several iterations, as more is known about tasks, materials and human resources the estimate must be refined (Field 1995). Cost budgeting is the process of establishing budgets, standards and a monitoring system by which the investment cost of the project can be measured and managed (PMI 1996). There are a number of distinct tasks to be undertaken in the process of estimating. These include:

1. A task list from the WBS
2. A list of materials, components, supplies
3. A PBS if required
4. A cost breakdown structure and cross references
5. Applying a rate to the cost of staff time
6. Any data not included above, for example extra temporary project staff

(Keller 1995)

Anticipated cost escalation as a result of inflation during the project must be also be included (Harrison 1992). In addition to this, the project estimate will need to include contingency allowances to cover minor changes and omissions and to provide some insurance against risk (Keller 1995).

## Contract

Contract terms normally encompass price, delivery criteria, completion time, payment guarantees, penalties and exclusion clauses. Both the client and contractor need to check that the contract contains a complete specification of what is to be done, states any constraints on how it is to be done, includes any standards or intellectual property rights that need to be adhered to by the contractor, sets out key delivery dates and milestones including interim stages and deliverables and ascertain whether any allowance for controlled change is included (TPi 1999).

## Risk

Risk is a major factor to be considered during the management of a project. Risk has been defined as '*The chance of exposure to the adverse consequences of future events*' (CCTA 1999). Project risk is the likelihood that a proposed system will not satisfy the project goals (Donaldson Dewitz 1996). The sooner a problem is discovered, the sooner corrective action can be taken and the possible side effects of the problem curtailed (Britton 1997). In order to contain the risks during a project, they must be managed in a disciplined manner, this involved risk analysis and risk management (CCTA 1999).

Risk assessment involves obtaining a clear definition of risk, including the sensitivity of the project to the risk and the likelihood of the risk occurring (Keller 1995). Highly structured projects whose requirements are straightforward and clearly defined, where the users know what they want, what the project out come should be and where their needs are unlikely to change run a much lower risk that projects whose requirements are relatively undefined, fluid and constantly changing, where outputs cannot easily be fixed because they are subject to users changing ideas or where the users cannot agree on what they want (Laudon & Laudon 2000).

## Risk Identification

The process of risk assessment is more than simply identifying the risks, it includes a clear definition of risks, analyses the risks in terms of their impact on performance, cost, schedule and quality and estimated projects exposure ( the probability of the risk occurring during the execution of the project) and prioritises the risks according to that exposure (Keller 1995). Figure 9 shows how assessments of risk fit into the planning of a project.

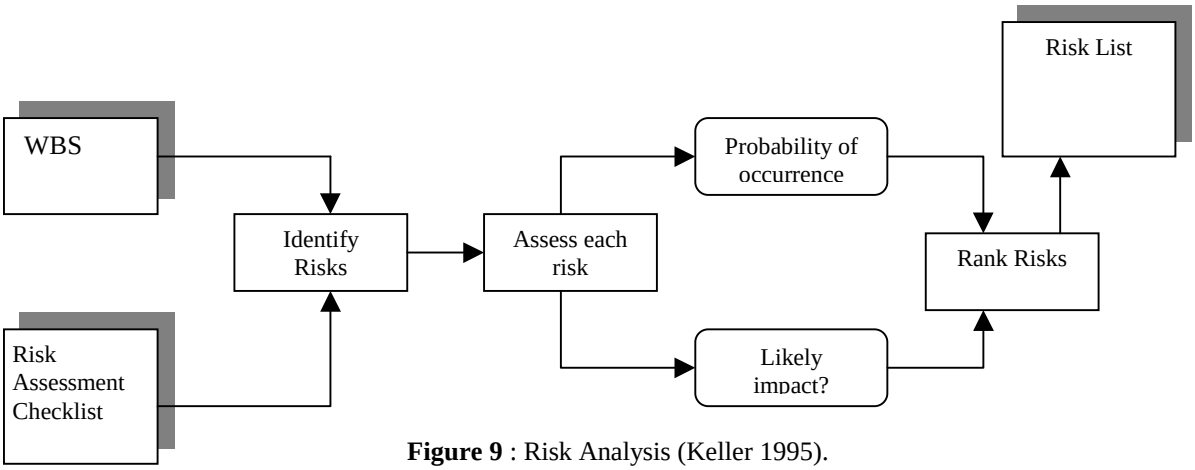



**Figure 9** : Risk Analysis (Keller 1995).

## *Risk Evaluation*

Researchers have identified three key dimensions that influence the level of project risk, these include project size, project structure and the level of technical experience of the staff and team (McFarlan 1981). These are summarised in Table 1.

| Size of Project | Structure | Technology Level | Degree Of Risk |
|---|---|---|---|
| Large | High | Low | Low |
| Small | High | Low | Very Low |
| Large | High | High | Medium |
| Small | High | High | Medium-Low |
| Large | Low | Low | Low |
| Small | Low | Low | Very Low |
| Large | Low | High | Very High |
| Small | Low | High | High |

**Table 1** : Evaluation of Project Risk (Laudon & Laudon 2000)

A project that is economically feasible may be infeasible for organisational, technical or operational reasons. A high-quality system that is delivered on time, within budget, and with high user commitment, and that helps the organisation meet its strategic objectives, will usually be one which considered the level of risk and the likelihood of the identified risks actually occurring (Donaldson Dewitz 1996). A typical Risk evaluation form is shown in Figure 10.

The higher the total score achieved in the evaluation, the lower the risk associated with the project. However, individual factors would also need to be taken into consideration because a negative rating on a few key factors can increase risk substantially. For example, negative ratings on 3c and 4c and positive ratings on all other factors would yield a total score of 10, indicating low risk. However, a

project requiring developers to use new technologies and lacking user support is actually high risk so the project managers judgement will usually be required to fully evaluate the risk involved (Donaldson Dewitz 1996). It is important to prioritise risks in terms of project exposure, effect and what problems will be associated with compounding risks (Keller 1995).

| **PROJECT RISK EVALUATION FORM** | | |
|---|---|---|
| **Project:** | **Completed By:** | **Date:** |

| **Factors affecting project risk** | **Rating*** | **Comments** |
|---|---|---|
| 1. **Characteristics of the organisation**<br>a. Has stable, well-defined objectives? | | |
| b. Is guided by an information systems plan? | | |
| c. Proposed system fits plan and addresses organisational objectives? | | |
| **2. Characteristics of the information system**<br>a. Model available/clear requirements | | |
| b. Automates routine, structured procedures ? | | |
| c. Affects only one business area?<br>(No cross functional or inter-organisational links) | | |
| d. Can be completed in less than one year | | |
| e. Uses stable, proven technology | | |
| **3. Characteristics of the developers**<br>a. Are experienced in chosen development methodology? | | |
| b. Are skilled at developing functional requirements? | | |
| c. Are familiar with technology and information architecture? | | |
| **4. Characteristics of the users**<br>a. Have business-area experience | | |
| b. Have development experience? | | |
| c. Are committed to the project? | | |
| **Total Points** | | |
| * +1=yes; 0=maybe; -1=no | | |

**Figure 10** : Project Risk Evaluation Form (Jordan & Machesky 1990)

## *Contingency Planning*

Contingency Planning involves '*identifying the range of alternative options for providing acceptable recovery strategies in the event of loss*' (PRINCE 1993). General contingency strategies are :

- **Prevention** where countermeasures are put into place which either stop the threat or problem from occurring, or prevent it having any impact on the project.
- **Reduction** where the actions either reduce the likelihood of the risk developing or limit the impact on the project to acceptable levels.
- **Transference** which is a specialist form of risk reduction where the impact of the risk is passed onto a third party.
- **Alternatives** procedures previously identified and described in detail which will come into force if and when the risk occurs or selecting alternative ways to proceed from the point at which the hazard occurs.
- **Acceptance** where it is decided to go ahead with the project and do nothing (this option should be a positive choice) (CCTA 1999).

## *Risk Management*

Risk Management is the *'identification of counter measures necessary to meet the requirements identified in risk analysis*' (Prince 1993). Risk management consists of four major activities.

**Planning** consists of identifying the quantity and type of resources required to carry out the actions and obtaining management approval for the provision of these resources.

**Resourcing** which will identify and assign the resources to be used to carry out risk avoidance. The resources required for the prevention, transfer or reduction actions will have to be funded from the project budget.

**Monitoring** - watching for early signs warning signs that a risk is developing and checking that the execution of the planned actions is having the desired effect.

**Controlling** which is taking action to ensure that the events of the plan really happen.
(CCTA 1999).

During the course of the project execution, it will be necessary to review the list of risks and risk factors to determine whether any risk has become or is likely to become critical at any time soon and whether

any new risks have arisen which require assessment and possible planning or immediate action (Keller 1995).

## *Control*

Changes are inevitable if a project is to take advantage of new opportunities, adapt to changing circumstances or to avoid problems. However, any change usually increases both the cost and duration of the project (Field 1995). Each project should have sufficient control mechanisms to allow project progress to be monitored. The controls selected for the particular project will depend upon the size of the project (TPi 1999).

### Monitoring and Control

Monitoring and control are the project manager's predominant activities during the execution of a project (Field 1995). The elements of control of any task are knowing what should happen, monitoring progress, comparing actual progress with planned progress and doing something if actual and planned progress differ (Carter *et al* 1988). Meredith and Mantel (1989) have defined control as '*the act of reducing the difference between plan and reality*'.

### Controlling the Project

Projects plans have little value if they are not executed in a controlled way that hold performance to plan (Morris 2000). The project manager needs to continually gather information about the status of the project , compare all current measurements with their desired values (as set out in the project plan) and initiate action to bring the project back under control where discrepancies occur (Field 1995). The resources expended on the project in terms of people, time and how money is spent (e.g. travel) also need to be monitored and controlled (TPi 1999).

### Controlling the Cost

The ultimate objective of project management is to monitor and control costs while keeping the project on schedule. Cost control is the process of gathering, accumulating, analysing, monitoring, reporting and managing the costs on an on-going basis (Thomas 2000). Reviewing the actual project costs for all completed and partially completed activities and comparing these costs with the planned costs can identify cost overruns for which corrective action may be taken (Markland *et al* 1995).

### Maintaining the Schedule

The method for estimating the date at which a project will be completed is to update the project network to reflect the current position. A less detailed method involves milestone tracking that concentrates on recording the rate of progress past the milestones. Deviations from the project schedule are known as slippage, which must be controlled to put the project back on track (Field 1995).

F. Brooks (1974) summarised the difficulties of getting projects back on schedule by coining the term the *mythical man-month*, which implied people are inter-changeable and can be added to a project at any time. In fact people are interchangeable only in project that require little knowledge, communication or learning and adding many new workers to an ongoing project may temporarily halt progress (Alter 1999).

Developing a course of action to quickly restore project control is critical to preserving project value, maintaining stakeholder support and improving team morale (Bailey, 2000).

## Quality

Quality is defined as part of ISO 8402 (1986) as '*..the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implicit needs*'. Quality is monitored by reviewing and testing what has been produced, a quality review is an examination of some part of the work which could vary from simply asking someone to check over work, to formal assessment of the product in which all problems are documented (TPi 1999).

Quality planning is an essential part of developing a project, to capture the quality assurance activities necessary for successful delivery. A key factor concerns acceptance criteria which provide decision rules by which a particular product can be accepted or rejected - this may include benchmarks where a deliverable may not be amenable to acceptance criteria (TPi 1999).

Validation is the process of checking that a product is what the client wants and verification checks that the product produced at one stage conforms to the specification that was supplied to it (Boehm 1981). A product of an acceptable quality will conform to all of the requirements, a product of unacceptable quality will conform to only some or none of those requirements (CCTA 1999).

A quality audit is carried out for the specific purpose of checking that quality standards are being applied, it involves establishing a review of the present state of the project against the project baseline - what was expected at this point. (Field 1995).

## Change Management

All users and managers have expectations of the project, over time these expectations can change (Whitten & Bentley 1998). The consequences of changes made during the project lifetime may be out of proportion to the actual change made, the effects of which may not be immediately apparent (Field 1995). The manager of a project can shorten the duration of an activity by assigning more resources to it. This will increase the cost of the activity and project managers need to consider such time/cost trade-offs (Markland *et al* 1995).

Changes are considered external if they directly affect the contract with the client. Despite efforts to keep fixed what the project is to achieve, new facets requiring development may be uncovered during its execution, a new technique or component may become available or the client may request changes. *Feature creep* is the uncontrolled addition of technical features to a system under development without regard to schedule and budget (Whitten & Bentley 1998). Internal changes are confined to the internal work of the project, which do not affect the agreed deliverables (Field 1995).

There is usually a standard form for the purpose of requesting and approving changes to a project, this identifies and gives the reason for the change, the requestor, the segments of the project affected and an estimate of the costs involved (Harrison 1992).

## Configuration Management

Configuration management has been defined as '*..the discipline of identifying the configuration of a system at discrete points in time for purposes of systematically controlling changes to this configuration and maintaining the integrity and traceability of this configuration throughout the system life cycle*' (Bersoff *et al* 1980). The basic idea is that the components produced during the development of a project form a configuration of identifiable items which may be changed only in an approved and recorded manner (Field 1995). An example of a configuration item could be the agreed interface between two designers of individual components of a finished item such as how a handle might fit on a door where the handle is being designed by one and the door by the other.

Configuration management has four main elements, (i) configuration identification which uniquely identifies all items, (ii) configuration control system through which changes may be made, (iii) configuration status accounting which records and reports the current status and the history of all changes made, thereby providing traceability and (iv) configuration auditing which confirms conformity between the items in the configuration and their specifications and through all project documentation (Field 1995).

For simple projects version control, component tracking and document revision can be achieved using manual methods. For larger projects there are a number of computer based tools available including MKS Source Integrity and Star Team Server (TPi 1999).

## Project Closure

Most projects have an end date, when the original objectives have been satisfied, the essence of a project closure is to inform all interested parties that the project is no longer operational (TPi 1999). A number of factors need to be taken into consideration including (i) handover and maintenance, (ii) documentation, (iii) contract completion, (iv) financial accounting and (v) the future of project staff (Field 1995).

Finally, the project should be reviewed and documented. The achievements should be compared with the plan in terms of quality, time and cost targets incorporating any follow-up actions that the project team would recommend to the client (Merdeith & Mantel 1989).

## *Methodologies*

The advantage of using a project management methodology is that some of the uncertainty of managing a project is reduced by using the framework of a defined set of techniques and procedures (Field 1995)It had been found that companies that adopt project management methodologies are more likely to meet their delivery schedules (Hart 1994). Examples of current methodologies are outlined below.

## Project Management Body of Knowledge (PMBOK)

In 1983, the Project Management Institute (PMI) published the a 'Project Management Body of Knowledge' which attempted to define what knowledge and skills the good project manager should have whose competence and skills will stem partly from their innate ability, their use of past experience and formal learning (Duncan 1994). The guide has been extensively revised and expanded and was released as the 'Guide to the Project Management Body of Knowledge' in 1996 (PMI 1996). It is possible to download the guide free from the PMI Web site at http://www.pmi.org .

The objectives of the PMI in producing the PMBOK have been to (i) identify generally accepted project management practice, produce a basic reference document, identify a common set of terms and act as a basis for project management training and accreditation (pmi.org 2000). The PMBOK is organised into nine key knowledge areas :

1. Project Integration Management
2. Project Scope
3. Project Time Management
4. Project Cost Management
5. Project Quality Management
6. Project Human Resource Management
7. Project Communications Management
8. Project Risk Management
9. Project Procurement Management

Each area is prefixed by the word Project to make clear that each area covers only those topics specific to project management (PMI 1996). The PMBOK identifies a set of processes for each phase of the project. A process is defined as '*a set of actions bringing about a result*' (PMI 1996). Five groups of processes have been have been identified : initiating, planning, executing, controlling and closing. Within each group there are *core* processes which are often interconnected so that the output of one process is input for others and *facilitating* processes such as quality planning and risk identification(Hughes & Cotterell 1999). For each process, PMBOK defines inputs, techniques that may be used and outputs (PMI 1996). One of the most useful sources to the PMBOK is the 'Project Managers Desk Reference' (Thomas 2000) which is also available on line at http://www.4pm.com.htm .

## *PRINCE*

Large organisations can have a number of projects being executed at the same time, each project making differing demands on management which in turn means that the degree of control will vary from project to project (Hughes & Cotterell 1999). The UK Government, through the Central Computer and Telecommunications Agency (CCTA) has sponsored a set of standardised procedures called PRINCE which stands for **P**rojects **IN C**ontrolled **E**nvironments which has become the *de facto* standard for government projects and is widely used in the private sector (CCTA 1999).

Although PRINCE was originally developed for the needs of information technology (IT) projects, the method as been used on many non-IT projects ((Hughes & Cotterell 1999). The method describes how a project is divided into manageable stages enabling efficient control of resource and regular progress monitoring throughout the project (TPi 1999). PRINCE is a process-based approach to project management, where the processes define the activities to be carried out. In addition, a number of components are described which are applied within the appropriate activities (CCTA 1999).

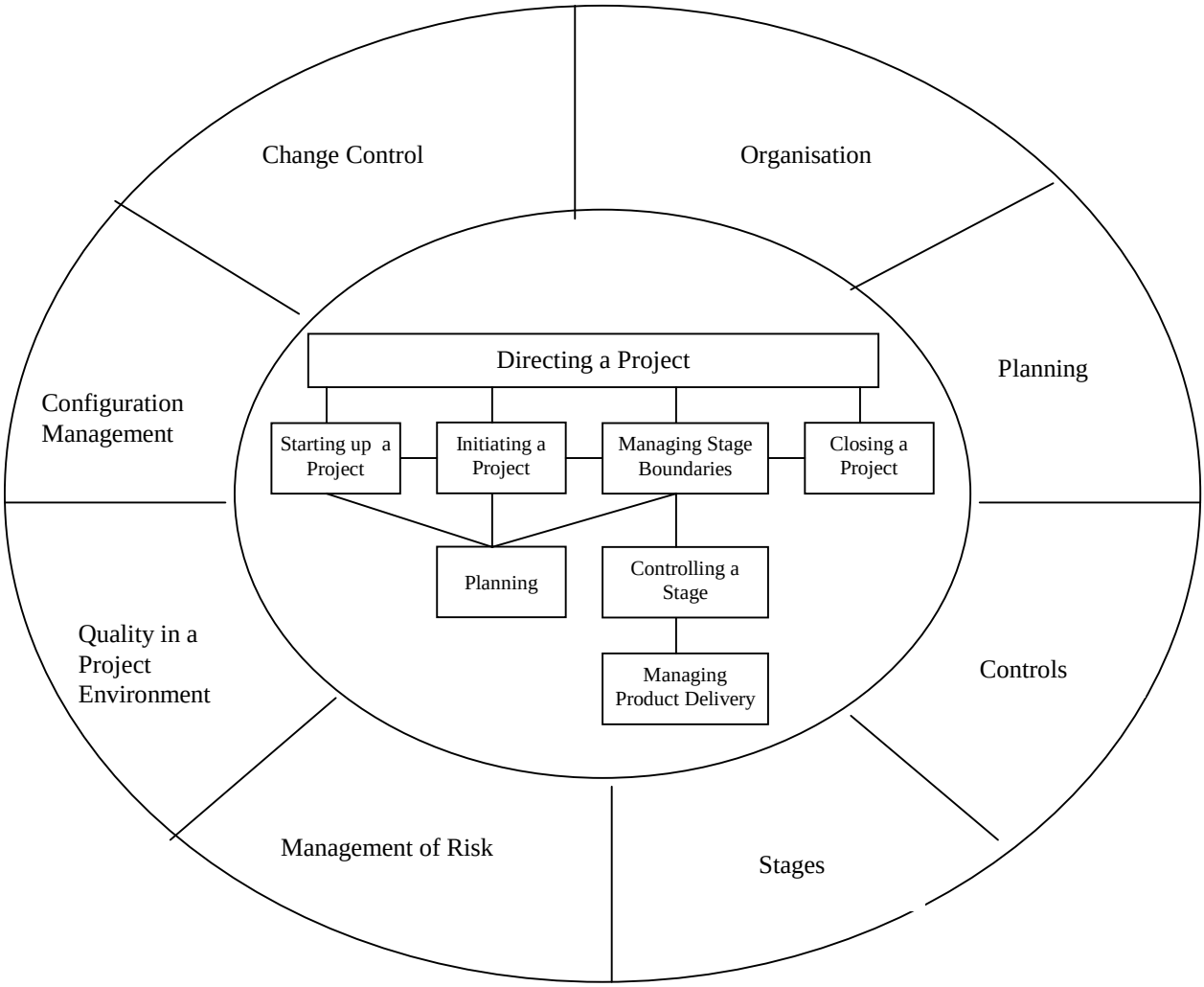



**Figure 11 :** PRINCE Processes and Components (CCTA 1999).

The PRINCE process model shown in Figure 11, consists of eight distinctive management processes covering the activities from starting the project, through controlling and managing the projects progress to the completion of the project (CCTA). Each process is defined with its key inputs and outputs together with the specific objectives to be achieved and activities to be carried out (PRINCE2 2000).

The process model provides the flexibility to establish a number of stages, each forming a distinct unit for management purposes (CCTA 1999). A key PRINCE 2 principle is to avoid too detailed planning at too early a stage, but to map out the detailed plan for the next stage as each stage is completed. Any inadequacies in the overall Project Plan can then be identified and updated (Hughes & Cotterell 1999). Project planning is product based and is focused on delivering results and are not simply about planning when the various activities on the project will be done (PRINCE2 2000). Throughout a PRINCE project, the projects business case which describes the organisation's justification, commitment and rationale for the deliverables or outcome is reviewed to ensure the business objectives, which often change during the lifecycle of the project are still being met (PRINCE2 2000).

Controlling changes is linked to configuration management which is focused on controlling the products being delivered knowing where they are at any point in time, what their status is, who is working on them and which is the latest version (CCTA 1999). While the PRINCE process approach is similar to the PMBOK, the PMBOK describes the components of processes at a much higher and more abstract level (Hughes & Cotterell 1999).) One of the most important benefits of PRINCE2 is the involvement of management and stakeholders at the right time and place during the project and good communication channels between the project, project management and the rest of the organisation (PRINCE2 2000)

## *Standards*

National Standards Organisations were formed to promote credibility in the commercial world, ensuring that there could be basic trust and common expectations about the nature and quality of products and the processes by which those products have been created (Jardins 1984).

## BS6079

The British Standards Institution published BS6079 : Guide to Project Management (1992) which is a set of guidelines which reflect current best practice. BS6079 provides credibility to the business community of broad project management principles. (Dooley 1997). BS6079 focuses on the project as a set of activities and encompasses detailed descriptions of techniques that cut across the normal functional structures of most organisations ((Hughes & Cotterell 1999).

It has been emphasised by the promoters of both PRINCE and BS6079 that the two standards are not in competition with each other, but rather that 'one of the major roles of PRINCE2 is to provide a means by which the British Standards can be implemented' (Newman 1997).

## ISO 12207

Both PRINCE2 and BS 6079 are British Standards, international standards are covered by ISO 12207 which relates specifically to software development and focuses on documentation as its primary area of concern.

## *Conclusion*

This paper has examined the essential principles of project management and the techniques used at all stages throughout the lifecycle of any project. Key aspects of a project and project management have been defined. The principal roles involved have been identified and their impact on the project discussed, including the interpersonal skills required of the project manager in terms of their interactions with all levels within the organisation. Project planning has been discussed in terms of the factors to be considered when setting up the project. Techniques for scheduling a project, including milestones, Gantt charts and networks have been described. The identification, evaluation and management of risks which could affect the attainment of project goals has been outlined. The application of quality auditing to ensure verification and validation of the project deliverables against the project baseline has been briefly outlined. Control mechanisms to ensure that projects can be monitored effectively have been discussed in terms of maintaining the project schedule and preventing cost over-runs. Finally, two of the most widely used project management methodologies, PMBOK and PRINCE II, and the standards to which they conform have been discussed.

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