Section 15

Project Engineering

15.1 Project planning

The most common tool to help plan and manage a project is the Programme Evaluation and Review Technique (PERT). In its simplest form it is also known as Critical Path Analysis (CPA) or network analysis. It is used for projects and programmes of all sizes and marketed as software packages under various trade names. The technique consists of five sequential steps.

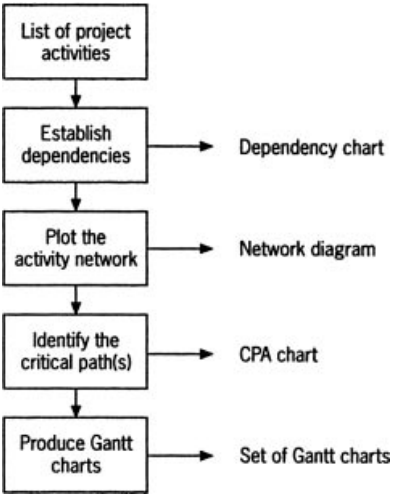

Figure 15.1

15.1.1 Listing the activities

All individual activities are input into the package. There may be thousands of these on a large construction programme.

Engineers' Data Book, Fourth Edition. Clifford Matthews.
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15.1.2 Tabulating dependencies

The dependency table is the main step in organizing the logic of the listed activities. It shows the previous activities on which each individual activity is dependent.

No.	Activity: e.g.	Preceding activity
1	Conceptual design	–
2	Embodiment design	1
3	Detailed design	2
4	Research materials	–

Figure 15.2

15.1.3 Creating a network

A network is created showing a graphical 'picture' of the dependency table. The size of the boxes and length of interconnecting lines have no programme significance. The lines are purely there to link dependencies, rather than to portray timescale.

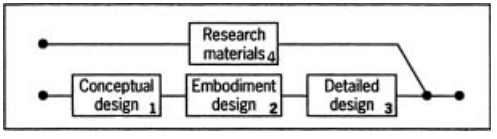

Figure 15.3 Network diagram

15.2 Critical path analysis (CPA)

The CPA introduces the concept of timescale into the network. It shows not only the order in which each project activity is done but also the duration of each activity. CPA diagrams are traditionally shown as a network of linked circles, each containing the three pieces of information shown. The critical path is shown as a thick arrowed line and is the path through the network that has *zero float*. Float is defined as the amount of

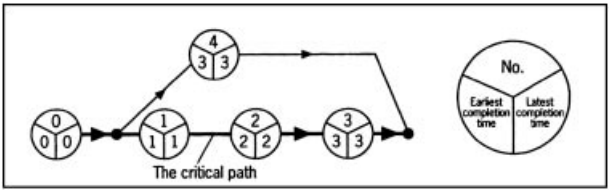

Figure 15.4 CPA chart

time an activity can shift, without affecting the pattern or completion date of the project.

15.3 Planning with Gantt charts

Gantt charts are produced from the CPA package and are used as the standard project management documents. Their advantages are:

- they provide an easy-to-interpret picture of the project;
- they show critical activities;
- they can be used to monitor progress by marking off activities as they are completed.

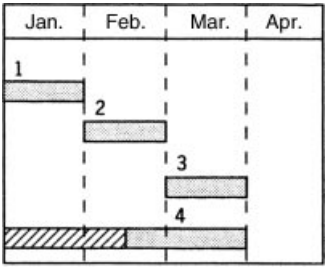

Figure 15.5 Gantt chart

A large construction or manufacturing project will have a hierarchy of Gantt charts to provide a general overview and more detailed analysis of the important parts of the project.

Useful Standards

CPA terminology and techniques are given in:

1. BS 4335: 1993: Glossary of terms used in project network techniques.
2. BS 6046: Use of network techniques in project management. (This is a withdrawn standard.)
3. BS 6079: 1996: Guide to project management.
4. BS ISO 10006: 1997: Guidelines to quality in project management.

15.4 Rapid prototyping

The later stages of the design process for many engineering products involve making a prototype. A prototype is a nonworking (or sometimes working) full-size version of the product under design. Despite the accuracy and speed of CAD/CAM packages, there are still advantages to be gained by having a model in physical form, rather than on a computer screen. Costs, shapes, colours, etc. can be more easily assessed from a physical model.

The technology of *rapid prototyping* produces prototypes in a fraction of the time, and cost, of traditional techniques using wood, card, or clay models. Quickly available, solid prototypes enable design ideas to be tested and analysed quickly – hence increasing the speed and efficiency of the design process.

15.4.1 Prototyping techniques

These are state-of-the-art technologies which are developing quickly. Most use similar principles of building up a solid model by stacking together elements or sheets. The main ones are:

- *Stereolithography* This involves laser-solidification of a thin polymer film which is floating on a bath of fluid. Each layer is solidified sequentially, the shapes being defined by the output from a CAM package.
- *Laser sintering* Here a CAM-package driven laser is used to sinter the required shape out of a thin sheet of powder.
- *Laminated manufacture* This is a slightly cruder version of the same principle. Laminated sheets of foam are stuck together in an automated process using glue or heat.

15.5 Value analysis

Value analysis (or value engineering) is a generic name relating to quantifying and reducing the cost of an engineering product or project. Value analysis is about asking questions at the design stage, before committing to the costs of manufacture. All aspects of product design, manufacture, and operation are open to value analysis. Several areas tend to predominate: shape, materials of construction, surface finish, and tolerances.

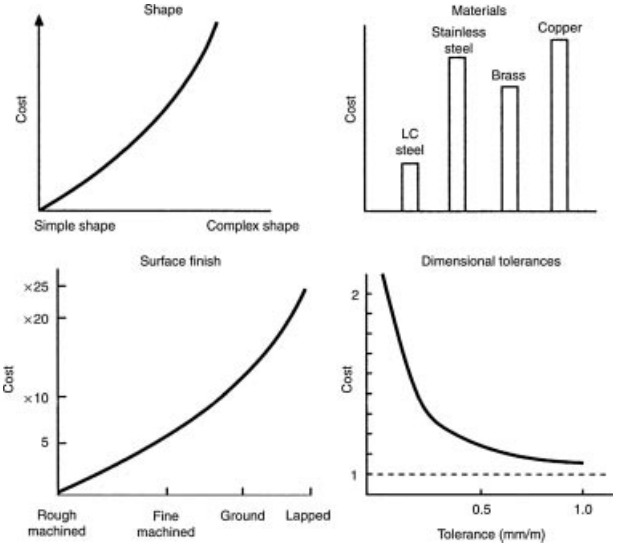

Figure 15.6

Techniques tend to be manufacturer-specific. One useful published document is:

PD 6470: 1981: *The management of design for economic production. Standardization philosophy aimed at improving the performance of the electrical and mechanical manufacturing sectors.*