

# **Use of network techniques in project management**

## **Part 3. Guide to the use of computers**

L'utilisation des techniques de réseau dans la  
gestion de projet  
Partie 3. Guide d'utilisation des ordinateurs

Anwendung von Verbindungsnetztechnik in  
der Projektierung  
Teil 3. Leitfaden für die Anwendung von  
Rechnern

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## Foreword

This Part of BS 6046 has been prepared under the direction of the Quality, Management and Statistics Standards Policy Committee. It is a revision of BS 6046 : Part 3 : 1981, which is withdrawn.

The aim of BS 6046 is to be of practical use to the manager who wishes to use project network techniques as a tool for project management. A project manager meets many problems of which only some can be foreseen; even those familiar with planning and controlling projects will encounter unexpected difficulties and will often be forced into management by crisis.

BS 6046 is designed to draw attention to the problems that project management can resolve in advance, and does this by helping those involved to ask the right questions. Although the use of project network techniques is not a prerequisite for project management and many of the aspects discussed apply whether or not such techniques are used, BS 6046 is principally concerned with their use. BS 6046 deals in some detail with the circumstances under which project network techniques are appropriate and stresses the management problems that arise in their application.

BS 6046 systematically examines the area of application of project network techniques in project management. It guides the less experienced reader logically through the more fundamental questions, while the structure enables those more experienced in project management to progress rapidly through to the more advanced topics. The best way of using BS 6046 is for the reader to become acquainted with its structure and the sequence in which various problems are approached.

BS 6046 concentrates on practical problems and possible methods of solving them and, as a guide to practice and application, it does not discuss theoretical aspects, neither does it provide detailed explanations. The reader's attention is drawn mainly to the questions that arise during project management and the use of networks. In particular, the general problem of communication, between different parts of the same organization and between different organizations, is stressed as is the importance of knowing the right questions to ask. The answers given here are a guide, based on long and wide-ranging experience; they are, however, opinions and not absolute facts. BS 6046 is a general interpretation and, as such, the views expressed should be examined critically in the light of the particular circumstances to which they are applied. The main value claimed is that widely discussed and agreed answers to frequently met problems tend to be well suited for most situations and provide an authoritative basis for inter-organizational project management arrangements.

BS 6046 is published in the four following Parts.

Part 1 Guide to the use of management, planning, review and reporting procedures

The important functions and organization of project management, as distinct from general management, are emphasized. Descriptions are given of the involvement of management as the project develops from the initial planning of the project and review systems to the procedures to be adopted in setting the stages and frequency of project review and methods of reporting.

Part 2 Guide to the use of graphical and estimating techniques

Practical considerations for the estimation of values needed for the analysis of project networks are discussed. Guidance is given on the factors to be considered in choosing between activity-on-arrow or activity-on-node techniques. Network drawing methods for the presentation of the two types of network are discussed and recommendations given for the conventions to be used and the level of detail to be included, as well as practical hints.

Part 3 Guide to the use of computers

Guidance is given on when and when not to use computers in conjunction with project networks. The different ways in which a computer may be used for processing project networks are described and assistance is given on how to select the actual computer package. This Part then refers to the purpose and significance of coding systems for use with project networks.

Part 4 Guide to resource analysis and cost control

This Part covers the use of resource analysis and project cost control as a natural extension to the use of time analysis in project network techniques. The two techniques are treated separately for the purpose of providing more effective management information.

In addition to a general editorial update of the standard, the major changes in this revision of BS 6046 : Part 3 are the introductory clause, which has been rewritten, and the clause and table concerning the selection of software packages, where now less emphasis is placed on the use of computer bureaux.

**Compliance with a British Standard does not of itself confer immunity from legal obligations.**

# Guide

## 0 Introduction

Providing a guide to the application of project network techniques based on accumulated practical experience, BS 6046 supplements BS 4335 first published in 1968 and subsequently revised in 1972 and 1987. BS 6046 concentrates on network-based systems, but also discusses related aspects of project organization and management insofar as they influence the application of such methods.

Projects differ from other enterprises in several ways, in particular by their transient nature, by the speed with which they normally have to be executed and by their relative complexity. Other features which distinguish projects include the following.

- (a) What happens during a project often affects the rest of the subsequent life of the end product (hardware or service).
- (b) The duration of the project is normally predetermined (finite) with definite start and termination dates specified.
- (c) The project organization is often temporary and may change from one phase to the next.
- (d) Most projects contain some elements of uncertainty and risk.
- (e) Many projects are non-repetitive, and often include some essentially unique features, often beyond the current state of the art.
- (f) Projects are normally not isolated, they interact with other projects, organizations and departments; their structures and systems are interactive organizationally, technically, economically and socially.

Two basic aspects are present in a project: first, the operational activities, e.g. the functions of design, procurement and construction, and secondly, management systems that are needed to plan and control the operational activities. BS 6046 deals primarily with the management systems, the details of which will depend on the type of project and the particular industrial sector in which they are applied. These systems also need to be adaptive as changes in project environment and phase occur. However, most projects, by their nature, contain similar stages, phases and procedures, which are diagrammatically summarized in figure 1 which is reproduced from BS 6046 : Part 1.

BS 6046 as a whole concentrates on the parameters of time, resources and hence costs in general. It deals with the basic requirements of project organization and management with project planning (where the datum conditions for the future conduct of the project are set down) and finally it deals with methods of controlling the subsequent performance of the project and some ways by which control may be maintained when changes occur.

Project network techniques as used now were developed in the USA, the UK and France more or less simultaneously in the mid 1950's. These developments included both activity-on-arrow and activity-on-node systems. A comparison between these alternative modes and detailed guidance on graphical and estimating techniques is given in sections 2 and 3 respectively of BS 6046 : Part 2 : 1992. With the exception of programme evaluation and review technique (PERT), which contained probabilistic elements appropriate to the research and development (R & D) area for which it was designed, the developments were aimed at improving the ability to plan and control complex engineering projects.

Since then the techniques have been extended to handle resources, uncertainty of outcome as well as of duration and many other specific applications.

The benefits of using such techniques can include:

- (1) clearer definition of the scope of the project and the complex interrelationships between tasks;
- (2) better coordination between different organizations within the project, and provision of information about each organization's progress and future plans to the others (communication links);
- (3) ease of preparing schedules of work to be carried out;
- (4) ready means of reviewing the project and exercising control over time, resources and costs;
- (5) clearer identification of critical and risk areas, an excellent model for 'what if' exercises and resultant management decisions.

Networks are more informative and can be easier to develop and maintain than bar charts. They provide a simple means of assessing the combined effects of activity logic constraints, limited resources, etc. in meeting a required project end date. For most time analysis, and resource analysis especially, computer processing is desirable and for this many computer packages are now available. This Part of BS 6046 gives means of assessing these computer packages and advice on coding systems and BS 6046 : Part 4 covers the use of resource analysis and project cost control in more detail.

The network techniques described enable the main functions of the management of projects, i.e. planning, coordination, monitoring and control, to be conducted in an efficient and logical manner, in order to control a project, rather than merely monitor what is taking place. If effective decisions are to be made by project management, it is necessary that these decisions are based on the most accurate and up-to-date information available; this requires an adequate communication system together with defined objectives and procedures. It also implies that management has to look at future plans as well as using past experience, to anticipate problems.



Communications have to be such that rapidly changing situations are quickly recognized for corrective action to be effected by management.

BS 6046 is intended to provide guidance to a number of groups of people as follows:

- (i) *general management*: in organizations that operate projects; when setting policies, awareness of available techniques and also their limitations; encouragement to use such techniques where suitable; the importance of being fully involved when projects are managed by these techniques;
- (ii) *project managers*: responsible for project performance, so that they may better cope with the many problems they meet (only some of which may be foreseen) and encourage better integration between the different disciplines taking part, aiming for a common goal;
- (iii) *project support staff*: coordinators, planners, cost engineers, etc., so that they may better appreciate the techniques available and their potential pitfalls;
- (iv) *educators*: those engaged in the teaching of, or research on, network-based techniques for project management who may need a basic reference on accepted practice.

BS 6046 is designed to draw attention to the problems that project management can resolve in advance by helping those involved to ask the right questions. Although the use of project network techniques is not a prerequisite for project management and many of the aspects discussed apply whether or not network techniques are used, the guide is principally concerned with their use.

Although BS 6046 has this emphasis on network-based techniques project managers can and often do make use of other techniques, e.g. operational research, work study, organization and methods (O & M), quality control, production control, data processing, computer and information systems and value engineering. It is the responsibility of project management to select and use these techniques as appropriate and to balance their impact on the project so that this is not jeopardized by over-enthusiasm for any single aspect or by conflict between opposing objectives. For example, equipment should not be over-designed or over-engineered at the expense of failing to meet a delivery date when equipment which performs quite satisfactorily can be delivered on time.

As with all management techniques, it is desirable that the use of a network-based project management system should receive full management backing within the company or organization and that there should be an adequate training programme for all personnel concerned with network and other techniques for project management.

## 1 Scope

This Part of BS 6046 gives guidance on the application of computing to project network analysis (PNA). It is intended to assist the inexperienced user of PNA to understand the implications of applying a computer to assist with both the analysis of a project network and the application of the results of that analysis. The advantages and disadvantages of computer application compared with manual analysis are discussed. Advice is given both on choosing a suitable software package and on the selection of computing facilities for processing the package.

Guidance is given on the choice and use of coding systems with project networks. The importance of significant coding systems is discussed together with the different approaches to the use of significance within the code and how the design of the code may be affected by the organization of both the project network and the company.

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover.

## 2 Definitions

For the purposes of this British Standard, the definitions given in BS 4335 apply. Additional computer related terms are included in appendix A.

## 3 Purpose, structure and recommended use of the guide

In addition to giving guidance to the inexperienced user of PNA, the purpose behind this guide is also to assist the experienced user to select a PNA software package when he feels that the use of a computer would be of assistance, or, alternatively, to remind the experienced user of the points to be considered when changing to a different software package.

Clause 4 relates to the initial decision regarding the use of computers for PNA. Clause 5 is of assistance in choosing an actual software package once the decision to use a computer has been made.

Clause 5 may be used without reference to clause 4 but attention is drawn to the basic reasons behind the decision to use a computer. Clause 6 gives information relating to the choice and use of a coding system for use with project networks.

The user is recommended to start at item 1 of table 1 and work through each of the questions given in each of the tables. Each question postulates a number of alternative answers. The factors affecting the user's choice of answer are given, together with comments. Whilst the logical arrangement used to construct the sequence of questions is thought to be reasonable, it should not be regarded as definitive and the user may need to return to earlier points as he proceeds through the guide.

NOTE. Although the guide may appear categorical in places, it should not be regarded as a rigid set of rules. When numbers are quoted they should be taken merely as an indication of approximate magnitude.

## 4 Choice between manual and computer application

A checklist for the choice between manual and computer application is given in table 1.

NOTE. This checklist assumes that there is agreement to use network techniques.

## 5 Selection of a software package

### 5.1 General

This clause relates to the choice of both a computer package and a computer processing method. There are a number of ways of achieving this solution. One way is to establish what is needed from a software package (by use of table 1) then find a package that appears to fit those criteria. One extra criterion that needs to be satisfied with this approach is the availability of the suitable computing hardware.

In some cases the package will only run on computers from a particular supplier.

An alternative is to survey the computing facilities available already and find a PNA package that can be used on them.

There are four main sources of computing:

- (a) an in-house mainframe;
- (b) personal computers;
- (c) a remote access computer;
- (d) a computer bureau service providing either batch or dial-up remote access.

A checklist to assist in selecting a software package is given in table 2.

### 5.2 Methods of computer processing

There are two basic ways in which computing can be accomplished; by batch processing or by interactive processing.

Batch processing implies that the data is assembled together with all the job control and report requests and handed over to the computer scheduler for processing. The user cannot influence the processing. When the job is completed the results are returned to the user. The time taken may vary from a minute to several days depending on various factors. The important fact is that errors or omissions in the data may cause hold-up or the whole cycle to be repeated so the turn-round time can be critical. If a batch processing approach is adopted, time should be allowed for additional attempts in order to obtain a successful initial run.

Interactive processing allows the user to interact with the computer as it is processing the data. This is the normal mode of operations for personal computers. Very often with this type of activity the data is checked for reasonableness as it is typed at the keyboard and thereby dispensing with the need for secondary runs. A possible drawback with this approach is the tedium introduced in a question and answer session with a computer to introduce data to the PNA package from another computer system. Similarly the output may be available immediately but not stored for future reference, so that if a second copy of a report is needed the interactive sequence needed will have to be repeated.

## 6 Choice of coding system

### 6.1 General

A checklist for the choice of coding system is given in table 3, which should be used in conjunction with the background information given in 6.2 to 6.5.

NOTE. For assistance in using this clause, see figure 2.

### 6.2 The purpose of coding

There are two areas of coding with which the PNA user should be familiar. Certain codes are an inherent attribute of the activity and are independent of the activity's place in the network. Included amongst these are responsibility codes (e.g. to indicate department, cost centre), resource codes (used to describe the types of resource required to carry out the activity) and cost codes (used to relate the cost of an activity to a company accounting system). These types of code are an invaluable aid to sorting and presenting the output results from computer analysis.

The other area of coding is that necessary to define uniquely the structure of the network, i.e. the relationship between all activities that together constitute the whole project.