

Guide to

Terotechnology —

(the economic management of assets) —

**Part 2: Introduction to the techniques
and applications**

Committees responsible for this British Standard

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- British Council of Maintenance Associations
- British Institute of Management (Asset Management Group)
- Chartered Institute of Management Accountants
- Chartered Institution of Building Services Engineers
- Consumer Policy Committee of BSI
- Department of the Environment (Building Research Establishment)
- Electricity Supply Industry in England and Wales
- Institute of Marine Engineers
- Institute of Materials Management
- Institute of Purchasing and Supply
- Institute of Scientific and Technical Communicators
- Institution of Electrical Engineers
- Institution of Incorporated Executive Engineers
- Institution of Plant Engineers
- Ministry of Defence
- Royal Institution of Chartered Surveyors

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Foreword

This Part of BS 3843 has been prepared under the direction of the Quality, Management and Statistics Standards Policy Committee.

In any organization it is necessary to identify and then choose between the investment options open to it and to make decisions on how best to invest the capital available. Once a decision has been made to make an investment into some form of physical asset or project, then the application of terotechnology should assist in the object of getting the best value for money from that investment and thus justify it.

In 1970 the then Department of Industry formed a Committee for Terotechnology which reported in 1973 to the Secretary of State. Soon after that the National Terotechnology Centre was born in 1975. In 1974 the Department of the Environment formed a Committee for Building Terotechnology which reported in 1977 under the title of "Terotechnology in Buildings".

In 1974 BSI published a revision to BS 3811 in which the official definition of "terotechnology" appeared. In 1984 BS 3811 was revised and extended to be of greater use to those practising terotechnology.

The Quality, Management and Statistics Standards Policy Committee which is responsible for BS 3811 has decided that the time is now right to produce a series of guides to terotechnology to assist industry, commerce and public services.

This series of guides sets out in detail all the activities that should be carried out to ensure that the organization which uses terotechnology can compete successfully and, at the same time, achieve consumer satisfaction.

Three Parts of this standard have been published, and further Parts are envisaged in order to give greater emphasis to certain aspects of terotechnology and to take account of new developments. The first three Parts may be summarized as follows:

Part 1: Introduction to terotechnology. This Part gives guidance on the formulation of a brief to senior management within an organization, to highlight the benefits to be gained from using terotechnology, together with the overall resources required for its efficient implementation. It is also an introduction to the concept of terotechnology for those members of an organization who are required to perform their duties within this concept.

Part 2: Introduction to the techniques and applications. This Part gives guidance on how and where organizations should apply terotechnology. It shows what should be considered and when, what techniques are available, and how to deploy and coordinate them.

Part 3: Guide to the available techniques. This Part gives guidance on the specific techniques and is divided into sections, one for each of the techniques considered. It also includes checklists as an aid to the verification that all functions within an organization are being carried out within the principles of terotechnology.

Throughout this standard use of the pronouns he, him and his is intended to be non-gender specific.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 22, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

0 Introduction

Readers who are unfamiliar with the wide ranging concepts of terotechnology are strongly advised to read Part 1 of this standard before studying this Part.

Terotechnology can be applied by a customer in acquiring assets, or components with which to improve or maintain assets. Equally, the same customer can apply terotechnology in purchasing components for incorporation into his own products.

Manufacturers, recognizing that their products may well become customers' assets, should use terotechnology to structure products to best suit the market's demands. In so doing, and by making his approach well-known, a manufacturer can achieve a significant advantage in the markets for his products. Indeed the terotechnology activities of the supplying and purchasing organizations will inevitably overlap or complement one another to the benefit of both. When it comes to the acquisition of production machinery, a manufacturer himself becomes a customer. It is then desirable that the manufacturer applies terotechnology both in his own acquisition of machinery, etc. and in the design of his products which are destined to become his customers' assets.

The same principles apply in the case of buildings, etc. Terotechnology should be applied to the design of all products as well as to the production process.

A nation practising terotechnology on a wide scale, both as user and manufacturer, will undoubtedly enhance the reputation of that nation's industry.

The management level at which terotechnology decisions are made depends largely on the potential importance of their consequences. The organization's hierarchy itself is unimportant to the success of terotechnology provided that the different levels of authority are clearly defined, that all are committed to the disciplines of the terotechnology concept and that there is a well-structured flow of decision data. Clearly, these needs can dramatically affect inter-departmental relationships and it is generally true that more open and more widely ranging relationships result. This stems from the basic need for people to be well informed to ensure that individual decisions integrate properly within the corporate terotechnology policy. Terotechnology requires the proper integration of activities towards and in decision making. Adoption of techniques without such integration is not in itself sufficient.

Most organizations have sufficient expertise to apply terotechnology, though a degree of further training should be considered in order to introduce new management methods, to develop new systems and relationships as well as to teach the specific terotechnology techniques. The training and subsequent changes can be beneficial in their own right simply because they stimulate interest in the organization and its objectives.

The key ingredients of success in the application of terotechnology are enthusiasm and cooperation throughout a well structured organization with impetus maintained by enthusiastic senior managers. Discipline, too, is important to efficient application and managers need to specify the degree of analysis which backs different levels of decision. It is essential that data are adequate to support the required confidence limits but care needs to be taken to avoid wasteful over-analysis.

Regardless of the success (or failure) achieved in the management of an asset, the experience can provide valuable feedback which is a fundamental requirement of terotechnology. This feedback is gathered by monitoring decisions, actions, consequences and the lifetime performance of the asset and can be used to improve confidence in new decisions.

The cyclic nature of terotechnology demands that decisions about asset management are reviewed in the light of increasing experience and knowledge. Throughout an asset's life, relevant data need to be collected and analysed to guide current management decisions and the consequences of resulting actions recorded, providing feedback to guide new decisions.

This structured, analytical approach results in better decision-making throughout the organization, thereby providing opportunities to improve profitability and/or efficiency.

This Part of BS 3843 describes the techniques of terotechnology firstly in terms of their application to the different stages in asset life and secondly by discussing the primary techniques in terms of their objectives and the mechanics by which they interact with others in the cyclic nature of terotechnology.

1 Scope

This Part of BS 3843 provides introductory guidance to managers on the techniques used in applying terotechnology. (The techniques themselves are described in Part 3 of this Standard). This Part outlines the techniques and describes how, generally, they are incorporated into decision making processes. It also illustrates how individual and departmental interests and considerations interact with others and emphasizes the importance of communication throughout the enterprise.

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 Part of BS 3843 the definitions given in BS 3811 apply, together with the following.

2.1 terotechnology

a combination of management, financial, engineering, building and other practices applied to physical assets in pursuit of economic life cycle costs

NOTE 1 Terotechnology is concerned with the specification and design for reliability and maintainability of physical assets such as plant, machinery, equipment, buildings and structures. The application of terotechnology also takes into account the processes of installation, commissioning, operation, maintenance, modification and replacement. Decisions are influenced by feedback of information on design, performance and costs, throughout the life cycle of a project.

NOTE 2 Terotechnology applies equally to both assets and products because the product of one organization often becomes the asset of another. Even if the product is a simple consumer item its design and customer appeal will benefit from terotechnology and this will reflect in improved market security for the producer.

2.2 asset

a physical item such as a building, plant or machinery which is acquired by a user and then employed by him in the pursuance of his business, trade or profession

2.3 board

superior management level of the organization, ultimately responsible for deciding upon and authorizing any new project, specifying the objectives and policies to be followed in assessing options

2.4 component

an element of the asset which can be acquired separately

2.5 feed

material to be processed by the asset to form the product

NOTE In certain cases, e.g. a social benefit office, this input might be in the form of data rather than physical material.

2.6 organization

the totality of the enterprise which is to undertake a proposed new or additional project

NOTE This may be a large industrial company, a public service or in the extreme an individual.

2.7 output

a quantitative and qualitative measure of the product which is to be supplied from the project

2.8 product

the output of the relevant assets when employed by the user, including physical items of any complexity (ranging from raw material to a complete system), services as defined in BS 3811, or more general services (e.g. banking, welfare, transport)

NOTE The product of one organization can often become the asset of another.

2.9 project

a discrete activity ordered by the board to allow an organization to supply a given output of the product, and the acquisition and use of an asset required to achieve this; deemed to start with the instruction from the board for a given objective to be met and extending until the asset is disposed of

2.10 spare

a replica or equivalent component purchased to replace the original component supplied as part of the asset

NOTE Replacement is normally expected to be required due to failure, in its widest sense.

2.11 technique

an identifiable mathematical or logical procedure or procedures or a subject area which is or has been studied analytically by experts

3 Principles of terotechnology

Investment in capital plant, buildings and equipment is fraught with uncertainties and risks which make the assessment of lifetime economics difficult. Terotechnology provides techniques within a structured approach which help an organization both to evaluate an investment and, having invested, to protect and service it economically throughout its working life.

Terotechnology's first and paramount prerequisite is communication. Because its techniques are interactive it is vital that departmental interests do not become isolated. Instead, there needs to be continuing dialogue between all the functional departments in the organization, and line managers need to understand the weight of every argument, for it is their responsibility to decide on the level of risk that is acceptable to the organization. Ultimately, the well-being of the organization itself depends upon sound judgement.

Clearly, the most financially desirable venture is worthless if based on unachievable technology and equally the cleverest invention is useless if it is beyond the financial reach of the market. As a general rule, however, ventures are rarely as clear cut, and careful, comprehensive analyses are required in evaluating all the factors that contribute to decisions. When investing in a domestic appliance for example, a wise buyer seeks the best buy to meet his or her particular needs. In reaching a decision, such factors as cost, capacity, appearance, potential time saving, running and servicing costs, maintenance and insurance are examined.

Decisions are often conditioned by advice from other users of similar products. Performance reviews throughout (and particularly at the end of) the appliance's life reveal whether the forecasts made at the time of purchase have been realized. This review provides valuable input to new decisions, firstly on whether or not to replace the appliance and, secondly, on the selection of a replacement.

This selection process marks the beginning of a new life cycle.

These thought processes represent the application of terotechnology in its simplest, and probably most effective form. The principal activities are best summarized as follows:

- a) the initial investment appraisal using the best data currently available;
- b) investment in the acquisition of the asset.

Then, when the asset has been acquired and its useful life progresses, the user develops:

- c) operational experience; and
- d) a maintenance history.

Finally, experience during these four activities is used in:

- e) a feedback of information into considerations of improvements to the asset or in its use; and
- f) disposal and replacement decisions.

Mass production cannot meet the individuals' specific needs. Instead, a wise manufacturer will include market research as a key element in applying terotechnology in respect of his products; on the results of such exercises he will ensure that desirable features are developed and undesirable ones dropped or designed out. Dissatisfied customers are the more likely to air their views and prompt, positive reaction by designers to the most common complaints should render the product more competitive and marketable. Negative attitudes to customer input have the opposite effect and many suppliers adopting a "take it or leave it" sales policy have found that customers have taken the latter choice. Often such suppliers have failed to survive.

An organization contemplating a multi-million pound capital project, perhaps to build a factory to produce domestic appliances, applies identical principles in its decision making. However, because the financial risks are very much greater, a structured, formal approach to lifetime costs and decision making is required. Unfortunately, far too frequently, economic appraisals and cost-benefit analyses are carried out merely to support an acquisition decision already made. Thereafter the asset is often managed "by instinct" and in ignorance of the industrial efficiency and product costs and/or benefits that can flow from the structured, scientific approach which this standard advocates. Terotechnology offers such a structured approach and this Part introduces the primary techniques available.

Part 1 of this standard describes the consequential benefits and costs of introducing terotechnology. Clause 5 of BS 3843-1:1992 lists the benefits to be gained by an organization through introducing terotechnology. This Part describes how those benefits can be achieved and emphasizes the need for regular, structured communication between different specialisms. Tables are used to illustrate this structure and to list the thought processes and techniques that support decision-making. All of the tables in this Part have a similar layout and they summarize those matters which can influence the major decision phases of the asset life cycle. These phases are Concept and Investment Decision, Acquisition, Useful Life (comprising Operation and Maintenance as the principal activities) and Disposal. The four columns of the tables list the following:

- a) primary analyses, listing the particular factors that need to be analysed as contributions to each major decision;
- b) considerations, providing an aide memoire of the matters that typically impinge on the factors of the primary analyses;
- c) techniques and procedures, outlining the methods by which the considerations can be measured objectively (and where necessary, optimized) in reaching judgements on the primary analyses factors;
- d) interacting interests, indicating those departments or activities within the organization which might input information to, or gain benefit from, the aspects of terotechnology listed in a), b) and c).

4 Life cycle analogies

The techniques applicable to terotechnology have evolved as a result of increased life cycle cost consciousness. These techniques are examined under the main headings which represent the key phases and aspects in an asset's life.

Each of these phases or aspects is roughly analogous to a human condition and such analogies may assist the understanding of them as follows:

- a) Investment Decision — conception;
 - b) Acquisition — birth;
 - c) Operation — working life;
 - d) Maintenance — health;
 - e) Disposal — death;
 - f) Review of life cycle — biography.
- } overlapping phases

Every phase or aspect needs to be considered before an investment decision is reached, all need to be monitored, when extant, for comparison with financial plans and each has to interact with others. As the asset's life progresses increasing amounts of hard data will become available for feedback to decision-making processes relating equally to its own remaining life, maintenance, refurbishment, disposal or replacement, and to any new similar project.

Each of these phases and the relevance of terotechnology in them are described in 6.2 to 6.5. These descriptions are written on the basis that an organization has decided that an activity is required to meet a given corporate objective. This may be to produce a specific output or may merely be to achieve a required turnover or profit. They are intended to cover all likely situations and are written from the point of view of the user organization which is to acquire an asset in pursuance of a project to achieve an output to meet such a corporate objective.

5 General considerations

5.1 Organizational strategies

An organization may wish to embark on a new project for a number of reasons. These include the following:

- a) to expand the organization's share of a market for a given product;
- b) to fill a gap perceived in the market: i.e. a new or updated product;
- c) to meet customers' requests;
- d) to conform to a statutory requirement;
- e) to support other activities being undertaken by the organization;
- f) to replace another project coming to an end.

In cases a) to e) the circumstances will directly determine the product and, in most cases, the output as well. Options will exist with respect to the assets with which to carry out the specified objectives. There will also be an interaction between the detailed design of the product and the assets needed to execute this design. This increases the number of potential options that will have to be considered.

In the last case f), the board may direct an objective that may not be specific in terms of the product but may be simply in terms of turnover or profit. This will increase the number of options open to the manager of the new project.

In all cases the organization is likely to be faced with a number of options, one of which might be not to proceed with a new project at all. By employing terotechnology techniques a best choice of option can be selected and decisions in respect of the asset made throughout the life cycle in the interest of achieving the most economic life cycle costs.

It is clear that, in pursuit of the terotechnology objective, the cost and benefit implications of all aspects of the asset's life need to be considered. Where costs and benefits are distributed in time throughout the life cycle, analytical techniques such as discounted cash flow are used to sensibly compare incomes and/or notional expenditures at different dates. However, in addition other aspects which may not have a notional cost and/or benefit implication need to be taken into account; in some of these a notional cost implication might be appropriately used. In other cases alternative approaches may have to be taken. The principal areas to be considered are outlined in 5.2 to 5.7.

Techniques based upon the principles of discounted cash flow are also used in comparing the costs and benefits arising from different forecast scenarios which identify the factors that maximize the benefits to the enterprise. Of equal importance are factors which could negate these benefits and these key areas of risk need to be identified and the risk minimized wherever possible. In essence, an attempt should be made to identify those uncertainty factors which have the greatest influence on the likely return (Sensitivity Analysis) and, if necessary, to concentrate resources on investigating those factors in more detail. This is particularly relevant to the most common source of risk which arises from uncertainty in the data used in the economic assessments.

There should be a corporate input to decisions to invest in capital projects so that the impact of existing policies on forecast scenarios (and possibly the converse) can be properly examined. The organization needs to ensure that the investment does not affect the nature and objectives of the business in an uncontrolled way because this could result in uncontrolled risk.

Inevitably any new project will result in change which can affect both the organization and those outside it. Such change may involve factors which are subject to external constraints and these have to be considered and their influence included in the investment appraisal.

5.2 The community

The social and environmental acceptability of changes are increasingly prominent considerations for organizations contemplating new investment or developing existing facilities. These aspects can impact with equal severity whether the proposal is to extend a dwelling house or to build a major production facility. People's awareness of such developments quite properly increases with improved living standards and wider educational aspirations. As knowledge grows, so increasingly more stringent international, national and local controls are applied to protect the environment. In addition to these legal constraints, developers also need to consider individual local acceptability as well as the specialist views of pressure groups. What may be regarded as a prosperity-generating asset by one section of the community can equally be considered a dangerous, toxic monstrosity by another.

Because of these differences of view, there is a risk of future growing public unacceptability which might limit the operation of the asset. For example, increased legislative requirements in regard to, say, effluents, noise and even demolition and disposal processes could significantly affect lifetime cost equations.

In planning changes the owner and/or user needs to assess the risk to the investment or the organization's overall image and the associated effect on profitability.

5.3 Nature of the business

Wise developers will also consider the risk that investment proposals pose for the organization's existing business. Here, concern centres on whether or not the proposed investment is concomitant with, or fundamentally different from, the organization's traditional business. For example, a proposed new project may produce goods or services repugnant to existing customers on political or ethical grounds or which may be seen to compete with products of customers who purchase the traditional products or services of the organization. This could be reflected in market resistance to the existing products and the consequent reduction in profitability having to be made good by income from the new investment. The corporate study might conclude that this effect would be so severe that the proposed investment would simply "cut off the company's nose to spite its face" and thus select different areas for investment.