

Guide to

Terotechnology

(the economic management
of assets)

Part 1. Introduction to terotechnology

Committees responsible for this British Standard

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- Consumer Policy Committee of BSI
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- 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 Mechanical Engineers
- Institution of Plant Engineers
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Contents

	Page
Committees responsible	Inside front cover
Foreword	3
Section 1. General	
0 Introduction	4
1 Scope	4
2 Definitions	4
Section 2. The concept of terotechnology	
3 Objectives of terotechnology	5
3.1 Primary objective	5
3.2 Lowest asset costs over life cycle	5
3.3 Approach to objectives	5
4 Principles of terotechnology	6
4.1 Scope of terotechnology	6
4.2 Participation of the whole organization	6
4.3 Interprofessional cooperation	6
4.4 Interdepartmental cooperation	6
4.5 Collection and analysis of data	7
4.6 Minimum activities necessary for implementing terotechnology	7
5 Benefits from introducing terotechnology	7
6 Costs of implementing terotechnology	8
Section 3. Introducing terotechnology to an organization	
7 General	9
8 Management participation	9
9 Organizational framework	9
10 Incorporation of terotechnology into activities	9
10.1 Modification of and additions to existing activities in the organization	9
10.2 Modification to customer/supplier relationship	10
10.3 Example of application of terotechnology in different project phases in a user organization	10
10.4 Effect on supplier organizations	11
11 Modifications to individual functional activities	12
11.1 Management	12
11.2 Accountants	12
11.3 Designers and project engineers	12
11.4 Purchasing executives	12
11.5 Production managers and engineers	13
11.6 Maintenance managers and plant engineers	13
11.7 Marketing executives	13
11.8 Effect on training	13

	Page
12 Problems experienced in introducing terotechnology and solutions found effective	13
12.1 General	13
12.2 The concept	14
12.3 Technical and economic problems	14
12.4 Management organization	15
12.5 Personnel management	15
13 Application of procedures and techniques	16
13.1 General	16
13.2 Procedures and techniques	16
13.3 Terotechnology checklists	16
Appendices	
A Summary of benefits from using terotechnology	19
B Example of a terotechnology checklist	20
C Bibliography	23
Table	
1 Some examples of relationships between life cycle functions and relevant techniques	17

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 in 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.

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

Section 1. General

0 Introduction

Terotechnology was developed in the context of larger organizations, with the objective of making them more efficient and competitive. However the objective of maximizing value for money spent, and the principles involved in achieving this, are equally applicable to small organizations or even individual consumers. Throughout this standard the applicability to a larger organization is used as a basis as this will represent the more complex situations. However, the activities and procedures are equally applicable to an individual acting on his or her own behalf in the several equivalent roles.

Whilst individual consumers may not read this guide it is likely that organizations representing them will. It is therefore important that producers give adequate consideration to the needs of such consumers if they are to capture and retain their consumers' regard.

The guidance can apply to the problems faced by small organizations as much as those faced by the larger, more complex organizations. Their problems may be simpler but the principles of problem solving remain the same. The small organization can therefore benefit from this guidance by selecting those parts of the decision-making process that can help them.

1 Scope

This Part of BS 3843 gives assistance in the preparation of a brief for senior management of organizations on how the principles and use of terotechnology can assist the decision making processes, the benefits which can be obtained from its adoption and the overall resources required for efficient implementation.

It also gives guidance to professional advisers and technologists who wish to know how the practice of terotechnology can improve the advice they give to senior management.

In addition, this Part is a general introduction to the concepts of terotechnology for all members of an organization wishing to adopt its principles, before progressing to a study of the various techniques available. The techniques are dealt with in Parts 2 and 3 of this standard.

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover. Other relevant publications are listed in appendix C for information.

2 Definitions

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

2.1 terotechnology¹⁾

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 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 (see note to 2.5).

2.4 user

An individual or an organization who acquires an asset and then employs it in the pursuance of his business, trade or profession.

2.5 supplier

The organization manufacturing or building or otherwise supplying an asset to a user.

NOTE. In industry generally a given organization usually acts as both user and supplier. For example, a manufacturer acquires machinery to manufacture his own output; in this he acts as user. The product, e.g. electric motors, is sold to customers and in this he acts as a supplier. Furthermore, his product, the electric motors, could well become the assets of his customers, in their role as a user.

2.6 life cycle

The period of time over which the life cycle costs of an asset, including the cost of ownership, are assessed.

NOTE. It is not necessarily linked with any accounting period, nor is it necessarily linked to the total life-span of the asset (this applies where it is intended to dispose of physical assets before they are obsolete or unusable for any other reason).

2.7 life cycle costs

The costs associated with acquiring, using, caring for and disposing of physical assets, including feasibility studies, research, development, design, production, maintenance, replacement and disposal; as well as all the support, training and operating costs generated by the acquisition, use, maintenance and replacement of permanent physical assets.

¹⁾Repeated from BS 3811.

Section 2. The concept of terotechnology

3 Objectives of terotechnology

3.1 Primary objective

Terotechnology is aimed at achieving the best possible value for money for a user from the procurement and subsequent employment of a physical asset. This may range from a complex building or engineering plant to a domestic appliance. Terotechnology can be applied with advantage by organizations of any complexity or even individuals.

A user would employ the principles of terotechnology in the selection of the asset and then in the subsequent management of it. A supplier, on the other hand, applies the principles in the design, manufacture and support for his product. This can achieve improved customer satisfaction generally. It may also act as a valuable incentive to potential customers, especially if they, as prospective users, are selecting their assets on the basis of terotechnology principles.

There is a close interrelationship between a supplier's product and the user's asset (see note to 2.5). A compatibility of approach should therefore be feasible and practicable.

An organization often acts both as a user and as a supplier. It acts as a user in respect to its acquisitions of assets with which it produces its own output products. In supplying these products, which might be either further assets, materials or a service, to its customers the organization is clearly acting as a supplier. It is essential that the organization gives full consideration to the acquisition and management of its own assets using terotechnological principles. It is equally important that it gives due consideration to its products and how these will best satisfy the terotechnological needs and aspirations of its customers. This is valid even when the customers for the products are the general public or individual members of it. In such cases the organization should make every effort to ascertain the terotechnological needs of its customers by market research and/or any other appropriate means and then to meet these needs as far as possible.

3.2 Lowest asset costs over life cycle

Terotechnology is applied to the assessment of the total costs involved with the asset over its full life cycle up to and including its disposal. This will include the cost of financing as well as the initial capital costs and subsequent revenue or running costs. These will be related to a defined level of performance and the expected life cycle. This latter may be determined by the perceived market for the product rather than the practicable life of the asset itself.

3.3 Approach to objectives

In most cases the life cycle cost assessment will be influenced by the relationship between the producer of the product and the customer who acquires it. The customer or client who orders a product specifically designed to satisfy his particular requirements will usually have a close liaison with designer and producer. He will therefore have a direct interest in the cost of ownership of the asset he will be acquiring and consequently in the life cycle costing implications of the different solutions which may satisfy his requirements. However, even a bespoke product may incorporate sub-assemblies, equipment or articles which are standard items and from which choices may be made.

On the other hand the manufacturer of a mass-produced item may have no direct personal involvement with the eventual purchaser. In order to establish the best market for his product he may therefore have to rely on techniques such as market research to identify the life cycle costs and reliability which will ensure satisfactory value for money. There will also be variations between those two extremes.

Nevertheless, in all cases there should be a need to identify the options which may be available in the procurement of the asset so that the most economic solution may be chosen which best fits the user's requirement. This solution will largely depend on a price/cost equation or a cost benefit analysis.

The full terotechnology cycle begins at the investment appraisal stage and ends with the disposal of the asset, but the application of terotechnology can be made at any stage in the life of a physical asset and continue for some or all of the remaining life cycle periods until disposal or replacement.

Maximum benefit will be obtained from applying the complete principles of terotechnology. However, many aspects of terotechnology are already being very successfully practised by many organizations under different names. The following list, which is not exhaustive, may help managers to identify those parts of terotechnology with which they are already familiar:

- (a) asset management (including physical asset management);
- (b) resource management;
- (c) life cycle costing;
- (d) cost of ownership;
- (e) total commitment for life;
- (f) womb to tomb costing;
- (g) cradle to grave management;
- (h) design for life costing;
- (i) life long care;
- (j) costs-in-use;
- (k) through life costing



Terotechnology is concerned with helping to optimise life cycle costs. In a case where the life cycle is short, the trade-off between initial and upkeep costs might point towards buying an asset with the lowest purchase price. This approach would obviously be undesirable where there was the possibility of retaining, for example, a plant for a longer period than originally intended. Such a policy would almost certainly result in unreliability and high upkeep costs, but the opposite does not necessarily follow.

4 Principles of terotechnology

4.1 Scope of terotechnology

Terotechnology is essentially concerned with the following:

- (a) the selection and provision of permanent (i.e. not consumable) physical resources used in the production of goods and services;
- (b) caring for those resources effectively and efficiently;
- (c) coordinating them to help achieve overall minimum costs over their life cycle;
- (d) feeding back information to improve them.

The successful application of terotechnology depends upon ability to balance factors which are uniquely important for a particular situation. It requires an understanding of management and accounting sciences and a general knowledge of engineering associated with the technological expertise appropriate to a particular industry.

In more specific terms, the application of terotechnology brings together the whole or parts of a number of techniques and disciplines. The blend and depth required of each will depend on the particular circumstances in which terotechnology is being applied. These techniques and disciplines include the following:

- (1) investment appraisal;
- (2) operational research;
- (3) replacement analysis;
- (4) marketing;
- (5) purchasing;
- (6) accounting;
- (7) design for reliability and maintainability;
- (8) preparation of specifications;
- (9) installation;
- (10) commissioning;
- (11) maintenance procedures and technology;
- (12) information systems;
- (13) programming;
- (14) technical communications.

The life cycle and performance of a total asset will be affected by the individual life cycles and performance of its constituent parts.

4.2 Participation of the whole organization

It will be seen from the outline of the scope of terotechnology given in 4.1 that it is essential that the whole of an organization is involved.

Terotechnology is essentially a multi-disciplinary contribution to optimizing life cycle costs, and the experience and skills of a number of specialists are required for its implementation. The basic principles of terotechnology can be applied within an enterprise without changing organizational structures (except where these are defective in themselves) and there is no need to create a new breed of specialist (a Terotechnologist). Save in exceptional circumstances, the range of skills and breadth of knowledge and experience necessary for its full implementation is unlikely to be acquired by any one individual.

Although terotechnology can be easily understood and applied by line management, engineers, accountants and others, in their daily working lives, the subject can be applied successfully at company level only with the active participation and understanding of senior management.

4.3 Interprofessional cooperation

The application of terotechnology demands that all those involved have a broad recognition of their own contribution together with that of their colleagues in other disciplines and its success is dependent upon effective communication between all parties. It requires an understanding of management and accounting and knowledge of the technology associated with the particular industry or asset.

The following are two examples which may help to illustrate this principle.

- (a) The designer of a product should take into account the feasibility of producing his design and its cost to the consumer in operation and maintenance.
- (b) When assessing the proposed design of a product the management will require feedback data on the price the market may be prepared to pay for the product and the cost of producing it.

However, it should be remembered that these are only two examples of a wide range of interrelationships and each member of the team should endeavour to prepare his own list of the ways in which his role should interact with the whole team. This is discussed in more detail in section 3.

4.4 Interdepartmental cooperation

It is common practice for senior management of an organization to require individual departments to optimize their individual activities. Unfortunately if this is taken as the primary objective of departments it can result in a less than optimum performance of the organization as a whole. This arises from the inevitable interaction of decisions between departments. Examples of this are not hard to find. If a purchasing department acquires

the cheapest possible asset it is likely that the operating and/or maintenance costs will tend to be higher. Similarly inadequate maintenance, to reduce maintenance costs, invariably results in penalties in the cost of operation and/or a shorter working life of the asset.

Consequent upon the above, the primary objective of all departments working under the principles of terotechnology, is that their individual decisions are made on the basis of achieving the best balance of cost and performance for the organization as a whole.

4.5 Collection and analysis of data

To action the optimization objectives described in 4.2 to 4.4, it will be clear that each individual department will require suitable quantitative data from all other interacting departments. These data need to be those required for the department to optimize its own decisions in the overall interest of the organization as a whole.

It is essential that there are communication channels between departments (see 4.3). It should be emphasised that part of the communications through these channels needs to be the data needed by other departments to carry out their own optimization exercises, on an organization-wide basis.

Furthermore, this can, and frequently does, require a department to collect data not required for its own purposes but necessary for proper use by other departments.

This collection, analysis and dissemination of data does not necessarily remain within the organization but can and should extend to the suppliers of the assets used by the organization. Only in this way, can the supplier organization refine its designs in the overall interests of its customer organizations.

Data may be required for central decision making. These may be central data or they may be departmental data, but they should be collected in a form which satisfies both the central and the departmental needs.

Experience to date has shown that in many organizations there is an advantage in appointing a senior person to oversee adoption of the principles of terotechnology throughout the organization. This person should be appointed by, and be responsible to, the Board of Management. Ideally he should be independent of any particular department, but in any case he needs to be free to cut across departmental boundaries.

4.6 Minimum activities necessary for implementing terotechnology

The minimum activities necessary for the implementation of terotechnology are the following:

- (a) decide what production and cost targets are to be met;
- (b) decide what physical assets are needed and how to use them to achieve the targets over a specified period, taking into account their forecast cost of ownership and use;
- (c) specify the performance of the assets to be acquired;
- (d) acquire, install and commission those assets;
- (e) care for them;
- (f) monitor their use;
- (g) replace and improve the assets and improve their care, using information from them to help minimize total life cycle costs.

5 Benefits from introducing terotechnology

The benefits which may be gained by the use of terotechnology may be broadly described as:

- (a) improved control by the client or senior management in the making of vital decisions; leading to
- (b) better investment decisions arising from:
 - (1) improved information regarding costs and performance requirements;

NOTE. Performance includes such things as:

- (i) reliability;
- (ii) durability and life expectancy/requirement;
- (iii) quality control;
- (iv) how well the product does its job;
- (v) safety, including statutory liability and product liability;

as related to particular patterns of expenditure and design choice.

- (2) improved client identification of requirements and development of a brief for the asset acquisition;
 - (3) information regarding the cost consequences of the options under consideration;
 - (4) better investment analysis of cost options available; leading to
- (c) better value for money from the final product and/or an improved market for the product.