

BS 7000-2:2015



BSI Standards Publication

# Design management systems –

Part 2: Guide to managing the design of manufactured products

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### Summary of pages

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## Foreword

### Publishing information

This part of BS 7000 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 September 2015. It was prepared by Subcommittee TDW/4/7, *Technical product realization – BS 8887 design for MADE*, under the authority of Technical Committee TDW/4, *Technical product realization*. A list of organizations represented on this committee can be obtained on request to its secretary.

### Supersession

This part of BS 7000 supersedes BS 7000-2:2008, which is withdrawn.

### Relationship with other publications

BS 7000 *Design management systems*, consists of the following parts:

- *Part 1: Guide to managing innovation;*
- *Part 2: Guide to managing the design of manufactured products;*
- *Part 3: Guide to managing service design;*
- *Part 4: Guide to managing design in construction;*
- *Part 6: Managing inclusive design – Guide;*
- *Part 10: Vocabulary of terms used in design management.*

Other parts may be added.

### Information about this document

This part of BS 7000 is a full revision of the standard and introduces multi-lifecycle considerations, along with the recommendations given in BS 8887-1.

### Use of this document

As a guide, this part of BS 7000 takes the form of guidance and recommendations. It should not be quoted as if it were a specification or a code of practice and claims of compliance cannot be made to it.

### Presentational conventions

The guidance in this standard is presented in roman (i.e. upright) type. Any recommendations are expressed in sentences in which the principal auxiliary verb is “should”.

*Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.*

### Contractual and legal considerations

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

**Compliance with a British Standard cannot confer immunity from legal obligations.**

## Introduction

Creating and delivering excellent products with market appeal, and attaining high levels of customer satisfaction requires an integrated approach to design, from the board of an organization to project managers and their multi-disciplinary teams.

Excellence in design is an important differentiating factor between competing products, and can be the key to company survival in increasingly competitive world markets.

The complex intellectual challenges presented in the design of manufactured products demand that the process is managed effectively if the outcome is to be successful. The concepts, principles and quality system elements described in this standard are applicable to all forms of manufactured products. Applying the principles described facilitates the creation of products that are produced on time and within budget, meet customer and organizational requirements, and have a better chance of competing successfully in world markets.

This standard sets out the tasks and responsibilities for creating and implementing an effective design policy for:

- a) senior executives, (see Clause 4);
- b) project managers and those involved in the design process (see Clause 5).

In large organizations, these two sets of tasks and responsibilities are frequently taken on by different individuals or groups. In small organizations, they are often undertaken by a single person or small team but are, nevertheless, distinct and different. All those involved need to be aware of what is required of them.

## 1 Scope

This part of BS 7000 gives guidance on managing the design of all types of manufactured products. It deals with every stage of the design process from product concept through to delivery, use and end-of-life processing.

*NOTE 1 This standard recognizes that small enterprises or those specializing in one-off products or special purpose end-of-life equipment often need to adapt the process to suit their method of operation.*

It is intended for use by all relevant levels of management, from board level to individual project level, in all types of organizations involved in the design of manufactured products.

Guidance is given on the application of general principles and techniques to the management of design, raising awareness of management issues and emphasizing the need for an integrated approach to the design of products. This standard is not intended to define design techniques.

*NOTE 2 For many products, particularly those that are complex, an integrated multi-disciplinary approach to design is needed. Documents recommended for guidance on general management techniques are listed in the Bibliography.*

Guidance on the management of innovation, service design and construction design is given in BS 7000-1, BS 7000-3 and BS 7000-4 respectively.

*NOTE 3 Guidance on procedures needed to meet statutory requirements, such as health and safety, or product certification and liability, is not intended to be comprehensive. Reference needs to be made to other documents where appropriate.*

*NOTE 4 This standard is intended to complement BS EN ISO 9001.*

## 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

BS 7000-10:2008, *Design management systems – Part 10: Vocabulary of terms used in design management*

BS 8887-1, *Design for manufacture, assembly, disassembly and end-of-life processing (MADE) – Part 1: General concepts, process and requirements*

BS 8887-2, *Design for manufacture, assembly, disassembly and end-of-life processing (MADE) – Part 2: Terms and definitions*

BS 8887-211, *Design for manufacture, assembly, disassembly and end-of-life processing (MADE) – Part 211: Specification for reworking and remarketing of computing hardware*

BS 8887-220, *Design for manufacture, assembly, disassembly and end-of-life processing (MADE) – Part 220: The process of remanufacture – Specification*

BS 8887-240, *Design for manufacture, assembly, disassembly and end-of-life processing (MADE) – Part 240: Reconditioning*

BS ISO 10007, *Quality management systems – Guidelines for configuration management*

## 3 Terms and definitions

For the purposes of this part of BS 7000, the terms and definitions given in BS 7000-10 and the following apply.

### 3.1 analogy

aid to creativity that compares a concept with something that exists elsewhere

### 3.2 audit

systematic examination to measure conformity with predetermined requirements

### 3.3 chain of custody

process whereby an organization monitors its products through every stage of the supply chain, including all stages of manufacturing, transportation and distribution

### 3.4 combination

utilization of two or more existing design methods to reach a design solution

### 3.5 configuration management

co-ordinated activities to direct and control configuration

*NOTE Configuration management generally concentrates on technical and organizational activities that establish and maintain control of a product and its product configuration information throughout the lifecycle of the product.*

[SOURCE: BS ISO 10007:2003, 3.6]

### 3.6 design control

component of a quality system that ensures the integrity of a design throughout its lifecycle

**3.7 design policy**

general rules relating to design discipline within an organization

*NOTE Can help to guide corporate behaviour in circumstances that tend to recur, though it might not prescribe for every eventuality.*

**3.8 design programme**

specific activities and investments to be undertaken over a specified period, broken down into stages, with resources and associated timescales

**3.9 design strategy**

chosen path formulated to achieve business and design objectives, supported by an indication of how resources will be committed

*NOTE Could relate to particular categories of design, types of project, sections of an organization and/or use of resources.*

**3.10 earned value analysis**

determination of the monetary value of work performed in any stage of the design process through assigning a value to the achievement of project work completed and comparing this with the actual and planned costs of the project

*NOTE Also known as “budgeted cost of work performed” (BCWP).*

**3.11 evaluation**

systematic examination of the outcome of an activity to determine the extent to which specified objectives have been fulfilled

*NOTE 1 Usually linked to a specific activity, e.g. system evaluation, project evaluation and design evaluation. Results are usually measured in terms of time, cost and achievement.*

*NOTE 2 Generally takes place at the end of an activity, but progress can be maintained by carrying out intermediate or stage evaluation, particularly where intermediate stage achievements have been planned.*

**3.12 general arrangement**

overall scheme, usually a drawing, which shows the main components of a design

*NOTE Also known as “design layout”.*

**3.13 inversion**

aid to creativity that considers the idea inside out or upside down

**3.14 manufactured product**

complete product produced singly, in batches, or in bulk by an industrial manufacturing system

**3.15 product specification**

reference specifying the features, characteristics and properties of a product, giving all the information that is required to create it

*NOTE Sometimes referred to as a technical specification.*

**3.16 risk management**

process whereby decisions are made to eliminate, mitigate or accept a known risk or hazard

**3.17 specification**

reference stating requirements that a product has to fulfil

*NOTE 1 A qualifier should be used to indicate the type of specification, such as product specification, test specification, etc.*

*NOTE 2 Normally includes or mentions drawings, patterns and other references and indicates the means and criteria for checking conformity.*

### **3.18 technical file**

product technical information collated to satisfy the documentation requirements of European Directives applicable to the product (e.g. CE Marking)

*NOTE Can comprise specifications, drawings, items lists, design descriptions, risk assessments, test reports, copies of instructions for installation, use and maintenance (this is not an exhaustive list).*

### **3.19 test plan**

plan outlining the test work to be undertaken to ensure that the performance requirements of the eventual product can be achieved

### **3.20 validation**

confirmation, through the provision of objective evidence, that the requirements for a specific intended use or application have been fulfilled

*NOTE 1 In design and development, validation concerns the process of determining a product's suitability and conformity with user needs.*

*NOTE 2 Validation is normally performed on the final product under defined operating conditions. It may be necessary in earlier stages.*

*NOTE 3 The term "validated" is used to designate the corresponding status.*

*NOTE 4 Multiple validations may be carried out if there are different intended uses.*

### **3.21 validation protocol**

statement of the method by which validation will be carried out, typically comprising a list of each product specification element, and for each a description of the nature of the validation

*NOTE Could be an inspection, test or review.*

### **3.22 validation report**

written report describing the results and outcome of conducting validation

### **3.23 value chain**

factors and activities undertaken by, or on behalf of, an organization that contribute to the value of its products as perceived by customers and users, from conception through to final disposal and recycling

### **3.24 verification**

confirmation, through the provision of objective evidence, that the specified requirements have been fulfilled

*NOTE 1 The term "verified" is used to designate the corresponding status.*

*NOTE 2 Confirmation can comprise such activities as:*

- a) performing alternative calculations;*
- b) comparing a new design specification with a similar proven design specification;*
- c) undertaking tests and demonstrations;*
- d) reviewing documents prior to issue.*

## 4 Managing the design of manufactured products at organizational level

### 4.1 Taking organizational responsibility for design

The ultimate responsibility for the quality of designs produced by, or on behalf of, an organization, rests with the board of directors, owner-managers or partners.

It is the board's collective responsibility to ensure that the organization has a clear sense of direction with respect to design programmes, so that all contributions can be harnessed to their full potential. It is the chief executive's responsibility to ensure that this direction is followed effectively and that design programmes make a full contribution to the organization's performance. Chief executives might assign day-to-day executive responsibility for design to other members of the board or executives in the management hierarchy who report directly to them. A chief executive's design committee, or design policy group, can be established to oversee the management of design at the organizational level.

Senior executives should demonstrate their understanding of responsibilities for and commitment to design programmes through their statements and actions. In particular they should ensure that competent and committed teams are brought together to address design requirements. Design responsibilities should be clearly articulated and communicated to colleagues throughout the organization. Executives and staff should be given guidelines within which to operate. They should know who to turn to for guidance, authorization to proceed with a particular design idea or project, or other design-related decisions.

It is also vital that all executives who have design responsibilities, or otherwise get involved in design activities, should have these responsibilities and activities stated in their contract of employment. These factors should be reviewed periodically.

Organizations develop their competence in design management over time.

### 4.2 Checklist of design management responsibilities at organizational level

The following design management responsibilities should be carried out at organizational level:

- a) establish clear ownership of design responsibility;
- b) provide a vision of the future with clear objectives;
- c) demonstrate genuine and visible commitment to effective design;
- d) show awareness of customers' interests and needs;
- e) formulate the organization's design strategy and policy;
- f) establish and maintain the organization's design standards and guidelines;
- g) provide organizational systems;
- h) encourage an understanding of the environmental dimension of design;
- i) ensure there is an understanding of the legal requirements of design;
- j) establish the organization's design team;
- k) provide for training in design management skills;
- l) motivate staff involved;

- m) harness appropriate technologies;
- n) promote awareness of competitors and their external activities and innovations;
- o) assess opportunities and risks attached to investments in design;
- p) fund design activities;
- q) provide adequate resources (personnel, equipment, information and facilities);
- r) understand organizational capabilities and limitations;
- s) ensure production capabilities and requirements and their consequent effects on design are understood;
- t) demonstrate a commitment to quality and reliability;
- u) audit the organization's design and design management practices;
- v) understand the impact of design on corporate identity;
- w) evaluate the contribution of design to corporate performance;
- x) nurture an environment that encourages innovation and creativity;
- y) address corporate social responsibility issues;
- z) establish an archival system to record key design information to be made available for later use in the product cycle. (The archive should remain accessible for several product cycles, so should be in a format which will remain readable).

### **4.3 Organizational design philosophy, objectives and strategy**

#### **4.3.1 General**

Given the strategic significance of design in the development of new products and services, design should be given serious consideration at board level. Using design on an ad hoc basis, or in an unstructured way, severely limits its contribution to the long-term success of the organization.

#### **4.3.2 Organizational design philosophy**

Consideration should be given to establishing the organization's design philosophy. The philosophy should include the organization's general stance towards design, the basic reasons for design discipline and its contribution to the organization's performance.

#### **4.3.3 Formulating the organization's design strategy**

The organization's design strategy should be drawn up as a prescription of approaches to be taken at senior level and how resources will be harnessed to achieve the objectives. These approaches might include setting up an appropriate system for re-using end-of-life products.

Where appropriate, these strategies might be developed into short- to medium-term design activities and longer-term investments in design that are reviewed before being sanctioned for implementation.

Design should be formally directed on a strategically planned basis; the following is a summary list of key actions.

- a) Reinforce the strategic importance of design by addressing design management issues regularly at senior executive meetings.
- b) Specify and periodically update the organization's design policies, objectives and strategies that facilitate the fulfilment of the organization's goals.

- c) Formulate the organization's design philosophy and promote it enthusiastically.
- d) Establish a design programme and control, review and update it at appropriate intervals to maintain its relevance to the fulfilment of the organization's objectives.
- e) Ensure that the design programme complements, enhances and is compatible with the other major plans of the organization.
- f) Establish corporate risks associated with design.
- g) Determine the return on investment on all resources committed to design (not just capital).
- h) Plan to provide the necessary finance and other resources to enable the organization's design programme to be implemented effectively.
- i) Assign design responsibilities to competent and qualified executives, then motivate them to acknowledge these responsibilities and their ability to perform to specification.
- j) Communicate the organization's design policies, objectives, strategies and programmes to all involved, and ensure that there is a common understanding of their substance and implications.
- k) Introduce and reinforce an appropriate design management system and infrastructure to sustain design work to the required standard, ensuring that it is integrated with other disciplines.
- l) Monitor and control expenditures against plans and time, and record achievements.
- m) Use the most appropriate skills available and bring others up to the required standard of performance through design awareness and training in design management skills.
- n) Underpin the importance of design as a strategic resource by maintaining a genuine and visible commitment to it.
- o) Establish an appropriate branding strategy for families of products.
- p) Establish policies which encourage a multi-lifecycle ethos typified by BS 8887 (all parts).

## 4.4 Providing investment

### 4.4.1 General

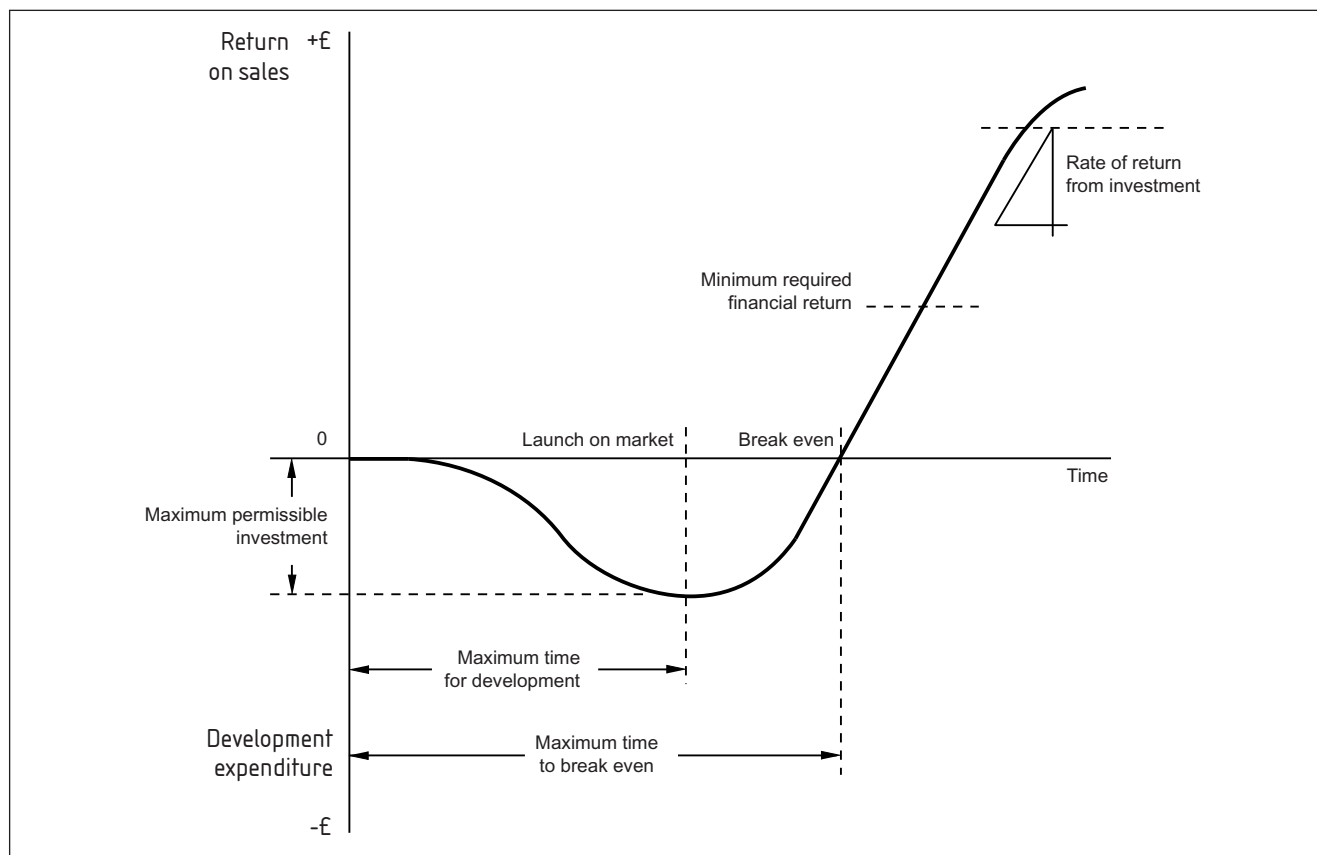
Senior executives should ensure that appropriate resources are made available when required to undertake the research, design and development work, as well as the associated training needed. Limiting investment in new product development is likely to jeopardize future competitiveness and profitability.

### 4.4.2 Formulating the organization's investment programme

The financing of product design activities should be written into the organization's business plan. The investment requirements and cash flow implications of design activities should be forecast and set out in the organization's design programme. Figure 1 shows that prudent investment in design has the potential to recover its initial costs and produce significant cash-flow.

The investment programme should set out all areas of design activity, the outcomes sought and the contribution to the attainment of the organization's objectives, considering the organization's available skills and resources.

Figure 1 Profile of cash flow during project lifecycle



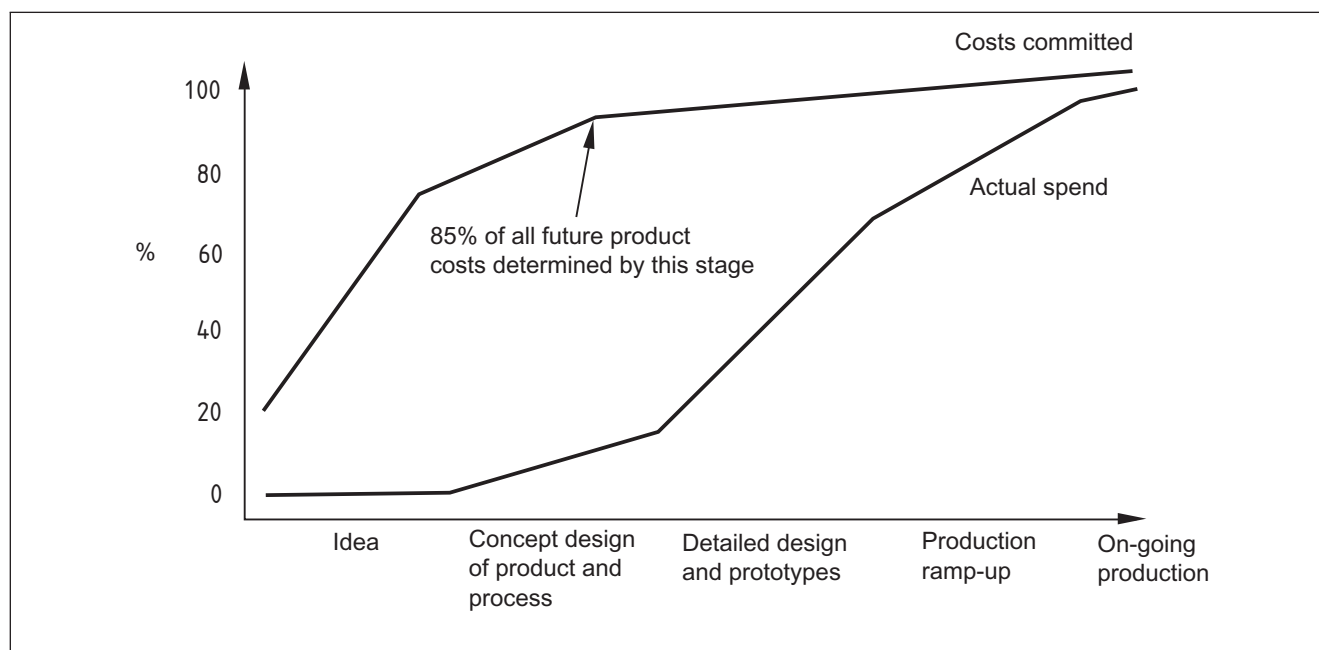
Senior executives should ensure that funds allocated to product design and development are spent as intended and not withheld or diverted unless there are overriding reasons. These should be clearly stated and carefully checked. If funds have to be reallocated, the impact upon the project and the overall design programme should be taken into consideration and the plans revised as necessary.

#### 4.4.3 Budgeting

An example of the financial commitment incurred during design, development and manufacture of a product is illustrated in Figure 2.

An easily comprehensible system of budgeting, with approved benchmarks on typical expenditure for different elements of work as well as the fair allocation of overheads, should facilitate financial planning for and costing of new or improved products.

Figure 2 Financial commitments during product design, development, manufacture and support



#### 4.4.4 Providing resources

Resource plans should be prepared which specify the resources to be committed to design and design management issues. Particular attention should be given to the following questions.

- Does the proposed project make appropriate use of in-house knowledge, skills and experience?
- Will new technologies be brought in or subcontracted to design specialists and/or suppliers?
- Will new equipment or design aids be developed specifically for the organization or could standard versions be used, perhaps with some minor customization?
- Does the accommodation provide the necessary space and technical services (e.g. clean conditions and environmental control), to allow team members to operate effectively?
- Are systems in place to enable the activity to progress smoothly from initiation through to completion? Are these systems adequately coordinated with the systems of other functions/disciplines?
- Are the necessary ancillary resources and activities in other functions planned so that product design progresses smoothly without cross-functional difficulties, especially at the transitions between phases/stages where responsibilities transfer from one function to another?
- Is training provided to raise awareness of design and the design processes among staff, and enhance design management skills?

#### 4.5 Putting infrastructure in place

##### 4.5.1 General

An effective system for managing design should be formally adopted and linked in with the management systems of other business disciplines.

#### 4.5.2 Formulating and managing the product design programme

Proposals for investments in design should be coordinated within an organization's design programme. This programme should set out specific activities in all categories of design to be undertaken, the outcomes sought and their contribution to the attainment of organizational objectives. The programme should summarize design briefs and specifications, with the planned work broken down into appropriate stages. Skills and other resources to be committed and outputs to be generated at each stage should be specified, together with associated timescales. It is important that this programme can be referred to and influenced by those involved and interested in design, in a formal, easily accessible working document.

There should be a formal procedure by which the organization's investments in design are evaluated and sanctioned. That procedure should be formally documented, transparent and made available to all appropriate personnel within the organization.

There should be a formal procedure for monitoring the progress of the organization's design programme, with reviews scheduled into the programme itself. Reports of findings should be submitted to senior executives for information and debate. Where slippage or deviations occur in relation to set goals, the senior executives should be informed of these as well as the remedial action taken.

#### 4.5.3 Managing risk

It is essential that risks are identified systematically from the early stages of planning a project. A system of risk management should be introduced that works effectively alongside the creative work.

*NOTE BS 6079-3, describes a process for identifying, assessing and controlling commercial risk within a broad framework.*

#### 4.5.4 Meeting market expectations and dealing with legal issues

The legal dimension of design is of crucial importance, due to the potential for litigation in the civil courts in respect of allegations made against products and associated manufacturing processes. It is also essential to protect the organization's intellectual property rights.

Copying products has become an easier and more rapid process. Counterfeiting and infringement of intellectual property rights are also more frequent and widespread. Consequently, there is a need for considerable vigilance to ensure that an organization conforms to local requirements wherever it operates, and profits for as long as possible from its intellectual assets.

There should also be formal procedures in place to:

- a) maintain records of key decisions, actions and changes that affect the design, (for use, among other things, as potential evidence in case of disputes, litigation and end-of-life decisions);
- b) check that similar designs, patents, trademarks and service marks have not already been registered;
- c) register designs, patents, trademarks and service marks;
- d) ensure that the design is documented and controlled from the start of the project;
- e) ensure that potential customers and suppliers sign non-disclosure agreements before being supplied with commercially sensitive design information;