

BS 8536-2:2016



BSI Standards Publication

Briefing for design and construction

Part 2: Code of practice for asset management (Linear and geographical infrastructure)



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Published by BSI Standards Limited 2016

ISBN 978 0 580 92299 2

ICS 03.080.99, 91.040.01

The following BSI references relate to the work on this document:

Committee reference FMW/1

Draft for comment 16/30333120 DC

Publication history

First published October 2016

Amendments issued since publication

Date	Text affected
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Foreword

Publishing information

This Part of BS 8536 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 31 October 2016. It was prepared by Technical Committee FMW/1, *Facilities management*. A list of organizations represented on this committee can be obtained on request to its secretary.

Relationship with other publications

BS 8536, *Briefing for design and construction*, comprises two parts:

- *Part 1: Code of practice for facilities management (Buildings infrastructure); and*
- *Part 2: Code of practice for asset management (Linear and geographical infrastructure).*

Information about this document

The initial drafting of this part of BS 8536 was produced in association with the Department for Business, Energy and Industrial Strategy (BEIS) as part of their ongoing programme of support for standardization.

Briefing for design and construction focuses on those aspects of design, construction, testing and commissioning, handover and start-up of operations that are concerned with achieving the required operational performance of a new or upgraded asset. These aspects can include: energy use and greenhouse gas emissions; water abstraction and consumption; waste prevention, reclamation, recycling, treatment and disposal; noise and vibrations; and asset availability, access, inclusiveness, utilization, safety, security, capability, capacity, resilience, serviceability/maintainability, adaptability, quality, cost, value and comfort.

The aim is fourfold: to improve the focus of the supply chain on the performance of the asset in use; to extend supply chain involvement through to operations and defined periods of aftercare; to involve the operator, operations team or asset manager, as appropriate, from the outset of the project; and to take account of the need to maximize the value of the asset.

This standard broadly aligns with the principles of *The soft landings framework* published by UBT and BSRIA [1] and the principles identified in *Government Soft Landings* [2]. Soft landings (2.1.61) is concerned with the smooth transition from design and construction into operation and use of an asset. It advocates close collaboration during briefing, design, construction and handover between the delivery team and the operator, operations team or asset manager, as appropriate, in matters affecting operations and end-users, in order to maintain focus on the required outcomes.

This standard forms part of an existing set of standards connected with asset/facilities management and building information modelling. Whilst this standard assumes the use of "BIM Level 2" for projects, the adoption of soft landings is not precluded where "BIM Level 2" cannot be achieved across the project.

Use of this document

As a code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

Any user claiming compliance with this British Standard is expected to be able to justify any course of action that deviates from its recommendations.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its 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.

The word “should” is used to express recommendations of this standard. The word “may” is used in the text to express permissibility, e.g. as an alternative to the primary recommendation of the clause. The word “can” is used to express possibility, e.g. a consequence of an action or an event.

Notes and commentaries are provided throughout the text of this standard. Notes give references and additional information that are important but do not form part of the recommendations. Commentaries give background information.

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.

0 Introduction

This British Standard considers matters relating to projects for the delivery of built assets according to defined operational requirements, including maintenance, and performance outcomes. For the purpose of this British Standard, the term “delivery team” covers the collective efforts of designers, constructors and other specialists, representing the disciplines and skill-sets engaged in the delivery of a new asset or the upgrading of one existing. An integrated delivery team offers benefits in terms of coordinated design and problem solving, as well as consideration of constructability and operational impacts. This British Standard emphasizes the importance of adopting a whole-life view of an asset and the need to realize value from it; not solely its design and construction or upgrading. In this regard, it is important to recognize that a vast amount of information and data about an asset is generated and exchanged during its lifetime and that a security-minded approach to the handling of such information and data will need to be adopted.

The principle of constructability is widely applied in design. However, the principle of operability has not historically been considered to the same extent. Design decisions have to be based upon accurate and relevant information and data, and their impact on operational needs has to be understood before they are committed to construction. The most effective time to comment on the suitability or effectiveness of design is before it is finalized. Testing assumptions during design is necessary to understand how the asset will perform in operation. Whilst it is too late to comment on the design of the asset once it is operational, systematic measurement, analysis, comparison and feedback can be useful in informing the design of future assets.

This British Standard is intended to complement and strengthen briefing practices and procedures by:

- a) promoting the early involvement of the operator, operations team or asset manager, as appropriate; and
- b) extending the commitment on the part of the delivery team to aftercare post-handover of the asset and its safe, secure, efficient and cost-effective operation in line with environmental, social, security and economic performance outcomes and targets.

The requirements of inclusive design and of managing design in construction have been incorporated to anticipate the implications for managing assets and their environments inclusively and effectively when they become operational. This British Standard outlines the primary activities, information, questions and deliverables to be addressed by the designers, constructors and other specialists to support their work and so ensure that the asset owner and the operator, operations team and asset manager, as appropriate, are provided with as much certainty as possible in regard to the required operational performance of the asset.

This British Standard broadly aligns with the principles of *The soft landings framework* published by UBT and BSRIA [1] and the principles identified in *Government Soft Landings* [2].

1 Scope

This Part of BS 8536 gives recommendations for briefing for design and construction in relation to energy, telecommunication, transport, water and other infrastructure to ensure that design takes account of the expected performance of the asset in use over its planned operational life. It is applicable to the provision of documentation supporting this purpose during design, construction, testing and commissioning, handover, start-up of operations and defined periods of aftercare.

This British Standard is not intended to provide detailed guidance on design or construction, but is concerned with information and data that are needed in order that due consideration can be given to operability and performance requirements for the new or upgraded asset. It does not cover decommissioning or other end of life activities.

This British Standard is intended for use by individuals and organizations preparing or contributing to design, construction and operations, in both the public and private sectors, including owners upgrading an existing asset, organizations procuring a new asset, and the designers, constructors, suppliers, operators, licensees, operations teams, asset managers and other specialists engaged in such activities.

2 Terms, definitions and abbreviations

2.1 Terms and definitions

For the purpose of this British Standard the following terms and definitions apply.

2.1.1 access

ability of reaching and using a service or facility
[SOURCE: BS ISO 16439:2014, 3.2]

2.1.2 activity

task that is needed to produce a deliverable

2.1.3 adaptability

ability to be changed or modified to make suitable for a particular purpose
[SOURCE: BS ISO 6707-1:2014, 9.3.78]

2.1.4 aftercare

defined period post-handover of an asset in which the delivery team passes on information and knowledge to the operator, operations team or asset manager, responds to queries and problems, and monitors and reviews the asset's performance

2.1.5 as-constructed information

expression of the design, its working detail, construction work and/or installations, functions and operation and maintenance needs of an asset in a form suitable for use in managing that asset

2.1.6 asset

item, thing or entity that has potential or actual value to an organization
[SOURCE: BS ISO 55000:2014, 3.2.1]

2.1.7 asset information model (AIM)

data and information that relate to assets to a level required to support an organization's asset management system
[SOURCE: PAS 1192-3:2014, 3.1.4, modified]

2.1.8 asset information requirements (AIR)

data and information requirements of the organization in relation to the asset(s) for which it is responsible
[SOURCE: PAS 1192-3:2014, 3.1.5, modified]

2.1.9 asset management

coordinated activity of an organization to realize value from assets
[SOURCE: BS ISO 55000:2014, 3.3.1]

- 2.1.10 asset management plan**
documented information that specifies the activities, resources and timescales required for an individual asset, or a grouping of assets, to achieve the organization's asset management objectives
[SOURCE: BS ISO 55000:2014, 3.3.3]
- 2.1.11 asset management system**
management system for asset management whose function is to establish the asset management policy and asset management objectives
[SOURCE: BS ISO 55000:2014, 3.4.3]
- 2.1.12 asset portfolio**
assets that are within the scope of the asset management system
[SOURCE: BS ISO 55000:2014, 3.2.4]
- 2.1.13 asset-related service**
support provision for an asset delivered by an internal or external service provider
- 2.1.14 asset system**
set of assets that interact or are interrelated
[SOURCE: BS ISO 55000:2014, 3.2.5]
- 2.1.15 baseline**
specification or product that has been formally reviewed and agreed upon, that thereafter serves as the basis for further development, and that can be changed only through formal change control procedures
[SOURCE: BS ISO/IEC 12207:2008, 4.6]
- 2.1.16 brief**
working document which specifies at any point in time the relevant needs and aims, resources of the client and user, the context of the project and any appropriate design requirements within which all subsequent briefing (when needed) and designing can take place
[SOURCE: BS 7832:1995, 2.1]
NOTE Annex A offers an example of a "Brief checklist".
- 2.1.17 briefing**
process of identifying and analysing the needs, aims and constraints (the resources and the context) of the client and the relevant parties, and of formulating any resulting problems that the designer is required to solve
[SOURCE: BS 7832:1995, 2.2]
- 2.1.18 building information modelling (BIM)**
process of designing, constructing or operating a building or infrastructure asset using electronic object-oriented information
[SOURCE: PAS 1192-2:2013, 3.7]
- 2.1.19 commissioning**
process by which equipment, a system, a facility or a plant that is installed, is completed or near completion is tested to verify if it functions according to its design specification and intended application
[SOURCE: BS ISO 50004:2014, 3.1.1]
- 2.1.20 common data environment (CDE)**
single source of information for any given project, used to collect, manage and disseminate all relevant approved project documents for multidisciplinary teams in a managed process
[SOURCE: PAS 1192-2:2013, A.30]

- 2.1.21 constructability**
degree to which the design of a planned asset assists its construction and utilization
- 2.1.22 cost-benefit analysis**
process that assesses the relation between the cost of an undertaking and the monetary value of the resulting benefits
[SOURCE: BS ISO 16439:2014, 3.10]
- 2.1.23 deliverable**
product or service as an outcome of a process
- 2.1.24 (project) delivery team**
group of organizations or individuals contracted either directly or indirectly to deliver services or products to the project
[SOURCE: PAS 1192-2:2013, 3.33]
- 2.1.25 design review protocol**
procedure for ensuring a structured and systematic review of a design at defined points in the project life cycle
- 2.1.26 digital plan of work (dPoW)**
generic schedule of phases, roles, responsibilities, assets and attributes, made available in a computable form
[SOURCE: BS 1192-4:2014, 3.3]
- 2.1.27 employer's information requirements (EIR)**
pre-tender document setting out the information to be delivered, and the standards and processes to be adopted by the supplier as part of the project delivery process
[SOURCE: PAS 1192-2:2013, 3.21]
- 2.1.28 end-user**
person receiving asset-related services
[SOURCE: BS EN 15221-1:2006, 2.4, modified]
- 2.1.29 engineered system**
combination of components that work in synergy to perform a useful function
- 2.1.30 environmental indicator**
sustainability indicator related to an environmental impact
[SOURCE: ISO 21929-1:2011, 3.11]
- 2.1.31 facilities management**
integration of processes within an organization to maintain and develop the agreed services that support and improve the effectiveness of its primary processes and activities
[SOURCE: BS EN 15221-1:2006, 2.5]
NOTE Also known as "facility management".
- 2.1.32 facility**
tangible asset that supports an organization
[SOURCE: BS EN 15221-1:2006, 2.6]
- 2.1.33 flawless start-up**
fault-free commencement of operations
[SOURCE: BS 8587:2012, 3.1.15]

- 2.1.34 handover**
act of passing responsibility for, and control over, an asset to the owner or operator following testing and commissioning
- 2.1.35 impact**
any change that might be adverse or beneficial
[SOURCE: BS ISO 15392:2008, 3.13]
- 2.1.36 inclusive design**
design that seeks to include everyone irrespective of needs, circumstances or identity
- 2.1.37 information exchange**
structured collection of information at one of a number of predefined stages of a project with defined format and fidelity for the purpose of communication
[SOURCE: PAS 1192-2:2013, 3.25, modified]
- 2.1.38 information model**
graphical model, non-graphical data and supporting documentation comprising the project information model (PIM) and asset information model (AIM) of an asset
- 2.1.39 key performance indicator (KPI)**
measure that provides essential information about the performance of asset-related services delivery
[SOURCE: BS EN 15221-1:2006, 2.13, modified]
- 2.1.40 level of definition**
collective term used for and including level of model detail and the level of model information
[SOURCE: PAS 1192-2:2013, 3.30, modified]
- 2.1.41 level of model detail**
description of the graphical content of an information model at each work stage
- 2.1.42 level of model information**
description of the non-graphical content of an information model at each work stage
- 2.1.43 occupant**
user who spends a significant proportion of their time in or about a facility
- 2.1.44 operability**
capable of being put into use as intended
- 2.1.45 operations team**
functional group responsible for the day-to-day running and maintenance of an asset
- 2.1.46 operator**
organization responsible for the day-to-day operation of an asset
- 2.1.47 organizational information requirements (OIR)**
data and information required to achieve the organization's objectives
[SOURCE: PAS 1192-3:2014, 3.1.26]

NOTE The management activities leading to the OIR are the equivalent of the employer's key decision points in PAS 1192-2.

- 2.1.48 owner**
individual or organization owning or procuring an asset
NOTE This can refer to both existing and prospective owners.
- 2.1.49 performance**
measurable result
[SOURCE: BS ISO 55000:2014, 3.1.17, modified]
- 2.1.50 plain language question**
request for information that is expressed in simple, easy-to-understand terms
- 2.1.51 portfolio management**
centralized management of the processes, methods and technologies used to analyse and collectively manage projects
- 2.1.52 post-implementation review (PIR)**
measurement of the outcomes of a project for the delivery of an asset and the performance of that asset in operation with the lessons to be learned for future projects
- 2.1.53 programme management**
process of managing a number of related projects
- 2.1.54 project execution strategy**
high-level statement of the intentions and arrangements for the execution of a project
- 2.1.55 project information model (PIM)**
information model developed during the design and construction phase of a project
[SOURCE: PAS 1192-2:2013, 3.35]
- 2.1.56 quality**
degree to which a set of inherent characteristics of an object fulfils requirements
[SOURCE: BS EN ISO 9000:2015, 3.6.2]
- 2.1.57 scope of work**
design, construction and/or installation, testing and commissioning, handover and start-up activities necessary to deliver an operational asset
- 2.1.58 security-minded**
understanding and routine application of appropriate and proportionate security measures in any business situation so as to deter and/or disrupt hostile, malicious, fraudulent and criminal behaviours or activities
[SOURCE: PAS 1192-5:2015, 3.1.26]
- 2.1.59 sensitive built asset**
built asset, as a whole or in part, that may be of interest to a threat agent for hostile, malicious, fraudulent and/or criminal behaviours or activities
[SOURCE: PAS 1192-5:2015, 3.1.27]
- 2.1.60 service level**
complete description of requirements of a product, process or system, with their characteristics
[SOURCE: BS EN 15221-3:2011, 3.1.11]

- 2.1.61 soft landings**
process for the graduated handover of a new or upgraded asset, where a defined period of aftercare by the delivery team is an owner's requirement that is planned and developed from the outset of the project
- 2.1.62 sponsor**
individual or organization initiating and promoting a project or scheme
- 2.1.63 stage**
division of a standardized process map for the acquisition of a facility, at some of which the requirements can be delivered
[SOURCE: PAS 1192-2:2013, 3.22]
- 2.1.64 stakeholder**
person, group or organization that has interests in, or can affect, be affected by or perceive itself to be affected by, any aspect of the project
[SOURCE: BS ISO 21500:2012, 2.14]
- 2.1.65 stakeholder impact analysis**
method for evaluating the influence that stakeholders possess in regard to an organization, asset or project
- 2.1.66 steady state**
stable operation and use
- 2.1.67 strategic asset management plan (SAMP)**
documented information that specifies how organizational objectives are to be converted into asset management objectives, the approach for developing asset management plans and the role of the asset management system in supporting achievement of the asset management objectives
[BS ISO 55000:2014, 3.3.2]
- 2.1.68 trigger-related event**
response to a trigger and the reflection of the altered state of the asset in the AIM
[SOURCE: PAS 1192-3:2014, 3.1.33]
- 2.1.69 upgrading**
major modification work on an asset or part thereof that improves its overall performance
- 2.1.70 value improving practice**
practice with a demonstrated, statistically-reliable connection between its use and a better outcome

2.2 Abbreviations

AIM	Asset Information Model
AIR	Asset Information Requirements
BIM	Building Information Modelling
BREEAM	Building Research Establishment Environmental Assessment Method
CDE	Common Data Environment
CDF	Concurrent Design Facility
COBie	Construction Operations Building information exchange
DQI	Design Quality Indicator
EIR	Employer's Information Requirements

ERP	Enterprise Resource Planning
HSSE	Health, Safety, Security and Environment
KPI	Key Performance Indicator
LEED	Leadership in Energy and Environmental Design
OIR	Organizational Information Requirements
PIM	Project Information Model
PIR	Post-Implementation Review
RASCI	Responsible, Accountable, Support, Consulted and Informed
SAMP	Strategic Asset Management Plan

3 Design and construction for operability

3.1 Key principles and requirements

COMMENTARY ON 3.1

Design and construction for operability takes into consideration the needs of the owner, operator, end-users and other key stakeholders in regard to a new or upgraded asset. The asset is likely to hold its value or benefit for the owner and end-users if it is trouble-free, efficient and cost-effective in terms of operation.

This British Standard broadly aligns with the principles of The soft landings framework published by UBT and BSRIA [1] and the principles identified in Government Soft Landings [2].

The overarching principles are that the project for the delivery of the new or upgraded asset should take account of operational requirements and the expected performance outcomes from the outset, through all work stages (see 3.5), and into operation. Design and construction should be guided by these principles and be followed by defined periods of aftercare to ensure that the owner, operator and end-users are able to derive the expected benefits and required operational performance of the asset.

NOTE 1 Projects are set up for success from the outset; otherwise, they are unlikely to achieve their expected objectives or match the operational performance required by the owner, operator and end-users where these are known. This implies an emphasis at the front end of the project, where the ability to influence changes in design is relatively high and the cost of making those changes is relatively low. It involves developing sufficient strategic definition through which the owner can articulate requirements and address uncertainty and risks, then make the decision to commit resources to the project in a controlled manner. The project might not be self-standing and, instead, might form part of a programme, portfolio or network. Interdependencies are likely to exist between such projects with the need to consider them holistically; notwithstanding, this British Standard addresses projects alone. It does, however, apply to situations where a project is broken down into sub-projects covering an asset system (see 3.4 and 4.1.1).

These principles should be supported by the following.

- a) The project for delivering a new asset or upgrading an existing asset should derive from the owner's asset management plan (see 2.1.10) aligned with the business objectives as part of an asset management system (see 2.1.11 and BS ISO 55000, BS ISO 55001 and BS ISO 55002).
- b) The owner or a delegated authority on the owner's behalf (see 3.6.3) should be capable of defining the business case for the project, its objectives,

expected benefits and the required operational performance of the asset (see 4.1.1). Appropriate professional advice should be sought where any aspect cannot be adequately defined.

- c) The owner or the delegated authority should be capable of expressing the security needs for the project and the ongoing operation of the asset. Appropriate professional advice should be sought where any aspect cannot be adequately defined. Where the project relates to a sensitive built asset, a built asset security manager should be appointed (see PAS 1192-5 for the development of an appropriate and proportionate security-minded approach).
- d) An evidence-based approach to design and construction should be adopted that is driven by outcomes that are explicit and measurable, wherever possible, and which reflects the requirements of the owner, operator, end-users and other key stakeholders in regard to the expected benefits and the required operational performance of the asset (see 3.2).
- e) Clear targets should be set for the expected benefits and the required performance outcomes at the start of the project (see 3.3), which should be aligned with the owner's business objectives, as reflected in the business case (see 4.1.1), and capable of being cascaded through the supply chain. These targets should be reviewed at defined information exchange points within work stages (see 3.9.4, PAS 1192-2, PAS 1192-3 and BS 1192-4) and, finally, during operation of the asset.
- f) Decisions in regard to design and construction should aim to maximize the value of the asset based upon the desired balance between cost, risk and performance (see 3.3 and BS ISO 55000, BS ISO 55001 and BS ISO 55002).
- g) The appointment of the delivery team (see 3.6.6 and PAS 91) should incorporate a commitment to defined periods of aftercare (see 4.1.4).
- h) A post-implementation review (PIR) should be undertaken at prescribed intervals during a defined period of extended aftercare with the involvement of the delivery team and this, including the lessons learned, should be recorded and stored in the asset information model (AIM) so that they are available to the owner, operator, licensee, operations team or asset manager, as appropriate, and other parties determined by the owner (see 4.8.2.3.4).
- i) The transition from design through construction and into operation should include the phased and final transfer of project information and data for operational purposes from the project information model (PIM) to the asset information model (AIM) (see 3.9.4 and PAS 1192-2, PAS 1192-3 and PAS 1192-5).
- j) The adoption of "BIM Level 2" should be considered to provide a fully-populated asset data set to support asset management through the use of the owner's defined enterprise system during the operational life of the asset (see 3.9.4 and BS 1192:2007, PAS 1192-2, PAS 1192-3, BS 1192-4 and PAS 1192-5).

NOTE 2 Formal methods exist for examining the relationship between benefits and costs such as cost-benefit analysis and benefit-cost ratio – see, for example, ASTM E2204-15, Standard guide for summarizing the economic impacts of building-related projects [3].

NOTE 3 PAS 91 provides detailed guidance on the prequalification of appointees.

NOTE 4 The common data environment (CDE) provides a single source of information for the project (see 3.9.4, BS 1192:2007, PAS 1192-2 and PAS 1192-3).

NOTE 5 There is a strong argument for creating the AIM at the start of the project so that it can be operated alongside the PIM and used by the owner to process information received throughout the project, rather than attempting to transfer all project information and data at once prior to handover of the asset (see 4.8.1 and PAS 1192-3). Doing so would provide more time for verification purposes and facilitate the training of the operator's or operation team's personnel in readiness for the start-up of operations.

NOTE 6 "BIM Level 2" represents federated file-based digital information with some automated connectivity (see PAS 1192-2 and PAS 1192-3).

NOTE 7 The owner might utilize an enterprise system [e.g. enterprise resource planning (ERP) system] to support its asset management.

NOTE 8 There is a relationship between this standard and BS ISO 55000, insofar as the latter deals with assets in general and this standard deals specifically with briefing for the design and construction of operational built assets.

3.2 Evidence-based approach

This British Standard recommends an evidence-based approach to design and construction, where decisions should be based on the best available information from multiple sources, including but not limited to the owner's business objectives, current operations, the lessons learned from previous projects, design modelling and simulation, and performance evaluations. This approach should be extended to include the provision of evidence to support proposals and recommendations prepared by the delivery team. Information and data for these purposes should be handled, stored and protected in accordance with the owner's security requirements (see PAS 1192-5).

NOTE 1 Evidence-based design and construction are likely to result in improvements to the project's expected benefits and the achievement of more exacting operational requirements with respect to environmental, social, security and economic performance, including demonstration of the owner's, operator's and end-users' satisfaction with the asset in operation.

NOTE 2 Information and data related to the owner's current and future business objectives and operations might include sensitive commercialeconomic details and intellectual property that need to be afforded appropriate and proportionate protection.

NOTE 3 BS 7000-4 provides guidance on the management of design, including a general approach to briefing.

3.3 Outcomes

Performance outcomes should be set at the Strategy work stage (see 3.5 and 4.1) and monitored during each subsequent work stage up to and including Operation and End of life (see 3.5 and 4.8), with post-implementation review (PIR) (see 2.1.52 and 4.8.2.3.4) at prescribed intervals during a defined period of extended aftercare (see 4.8.2.3) which should be used as the basis for measuring operational performance.

- a) Environmental – the asset should meet performance targets, such as those for energy use, greenhouse gas emissions [carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O) and hydrofluorocarbons among others], water (e.g. quality, abstraction, consumption and pollutant prevention), soil and landscape (e.g. quality, remediation and changes), noise and vibrations, waste (e.g. prevention/reduction, reclamation, recycling, treatment and disposal) and/or other environmental indicators defined by the owner and operator (see Annex B for an approach and typical measures forming a part of the PIR).
- b) Social (i.e. functionality and effectiveness) – the asset should be designed and constructed to meet performance targets, such as those relating to asset

availability, utilization, access, inclusiveness, safety, capability, capacity, resilience, serviceability/maintainability, adaptability, quality and comfort, and/or others defined by the owner and operator (see Annex C for an approach and typical measures forming a part of the PIR, and BS ISO 15686-2 for an approach to service life prediction).

- c) Security – the asset and the creation, use, storage and disposal of asset-related information and data should meet the security requirements of the owner, operator, licensee, operations team or asset manager, as appropriate, and end-users (see PAS 1192-5 for the development of an appropriate and proportionate security-minded approach).
- d) Economic – the asset should meet performance targets for capital cost and operational cost to enable whole-life costs to be estimated and value to be assessed (see Annex D for an approach and typical measures forming a part of the PIR).

Performance outcomes and targets should be specific to the project and should be verified in each work stage (see 3.5 and Clause 4). As far as possible, a quantitative approach should be taken to measuring performance and value. Consideration should be given to differentiating outcomes over various planning horizons (i.e. short, medium and long term) or other agreed basis, particularly in regard to environmental performance and certain aspects of social performance (e.g. asset availability, inclusiveness, utilization, safety, capacity, resilience and serviceability/maintainability). Consideration should be given to whole life carbon as part of the measurement of environmental performance over the long term and as a basis for the assessment of the asset's sustainability (see PAS 2080).

NOTE 1 An indicator is a quantitative, qualitative or descriptive measure. PD ISO/TS 21929-2 provides examples of environmental, social and economic performance indicators. It includes a framework for developing indicators for use in the assessment of economic, environmental and social impacts, and establishes a core set of aspects and impacts to be taken into account when developing systems of indicators.

A number of methods exist for measuring performance. One example is the Design quality indicator (DQI) [4], which is a five-stage method for evaluating the design over the project life cycle against three quality principles: functionality, build quality and impact. Another example is the BREEAM Communities [5], which is a scheme for measuring and certifying the sustainability of large-scale development plans. It provides a framework to support planners, local authorities, developers and investors through the master planning process.

NOTE 2 PAS 2080 specifies requirements for the management of whole life carbon in infrastructure, both in the provision of new assets and the upgrading of existing infrastructure. It covers requirements for establishing effective governance systems for reducing whole life carbon through the use of a carbon management process.

NOTE 3 A new or upgraded asset can help the owner to meet the requirements of key stakeholders, such as regulators, and new legislation.

NOTE 4 It is important to recognize that the full impact of the new or upgraded asset might not be seen for many years. For this reason, the evaluation of the asset's performance over what might be regarded as the long term falls outside the scope of this standard.

NOTE 5 The realization of value from an asset depends upon many factors, including striking the desired balance between cost, risk and performance. The definition of what constitutes value depends on the entity owning or operating the asset and could extend to other key stakeholders. Value can be tangible or intangible, financial or non-financial, and changes over the life of the asset (see BS ISO 55000). Benefit and utility are synonymous with value and all three are linked to cost.

3.4 Process requirements

The following requirements should be met as the minimum.

- a) Design and construction – the asset should be designed and delivered to the required operational requirements to allow it to perform as expected for its planned life subject to an appropriate maintenance regime (see 4.3.2.3, BS ISO 15686-2, BS ISO 15686-5, BS 8210 and BS 8544). Where the project covers an asset system, additional processes for capturing and managing requirements should be considered (see 4.1.1). In this regard, the owner should determine whether or not specific processes for configuration management, system integration and verification are required during design and construction (see 4.5.1 and BS ISO/IEC/IEEE 15288). Where deemed necessary, these processes should be incorporated in the relevant work stages (see Clause 4).
- b) Commissioning, training and handover – the commissioning and handover of the asset should be supported by training to meet the needs of the operator, end-users and other key stakeholders (see 4.6 and 4.7).
- c) Asset management – the asset management plan should be efficient and cost-effective in terms that are quantifiable (see 3.7 and 4.7.7).
- d) Information and security management – the management of information and security should be efficient and effective in terms that are quantifiable (see PAS 1192-5).

The processes in a) to d) should be measured principally through key performance indicators (KPIs) to determine their effectiveness.

NOTE 1 Operational requirements can extend to the owner's internal technical standards for design, construction, operation and maintenance.

NOTE 2 KPIs measure progress towards achieving objectives or other factors that are critical to success (see BS EN 15221-1). They represent the significant measures that allow the owner to act quickly upon any deviation in performance.

3.5 Plan of work

COMMENTARY ON 3.5

A plan of work outlines the work stages and the digital plan of work establishes the level of model detail and the level of model information that need to be delivered by each originator during delivery, or upgrading, and operation of the asset in each work stage for a specific project. Progression depends on satisfying predefined criteria at decision points (or gates) that include requirements relating to environmental, social, security and economic performance. In this regard, it is important to recognize the iterative nature of some work activities, where the need to reassess assumptions is a normal and necessary feature. In the case of design, the process is not linear and is likely to involve some degree of iteration in order to converge on an acceptable solution.

The work stages should be based on the following and may be adjusted to suit the owner's specific needs.

- 0 **Strategy** – defines the owner's/sponsor's business plans and case for the project, including required outcomes and other core considerations.
- 1 **Brief** – develops the project objectives, including required project and performance outcomes from the asset over different planning horizons.
- 2 **Concept** – prepares the concept design, including outline proposals for the general design treatment, structural design and engineered systems.

- 3 **Definition** – develops the design, including coordinated and updated proposals for the general design treatment, structural design and engineered systems.
- 4 **Design** – prepares the technical design, including structural and engineering design information, detailed cost and operational data.
- 5 **Construct and Commission** – plans, organizes and coordinates off-site fabrication with on-site construction, including transportation, assembly, testing and commissioning.
- 6 **Handover and Close-out** – training of the operations team and handover of the asset to the owner/operator and start-up of operations.
- 7 **Operation and End of Life** – steady-state operations, aftercare, post-implementation review (PIR), including benchmarking and lessons learned.

NOTE 1 This recommended plan of work reflects a generic approach derived from various sources including the Construction Industry Council and the BIM Task Group (www.bim-level2.org) [viewed 2016-10-05].

The plan of work should ensure that the deliverables of all originators of information and data are identified and appropriate to the decisions required at each work stage, and should be adopted as the basis for delivering, or upgrading, and operating the asset. This plan should be specific to the project, “digitally checkable” and capable of supporting “BIM Level 2” (see 3.9.4).

NOTE 2 “BIM Level 2” represents federated file-based digital information with some automated connectivity. A digital plan of work (dPoW) implies the use of “BIM Level 2”. The BIM Toolkit [6] (<https://toolkit.thenbs.com/>) [viewed 2016-10-05] has been developed as an optional tool to provide step-by-step help to define, manage and validate responsibility for information development and delivery at each work stage.

Figure 1 outlines the progression from the Strategy work stage through to Operation and End of Life, where the decision to proceed from one work stage to the next depends upon the owner signing-off on key decisions. For this reason, decision points (or gates) should be incorporated into each work stage to evaluate the progress achieved in alignment with the expected benefits, operational requirements and the required environmental, social, security and economic performance of the asset (see 3.3). The owner should determine the timing of decision points, information exchanges (see 3.9.4 and PAS 1192-2, PAS 1192-3, BS 1192-4 and PAS 1192-5) and the criteria to be satisfied, taking into account the adopted procurement method.

NOTE 3 Decision points can occur at any time within a work stage and are likely to be determined by the owner's internal policy and decision making. It would not be appropriate for the delivery team, when appointed, to determine such timing. Discussion between the owner and delivery team on the alignment of decisions and information exchanges would, however, be in both parties' interest.

Figure 1 Work stages

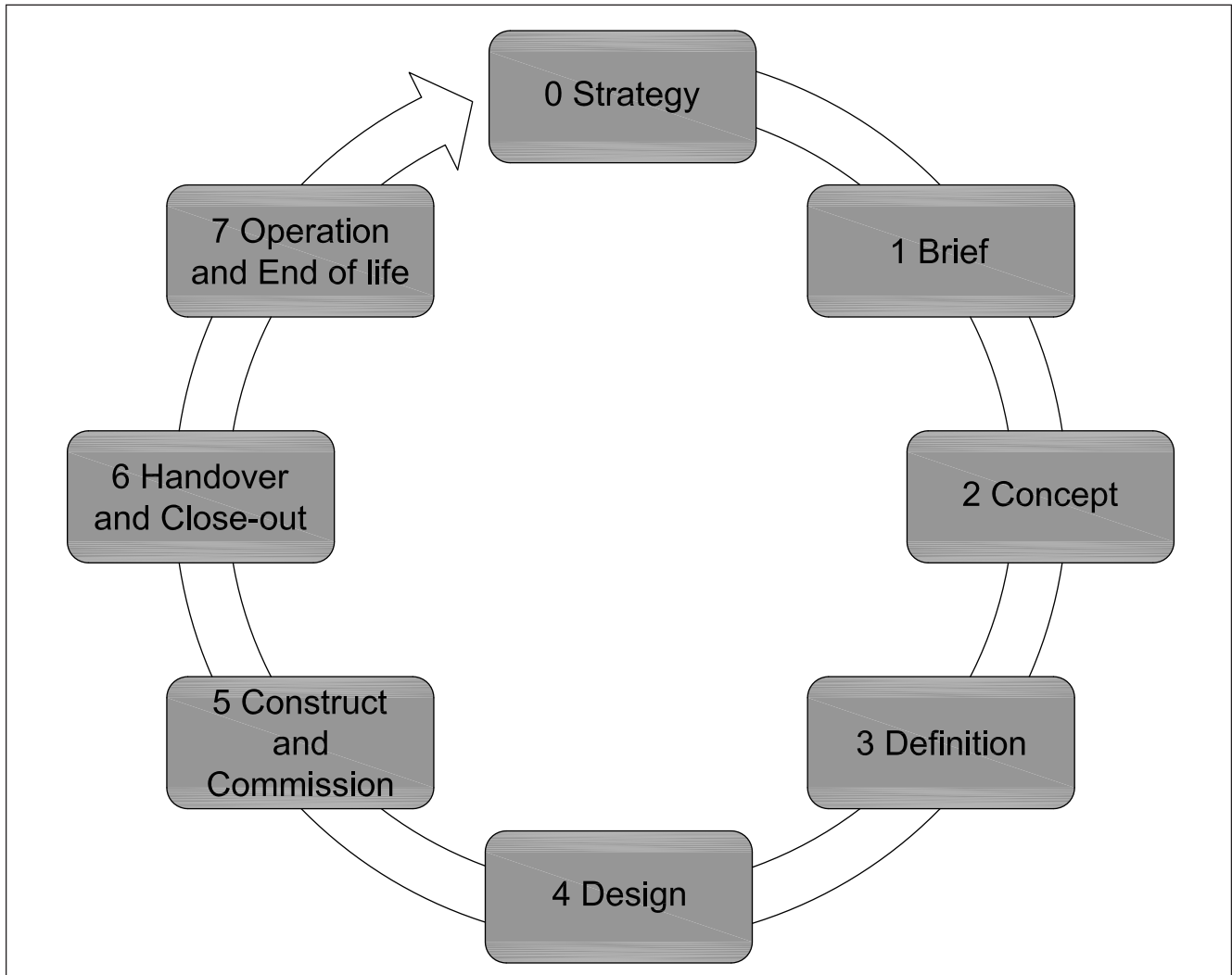
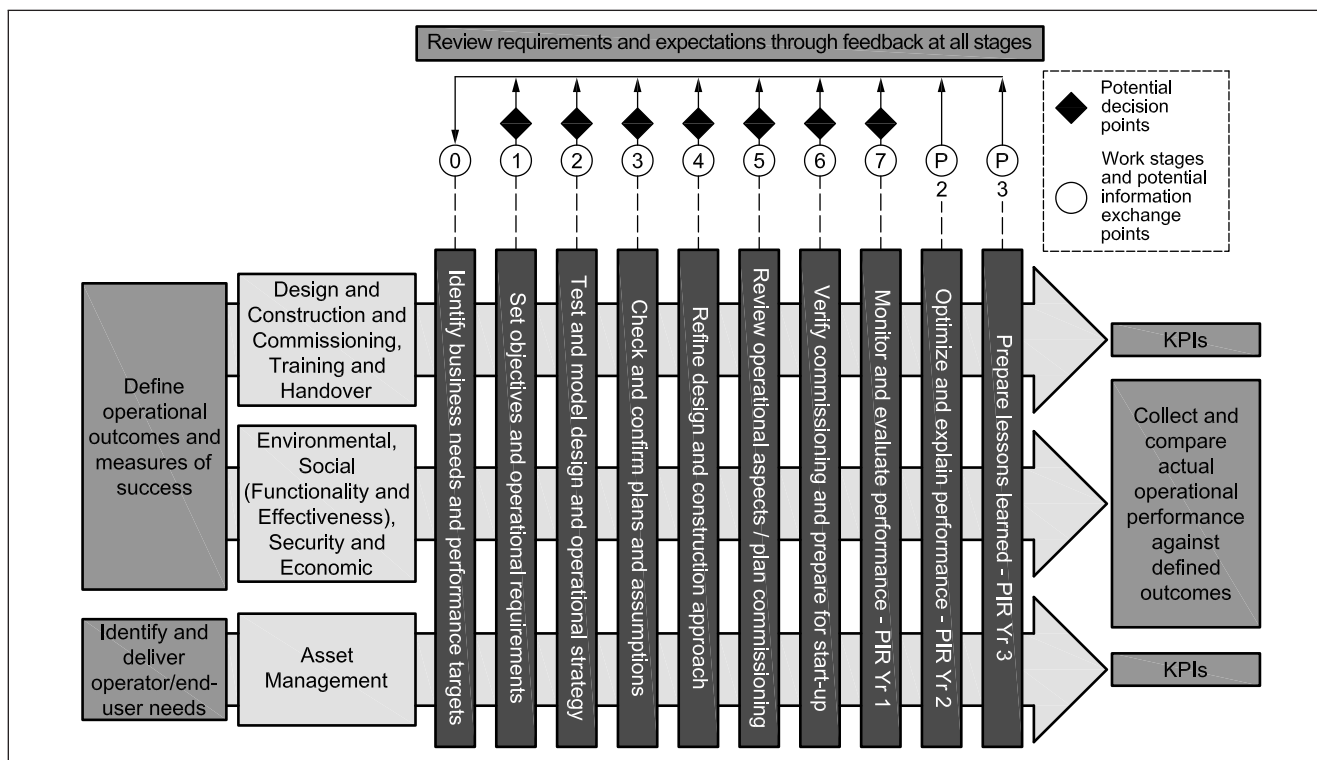


Figure 2 summarizes the overall approach in which requirements and expectations are reviewed through continual feedback. Progression to the next work stage should be conditional upon satisfying defined criteria relating to the expected benefits, operational requirements and the required environmental, social, security and economic performance of the asset (see 3.3).

NOTE 4 The approach advocated in Figure 2 reflects the information delivery cycle described in PAS 1192-2 and effectively extends its scope to cover performance-related requirements for the asset.

Figure 2 Overall approach highlighting the importance of performance reviews and feedback



3.6 Roles and responsibilities

3.6.1 General

COMMENTARY ON 3.6.1

BS ISO 55000, which is concerned with “management systems for the management of assets”, adopts the term “organization” throughout to refer to the entity receiving asset management. This part of BS 8536 is concerned with a broader range of considerations that involve multiple entities, including asset owners, operators, licensees, designers, constructors and other specialists. For clarity, this standard differentiates between entities by name; hence, the term “organization” is used in a general sense only.

The owner or any delegated authority on its behalf (see 3.6.3) should ensure that there is a clear governance structure with defined roles and responsibilities that are resourced by personnel with the appropriate level of competence, skills and experience.

The appointment of a delivery team (see 3.6.6), and operator, operations team or asset manager (see 3.6.4), as appropriate, should be made having regard to the need to establish the clearest possible understanding of the respective parties’ duties and obligations from the outset of the project. The incorporation of periods of aftercare within the Operation and End of life work stage extends the traditional involvement of the delivery team, so the particular commitments this entails from all affected parties should be made explicit. The appointment of the operator, operations team or asset manager, as appropriate, should be made before any decision is reached on whether or not to proceed with the project. Where this is impractical, the owner should ensure that expertise on asset management is available so that operational requirements and the expected performance of the asset form an integral part of the decision making.

NOTE 1 PAS 91 provides detailed guidance on the prequalification of appointees.

There should be, from the outset of the project, an explicit working approach that requires agreement between the various parties on the work activities and their timing, with the associated information requirements and deliverables (see Clause 4). The basis upon which decisions are to be made should be clearly defined and communicated to all involved parties from the earliest practicable point. This task can be greatly assisted if the owner or delegated authority is proactive in ensuring that the roles and responsibilities of the parties are properly defined and communicated.

NOTE 2 Defining and managing the organizational information requirements (OIR), the employer's information requirements (EIR) and the built asset security information requirements (BASIR) are important considerations (see PAS 1192-3, PAS 1192-2 and PAS 1192-5, respectively).

NOTE 3 Agreeing the working approach and the basis of decisions up front is likely to avoid inefficiencies and reduce the potential for conflict between the parties.

Where the asset is sensitive or the owner and/or operator has decided to implement more than baseline security measures, advice/guidance should be sought from the owner's/operator's built asset security manager on all security aspects related to the design, construction and operation of the asset and the protection of asset information and data (see PAS 1192-5).

3.6.2 Owner

COMMENTARY ON 3.6.2

Soft landings [1], [2] is intended to assist owners and operators in getting the best out of their new or upgraded asset by providing a unified approach for addressing outcomes from an integrated process of briefing, design, construction and commissioning of the asset. The emphasis is upon greater involvement of the delivery team with the operator, operations team or asset manager, as appropriate, and end-users before, during and after completion of construction, to assure operational readiness in the expectation of a flawless start-up, steady-state operations and sustained performance in use. Much of the information required to support soft landings is already collected in the normal course of delivering a project. Where soft landings has been adopted, the owner is expected to nominate a person with responsibility for ensuring that it is developed to suit the project throughout design and construction and into operation of the asset. This person might be referred to as the "soft landings champion", "owner's representative" (see BS 8536-1), "project sponsor" or by some other term of the owner's choosing. The term "sponsor" has been adopted in this standard (see 3.6.3).

The owner should appoint a sponsor (see 3.6.3) whose principal task is to ensure that design and construction is planned, implemented and controlled to ensure a smooth transition into operation and for the defined periods of aftercare. The sponsor should be expected to have first-hand working knowledge of the owner's organization and an understanding of the asset's future. Where an existing asset is to be upgraded, the sponsor should have an understanding of its history.

NOTE There is the chance that the sponsor might be seen as a project manager. For clarity, the project manager is responsible for delivering the asset to an agreed scope of work, schedule and cost/budget and, normally, has no involvement or interest once the project has been delivered and the asset is operational. Similarly, the asset manager might have limited expertise or interest in the project's delivery, other than to ensure that the asset, once delivered, performs as required. There is, therefore, the need for a person who possesses a more strategic interest in, and understanding of, the combined project delivery and asset management process than either of the aforementioned.

3.6.3 Sponsor

COMMENTARY ON 3.6.3

A sponsor often acts as the owner's "internal client" to provide leadership during project development, to ensure that the project is efficient and cost-effective. The sponsor is normally accountable for the business case, obtaining funding and determining performance and other requirements, and is supported by the delivery team, if appointed at this time (see 4.1.2). The sponsor maintains an overview of the project, ensuring it remains on target to deliver the expected benefits and achieve the required operational performance. This role includes responsibility for ensuring that the principles of soft landings are incorporated into the project delivery process and into operation of the asset for an agreed period of extended aftercare.

The sponsor should be appointed for the entire period from the Strategy work stage and into Operation and End of life, including the full period of extended aftercare, to provide continuity of purpose and consistency of approach. The sponsor should report to the owner and should consult with the representative(s) of end-users or other key stakeholders as appropriate. The role of the sponsor should not duplicate that of the project manager, where appointed.

The role of the sponsor should be to maintain the focus of all parties on the required project outcomes and operational performance, as well as on an evidence-based approach during all work stages from Strategy through to Operation and End of life, including the period of extended aftercare. The role of the sponsor should not be delegated to another party, but another person or persons may be engaged in a supporting role to deal with any day-to-day questions and issues that arise which would distract the sponsor from more strategically-important matters.

The role should involve regular reference to the schedules or equivalent documentation that identify the work activities of the delivery team with their associated information requirements and deliverables. The sponsor should facilitate input from the operator, operations team or asset manager, as appropriate, and end-users to the work of the delivery team. The sponsor may communicate directly with the designated manager for the construction work.

The sponsor should ensure that the following are achieved, as a minimum:

- a) establishment of the expected benefits and required operational performance of the asset (see 3.3) and the operational budget;
- b) verification through successive work stages that the expected benefits and required operational performance will be achieved (see Clause 4);
- c) plans for commissioning, training and handover of engineered systems and the phasing in of asset management (see 4.6, 4.7 and 4.8);
- d) liaison with the owner's built asset security manager, where one has been appointed, to ensure that the owner's security requirements are fulfilled;
- e) post-implementation review (PIR) to establish if the asset is performing as expected (see 4.8.2.3.4), including measurement of actual operational performance against the required performance from environmental, social, security and economic perspectives (see 3.3) based on information and data taken from reliable sources during the extended period of aftercare; and
- f) coordination of the preparation of an advisory report by the operator, operations team or asset manager, as appropriate, with input from the delivery team where required (see 4.8.5), during the extended period of aftercare covering the need for any corrective actions, the presentation of benchmarking data and the lessons learned (see 4.2.2.2).

NOTE PAS 1192-2 refers to an employer's representative possibly having responsibility for ensuring that information requirements are included in project contracts and for subsequently authorizing the transfer of information. This is a role that can be fulfilled by the sponsor.

3.6.4 Operator, operations team and asset manager

COMMENTARY ON 3.6.4

The owner might be the operator of the asset or another party might fulfil this role, including those situations where a licence is granted to operate a service based on the asset as would occur in the case of a toll road, bridge or tunnel. In all situations, it is necessary that the interests of the operator are taken into account from the outset. These interests extend to the needs of the end-users of the asset. In a larger organization, an operations team, asset management team or, perhaps, an asset manager is responsible for the asset on a day-to-day basis, including its maintenance; or a separate organization, acting as a concessionaire or licensee, might be responsible. In a smaller organization, there might be no equivalent arrangement. Nonetheless, someone has to provide expertise on operational matters and that might have to fall to a consultant engaged for this purpose. This person is necessary to provide comment and advice on the implications of design and construction proposals from an operational perspective as they are developed from the Strategy work stage through to the Handover and Close-out work stage.

The operator, operations team or asset manager, as appropriate, should be given authority by the sponsor to provide appropriate information and data concerning the operational strategy and operational requirements, including performance outcomes and targets, operational cost and budgets, and the procurement of asset-related services where applicable (see BS 8572), to the delivery team. The delivery team should ensure that contributions are duly recorded and made available to the sponsor upon request. A RASCI chart should be created by the sponsor to clarify overall responsibilities.

NOTE 1 Annex E gives an extract from a RASCI chart.

NOTE 2 PAS 1192-3 contains guidance on the need for the operator, operations team or asset manager, as appropriate, to identify the owner's information needs, referred to as the employer's information requirements (EIR) in PAS 1192-2 (see 3.9.1).

NOTE 3 PAS 1192-5 contains guidance on the need for a security-minded approach to asset management and the need for the owner/operator to set out a security strategy, security management plan and security information requirements for the asset.

3.6.5 End-users

COMMENTARY ON 3.6.5

The users of the asset are a key stakeholder group and are collectively referred to as "end-users" because they are generally the ultimate beneficiaries of the services provided by the asset in operation.

The sponsor should ensure that the interests and needs of the end-users of the asset are taken into account through a process of stakeholder engagement (see 4.1.3). Depending on the number and diversity of end-users, the sponsor may consider it appropriate to arrange for representation on a group, rather than an individual, basis.

The collection, use and storage of personally-identifiable information and data should be handled in a security-minded manner.

NOTE Asset-related systems might contain a range of information and data about end-users, for example information about passes or access tokens and emergency contact details.

3.6.6 Delivery team

COMMENTARY ON 3.6.6

An integrated, collaborative approach to design and construction is necessary to assure both the constructability of the design and the operational performance of the asset. The term “delivery team” is used throughout the standard to refer to the combined, collaborative efforts of the many disciplines that can be required to assist in transforming the owner’s business objectives into an operational asset. An integrated delivery team reduces the likelihood of “silo working”, decreasing the prospect of errors and omissions. Specialist contractors, suppliers and manufacturers can be regarded as an integral part of the delivery team. Particular requirements in regard to these supply chain entities warrant additional consideration (see 3.6.7).

The sponsor should appoint an integrated delivery team to ensure there is an emphasis on collaborative working based on shared responsibilities and goals that are aligned with those of the owner and the operator, where the latter is a separate entity (see 3.6.4), and/or the operations team. The sponsor should determine the composition of the delivery team, taking account of the breadth and depth of competences, skills and experience needed in the project through each successive work stage from Strategy through to Operation and End of life while maintaining continuity of purpose in regard to the owner’s business objectives throughout (see 4.1.1). The team should be extended by the sponsor to include personnel from the operations team or, where no such arrangement presently exists, an asset manager should be appointed to ensure that operational requirements and performance outcomes (see 3.3) are taken into account in each work stage.

The delivery team should support the role of the sponsor in pursuing an operational asset that meets defined performance outcomes and targets. The delivery team should nominate a person from within its body to be responsible for coordinating all transition-related activities with the sponsor.

The delivery team should ensure that roles and responsibilities for the project are aligned to work activities, with their associated information requirements and deliverables. Responsibility assignment matrices (e.g. RASCI charts) should be prepared for this purpose by the delivery team, and their format should be approved by the sponsor. Each RASCI chart should be updated as necessary in each work stage and in readiness for the subsequent work stage (see Clause 4). RASCI charts should be coordinated with an organization chart for the project prepared by the delivery team to show reporting/communication between all parties within the project delivery organization, with interfaces to external entities and other key stakeholders as appropriate. Design responsibility matrices should complement the use of RASCI charts by providing a focus on assigned design responsibilities, the level of model detail and the level of model information exchanged (see 3.9.4).

NOTE 1 Annex E gives an example RASCI chart and a detailed responsibility matrix.

The delivery team should advise the sponsor of the need for any additional competences, skills and experience required in the team as soon as it becomes apparent. Where the engineered systems are complex, the owner, or the sponsor on its behalf, should consider the appointment of an independent commissioning manager if not already appointed. The commissioning manager should be appointed early in the project’s life. Where there is a known or perceived security threat to the asset, the owner should consider the appointment of a built asset security manager, if not already appointed, at the outset of the project.

NOTE 2 PAS 1192-5 outlines a security triage process which an owner can use to establish the level of security-minded approach required for its asset and associated information and data, and any asset information and data it might hold regarding neighbouring assets or facilities.

3.6.7 Specialist contractors, suppliers and manufacturers

COMMENTARY ON 3.6.7

In the course of delivering a new or upgraded asset, much work devolves to specialist contractors, suppliers and manufacturers. The success of the transition from design through construction and into operation depends on the effective integration of the supply chain covering all of the entities necessary for delivering the operational asset. The management of multiple organizational, technical and contractual interfaces between these entities is part of the task and is a factor in that success. Specialist contractors have a pivotal role in the sense of standing between the designers and construction managers and the manufacturers and suppliers of myriad materials, products, components and systems. It is essential that specialist contractors are effectively integrated into the approach to be taken, including the work activities, information requirements and deliverables in each work stage.

As far as practicable, specialist contractors, suppliers and manufacturers should adopt an approach that supports the key principles (see 3.1) throughout all work stages in which they are involved. Each specialist contractor, supplier and manufacturer, as appropriate, should identify its contact person for the purpose of transition and inform the transition coordinator (see 3.6.6) within the delivery team. The contact person should attend meetings of the delivery team, when requested, to present proposals concerning the respective parties' work, including details of the operational requirements of systems, equipment, controls and user interfaces, as appropriate.

Specialist contractors should be retained to assist the owner and other members of the delivery team during handover and to monitor performance during start-up and operation of the asset. Specialist contractors may be based on site full-time during an initial period of aftercare (see 4.8.2.2) to assist with end-user queries and to undertake optimization of systems as necessary. In this case, the sponsor should make these requirements clear and ensure that they are embodied in the scope of work and subsequent agreements with the specialist contractor.

NOTE PAS 91 provides detailed guidance on prequalification for construction tendering.

Specialist contractors identified by the sponsor might be required to provide support for an extended period of aftercare (see 4.8.2.3), in which case the roles and responsibilities should follow those required in the Operation and End of life work stage.

Specialist contractors should be required, where appropriate, to contribute their information and data to the common data environment (CDE) (see BS 1192:2007, PAS 1192-2, PAS 1192-3 and PAS 1192-5). Depending on the security requirements of the owner/operator, any specialist contractor supplying information relating to sensitive aspects of the asset should follow the owner's/operator's security policies, processes and procedures regarding the creation, use, storage and disposal of asset information and data.

3.7 Collaboration and alignment

COMMENTARY ON 3.7

"Design and construction for operability" aligns the interests of those who design and construct an asset with those who subsequently operate and use it. Success is due, in large part, to a collaborative approach between the various parties, but also to monitoring and verifying the alignment of the work of the delivery team and the developing design with the expected benefits and required operational performance of the asset.

The sponsor should ensure that the delivery team understands the necessity of a collaborative approach to its work and the importance of active engagement with the operator, operations team or asset manager, as appropriate. The delivery team should provide evidence of its approach in the form of a schedule of work activities, with their associated information requirements and deliverables, for each work stage (see Clause 4). This should take the form of a responsibility assignment matrix (e.g. a RASCI chart) to cover the work activities with their associated deliverables for each work stage. This should be supplemented by a detailed responsibility matrix covering assigned design responsibilities, the level of model detail and the level of model information exchanged (see 3.9.4).

NOTE 1 Annex E gives an example RASCI chart and a detailed responsibility matrix.

The delivery team should obtain early input about the operator's, end-users' and other key stakeholders' interests and needs, which should be assisted by the sponsor who should prepare a plan for stakeholder engagement (see 4.1.3). End-users, or their representative(s), should be allowed to express their views in an environment that is conducive to obtaining an honest and accurate understanding of their needs.

An aim should be to establish clear measures, outcomes and targets for environmental, social, security and economic performance. In the case of environmental outcomes, these should cover energy performance, in particular energy use and greenhouse gas emissions, water consumption, waste reduction, noise and vibrations, and social outcomes should cover functionality and effectiveness, for example asset availability, utilization, access, inclusiveness, safety, capability, capacity, resilience, serviceability/maintainability, adaptability, quality and comfort. Security outcomes should focus on the practical steps to be taken to reduce the risk of loss, compromise or disclosure of information and data about sensitive aspects of the design, construction or operation of the asset. Economic outcomes should focus on capital, operational and whole-life costs as early as possible and, thereafter, should consider ways in which costs might be reduced whilst maintaining functionality and effectiveness. All performance outcomes and targets should, as far as practicable, be subject to monitoring and verification through all work stages.

NOTE 2 The adoption of value improving practices, if properly controlled, can assist in identifying functions that add cost, but which are of no value to the owner, and then eliminating them. Value engineering is a common and proven methodology for this purpose. It is important, however, to ensure that value engineering is a genuine attempt to seek value improvement, which implies a relationship between cost and quality, and is not simply a cost-cutting exercise. The adoption of whole-life costing and applying lessons learned can be similarly regarded as value improving practices.

Commissioning, training and handover should be planned jointly by the delivery team and the operator, operations team or asset manager, as appropriate, overseen by the sponsor, to ensure operational readiness, flawless start-up and early optimization of operational performance (see 4.6 and 4.7). End-users, or their representative(s), should be involved in this planning.

The delivery team should be involved in post-implementation review (PIR) as a process for evaluating the performance of the asset over at least the first three years of its operational life to establish actual outcomes and to record and share lessons learned (see 4.8.2.3.4). The PIR should extend to measuring the impact of the operator's or operations team's asset management plan on the performance of the asset (see 3.4 and 4.7.7).

NOTE 3 The advantages of this approach, including post-implementation review (PIR), are the optimization of operational performance of the asset within the operational budget as soon as possible and the alignment of operational performance with the required performance outcomes set prior to the start of design and construction. Achievement of the required outcomes could be regarded as an indication of the operator's and end-users' likely satisfaction with the asset and offers some assurance with respect to operational cost.

The sponsor should ensure that operational input is a continual, but controlled, contribution during design and construction work to ensure that the design of the asset is subject to evaluation from an operational perspective. A design review protocol should be used to support this work, together with a plan for information exchange (see BS 1192-4). The delivery team should respond on matters of alignment of the developing design with the expected outcomes, changes to the design that have been necessary and the extent to which performance targets for the operational asset are likely to be met. Confirmation of the associated capital and operational costs should be provided by the delivery team, with input from the operator, operations team or asset manager, as appropriate, at points defined for each work stage for the purpose of information exchange (see 3.9.4, Clause 4 and PAS 1192-2, PAS 1192-3, BS 1192-4 and PAS 1192-5).

3.8 Risk (threat and opportunity) management

The threats and opportunities that could affect realization of the value and performance of the asset should be systematically assessed and managed in each work stage. This assessment should be undertaken periodically to identify any condition or event that could erode value or impact negatively or positively on the operation of the asset and determine the actions needed to manage them. The assessment should include identification and analysis of threats (downside risks) and opportunities (upside risks), responses to risks and the controls to be applied. Security risks, in particular, should be assessed at various points throughout the life cycle and when certain trigger-related events occur, with the security strategy updated accordingly.

Account should be taken of the operator's and end-users' interests in the asset when identifying and assessing threats and opportunities. Details of such risks and actions arising should be recorded in a risk register and reflected in the estimates of capital cost and operational cost and the project schedule.

NOTE 1 Downside risks are factors that can have a potentially negative impact on the asset, such as hazards faced in the construction work, and are commonly referred to as threats. Upside risks are factors that can add value to the outcome and are more commonly referred to as opportunities. The latter might arise from a re-examination of the scope of work against the business and project objectives, e.g. changes to take advantage of more energy-efficient technology.

NOTE 2 PAS 1192-5 includes a risk management process for assessing the security risks throughout the asset's life and requirements for developing and maintaining holistic security risk management.

The risk register should be established and maintained from the outset and is one of the deliverables in the Strategy work stage (see 4.1.9). It should be used to record any identified threats and opportunities, an assessment of their potential impact and the likelihood of their occurrence. For threats, actions should be explored to reduce or avoid their potential impact. For opportunities, actions should be explored to realize or enhance the improvement. The risk register should be kept up to date throughout all work stages so that it reflects the current situation and should be utilized in the process of collating lessons learned.

NOTE 3 A risk register formally records conditions or events, which could threaten or improve outcomes, to be taken into account in risk assessment/analysis. The register is not simply a repository, but a tool to help gain a current understanding of conditions or events and the threats and/or opportunities they represent. As time passes, some threats and opportunities will materialize, others might disappear and new ones will appear. Annex F provides examples of threats and opportunities.

3.9 Information requirements

3.9.1 Employer's information requirements (EIR)

COMMENTARY ON 3.9.1

The employer's information requirements (EIR) set out the information to be delivered, and the standards and processes to be adopted by the delivery team, including its supply chain, as part of the project delivery process. The information requirements set out in the EIR are intended to provide enough information to answer the "plain language questions" required at a particular work stage at an appropriate level of model detail (see 3.9.3, Annex G and BS 1192-4). The EIR would be expected to include the following as a minimum: a) information management; b) commercial management; c) security management (see PAS 1192-5); and d) competence assessment. The EIR would normally exist as a self-standing document, cross-referenced to other documentation used across the work stages. It does not, however, expressly consider the information that the delivery team or the operator, operations team or asset manager, as appropriate, might need from the owner or the sponsor on its behalf.

The owner should define its requirements adequately and clearly in terms of the information to be provided by the delivery team and its timing, and the standards and processes to be adopted in this regard. The points at which information exchanges are required should be specified in the EIR by reference to the applicable work stage and decision point (or gate) (see 3.5).

NOTE 1 PAS 1192-2, BS 1192-4 and PAS 1192-5 provide detailed guidance in this regard. In the case of information management, BS 1192-4 offers an approach to the definition of information requirements in relation to the asset, the business context and matters of compliance. The EIR can incorporate a schedule of plain language questions (see 3.9.3 and Annex G).

NOTE 2 PAS 1192-5 provides guidance on the creation of a security management plan and the development of security information requirements that inform both the EIR and the asset information requirements (AIR) (see 3.9.2).

NOTE 3 BS 1192-4 provides guidance on a common structure for the exchange of information, i.e. COBie, to ensure that information can be reviewed and validated for compliance, continuity and completeness.

A closely-related document is the brief, which should be used as a basis for developing and, subsequently, for evaluating design and construction proposals (see 4.5.7). The brief should be delivered in a digitally-checkable form supplemented by the EIR.

3.9.2 Asset information requirements (AIR)

The owner should define the asset information requirements (AIR) to be met in order that the organizational information requirements (OIR) can be satisfied, together with the information exchanges by which information and data are transferred to, and from, the asset information model (AIM) (see PAS 1192-3 and PAS 1192-5). This transfer should be phased so that the operator, operation's team or asset manager, as appropriate, is given sufficient time to verify information and data, as well as prepare for its new or changed responsibilities, including any training that might be necessary.

NOTE Organizational information requirements (OIR) are broadly synonymous with plain language questions (see 3.9.3 and PAS 1192-2).

3.9.3 Plain language questions

COMMENTARY ON 3.9.3

The sponsor requires information from the delivery team. Similarly, the delivery team requires information from the sponsor and the operator, operations team or asset manager, as appropriate, in order to perform its work and to contribute effectively to the expected outcomes. This communication is best handled through a structured information exchange, where all questions are framed in plain language, with the answers recorded and shared within the delivery team and with the operator, operations team or asset manager, as appropriate. The efficiency of this process depends to a large extent on the clarity with which questions are put by the sponsor, or to the sponsor, how the subsequent answers are interpreted and how the decisions that arise from them are implemented. This often involves confirming understanding then recording details in the owner's information management system, including the relevant parts of the project information model (PIM).

Plain language questions should be drafted for each work stage for the purpose of obtaining information to enable decisions to be taken in a timely and effective manner, including the key question of whether or not to proceed to the next stage. The purposes for which information is required should be stated. The information required to answer questions, and any clarification or confirmation arising, should be delivered at the appropriate information exchange points (see PAS 1192-2, PAS 1192-3 and PAS 1192-5).

NOTE 1 There is a crossover from plain language questions to EIR and vice versa (see 3.9.1). The organizational information requirements (OIR) are broadly synonymous with plain language questions, where the intention is for the owner, or sponsor on its behalf, to elicit information from the delivery team and vice versa. Annex G gives example plain language questions to be asked of the delivery team by the sponsor.

NOTE 2 A list of security-related plain language questions are available on the CPNI website: <http://www.cpni.gov.uk/advice/Cross-cutting-advice/Digital-built-assets-and-environments/> [viewed 2016-10-05].

3.9.4 Information management and modelling

Information management should be recognized as encompassing the definition and management of the information model from design, through construction, and into operation of the asset (see PAS 1192-2). The use of information modelling in general and the creation and management of a project-specific building information model in particular should be seen in the context of the owner's information management system. The owner should take steps to ensure that there is sufficient information technology in place to support "BIM Level 2", where this is to be adopted.

The sponsor should consider the following requirements with respect to BIM:

- a) the common data environment (CDE) to be used – BS 1192:2007, PAS 1192-2, PAS 1192-3 and PAS 1192-5 provide guidance in this regard;
- b) details of the information required from the delivery team to support optimal operational performance of the asset – PAS 1192-3 and PAS 1192-5 provide guidance in this regard;
- c) the format and means for information exchange – COBie may be used for this purpose – BS 1192-4, PAS 1192-2, PAS 1192-3 and PAS 1192-5 provide guidance in this regard;

NOTE 1 COBie provides a common structure for the exchange of information and ensures that information can be reviewed and validated for compliance, continuity and completeness.

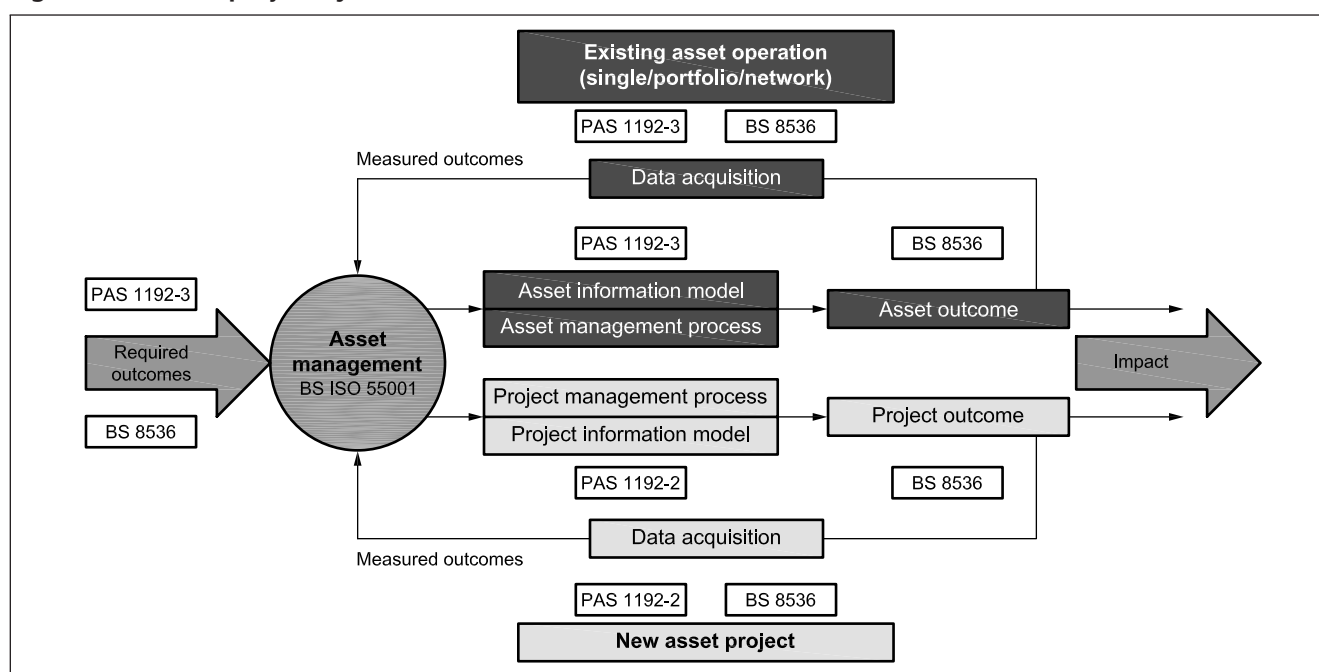
- d) the structure and format of the asset information model (AIM) that is to

receive the content from the project information model (PIM) – PAS 1192-3 and PAS 1192-5 provide guidance in this regard;

- e) details of how content from the project information model (PIM) is to be transferred into the owner's asset information model (AIM) – PAS 1192-2, PAS 1192-3 and PAS 1192-5 provide guidance in this regard;
- f) requirements, policy, processes and procedures for the security of information and data, including the management of access, both physically and digitally – PAS 1192-5 provides guidance in this regard; and
- g) software to be used to meet operational and security requirements, such as the owner's defined enterprise system (see PAS 1192-3 and PAS 1192-5).

NOTE 2 Figure 3 brings into focus the relationship between assets and projects. A common failing in practice is that the systematic feedback that occurs in the asset management process is not mirrored in the project management process. The result is that project outcomes are not acquired and analysed, and so cannot be transferred to the owner's asset management system. The figure also emphasizes the important relationship between this British Standard and those standards supporting "BIM Level 2", namely PAS 1192-2, PAS 1192-3 and BS ISO 55001. PAS 1192-5 contains further information on how security requirements can be integrated into these information models.

Figure 3 Asset-project systems and feedback



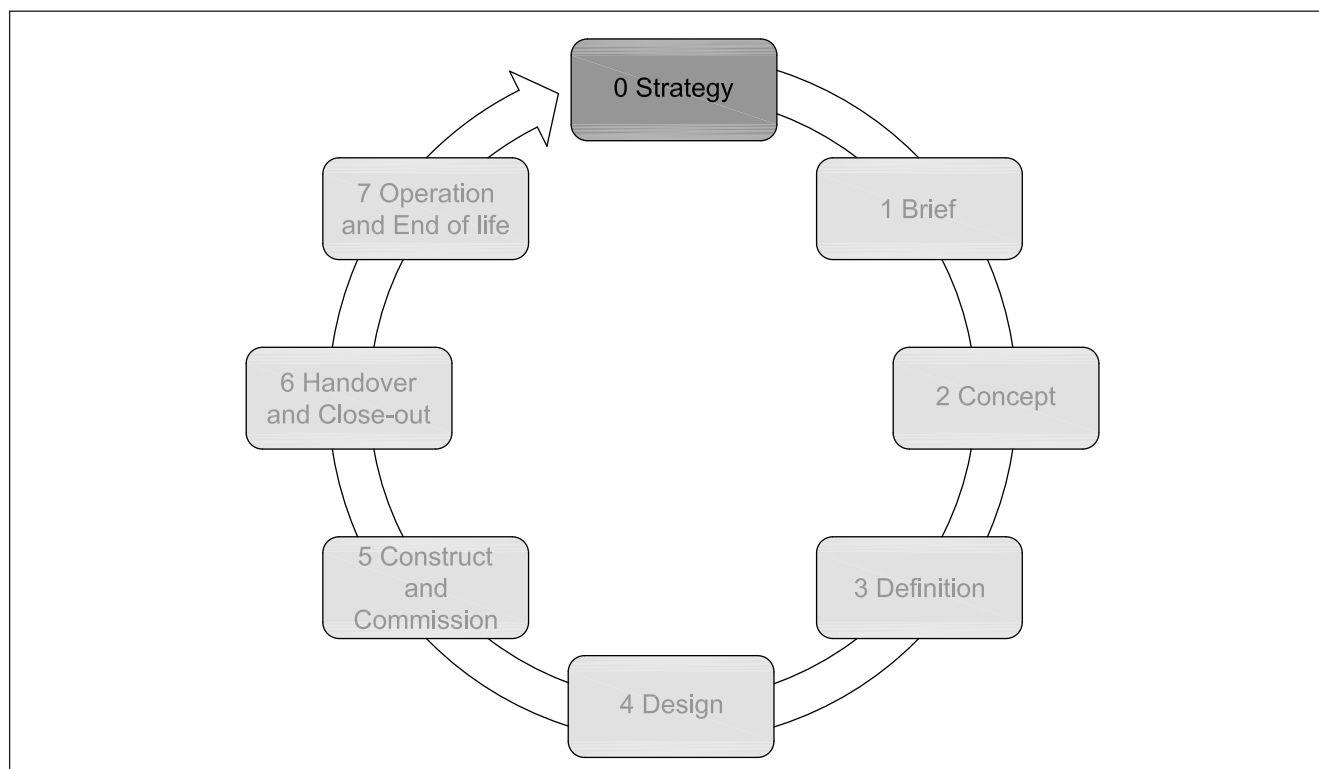
3.10 Arrangement of work stages

NOTE Clause 4 is structured in accordance with the work stages outlined in the plan of work (see 3.5) as the project progresses from its commencement to the operation of the asset. The same or similar headings are used in each work stage, wherever practicable, to ensure consistent treatment of both guidance and recommendations. In a number of cases, the latter are broadly similar, although might contain important differences.

The requirements contained in each work stage (see Clause 4) should be properly considered before they are encountered and the preceding stage, where applicable, should be concluded satisfactorily before the transition to the next work stage. Work stages or parts of them should not be omitted, but the approach may be scaled down if it is felt that the requirements are inappropriate or in excess of reasonable needs.

4 Work stages

4.1 Strategy



4.1.1 General requirements

COMMENTARY ON 4.1.1

The Strategy work stage is concerned with defining the business case for the new or upgraded asset, the project outcomes, required operational performance and other core considerations. It provides an essential baseline to assist in clarifying strategic intentions, not least the asset's contribution to the business of the owner. This stage can be thought of as one of strategic definition.

The owner, or the sponsor on its behalf, should develop the business case and supporting considerations, including the expected benefits and the required performance of the new or upgraded asset, in terms of its contribution to the business. The work activities associated with this strategic definition (see 4.1.2) should be identified together with the information and data required for this purpose (see 4.1.6). Where the project is intended to cover an asset system and the needs of multiple stakeholders (see 4.1.3), a formalized approach to capturing and managing requirements should be considered (see 3.4, 4.1.2 and BS ISO/IEC/IEEE 15288).

NOTE *In the public sector, the development of the business case is highly prescribed. HM Treasury [7] defines a five-case model for the new or upgraded asset. This anticipates a well-founded case for change that provides a holistic fit with other parts of the sponsoring organization and the public sector (i.e. the strategic case), and which demonstrates best public value (i.e. the economic case), commercial viability (i.e. the commercial case), affordability (i.e. the financial case) and achievability (i.e. the management case) among other criteria.*