BSI Standards Publication

Asset management — Management systems — Guidelines for the application of ISO 55001

bsi.

National foreword

This British Standard is the UK implementation of ISO 55002:2018. It supersedes BS ISO 55002:2014, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee AMS/1, Asset management.

A list of organizations represented on this committee can be obtained on request to its secretary.

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

Published by BSI Standards Limited 2018

ISBN 978 0 580 97128 0

ICS 03.100.70; 03.100.01

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

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2018.

Amendments/corrigenda issued since publication

Date	Text affected

BS ISO 55002:2018

INTERNATIONAL STANDARD

ISO 55002

Second edition
2018-11-23

Asset management — Management systems — Guidelines for the application of ISO 55001

Gestion d'actifs — Systèmes de management — Lignes directrices relatives à l'application de l'ISO 55001

Reference number
ISO 55002:2018(E)

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 251, *Asset management*.

This second edition cancels and replaces the first edition (ISO 55002:2014), which has been technically revised to improve the guidance on the development and application of an asset management system.

The following changes have been made:

— the ISO 55000 "fundamentals" (value, alignment, leadership and assurance) have been addressed in each clause, whenever applicable, stating the contribution of the requirements specified in ISO 55001 to achieving the fundamentals;

— the application of the requirements of ISO 55001 to the domains of asset management identified in ISO 55000 (see ISO 55000:2014, Figure 1) have been clarified, i.e. to the asset portfolio, to the asset management system and to asset management, stating the adequacy of the requirements to each domain, whenever applicable;

— linkages between clauses have been provided, by stating the relevant interconnections (e.g. "see 6.2.1");

— annexes have been added on cross cutting concepts, present in the main text of this document to provide a combined guidance for specific themes in asset management that were identified as being addressed in several clauses.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

0.1 General

This document provides guidance for the application of a management system for asset management, referred to as an "asset management system", in accordance with the requirements of ISO 55001.

This document provides explanatory text intended to clarify the requirements specified in ISO 55001 and provides examples to support implementation of these requirements. It does not provide guidance for managing specific asset types.

This document provides guidance for use by:

a) those involved in the establishment, implementation, operation, maintenance and improvement of an asset management system;

b) those involved in delivering asset management activities, including service providers.

General information on asset management, and information on the terminology applicable to this document, is provided in ISO 55000.

0.2 Assets, asset management and the asset management system

An asset is something that has potential or actual value to an organization. Asset management enables an organization to realize value from assets in the achievement of its organizational objectives. An asset management system is used by the organization to direct, coordinate and control asset management activities.

NOTE An asset management system can be established by any organization, which can be a sole-trader, company, corporation, firm, enterprise, authority, partnership, charity or institution, or part or combination thereof, whether incorporated or not, public or private. The organization, for example, can be an asset owner, custodian, operator, service provider, subsidiary, alliance or joint venture.

The asset management system, asset management and the asset portfolio should be aligned to, and support delivery of, the organizational objectives and the organizational plan.

Organizational objectives are generally developed as part of the organization's strategic level planning activities and are given in documented information within an organizational plan. The organizational objectives form a key part of the context of the asset management system and are the starting point for establishing the asset management objectives.

Understanding the context of the organization enables the organization to design, implement and maintain its asset management system, asset management and the assets, in alignment with the purpose of the organization, its objectives and its stakeholder needs and requirements.

The asset management system includes:

a) the asset management policy (see 5.2);

b) the asset management objectives (see 6.2);

c) the strategic asset management plan (SAMP);

d) the asset management plan(s) (see 6.2.2);

e) supporting activities (see Clause 7);

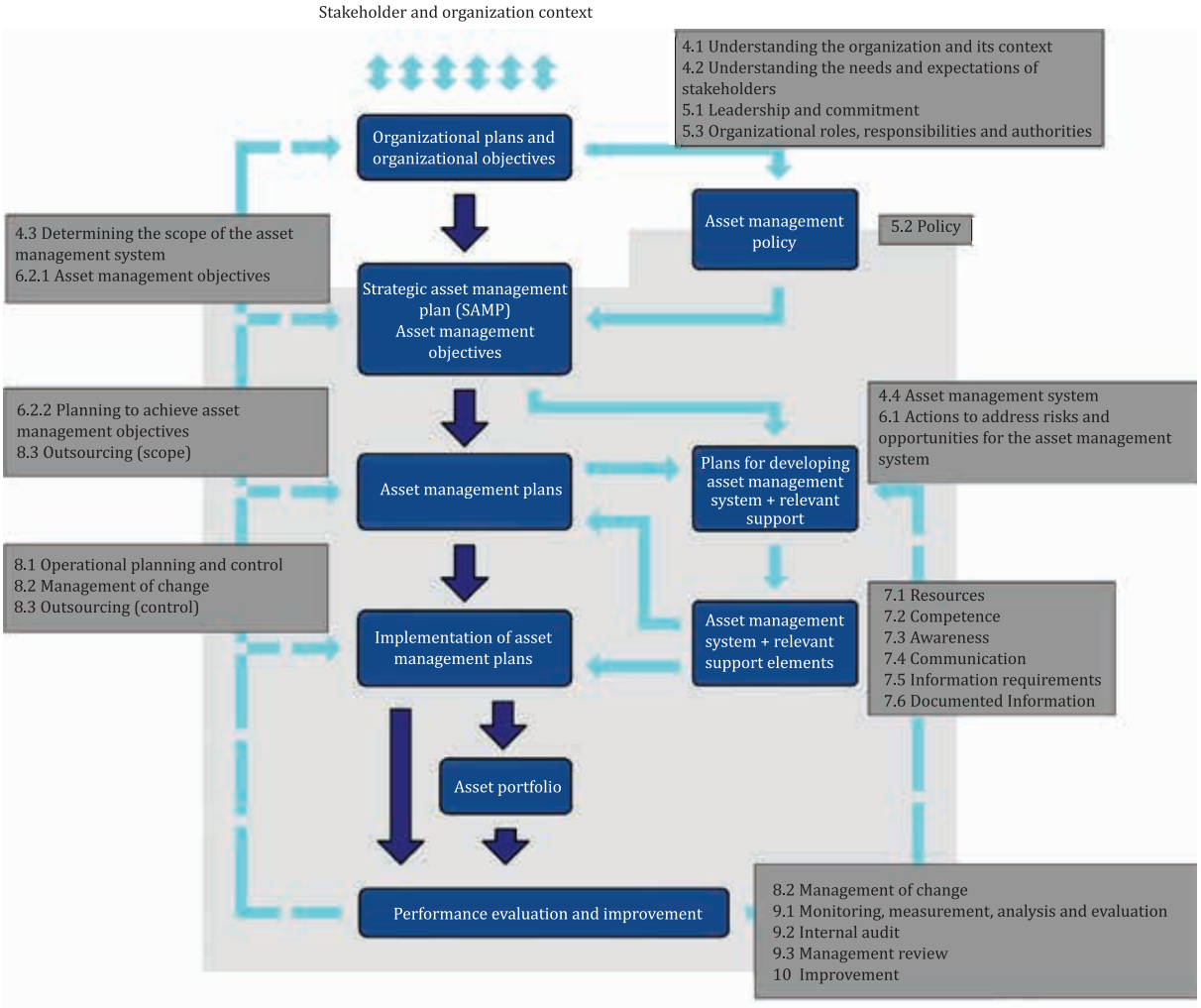
f) operational planning and control (see Clause 8), including the processes and procedures employed to manage assets in the asset portfolio throughout their life cycle;

g) performance evaluation (see Clause 9);

h) improvement activities (see Clause 10);

i) guidance on how it relates to or interfaces with other relevant policies and processes and management systems.

Figure 1 shows the relationship between the key elements of an asset management system, together with the related clauses in ISO 55001.



NOTE 1 Only the primary connections are shown to avoid over-complexity.

NOTE 2 This does not aim to repeat the distinction between asset management and an asset management system: it is a connections view showing directions of influence.

NOTE 3 The grey highlighted box designates the boundary of the asset management system.

Figure 1 — Relationship between key elements of an asset management system

0.3 Structure of this document

This document provides guidance on the implementation of the requirements for an asset management system specified in ISO 55001. By doing so, this document follows a similar structure and sequence of clauses and subclauses as in ISO 55001 (the subclauses in Clause 6 and Clause 10 are not in strict alignment). Throughout this document distinction is made, where relevant, between assets and asset portfolio, asset management and the asset management system. In ISO 55000:2014, 2.4.3, the relationship between these three concepts is clarified. An asset management system is used by the organization to direct, coordinate and control asset management activities to realize value from its assets for the organization and for its stakeholders. When applying ISO 55001, it is relevant to be aware of this relationship. An organization should, for example, distinguish between monitoring and

evaluating the performance of its asset portfolio, its asset management and its asset management system and the use of results of these different types of monitoring and evaluation in the processes for continual improvement at various levels. Where relevant, this document details how an organization should distinguish between assets and asset portfolio, asset management and the asset management system to ensure that the application of ISO 55001 promotes realization of value from its asset portfolio.

In addition, this document also addresses several subjects that are relevant for the effective implementation of asset management, but that are not related to one specific (sub)clause of ISO 55001.

Asset management is the coordinated activity of an organization to realize value from assets (see the definition in ISO 55000:2014, 3.3.1) and although the requirements in ISO 55001 cover the overall approach of comprehensive asset management, there are elements that are linked to several clauses. As special care should be given to the alignment of these cross-cutting elements, these subjects are addressed in annexes to this document.

In the design and improvement of the asset management system and execution of asset management, four pathways are of key importance:

— the line of sight from context of the organization to asset management policy to the SAMP to asset management plans to operation;

— objectives, derived from the organizational objectives to strategic asset management objectives, to asset management objectives; these are often translated into a hierarchy of key performance indicators;

— decision-making criteria and decision-making processes;

— risk management is developed at all levels, from the top level in the organization (down) to daily operations; the risk management framework is aligned with the design and improvement of the asset management system and the risk management process with the asset management execution.

The concurrence of these four elements is one of the key aspects of asset management. In particular, the alignment of decision making and setting of objectives is not straightforward. These are developed together and can need several iterations before they are fully aligned and mature.

To support this overall alignment, Annexes A to H provide information on:

a) the concept of value as a fundamental in asset management (Annex A);

b) defining the scope of an asset management system (Annex B);

c) the objectives and structure of the SAMP (Annex C);

d) the principles behind asset management decision making (Annex D);

e) addressing risk management in asset management (Annex E);

f) the relationship between the financial and non-financial functions in asset management (Annex F);

g) scalability of asset management systems for varying organization sizes and complexity (Annex G);

h) information on asset management activities (Annex H).

0.4 Language applied in this document

In this document, the following verbal forms are used:

— “shall” indicates a requirement;

— “should” indicates a recommendation;

— “may” indicates a permission;

— “can” indicates a possibility or a capability.

Information marked as “NOTE” is for guidance in understanding or clarifying the associated text.

INTERNATIONAL STANDARD **ISO 55002:2018**

Asset management — Management systems — Guidelines for the application of ISO 55001

1 Scope

This document gives guidelines for the application of an asset management system, in accordance with the requirements of ISO 55001.

This document can be applied to all types of assets and by all types and sizes of organizations.

NOTE 1 This document is intended to be used for managing physical assets in particular, but it can also be applied to other asset types.

NOTE 2 This document does not provide financial, accounting or technical guidance for managing specific asset types, however, in Annex F information is provided on the relationship between the financial and non-financial asset management functions.

NOTE 3 For the purposes of ISO 55000, ISO 55001 and this document, the term "asset management system" is used to refer to a management system for asset management.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

ISO 55000:2014, *Asset management — Overview, principles and terminology*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 55000 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 Context of the organization

4.1 Understanding the organization and its context

4.1.1 General

When establishing or reviewing an asset management system, it is important to ensure that its design, scope and implementation are consistent and aligned with the external and internal context of the organization.

4.1.2 External context

Understanding the organization's external context can include, but is not limited to, consideration of the following:

a) the social and cultural, political, legal, regulatory, financial, technological, economic, competitive and natural environment factors, whether international, national, regional or local;

b) key drivers and trends in factors that are identified as potentially having an impact on the objectives of the organization;

c) relationships with, and perceptions and values of, external stakeholders.

NOTE "Stakeholder" can also be referred to as an "interested party".

4.1.3 Internal context

Understanding the organization's internal context can include, but is not limited to, consideration of the following:

a) governance requirements;

b) policies, objectives and the strategies that are in place to achieve them;

c) the organization's culture and values;

d) organizational structure, roles, accountabilities and authorities;

e) the size and complexity of the organization;

f) capabilities, understood in terms of resources and knowledge (e.g. capital, time, people, systems and technologies);

g) information systems, information flows and decision-making processes (both formal and informal);

h) standards, guidelines and models adopted by the organization;

i) relationships with, and perceptions and values of, internal stakeholders;

j) the form and extent of contractual relationships;

k) the organization's risk management plans including tolerance limits, risk attitude and capacity;

l) asset management practices and other management systems, plans, process(es) and procedure(s);

m) integrity and performance of the assets and asset systems, and the outputs of consequent evaluations or reviews;

n) the size, complexity and criticality of the assets;

o) feedback from the investigation of previous asset and asset system failures, incidents, accidents and emergencies, and any systemic or statistical analyses and evaluations;

p) assessments of the ability of the asset management system to achieve the intended outcomes of the organizational objectives;

q) feedback from previous self-assessments, internal audits, third party and certification reviews.

At the strategic level, tools such as Strengths, Weaknesses, Opportunities and Threats (SWOT) analysis and Political, Economic, Social, Technological, Legal, Environmental (PESTLE) analysis may be used for identification and evaluation of contextual issues. A simpler approach, such as brainstorming, can be useful for organizations, depending on the size and complexity of their operations.

The processes and associated outputs used for evaluating the organization's context can be considered necessary for the effectiveness of the asset management system, and may, therefore, be maintained as documented information (see ISO 55001:2014, 7.6.1). The triggers and review frequency for conducting these processes should also be defined in documented information.

4.2 Understanding the needs and expectations of stakeholders

4.2.1 General

The organization should identify and review the stakeholders that are relevant to the asset management system, asset management and the assets, and the needs and expectations of these stakeholders. The identification and review of the stakeholders' needs and expectations will enable the identification of the value the stakeholders could receive from the organization's assets (see Annex A for a discussion on the concept of value in asset management).

4.2.2 Internal stakeholders

Internal stakeholders can include the following:

a) employees of the organization;

b) groups within the organization, i.e. functional groups (e.g. engineering, finance, accounting, maintenance, operations, purchasing, receiving, logistics, communications and information management) or other groups (e.g. safety representatives);

c) shareholders, management consortiums, owners.

4.2.3 External stakeholders

External stakeholders can include the following:

a) customers, users;

b) suppliers, service providers and contractors;

c) non-governmental organizations, including civil society organizations, consumer organizations and the media with an interest in issues related to asset management;

d) government organizations, government agencies, regulatory authorities, and politicians at all levels of government;

e) taxpayers;

f) local communities;

g) those in society interested in social, financial, environmental or other forms of sustainability;

h) investors, financial institutions, rating agencies, brokers and insurers;

i) external employee representatives (e.g. an employee of an industry body/union).

4.2.4 Stakeholder needs and expectations

Stakeholders' needs and expectations should be defined in documented information and be communicated. This may be captured in a high-level statement of stakeholder needs within the SAMP, recognizing that more detailed statements will follow in the asset management plans to specifically address the expectations of different stakeholder groups. These statements should reference any mandatory requirements.

The organization should consider a means of tracking how current the information collected is, and the methods involved for its collection. When engaging with stakeholders to determine their needs

and expectations, the organization can use the list of context-related issues given in 4.1 to frame the discussions.

One objective of asset management is to enable the organization to meet the service needs of the customers and users of its asset(s). The organization should measure the levels of service (see 6.2.1) that its assets deliver, and evaluate these against the needs and expectations of its customers and users. A level of service review process can be a useful approach to understand the expectations of customers and users.

Stakeholders are likely to make judgements about the organization's asset management and its asset management outputs and outcomes based on their perceptions. These can vary due to differences in values, needs, assumptions, concepts and concerns, as they relate to the issues under discussion. Since the views of stakeholders can have a significant impact on the organization's asset-related decisions, it is important that their perceptions are determined, recorded and taken into account in the organization's decision-making process (see also Annex D).

Defining how asset-related decisions are made, and ensuring understanding of the process, are an important part of asset management. The criteria for decision making are influenced by the needs of external and internal stakeholders, by the asset management policy and by the risk attitude of the organization (see Annex D). The external and internal stakeholders' input to establishing decision-making criteria is important for setting priorities and resolving conflicting requirements. Decision-making criteria should be appropriate to the importance and complexity of the decisions being made. These criteria should be used to evaluate competing options to meet asset management objectives and develop asset management plans. The criteria can be expressed in a number of ways, to support quantitative, semi-quantitative or qualitative decisions. The processes to establish the decision-making criteria that guide asset management should be clear and be defined in documented information.

4.2.5 Communication with stakeholders

The level of detail needed when reporting to stakeholders will vary from one stakeholder to another, depending on the scope of the organization's activities, the complexity of the assets being managed and the importance of the stakeholder to the organization. The details reported should only disclose proprietary information as appropriate for the stakeholders receiving the information. The organization should be aware that there can be legal and regulatory requirements associated with reporting to specific stakeholders.

Stakeholders generally should be informed about the decisions that can affect them and should be given an opportunity to provide input into decisions that can have an impact on them. Failure to both communicate and consult in an appropriate way about asset management activities can in itself constitute a risk, because it could later prevent an organization from fulfilling its objectives.

It is important that the terminology used in communicating with stakeholders is consistent and aligned with other functions in the organization; this is particularly necessary when communicating financial information (See Annex F).

Organizations could manage their communication needs through registers or matrices identifying with whom, what, when, how and why they need to communicate.

4.3 Determining the scope of the asset management system

Based on the outcomes of reviews of its context and stakeholders (see 4.1 and 4.2), the organization should define (or review) the boundaries of the asset management system, and establish its scope. It should be communicated to all relevant stakeholders, both internal and external to the organization.

The scope should:

a) consider the range, grouping and functional connectivity of the assets involved in delivering an output or outcome to the customers or other stakeholders;

b) address the relevance of the assets considered for inclusion in the scope to be appropriate to the context and purpose of the organization and include all significant assets;

c) identify the organization's units, locations and contractual boundaries.

Annex B provides further guidance in establishing the scope of the asset management system in various situations, including where different organizations are involved in managing a specific asset portfolio (e.g. where an asset owner outsources most or all of the asset management activities).

4.4 Asset management system

4.4.1 General

In the initial development of the asset management system, the organization should outline how it will establish, implement, operate, maintain and improve the asset management system. An initial review of the organization's current processes and capability against the requirements of ISO 55001 will determine the areas that should be developed to support the functioning of a compliant asset management system and any corresponding improvements of capability required.

The asset management system should not stand alone. Part of successful asset management is the ability to integrate asset management processes, activities and data with those of other functions or management systems in the organization; for example, quality, finance, accounting, safety, risk and human resources. Where possible, existing business processes should be leveraged to avoid unnecessary new work and duplication of existing work and data. These interactions with the existing processes should be clearly communicated to all involved.

Asset managers should ensure the organization has sound methodologies to manage costs and benefits in a way that allows them (or the organization) to make the most appropriate decisions on how to maximize value from assets for both the organization and its various stakeholders.

Consideration should be given to prioritizing elements of the asset management system for development, as there is usually a limit on resources available. The review can guide the organization in formulating plan(s) for implementing and prioritizing improvements to its asset management system.

An appropriate starting point may be the establishment of an asset management policy, which often helps to provide focus for the organization and to identify its intentions. Following this, the organization should develop its SAMP in alignment with the policy. In some cases, an organization may prioritize enabling and support elements (as per ISO 55001:2014, Clause 7) and implementing operational controls (as per ISO 55001:2014, Clause 8). The organization should define the asset management system in documented information. The processes for developing the asset management system, the SAMP and the asset management plans (in alignment with ISO 55001:2014, 7.5 and 7.6), should also be defined in documented information, to the extent needed to ensure that the asset management system is effective.

It is important to be aware of, and to clarify, any variations in terminology between ISO 55000 and the terminology used in the organization's common practice.

Conformity to the requirements of ISO 55001 should be considered as achieving only the minimum starting point for an effective asset management system and should not be seen as the final goal. Moving beyond conformity also requires embracing the fundamentals of asset management described in ISO 55000 (i.e. alignment, assurance, leadership and value).

An asset management system and asset management activities should be scaled to the size and complexity of the organization and its assets and their criticality. For example, for small organizations, the organizational plan can be a single piece of documented information that includes separate sections on:

a) the organizational objectives;

b) the SAMP;

c) the asset management plan(s).

While it is necessary to distinguish between the SAMP and the asset management plan(s), it is not a requirement of ISO 55001 to create separate pieces of documented information for each.

See Annex G for further information on the scalability of asset management.

4.4.2 Strategic asset management plan

The principles by which the organization intends applying asset management to achieve its organizational objectives should be set out in an asset management policy. The approach to implementing these principles should be defined in a SAMP, as documented information.

NOTE A SAMP can be referred to by other names, e.g. "asset management strategy".

The SAMP details the asset management objectives, explains their relationship to the organizational objectives and the framework required to achieve the asset management objectives.

Asset capability and performance, as well as the outputs from asset management activities [e.g. the asset management plan(s)], can be key inputs into establishing realistic and achievable organizational objectives. There should be a "two-way" linkage between the organizational plan and SAMP, and they should be developed through an iterative process. For example, the organizational objectives should not be developed in isolation from the organization's asset management activities.

In developing its SAMP, the organization should consider, amongst other things:

a) the context of the organization, see 4.1;

b) the expectations and requirements of stakeholders, including stakeholder value, see 4.2 and Annex A;

c) activities that can extend beyond the organization's routine planning timeframe, and which should be subject to regular review;

d) the scope of the asset management system, see 4.3 and Annex B;

e) the financial, human and other resources that are available.

The organization should regularly review this information and adapt the SAMP when necessary.

One of the functions of the SAMP should be a high-level plan that:

— translates organizational objectives into asset management objectives;

— identifies and defines the processes the organization uses to establish its asset-related decision-making criteria (see Annex D);

— guides the development of the asset management plan(s), which should set out the asset level activities. The asset management plan(s) can be cascaded into multi-levels in large organizations or in organizations with complex asset portfolios.

There should be alignment and consistency between:

— the organizational objectives;

— the asset management policy;

— the SAMP;

— the asset management objectives;

— the asset management plan(s).

This will reinforce, within the organization, that activities undertaken directly on the assets support the delivery of the organizational objectives (vertical alignment of asset management).

It is important that this alignment is communicated to ensure that external stakeholders and internal stakeholders, at all levels of the organization, understand why asset life cycle activities and asset management activities are implemented.

See Annex C for further information on the content and development of the SAMP.

5 Leadership

5.1 Leadership and commitment

5.1.1 General

Leadership should be exercised at all levels within the organization, however, top management should ensure that it demonstrates leadership and commitment by taking an active role in engaging, promoting, directing and supporting, communicating and monitoring the performance, effectiveness and continual improvement of the assets, asset management and the asset management system. The ways these can be demonstrated are based on various factors, such as the size and complexity of an organization, its management style and culture.

For an organization, "top management" are executives and senior managers holding the highest-level positions within the organization. Positions can include the chief executive officer, managing director, senior vice-president, general manager, executives serving on the board of directors, executive and non-executive directors including executive vice-president, managing partner(s), single owner, partner(s), elected officials, senior executives/managers, and department heads. It can also be a (separate) supervisory board.

Top management has the power to delegate authority and provide resources within the organization. If the scope of the management system covers only part of an organization, then top management refers to those who direct and control that part of the organization.

Each organization has different needs and its own specific solutions that will be decided by top management.

Top management may appoint an individual to oversee the development, implementation, operation and continual improvement of an asset management system, however, it is important that top management retains ownership of the asset management system and provides clarity with respect to responsibilities and accountabilities.

5.1.2 Responsibilities

Top management responsibility includes:

a) ensuring that internal stakeholders, at all levels of the organization, are appropriately engaged in the planning, development, implementation, and operation of the asset management system;

b) creating the vision, culture and values that guide the asset management policy and practice, and actively promoting these values inside and outside the organization;

c) ensuring the asset management policy aligns to the purpose of the organization, and is consistent with the organizational plan and other relevant policies of the organization;

d) ensuring that those in leadership positions, at all levels within the organization:

   1) facilitate the understanding of stakeholder value expectations and translation of the organization's objectives into asset management objectives;

2) lend their authority in supporting the asset management system and be active and visible champions and sponsors for asset management;

3) achieve alignment to other management systems within the organization through appropriate cross-functional approaches and design of the organization's divisional or departmental structures;

4) support integration of asset management systems into business processes, creating vertical and horizontal alignment of the asset management system;

5) support the incorporation of stakeholder needs and requirements into the organization's continual improvement process(es);

6) provide appropriate resources to support the asset management system (these resources include appropriate levels of funding, adequate and competent human resources, information technology support and, adequate resources to promote cross-functional teams' collaboration and continual improvement);

7) recognize and resolve any conflicts between the internal culture of the organization and the performance of its asset management and asset management system;

8) communicate the organization's asset management objectives and the importance of its asset management system to relevant employees, customers, suppliers, contractors and other stakeholders;

9) use two-way communication and be open to receiving information aimed at improving the assets, asset management and asset management system from all levels within the organization as well as customers, suppliers, contractors and other key stakeholders.

5.1.3 Commitment

Top management commitment to asset management can be demonstrated by:

a) making reference to asset management policy in communications;

b) engaging in setting the objectives and measures of success for the people responsible for the asset management system:

   1) by setting priorities for these objectives;

   2) by allocating appropriate resources for the achievement of these objectives;

c) establishing a strong collaborative work culture that is focused on delivering the asset management objectives;

d) using agreed decision-making criteria for asset management decisions;

e) supporting asset management-related improvement activities;

f) supporting personal and career development pathways that encourage and reward time spent in roles associated with asset management and the operation of the asset management system;

g) monitoring the asset management system performance and ensuring corrective or preventive actions, including opportunities for continual improvement;

h) addressing asset-related risks and incorporating these risks into the organization's risk management processes;

i) aligning asset management and the asset management system to other functions and management systems in the organization; for example, its approach to risk management;

j) ensuring collaboration across the organization to achieve the organizational objectives.

5.2 Policy

The asset management policy provides the organization's vision, values, intentions and direction about asset management, see Annex A. This policy should align with the organizational objectives.

The asset management policy is a short statement that sets out the principles by which the organization intends to apply asset management to achieve its organizational objectives. The asset management policy should relate to top management's overarching intentions for assets, asset management and asset management systems and should not relate to specific assets.

The asset management policy should be established and authorized by top management in order to demonstrate its commitment to asset management. The asset management policy should operate at a high level and align with the other policies of the organization, such as its quality policy (e.g. a quality policy related to ISO 9001) or occupational health and safety policy (e.g. related to ISO 45001), corporate risk management policy (e.g. related to ISO 31000) or policies related to financial management and reporting [e.g. International Financial Reporting Standards (IFRS)].

The policy should set out the organization's commitments and expectations for continual improvement of assets, asset management and the asset management system. It should be aligned to and demonstrate support for the organizational objectives.

The asset management policy should align to the purpose of the organization and be consistent with the organizational plan and the other relevant policies of the organization.

The asset management policy should provide guiding principles for asset management and asset management objectives, and include, for example, commitments for:

a) satisfying applicable legal and regulatory requirements;

b) providing resources to realize the asset management objectives;

c) reporting on and evaluating asset management performance;

d) supporting long-term objectives, sustainable outcomes and stakeholder requirements;

e) abiding by any relevant contractual obligations;

f) continual improvement of asset management and the asset management system.

The policy should be maintained as documented information and be available to the organization's internal and external stakeholders, as appropriate (see ISO 55001:2014, 7.3). Separate documented information on the asset management policy might not be required but the asset management policy should be identifiable and prioritized in strategic documented information.

The asset management policy should be communicated within the organization (in accordance with ISO 55001:2014, 7.3).

There should be processes in place to review and update the asset management policy, especially if the organization's external or internal context changes.

5.3 Organizational roles, responsibilities and authorities

The responsibilities and authorities of key functions in the organization should be defined. These definitions should include both internal and outsourced roles and responsibilities. The interfaces between the functions should be clearly established. This clarity of delineating responsibilities becomes more important in situations in which asset management activities are outsourced.

It should be clear whose role is responsible for which activity. This role and activity alignment can be achieved through the development of accurate job descriptions and role statements, by including asset management responsibilities in existing job descriptions, or through the establishment of documented information giving an organizational chart.

Top management should assign internal roles with the delegated authority to:

a) ensure the asset management objectives, as stated in the SAMP, align to the asset management policy and organizational objectives;

b) support and ensure the asset management system is suitable, adequate and effective;

c) report to top management on the performance of asset management and the asset management system.

Top management should assign responsibility for managing the availability of competent and capable resources; this will require consideration of:

— an individual's experience and competence (see 7.2);

— support for the role through formal and informal training and mentoring;

— other workload requirements and their variability, which can impact the individual's ability to deliver on asset management related objectives;

— the individual being able to demonstrate an understanding of what the responsibilities mean in the context of their role (see 7.3).

In small or medium-sized organizations, multiple asset management functions may be assigned to one individual. This smaller scale does not change the need to communicate the arrangements to other stakeholders, or to clarify the responsibility of the individual.

For contractors and external service providers, their responsibilities and the competence required should be specified in the documented information for the contract or agreement (see 8.3).

6 Planning

6.1 Actions to address risks and opportunities for the asset management system

6.1.1 Purpose and content of planning

The purpose of planning is to derive asset management objectives from the organization's objectives and determine the activities and resources necessary to achieve them. The starting point for planning is to understand the context of the organization (ISO 55001:2014, 4.1) and the requirements of stakeholders relating to managing assets (ISO 55001:2014, 4.2).

Planning is an iterative process combining top-down strategic direction and bottom-up identification of needs based on the current performance of assets, asset management and the asset management system. Objectives and plans can be developed at different levels. The SAMP (see 4.4.2 and Annex C) covers the strategic objectives, strategies, decision-making criteria and high-level plans for the entire asset portfolio and the asset management system. The asset management plans can be developed for an asset portfolio and/or assets; for example, at business unit level, at a site/facility level or at the complex asset system level. The interrelation between different levels of planning is illustrated in Figure 1.

In planning, an organization should:

a) adhere to the asset management policy and incorporate asset management principles (see ISO 55000:2014, 2.4.2);

b) address risks and opportunities for the asset management system (see ISO 55001:2014, 6.1) and the asset management objectives (see ISO 55001:2014, 6.2), taking into account how these risks and opportunities can change with time;

c) consider costs, performance and risks related to the asset portfolio by applying the organization's decision-making criteria and approach to risk management;

d) align the timeframe with the organization's planning and other management systems, while also considering longer-term implications;

e) consider the results of performance evaluation, including internal and external audits as well as management review.

6.1.2 Risks and opportunities

When planning for the asset management system, managers within the organization should ensure that risks and opportunities are determined and plan actions to address them. The purpose is to prevent or reduce negative consequences, reduce the probabilities of undesired effects and to pursue opportunities that could enhance the achievement of the organization's asset management objectives. It should be noted that risks and opportunities are addressed through the planning process, as explained in 6.2 and Annex E.

Examples of risks to the asset management system could be: the failure or lack of processes in the organization; IT systems not functioning as required; and unclear or insufficient responsibilities, authorities and competences of personnel. Examples of opportunities could be; the improvement of processes; and the potential use of new technology.

The approach for managing risks associated with the asset management system should be aligned with the organization's overall risk management approach. Further guidance on this matter can be found in Annex E.

In addressing the risks, an organization should establish and implement a process to identify, analyse and determine actions to manage risks on a regular basis. Risk criteria that are defined as part of the decision-making criteria should be applied in determining these actions. The actions can include changes to the asset management system.

The organization should implement a process to evaluate the effectiveness of the actions taken to manage the risks and opportunities (see ISO 55001:2014, 8.1 and 9.1).

6.2 Asset management objectives and planning to achieve them

6.2.1 Asset management objectives

Asset management objectives provide direction for the organization to ensure that its asset portfolio can fulfil its requirements (see the fundamental "assurance" in ISO 55000:2014, 2.4.2). The organization should take into account the value to be derived from its assets for stakeholders when setting its asset management objectives (see Annex A for information on the concept of value in asset management). Objectives can be defined at multiple levels (e.g. strategic, tactical and operational), and vary in detail and timeframe. The strategic asset management objectives (e.g. at the asset portfolio level) should be used to inform lower level asset management objectives (e.g. at business units, asset systems, asset groups) and to enable asset management plans to be developed (see Annex C). Generally, organizations limit strategic objectives to a smaller number, to provide focus and to target efforts.

Asset management objectives should be specific, measurable, achievable, realistic and time-bound, if practicable. Furthermore, these can be stated both quantitatively (e.g. plant availability or quantitative risk acceptance criteria) and qualitatively (e.g. perception of social responsibility, reputation or ethical values). Objectives should be available as documented information in the SAMP and be communicated to stakeholders to increase awareness and commitment. Specific objectives should be allocated to those who are responsible for achieving them. Achievement of asset management objectives should be monitored and reviewed (see ISO 55001:2014, Clause 9). Deviations could be used for determining improvement actions or for directing revisions to the asset management objectives.

During the development of its asset management objectives, the organization should:

— review risks and opportunities, such as the potential impacts from the failure of assets, or from the asset management activities;

— review the importance of assets related to their intended outcomes (i.e. the criticality of assets).

Examples of factors that can be addressed by objectives include:

a) for asset management:
   - total cost of ownership;
   - return on capital employed;
   - compliance with contractual terms and conditions;
   - customer satisfaction;
   - society or reputation survey results;
   - environmental impact (e.g. carbon emissions costs);
   - levels of service;
   - future demand;
   - return on investment in terms of stakeholder value (social, environmental, etc.);
   - level of asset management maturity (by benchmarking);
   - alignment and process efficiency;
   - competence levels;

b) for assets/asset portfolios:
   - asset performance (e.g. uptime, efficiency);
   - unit cost of product or service;
   - dependability, including availability, reliability, maintainability and supportability (e.g. down time, mean time/ distance between failures, mean time to repair);
   - asset condition;
   - health, safety and environmental performance;
   - total cost of ownership;
   - life cycle costs;
   - lifetime expectancy;
   - asset energy performance.

Asset management objectives should be subject to regular management review (9.3) and such reviews should inform the continuous improvement process (10.4).

6.2.2 Planning to achieve asset management objectives

6.2.2.1 General

The organization should plan and prioritize activities and resources to achieve its objectives. The asset management plan(s) should be defined in documented information at a level of detail that is appropriate to the size and complexity of the organization and the asset portfolio in the scope of the asset management system (see Annex B). For smaller organizations, the SAMP and asset management plans can be in a single piece of documented information (see Annex C). The SAMP is often used for longer-term planning and should be made available to different stakeholders, such as regulators and executive

boards. An asset management plan includes more details about activities and resources needed to support users of this plan, such as project or operations managers. In addition, the organization should consider the need to define the processes and methods used for asset management planning.

The timescale chosen for asset management plan(s) should reflect the organization's period of responsibility or the lifetime of the assets/asset portfolio. For example, a service provider managing the asset over its contracted period could be planning for the asset management during this period; however, it can have to take account of any longer-term obligations or liabilities imposed by the client in the contract.

Life cycle costs (capital, operational and financing costs and expenditure) should be considered in the decision-making process (see Annex D).

In some situations it is appropriate to consider planning for the life cycle of individual assets. In a network of interdependent assets, individual assets can be at different stages of the life cycle; consequently, at any given time, different assets of the same type might need different activities, for example, due to their age, condition, or performance. When planning, the organization could evaluate options for investing in its asset portfolio, or operational alternatives, which could include solutions that do not require owning an asset (e.g. leasing).

This planning should be aligned and integrated with the organization's other planning activities (e.g. financial, human resources and other support functions). It is important for the organization to commit the resources that are identified in the asset management plan(s) as being necessary. Implementation of the asset management plan(s) is an iterative process that involves resolving conflicts between what is planned and what can be realized within financial constraints. If resources become constrained, it can be necessary to reassess the asset management objectives (both for the short-term, as well as the consequences for the longer-term) and prioritize activities accordingly.

The organization should apply a consistent approach when determining the financial implications of the asset management plan(s). Once the financial implications have been considered, the organization should ensure that the asset management plan(s) and the financial plans are aligned and reconciled. Decision-making processes should take into account the difference between financial and technical aspects of the asset portfolio. Consideration can also be given to the potential costs of not making those decisions and any resulting pricing impacts upon the organization's products and services.

The asset management plan(s) should be reviewed periodically to ensure continual alignment with, and appropriateness of, the asset management objectives.

6.2.2.2 Asset management plan

There is no firm requirement on what should be included in an asset management plan or how it should be structured. However, it is common practice for such a plan(s) to contain:

— the rationale for the proposed asset management activities and the objectives they are intended to achieve;

— operational and maintenance plans;

— capital investment (overhaul, renewal, replacement, enhancement and disposal) plans, and financial and resource plans.

Furthermore, asset management plans are often based on a review of earlier achievements.

When developing, or reviewing asset management plan(s), the organization should consider:

a) the scope of the asset management plan, including which objectives and associated risks and opportunities are being addressed and over what timeframe;

b) the performance of the asset portfolio and the intended outcomes in terms of level of service, product to be provided, future demand, etc.;

c) who should be responsible for developing and implementing the plan(s), its continual improvement and communication to stakeholders;

d) the environments in which the asset portfolio is operating or is intended to operate;

e) the identified activities to achieve the objectives and address the asset portfolio and asset management related risks;

f) requirements for programmes of activities, including the processes and methods (see 8.1);

g) the trade-off between capital and operational expenditures, including non-asset solutions;

h) the activities to be outsourced and any need for controls and operational oversight (see 8.3);

i) the risks to be managed during the organization's period of responsibility, including any residual liabilities beyond the period of operation or use of the asset;

j) continuity and contingency planning based on identified risks;

k) preventive, corrective and continual improvement actions identified (see Clause 10);

l) a process for prioritizing unplanned activities, including the management of change;

m) whether appropriate resources and funding are available in the right timeframe;

n) standards and technical specifications as applicable for planning.

A key aspect of planning is the identification of events in which the functionality of assets is compromised, including potentially catastrophic events in which function is completely lost. For identified risks that cannot be eliminated or controlled otherwise, contingency plans and resilience actions should be established in order to mitigate or control the impact in the event an adverse event occurs.

A contingency plan and resilience actions should ensure that business objectives are delivered as far as practicable, and that functionality is restored. The organization can establish monitoring systems to identify abrupt changes in circumstances, in order to initiate the contingency action.

See, for example, ISO 22301 for further information on business continuity and ISO 22320 for further information on emergency management or other specific standards and technical requirements.

NOTE ISO 55000:2014, 2.5.1, gives the following advice: "The asset management plan can enable an organization to create a link, if needed, between its asset management system and a variety of specific, technical asset management requirements. These specific, technical requirements are given in standards both inside and outside the ISO environment, and at the international, regional or national standardization levels; such standards provide information on strategies and tactics, as well as specific design, construction, material or process requirements."

7 Support

7.1 Resources

7.1.1 General

During the development and implementation of the asset management system, the organization should determine the resources required by giving consideration to:

a) its asset portfolio;

b) its asset management system;

c) its asset management activities derived from the SAMP and asset management plans;

d) the organizational objectives and asset management objectives;

e) performance monitoring activities;

f) improvement activities to correct any nonconformities.

The organization should map its available resources to the required resources for its planned activities to determine any gaps. This gap analysis can be used as an input to the improvement process. This analysis applies across all asset management activities, can be extensive and can require prioritization and programme planning of many projects to close these gaps.

Resource requirements should be included and incorporated into the planning process, in all time frames, to ensure that adequate and appropriate resources are available to deliver the plans. This approach should include consideration of the organization's resourcing strategy (e.g. for human resources, and whether skills and capabilities are "core" or whether they can be outsourced). Resource considerations can also result in changes to the way planned requirements are delivered (e.g. the use of hired assets).

7.1.2 Asset portfolio

When determining the resources required to execute the activities for its asset portfolio, the organization should consider the following:

a) asset preservation activities, as identified in its asset management plans;

b) asset preservation consumables, as identified in its asset management plans;

c) raw materials required by the asset portfolio for achieving value creation;

d) any changes in or to the asset portfolio over time that will require a review of resource requirements;

e) any changes to asset utilization.

7.1.3 Asset management system

When determining the resources required for its asset management system, the organization should consider its asset management policies, objectives, strategies, plans and decision-making criteria. To enable the management of policies, objectives, processes and management system elements, such resources can include:

a) communication systems;

b) document management systems;

c) human resource management systems;

d) information technology systems.

7.1.4 Asset management

When determining the resources required for its asset management activities, the organization should consider the following:

a) the delivery of asset management activities;

b) the control of asset management activities;

c) personnel competence;

d) outsourced activities;

e) timely availability of investment and operational finance;

f) safe access to asset portfolios to perform asset management activities.

7.2 Competence

7.2.1 General

7.2.1.1 The organization should determine the competence levels required for all asset management roles responsibilities and accountabilities, as well as the awareness, knowledge, understanding, skills and experience needed to fulfil them. This should include consideration of the following:

a) the organization's culture;

b) human error;

c) the organization's asset portfolio;

d) the organization's asset management system;

e) the organization's SAMP, asset management plans and asset management activities.

7.2.1.2 The organization should perform competency assessments against the identified requirements. The assessments can be used for:

a) improving competency and establishing training plans that identify the training, education, development and other support needed to attain the required competence;

b) conducting training as identified or appoint/contract competent persons;

c) creating staff development plans;

d) evaluating the post-training competence of the person(s) against the defined requirements to ensure improvement.

7.2.1.3 The organization should retain appropriate documented information as evidence of competence. Methods of managing such documented information can include:

a) a human resource management system to record the competency levels of staff members, including their qualifications and expertise;

b) a work management system to record which members of staff completed asset management activities.

7.2.1.4 Competence reviews should also be conducted when a significant change occurs to the asset portfolio, asset management system and asset management. Methods of completing this review can include:

a) a competency audit process to adjust for changes resulting from the asset management plans;

b) succession planning.

7.2.1.5 In the event that the organization decides to outsource any aspect of the asset management system, the organization should ensure that the external resource providers can demonstrate their competence against the required activities. The organization should, depending on the risks involved, validate claims of competence, and have a process to ensure that any third-party resource provider continues to provide competent resources.

7.2.2 Asset portfolio

When determining the competencies required to execute its activities for its asset portfolio, the organization should consider the following:

a) asset types;

b) asset systems;

c) asset configurations;

d) asset and asset system risks and opportunities, including financial and non-financial consequences;

e) performance evaluation and improvement plans;

f) change management.

7.2.3 Asset management system

When determining its competence requirements for operating its asset management system, the organization should consider the requirements of the enabling systems and tools.

7.2.4 Asset management

When determining its competence requirements for its asset management activities, the organization should consider the following:

a) leadership requirements;

b) the culture in the organization;

c) change management;

d) decision-making methods and criteria;

e) appropriate and effective processes for managing competence and leadership.

7.3 Awareness

7.3.1 General

Persons working under the organization's control should have appropriate awareness of the organization's context, the asset management objectives, asset management system, activities and asset portfolio. Such persons can include staff, contractors, internal or external service providers, and suppliers. The specific awareness needs of any stakeholder under the organization's control should be determined by their role and its relationship to the organization meeting its asset management objectives.

All persons with assigned roles and accountabilities that can have an impact on the outcomes of asset management should have:

a) their roles and accountabilities communicated to them via planned communications;

b) the training, education, development and other support needed to perform their role;

c) the ability to demonstrate their awareness and understanding of the risks and opportunities and asset management objectives related to their role;

d) an understanding of the risks of not conforming to the requirements.

A review of the results of the building of awareness process should be included in the scope of the internal audit programme and should also form part of a structured change management process.

7.3.2 Asset portfolio

When determining awareness needs of stakeholders regarding the assets, asset types and asset systems within the asset portfolio, the organization should consider the following:

a) current state and performance;

b) required future state and performance;

c) current associated risks;

d) future state associated risk and performance;

e) any changes to the asset portfolio.

7.3.3 Asset management system

When determining awareness needs of stakeholders regarding the asset management system, the organization should consider the following:

a) the current asset management system;

b) the required future state of the asset management system;

c) risks associated with the current asset management system;

d) risks associated with the required future state of asset management system;

e) any changes to the asset management system in progress;

f) the visual display of asset management system performance indicators in central locations;

g) how well the organization is performing in meeting the above indicators.

7.3.4 Asset management

When determining awareness needs of stakeholders regarding the asset management activities, the organization should consider the following:

a) leadership requirements;

b) expected behaviours;

c) the culture in the organization;

d) change management;

e) the processes used for managing competence, culture and leadership;

f) visual display of asset management policy and objectives in appropriate locations;

g) visual display of asset management performance.

7.4 Communication

7.4.1 General

Asset management activities carried out by the organization should be communicated to relevant stakeholders periodically, in a coordinated way, as an integral part of the organization's asset

management system. When establishing its communications, the organization should use a systematic approach to identify any gaps in awareness and information needs, including:

a) the organization's context;

b) stakeholder and other applicable requirements (including legal and regulatory requirements);

c) events that change risks or opportunities;

d) the organization's requirements pertaining to asset management.

These can be included in a communication plan.

7.4.2 What to communicate

In order to promote engagement with stakeholders, create transparency and ensure accountability for its asset management, the organization’s communications should include the following:

a) the benefits and performance of asset management;

b) the performance of the asset portfolio;

c) any improvements or changes and how these are expected to affect objectives, risk and value;

d) changes in the organization’s context;

e) any changes in resource requirements.

7.4.3 When to communicate

The frequency of the organization’s communications can be determined by:

a) stakeholder and other applicable requirements (including legal and regulatory requirements), asset management objectives and asset management plans;

b) when a significant change occurs;

c) after incidents occur, to enhance or restore reputation;

d) during personnel performance and development meetings.

7.4.4 With whom to communicate

The target audience for the organization’s communications can include the following:

a) stakeholders impacted by asset management and any changes;

b) stakeholders who can impact asset management and create changes.

7.4.5 How to communicate

The delivery of the communications should consider the following:

a) communication policy;

b) communication format;

c) social media controls;

d) stakeholder and other applicable requirements (including legal and regulatory requirements);

e) language, inclusive of common terminology;

f) language translation.

7.5 Information requirements

7.5.1 General

Availability and quality of information is vital for all aspects of asset management. An organization should determine its information requirements and put in place systems and processes for the collection, collation, storage, maintenance and transfer of asset information to enable the achievement of its asset management objectives. Organizations should also consider information as an asset to be managed as part of the same asset management system.

Information systems and associated processes should provide information to address both current and future risks and opportunities to enable the asset management function to make informed decisions. Such information should also enable the organization to identify and plan for contingencies.

When determining its information requirements and the quality of information, the organization should consider:

a) the required structure and format of data to enable exchange;

b) the criticality and value of the information to enable decision making, relative to the cost and complexity of collecting, processing, managing and sustaining the information;

c) the need to align its information requirements to the level of risk posed by an asset, asset management activity or the asset management system processes;

d) information needed for contractual and other applicable requirements (including legal and regulatory requirements);

e) its asset portfolio;

f) its asset management system;

g) its asset management activities.

The organization should specify the attributes and quality requirements for its identified information and implement and maintain processes for managing its information. The organization should also consider security requirements for its information (see ISO/IEC 27001).

The organization should determine the requirements for alignment of financial and non-financial information relevant to asset management throughout the organization, such as:

— the alignment of information requirements for different levels and functions within the organization; this can include vertical alignment from top management down and horizontal alignment between asset, financial and risk management functions by using common terminology;

— the alignment of financial and non-financial information (realizing that for some types of organizations, e.g. government-type agencies, there are provisions that make their functional areas independently accountable for their own domain terminology; in such cases, a common terminology is unlikely to be achieved, however, conflicting terminology should be resolved where possible and detailed in documented information);

— the need for financial information regarding assets to be appropriate, consistent and traceable, and to reflect the technical and operational reality of the assets (e.g. completeness, accuracy, proper valuation and presentation, including ownership, can be achieved through employing identifiable and auditable accounting records that are linked to the technical asset records).

7.5.2 Asset portfolio

When determining its information requirements and information relating to individual assets, asset types and asset systems, the organization should consider the following:

a) identification and description (e.g. asset ID, location, topology, asset type, function, design parameters, date of acquisition and entering service);

b) utilization;

c) criticality;

d) performance;

e) specific risk;

f) specific competence requirements;

g) commercial information (e.g. vendor/contractor, service provider, legal and contract documents, licences, warranties);

h) financial information (e.g. acquisition cost, replacement cost, operating cost, maintenance cost, disposal cost, carbon emissions and usage costs, life cycle cost, asset value, expected service lives, depreciation, residual value/liability).

7.5.3 Asset management system

When determining its information requirements and information relating to its asset management system, the organization should consider the following:

a) organizational and asset management objectives;

b) information required for developing the SAMP and asset management plans, including life cycle information;

c) identifying, evaluating and managing risks and opportunities relating to assets, asset management and the asset management system;

d) sharing of information with its outsourced service providers;

e) defining roles, responsibilities, competence requirements and authorities, including those of outsourced services providers;

f) information requirements for performance evaluation and improvement;

g) the need to prioritize data and information;

h) adequate information required for the performance of different roles within the organization.

NOTE 1 ISO/TS 8000-1 provides guidance on measuring and managing data quality.

NOTE 2 Building information modelling (BIM) approaches are increasingly being used to ensure asset data and information is shared between different organizations in a controlled way and that the information is not lost between key stages in the life cycle of assets (e.g. between projects for creating/modifying an asset and its subsequent operation and maintenance by different service providers).

NOTE 3 There are a large number of existing information standards produced by various standards bodies. Relevant asset management subject areas are listed in Annex H.

7.5.4 Asset management

When determining its information requirements and information relating to its asset management activities, the organization should consider the following:

a) leadership requirements;

b) its culture;

c) visual display of asset management policy and objectives in central locations;

d) visual display of asset management performance.

7.6 Documented information

7.6.1 General

The organization should control the documented information needed for conformity to ISO 55001.

While ISO 55001 clearly states requirements for the control of documented information (which are consistent with other International Standards for management systems), there has deliberately been a lack of prescriptive requirement set down on what should be detailed as documented information. This reflects the wish to avoid constraining organizations or requiring documented information that is not cost effective or useful. In practice, organizations wishing to conform to ISO 55001 should put in place adequate documented information to ensure not only that the SAMP and plans are formally defined, but also other activities and standards are controlled. The information required should be appropriate to the complexity of the assets and the asset management activity, as well as to applicable legal and regulatory requirements.

NOTE Further guidance on documented information can be found in ISO/TS 9002:2016, 7.5.

7.6.2 Creating and updating

When the organization creates and updates documented information, it should ensure that the appropriate identification, format and media are used, and that the documented information is reviewed and approved.

7.6.3 Control of documented information

The organization should ensure that documented information is available in a suitable medium, whenever needed, and that it is adequately protected.

NOTE Useful reference standards that can assist with designing a documented information management system include ISO 15489-1, ISO 16175-3 and ISO 30301.

8 Operation

8.1 Operational planning and control

8.1.1 General

The organization should plan and control operational processes, including their decision-making criteria, for the implementation of:

a) the SAMP (see 4.4.2 and Annex C);

b) the asset management plans (see 6.2.2);

c) actions determined for managing risks and opportunities for the asset management system (see 6.1);

d) determined corrective and preventive actions (see 10.2 and 10.3) that are not specifically included in the SAMP and/or asset management plan(s).

Organizations should implement processes that are appropriate for delivering different types of activities on assets; for physical assets these may include project management, creation/acquisition, utilization/maintenance, renewal/disposal.

8.1.2 Operational objectives and decision-making criteria

The objectives determined in operational planning should be aligned with strategic asset management objectives and targets to facilitate operational decision making (see Annex D). For example, if the SAMP specifies availability objectives for an asset system, this element should be cascaded into an aligned measurable technical specification of the performance of the assets within the asset system [e.g. overall equipment effectiveness (OEE) or mean time between failure (MTBF)].

8.1.3 Operational planning and control processes

The organization should establish operational planning and control processes that identify who is responsible for each process and how the defined activities should be performed, including consideration of how risks arising during implementation of activities can be identified and managed.

In implementing processes and activities, the organization should consider, for example:

a) roles and responsibilities of personnel;

b) operational procedures and/or instructions;

c) allocation of resources;

d) competence requirements for relevant roles;

e) the availability and capture of relevant data and information that can be used to inform decision-making criteria;

f) technical standards and specifications used by the organization.

The organization should maintain documented information of processes and activities as appropriate (see 7.6), to enable verification that process steps are followed as designed and the expected output of the processes are achieved.

8.2 Management of change

Management of change is important to address internal or external changes affecting assets, asset management or the asset management system that can impact the organization's ability to achieve its asset management objectives. Risks associated with changes should be evaluated and managed to ensure that the integrity of the asset management system is maintained and risks arising from changes remain at an acceptable level. Changes can be in:

— asset portfolio;

— asset management practices/activities;

— the asset management system processes;

— the structure of the organization.

The organization should establish (a) process(es) and programme(s) for the management of both temporary and permanent change. The process(es) for managing change can address, for example:

a) authority for approval of changes;

b) analysis of any potential integrity implications for operations;

c) compliance with external and internal requirements, and approved standards;

d) documented information requirements, including the reasons for change;

e) communication of risks associated with changes and actions to mitigate the risks;

f) the expected timeframe in which a change occurs or is expected to last;

g) culture and competence requirements for managing change.

The process for regularly identifying, communicating and reporting possible changes can be integrated into routine work processes. For example, if an organization conducts regular scheduled meetings to discuss operational performance, it can include an agenda item for the identification of actual or potential changes. Identified changes should be assessed for risks. This assessment could include unintentional consequences that can impact other parts of the organization as a result of the change. Depending on the risk management approach of the organization, the risks could be prioritized and mitigating actions defined. Mitigating actions should be taken prior to implementation of the change if possible.

Examples of changes that should be addressed by the management of change process include the following:

— factors external to the organization (including new legal and regulatory requirements);

— demands for products and services, contractors or suppliers;

— supply chain constraints;

— asset management policy and objectives;

— changes arising during implementation of plans;

— process(es) or procedure(s) for asset management activities;

— divisional or departmental structures in the organization, roles or responsibilities;

— demands on resources, including competing demands;

— new assets, asset systems or technology (including obsolescence);

— necessary modifications required to ensure asset function, asset performance and/or asset life.

8.3 Outsourcing

An organization may choose to outsource certain asset management activities to an external provider rather than performing these activities in-house. Details of outsourced activities (which can influence the achievement of the asset management objectives) should be defined, maintained, controlled and retained as documented information to provide assurance that performance and service levels are aligned with the asset management plan(s).

The organization should ensure that the extent of the outsourcing and the processes of the external service provider(s) are aligned with the asset management system (see Annex B). The extent of outsourcing could require an external service provider to establish its own asset management system that is aligned with the organization's asset management objectives.

When deciding to outsource asset management activities, the organization should consider the risks to its assets and asset management system and who is best suited to retain and manage those risks. For example, activities that can cause damage to the organization's reputation generate high risks and should be retained and not be outsourced. The transparency and performance of outsourced activities should be subject to regular performance review.

The organization should exert leadership and formalize the outsourcing relationship (e.g. through a contract, service level agreement or other appropriate commercial mechanism) in order to, for example:

a) specify objectives and requirements of the asset management system for the service provider(s);

b) define governance arrangements of outsourced activities, including how they are to be organized and structured (e.g. responsibilities and authorities) and how the outsourced activities are managed internally;

c) define the scope and boundaries of the processes and activities that are outsourced, including the interfaces with the service provider, control activities, quality requirements for services and people (7.2 and 7.3), timelines, financial implications, feedback and improvement activities;

d) set up processes for the exchange of information, knowledge, competences, people, processes, data and technology between the organization and its service provider(s), including the requirements for documented information (7.6) and its updating, the ownership and responsibility for data, intellectual property protection and corporate knowledge (including knowledge generated during the relationship);

e) create a process of handing over and/or taking back the control over asset(s) and/or the asset management activity, including the required state of the assets and asset management activities (e.g. covered in an exit plan);

f) outline how the outsourced activities support the overall asset management objectives of the organization.

The organization and the service provider should determine and agree on how the outsourced activities will be jointly managed and led.

9 Performance evaluation

9.1 Monitoring, measurement, analysis and evaluation

9.1.1 General

9.1.1.1 Performance evaluation of asset portfolios, asset management systems and asset management is a critical input and trigger for any improvement process (see Clause 10) and gives assurance that the organization is monitoring the aspects that can compromise the value the assets create for the organization or the delivery of asset management objectives. When determining what requires to be monitored, consideration should be given to:

a) stakeholder and other applicable (including legal and regulatory) reporting requirements;

b) asset management objectives;

c) decision-making criteria and methodology.

The organization should (see ISO 55001:2014, 7.5) ensure that there is consistency and traceability between technical asset information, asset management information, asset management system information and financial records. Aspects to be considered for this information are currency, accuracy and completeness.

9.1.1.2 To set up appropriate performance evaluation an organization should address the following key aspects:

a) uniform technical, operational and financial terminology;

b) technical, operational and financial linkage, which is consistent and traceable to the assets at a predefined level of detail;

c) adequate and accurate financial and non-financial data and information of technical and operational events that have a potential impact on the organization's risks;

d) decision-making methods, assumptions and criteria for evaluation that form the basis of the organization's asset management;

e) policies, objectives, strategies and plans (including the organizational plan level);

f) risks and opportunities (including the overall level for the organization).

Outputs of performance monitoring should be used as inputs into the improvement process, as appropriate.

The frequency of performance evaluation activities is based upon significant change, rate of change, deviation or nonconformity and not just on fixed time intervals.

9.1.1.3 The asset management system should be described in documented information (including details of the objectives, strategy, methods and decision-making criteria, and the associated accountability) to a level that is appropriate for performance evaluation. The SAMP should provide the rationale and approach, and will normally include the asset management objectives (see Annex C). In the context of planning (see Clause 6) performance evaluation should be used to:

a) establish a baseline for the current and future state of the asset management system, asset management and portfolio assets;

b) support the definition of realistic and achievable targets for each performance metric;

c) identify the need for change;

d) allow for the evaluation of alternative solutions and final selection;

e) plan and schedule activities;

f) evaluate risks to asset management objectives;

g) allow asset management plans to be produced.

In the context of support (see Clause 7), performance evaluation should be used to estimate resources needed to perform planned activities, ensure such resources are available and validate the effectiveness of the activities.

In the context of operation (see Clause 8), performance evaluation should be used to derive criteria for process control, monitor risks and manage change.

In the context of improvement (see Clause 10), performance evaluation should be used to begin and end the improvement process (when the desired performance has been achieved) and evaluate its results.

Information on all performance evaluation activities and their results should be available as documented information to enable compliance, traceability, transparency, management of change and to establish an audit trail.

9.1.2 Performance monitoring

9.1.2.1 General

In the development and maintenance of performance monitoring, the organization should be:

a) setting quantitative and qualitative performance metrics including leading and lagging indicators;

b) identifying patterns and behaviours that enable improvement activities (see Clause 10);

c) utilizing decision-making criteria that take into account the variability, magnitude and rate of change of the performance parameters that are monitored;

d) providing information for decision making at different levels within the organization;

e) ensuring alignment between performance indicators;

f) ensuring that reported information used for monitoring has the same meaning with respect to different functions in the organization;

g) utilizing a consistent set of asset classification and hierarchical structures;

h) ensuring that change in future value of the assets and their risk profiles are evaluated in both a financial context and a non-financial context;

i) considering changes in the organization's context, as well as stakeholder and other applicable requirements (including legal and regulatory requirements), when determining monitoring frequency.

9.1.2.2 Asset portfolio

When determining the parameters and frequency for performance monitoring activities related to asset portfolios, the organization should consider, amongst others, the following:

a) identification of both functional failures and failure modes of assets;

b) identification of both proactive and reactive monitoring parameters for performance;

c) provision of sufficient information to enable separation between possible failure modes and the subsequent elimination of non-relevant ones;

d) detectability of functional failures and failure modes;

e) expected rate of change or deterioration;

f) variability and repeatability of deterioration characteristics and behaviours;

g) historical evidence of asset performance;

h) interdependencies between assets and asset systems, particularly for individual assets that operate within an asset system (e.g. vehicle fleets);

i) the costs and benefits of monitoring;

j) how risk changes with time and the controls utilized;

k) asset criticality, including risks associated with failure or nonconformity;

l) the time required to plan and execute corrective actions;

m) determination of triggers and thresholds required in order to:

   1) begin additional analysis;

   2) determine the type of analytical action;

   3) evaluate the urgency of corrective action;

   4) determine when to end the analytical action.

Many of the above considerations for physical assets are included in the determination of dependability characteristics and performance throughout an asset's life cycle. Such an approach includes methods such as failure modes, effects and criticality analysis (FMECA), failure modes symptoms analysis (FMSA), failure reporting and corrective action system (FRACAS) and in the concept of probability failure (PF)

interval that are described within the various International Standards pertaining to the condition monitoring of machine systems, dependability and reliability-centred maintenance (RCM).

Criticality analysis should include severity analysis of the impact on value and risk, being both financial and non-financial. An asset breakdown structure can be used to identify the individual components of an asset, to enable the organization to take into account the significance of, and differences between the value and risk of components in relation to the parent asset.

9.1.2.3 Asset management system

Monitoring asset management system performance is normally carried out as an input into management review and should address the following:

a) the effectiveness of the organization's achievement of its asset management policy, strategies and objectives;

b) changes in internal and external issues and risk profile relevant to the asset management system;

c) the efficiency with which the organization's asset management policy, strategies and objectives are met;

d) the performance of activities outsourced to external providers;

e) measures to monitor nonconformities;

f) the effectiveness of corrective actions to the management system, including actions from previous reviews;

g) compliance with the internal audit plan and closure rate of audit actions.

9.1.2.4 Asset management

Monitoring asset management performance should focus on whether or not the asset management activities achieve the intended value from the assets. This should include consideration of the effectiveness and efficiency of asset management decision making. This in turn can include evaluations of cultural, behavioural, human error, knowledge management, intellectual property management, and change management perspectives and activities.

Such monitoring activities should:

a) enable top management to make statements regarding the organization's:

   1) ability to manage its assets;

   2) compliance with applicable requirements (including legal and regulatory requirements);

   3) ability to manage asset management related risk, including stakeholder commitments and changes in business and technological environment and the organization's context;

b) determine the achievement of value creation, alignment within the organization, leadership performance, and assurance of business performance and risk;

c) assess the performance of the asset management activities and the achievement of the organizational objectives;

d) enable the organization's culture to change and support change management activities;

e) provide input into improvement of asset management decision making.

9.1.3 Evaluation of the performance of the asset portfolio and asset management processes

The organization should conduct evaluations of its asset portfolio, asset management and asset management system in order to ensure their continuing suitability, adequacy and effectiveness.

The evaluations should address the possible need for changes to policy, objectives, strategies, and other elements of the asset management system (e.g. in the light of reviews, changing circumstances, the commitment to continual improvement).

An evaluation of the organization's assets and asset management activity should verify whether:

a) the organization's asset management policy, strategies, objectives and asset management processes accurately reflect its organizational context, priorities and requirements (i.e. the organizational objectives);

b) the persons doing work under the control of the organization are competent;

c) its procedures are effective and up-to-date;

d) processes have been effectively defined in documented information, effectively implemented and complied with;

e) there are processes for ongoing training and awareness;

f) the organization's assets and asset management fulfil their required function;

g) the organization's asset management is appropriate to the level of risk it faces;

h) the asset management plan(s) and processes have been effectively communicated to relevant stakeholders;

i) persons doing work under the organization's control understand their roles and responsibilities;

j) change control processes are in place and operate effectively;

k) any changes (internal or external) that impact the organization are reviewed in relation to the asset management activities.

Outcomes from the evaluation can include evidence of whether:

— there is proactive management and governance of the organization's asset management;

— people are trained and competent;

— there is operational planning and control of asset management;

— the organization's asset management activities comply with its processes;

— significant changes in the organization have been reflected in the organization's asset management processes in a timely manner.

9.2 Internal audit

Internal audits should provide information on the effective implementation of the asset management system, including information on the adherence to the asset management fundamentals as defined in ISO 55000. Internal audits should not only evaluate the effective implementation of processes, but also the extent to which these processes result in the intended outcomes (e.g. assets that add value to the organization) in order to provide top management with information required to evaluate the effectiveness of the asset management system and to identify opportunities for improvement.

The organization should carry out audits taking into account the guidelines in ISO 19011 and the requirements of ISO 55001 and consider remote auditing when applicable.

Internal audits should be based on the full scope of the asset management system; however, it is not necessary for each audit to cover the entire system. Audits can be divided into smaller parts provided the audit programme ensures that all of the organization's units, functions, activities and system elements, and the full scope of its asset management system, are audited within the auditing period designated by the organization. In deciding the scope of an audit, it is good practice to consider the risk associated with both the asset management system and the assets. This can aid the relevance of an audit by focusing on the organization's risk areas.

Internal audits of the asset management system may be performed by personnel from within the organization or by external persons selected by the organization, working on its behalf. In either case, the persons conducting the audit should be competent and in a position to do so impartially and objectively.

The organization should ensure:

— that in establishing the competence requirements for auditors conducting internal audits the requirements in ISO/IEC TS 17021-5 are considered where appropriate;

— that auditor rotation occurs between audits in order to prevent repetition of audit findings and outcomes.

Based on the results of internal audits the organization should be able to evaluate whether:

a) significant changes in the organization have been reflected in the organization's asset management processes in a timely manner and whether these significant changes were effectively managed;

b) the auditing level is done at a level suitable to the risk, complexity and value of the assets.

9.3 Management review

Management reviews provide top management with an opportunity to evaluate and improve the continuing suitability, adequacy and effectiveness of the organization's assets, asset management and asset management system. The management review should cover the asset portfolio, scope of the asset management system and the asset management activity, and evaluate the organization's adherence to the asset management fundamentals as defined in ISO 55000.

Management reviews should allow the organization to consider whether the asset management policy and objectives continue to be appropriate for the organization's purpose. They should enable the organization to establish new or updated asset management policies and objectives for continual improvement, appropriate to the coming period, and consider whether changes are needed. Management reviews should also address the long-term financial sustainability of the assets that the organization relies upon for meeting its objectives.

In addition to the requirements for management reviews, the following inputs are recommended:

a) evaluations of improvements in performance when addressing incident investigations, corrective actions and preventive actions;

b) developments in external requirements (including legal and regulatory requirements) related to asset management;

c) results of communication, participation and consultation with employees and other stakeholders (including complaints);

d) trends apparent from nonconformities, corrective actions, results of monitoring and measurement, and audit findings;

e) criteria used to define asset portfolios, parameters and frequency of performance monitoring;

f) possible reviews of activities required to provide assurance of the fulfilment of stakeholder and other applicable requirements (including legal and regulatory requirements);

g) results of other evaluations of the assets or asset management system;

h) evaluations of outsourced asset management systems and activities.

The outputs from management reviews should include decisions and actions relating to improvements in organizational plans, objectives, asset management system and activities, including:

— changes to the scope, policy and objectives;

— changed criteria for asset management decision making;

— updates to performance requirements;

— changes to resources including financial, human and physical resources;

— changes to controls and how their effectiveness is measured, including roles, responsibilities and authorities;

— changes to asset portfolio and criteria in performance evaluation, including those for monitoring and internal audit;

— conclusion that the asset management system is effective in providing assurance of the fulfilment of stakeholder and other applicable requirements (including legal and regulatory requirements);

— changes in procedures, instructions and working methods.

The organization should communicate the results of management reviews to relevant stakeholders.

10 Improvement

10.1 General

Improvement is a critical process for the correction of any nonconformities and for the generation of increased value derivation. Continual improvement should be regarded as an ongoing iterative activity, with the ultimate aim of delivering the organizational objectives. Improvement can also be achieved through adoption of new technology or employee-led innovation.

In the context of:

a) planning (see Clause 6), improvement should be sought in:

   1) alignment between asset management objectives and organizational objectives;

   2) improvements in the effectiveness and efficiency of achieving asset management objectives;

   3) improved control of risks and opportunities;

   4) innovative approaches for delivery of asset management activities;

   5) improved outsourcing/supply chain arrangements;

   6) effectiveness of corrective actions (for occurred nonconformities) and preventive actions (for potential nonconformities);

   7) task planning and scheduling accuracy in achieving the asset management objectives;

   8) exploitation of opportunities to improve not related to a nonconformity;

b) support (see Clause 7), improvement should be sought in:

   1) resource quality and availability;

   2) competences;

3) awareness and communication;

4) task and human error rate;

c) operation (see Clause 8), improvement should be sought in:

1) effectiveness and efficiency of processes;

2) effectiveness and efficiency of activities related to objectives, risks and opportunities;

3) quality of outputs;

d) performance monitoring (see Clause 9), improvement should be sought in:

1) detection of failure or nonconformity;

2) diagnosis accuracy;

3) monitoring strategies and plans.

The organization should retain documented information as evidence of the results of improvement activities.

10.2 Nonconformity and corrective action

10.2.1 General

The organization should be aware that nonconformities (including failures and incidents) can occur in its assets, asset management and asset management system, risking compromising the organization's achievement of the fundamentals as defined in ISO 55000:2014, 2.4.2. The organization should establish plans and processes to control nonconformities and their associated consequences, to minimize any adverse effects on the organization and on stakeholder needs and expectations. This can be accomplished by:

a) creating documented information on, and reviewing, past nonconformities;

b) evaluating how the consequences were dealt with;

c) determining methodologies to prevent future nonconformity.

Corrective actions are actions taken to address the root cause(s) of identified nonconformities, or incidents, in order to manage their consequences, and to prevent or reduce the likelihood of recurrence.

Aspects to be considered in establishing and maintaining corrective action processes should include:

— identification and execution of corrective measures, both for the short-term and the long-term;

— assessment of asset criticality, including risks and the value associated with failure or nonconformity correction;

— evaluation of any impact on risk identification and assessment results, including any need to update risk identification, assessment and control report(s);

— documenting any required changes in processes or procedures resulting from the corrective action or risk identification, assessment and control, and execution of these changes.

The organization should establish, implement and maintain processes and (as applicable) procedures for the handling and investigation of nonconformities, failures (functional and physical) and incidents associated with asset portfolio, asset management and the asset management system. These processes and (applicable) procedures should define the decision-making criteria for the investigation of nonconformities or incidents and the necessary responsibilities and authorities (see ISO 55001:2014,

10.1). Such processes, (applicable) procedures and activities should be proportionate to the situation, risks and opportunities and consider strategic, tactical and operational levels within the organization.

10.2.2 Investigation of asset-related nonconformities

The processes for investigation should focus on physical, systemic, latent and human error root causes to ensure the adequacy of any corrective actions.

Most methods applicable to assets are contained within the root cause analysis domain and include relational, causal, probabilistic and event-based methods, such as Ishikawa diagrams, causal tree, fault tree, event tree and logic tree.

NOTE Further guidance on some of these methodologies and principles can be found in IEC 62740 and IEC 62508.

10.2.3 Investigation of asset management system nonconformities

Most methods applicable to asset management systems are contained within the systemic analysis domain and include incident (safety) based methods such as management oversight risk tree (MORT), incident cause analysis method (ICAM) and tripod beta method (TRIPOD).

10.2.4 Investigation of asset management nonconformities

Most methods applicable to managing and decision making are contained within the human error and risk analysis domain and include human error- and cognitive-based methods, such as cognitive event tree (COGENT), the reason model, technique for human error rate prediction (THERP) and human error analysis (NASA method).

10.2.5 Processes for implementing corrective actions

The organization should establish, implement and maintain processes for implementing corrective actions for eliminating the causes of nonconformities or incidents that are identified from investigations, evaluations and audits, to avoid their recurrence.

Any corrective actions taken and their timings should be commensurate with the risks encountered. Where a corrective action identifies, new or changed risks, or the need for new or changed processes, procedures or other arrangements to control life cycle activities, the proposed actions should be risk assessed prior to implementation (see 8.2).

The organization should monitor the timely completion of the corrective actions. Performance monitoring should be used to evaluate the effectiveness of the corrective actions to prevent recurrence.

10.3 Preventive action

10.3.1 General

Preventive actions, which may include predictive actions, are those taken to proactively address the root causes of potential failures or incidents and intervene before the risks become unacceptable.

The organization should establish, implement and maintain processes for initiating preventive or predictive actions. Elements to be considered in establishing and maintaining preventive and predictive action processes include:

a) use of appropriate sources of information;

b) identification of any potential failures, their behaviours and their risks;

c) use of an appropriate methodology;

d) definition and use of risk and value-based decision-making criteria;

e) use of appropriate technology commensurate with the risk, value and behaviours expected;

f) documenting any changes in processes and procedures resulting from the preventive action;

g) assessment of the preventive action;

h) changes to the asset management plan(s) based on preventive actions.

10.3.2 Preventive actions for asset portfolio

Preventive actions for assets, usually based upon performance monitoring outputs, are prompt changes in asset activities, tactics, plans and procedures that usually result in some form of corrective activity or intervention. These actions are usually highly dependent on the effectiveness of performance monitoring (see Clause 9) as well as resources (see Clause 7).

10.3.3 Preventive actions for asset management system

Preventive actions for the asset management system, usually based upon performance monitoring outputs, are prompt changes in policy, plans and procedures that usually result in some form of corrective systemic change. These actions are highly dependent on information resource management (see Clause 7) and the monitoring (see Clause 9) of communication and information.

10.3.4 Preventive actions for asset management

Preventive actions for asset management, usually based upon performance monitoring outputs, are prompt changes in leadership, behaviour and practices via corrective decision making, change management, training and the development of competence. These actions are highly dependent on the human factors dimension of resource management (see Clause 7) and the monitoring (see Clause 9) of aspects of the organization's culture.

10.4 Continual improvement

10.4.1 General

The organization should establish, implement and maintain processes and (as applicable) procedures for the continual improvement of its assets, asset management and the asset management system. These processes and procedures should define the decision-making criteria for continual improvement and the necessary responsibilities and authorities (see ISO 55001:2014, 10.3). Such processes, procedures and activities should be proportionate to the situation, risks and opportunities and consider strategic, tactical and operational levels in the organization.

Continual improvement should be regarded as an iterative activity, with the ultimate aim of delivering the organizational objectives. It should not be interpreted as cyclic (e.g. annual) improvement in asset, asset management and asset management system performance parameters just because they can be achieved. Continual improvement processes should be commenced and also stopped based on changing risks to the organization, or to its objectives and value.

Although the opportunities for improvement can be widely different in scope and effect, the approach for processing them may consist of the following steps:

a) identification of improvement needs and potential;

b) evaluation of options;

c) estimation and determination of financial and non-financial consequences;

d) risk assessment and management of change aspects;

e) links with decision-making criteria;

f) selection and execution;

g) tracking of outcomes and review.

The organization should actively seek and acquire knowledge about new asset management-related technology and practices, including new tools and techniques, which should be evaluated to establish their potential benefit to the organization and be incorporated into the asset management system as appropriate. Examples include:

— active participation in professional bodies and industry associations;

— conferences, seminars, publications, (online) forums, journals;

— benchmarking and technology transfer initiatives, and competitor check-ups;

— engaging specialist organizations;

— research, development and innovation;

— consultation of suppliers and clients.

10.4.2 Continual improvement for asset portfolio

Continual improvement actions for assets, including individual assets, asset types and asset systems, are long-term changes in assets, asset strategies, decision-making methods and criteria that are intended to produce sustained improvement in value derivation, effectiveness and efficiency from the assets. These actions are usually highly dependent on the effectiveness of performance monitoring (see Clause 9) as well as resources (see Clause 7).

10.4.3 Continual improvement for asset management system

Continual improvement of the asset management system are long-term changes in policy, objectives, SAMP, strategies, roles and responsibilities, personnel competence assurance, decision-making methods and criteria that are intended to produce sustained improvement in value derivation, effectiveness and efficiency from the asset management system. These actions are highly dependent on information resource management (see Clause 7) and the monitoring (see Clause 9) of communication and information.

10.4.4 Continual improvement for asset management

Continual improvement actions for asset management are long-term changes in leadership and culture that are intended to produce sustained improvement in value derivation, effectiveness and efficiency from the asset management leadership and activities. These actions are highly dependent on the human factors dimension of resource management (see Clause 7) and the monitoring (see Clause 9) of aspects of the organization's culture.

Annex A
(informative)

Consideration of "value" in asset management

A.1 Overview

ISO 55000:2014, 3.3.1, defines asset management as the "coordinated activity of an organization to realize value from assets". It is therefore important that the organization implementing an asset management system understands what that realizable value is, or what it means, both to the organization and to its stakeholders. To define and measure value for the organization in accordance with the intent of ISO 55000 and ISO 55001, it is necessary to consider a consolidated view of how it is described and used in both ISO 55000 and ISO 55001.

ISO 55000:2014, 2.4.2 a), states: "The value (which can be tangible or intangible, financial or non-financial) will be determined by the organization and its stakeholders, in accordance with the organizational objectives"; however, ISO 55001 doesn't use the term. Further complexity in the understanding of what "value" means are the references within ISO 55000 to the organization's "values" and stakeholder "concerns and expectations" (ISO 55000:2014, 2.5.3.2) and the need to preserve "asset value" [ISO 55000:2014, 2.2 a)].

There are, therefore, the following concepts of value used in the ISO 55000 family:

a) value *generation* (benefits from use, ownership or custodianship of assets);

b) value *determination* (such as valuation of assets or the organization, for example, the sale price of the asset or organization, if you sell it);

c) values (principles that guide an organization's internal and external conduct).

A.2 Common uses of the concept of value in asset management

The specification of "value" for an organization or its stakeholders can vary, even within the organization, and different stakeholders gain different types of value from the way an organization manages its assets. The following examples illustrate how value may be defined or viewed by different stakeholders.

a) Potential investors or lenders, finance managers, accountants and valuers focus on the organization's value, their risk exposure, and return on investment. Assets and their realizable capability only play one part in determining the organization's value, particularly for private or publicly-traded organizations where value (which, for the latter, is typically represented by share price) is also driven by market forces and business strategy. Government agencies, and other organizations that are not driven by the value of the organization as a sellable entity or share value, still need to demonstrate they are financially viable, can service their debt and need to value the organization for regulatory purposes.

b) Determining the value of the assets and related financial representation of asset consumption/deterioration for taxation purposes is also required for some stakeholders.

c) Stakeholders such as shareholders or lenders can be focused on the return on their investment in the organization, their interest can be focused on the value determination (in terms of, for example, the increased or decreased value of their shareholdings) and value generation, in terms of dividends (for equity owners) or interest and repayment of debt (for lenders). All these elements are again monetary focused.

d) Customers are stakeholders that can be interested in the price-benefit, or value for money, relationship between themselves and the organization. Accordingly, they can also be concerned with a monetary measure (price), but they also receive value (benefit) that is usually non-monetary (e.g. safe drinking water or reliable electricity services, or the reliability/dependability of a product, such as a car that is built using the manufacturer's assets). The benefits can be quantified by criteria focused on quality and quantity (measurable), or measures that can require surrogates, such as using customer satisfaction to represent performance (e.g. while duration of repair time can be a good measure of activity or process performance, customer satisfaction with how fast a repair is completed is useful as an output measure, with the availability or continuity of supply being of value to the customer; in this case, it can also be used to help determine the actual performance target for repair time).

e) For organizations providing public services or services where no direct payment is received, quite frequently there is no direct relationship between money paid by the community or "customers" and the service supplied. These services can vary from a local government or council providing library services funded by local taxes or rates, to a national government's defence capability, funded (again) through taxes. The value collectively received or perceived by the community can still be measured, despite the fact any particular member of the community might not use a particular service.

f) Stakeholders, as well as issue-specific regulators or groups, or the community at large, can consider other aspects of value derived from the asset(s), such as reductions in occupational health and safety incidents (or risk of them occurring), or environmental protection or improvement.

A.3 The concept of value within the ISO 55000 family

Applying the meaning and use of the term "value" in the ISO 55000 family of standards includes the need to understand the construct of how the identified realizable value, and hence the definition of asset management, is vertically cascaded into organizational objectives and asset management objectives, the purpose and use of the asset management system, asset management activities and assets.

ISO 55000:2014, 2.4.2 a), states:

> "The value… determined by the organization and its stakeholders, in accordance with the organizational objectives.
>
> This includes:
>
> 1) a clear statement of how the asset management objectives align with the organizational objectives;
>
> 2) the use of a life cycle management approach to realize value from assets;
>
> 3) the establishment of decision-making processes that reflect stakeholder need and define value."

ISO 55001 builds on these statements:

— ISO 55001:2014, 4.2, states: "The organization shall determine… — the criteria for asset management decision making";

— ISO 55001:2014, 6.2.1, states: "The asset management objectives shall: … — be consistent and aligned with the organizational objectives;…" and "— be established and updated using asset management decision-making criteria";

— ISO 55001:2014, 6.2.2, states:

> "When planning how to achieve its asset management objectives, the organization shall determine and document:
>
> a) the method and criteria for decision making and prioritizing of the activities and resources to achieve its asset management plan(s) and asset management objectives";.

These statements collectively establish the link between the concept of "realization of value" as used in ISO 55000 and the requirements in ISO 55001, i.e. the value to be realized for the organization and its stakeholders is expressed through the organizational objectives, asset management objectives and decision-making criteria. The value realized is measured through the achievement of organizational and asset management objectives. The relationships are shown diagrammatically in Figure A.1.

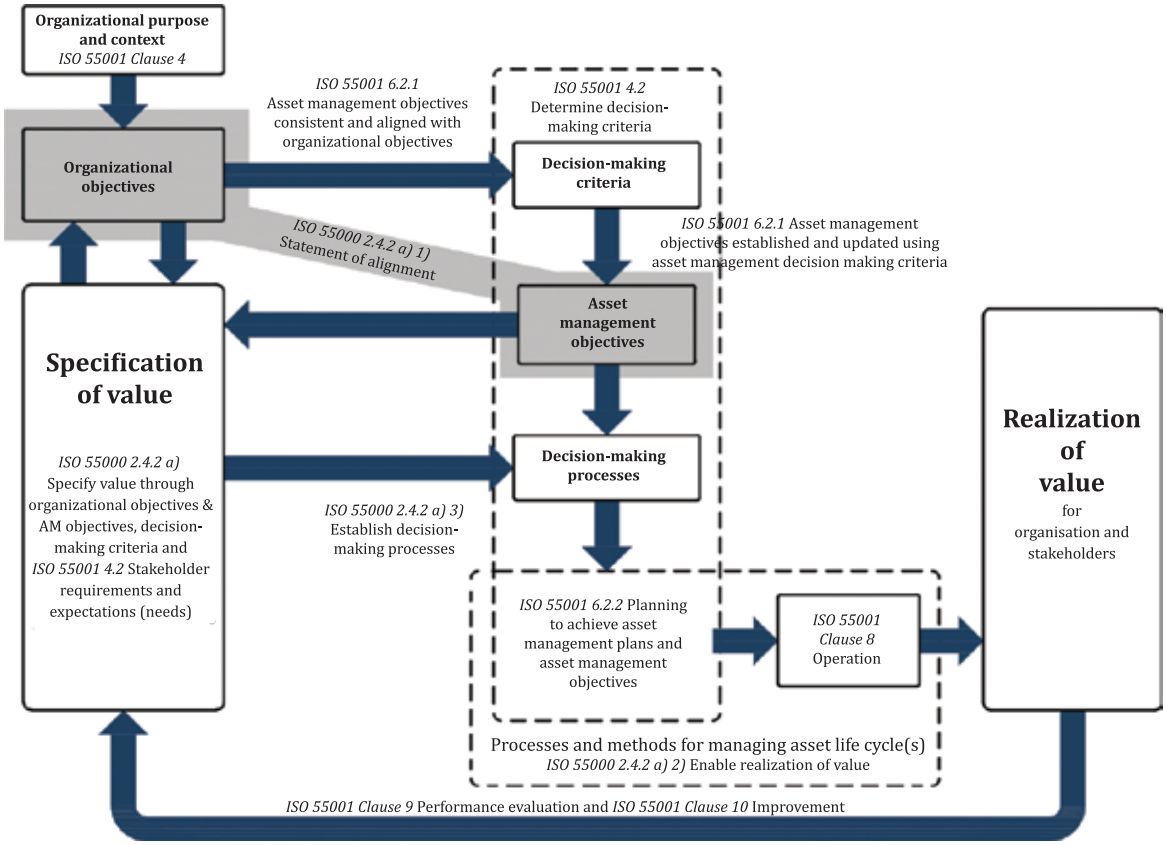


Figure A.1 — Relationship of ISO 55000 and ISO 55001 references to value, objectives and decision making

A.4 Relationship of "values" and "value generation"

An organization and its stakeholders have values (whether they are given in documented information or not). These values can include a commitment to standards of ethical behaviour or social responsibility and can play a role as drivers in establishing organizational objectives and asset management objectives, as well as how these objectives are achieved. Value generated by managing the assets is then directly linked to the objectives.

An organization may consider the ability to demonstrate it is behaving ethically as generating value and this response can then be translated into a measure of reputation and subsequently customer preference. There are numerous examples of organizations rebranding themselves in an attempt to recover from a lost or damaged reputation and restore lost market share.

A.5 "Value generation" versus "value determination"

Accounting for the value determination of the asset(s) is necessary for purposes of finance, investment decision making, insurance, taxation and regulation. Value determination of the asset can be derived from the future income generation potential of the asset, its depreciated replacement cost or can be determined simply as the market value of the asset as if it were to be sold.

The value generation from the assets is the benefit derived from their operation or use. The relationship between the value of the asset(s), and the value generated from the use of the assets is rarely determined by a simple measure, such as a percentage rate of return, especially where value is defined using non-financial metrics (or a mixture of financial and non-financial metrics). It is up to the organization to define the way it will seek to generate value from its assets and to build its management system and decision-making methodologies to support this definition. In doing so, the organization should give particular focus to the elements of the management system that address evaluation and continuous improvement.

For example, where an asset is generating financial benefits, the acquisition, renewal or replacement cost of assets and their operating and maintenance costs are important considerations in decision making and the ability to derive value from the use of assets. If the replacement or operation and maintenance cost is higher than the ability of the asset to generate a financial return (value generation), then the organization might not meet its performance targets for financial return. This situation also leads to decisions around pricing for services or products, the sale price of the assets or the organization itself, or the viability of the organization renewing or replacing the assets, or, ultimately, even continuing to provide the product or service.

Alternatively, where an asset is generating non-financial benefits or value (value generation) and does not generate sufficient revenue to cover the costs of the provision of the service, then decision making requires consideration of reduction in the level of service, seeking alternative funding sources, such as cross-subsidies or government support, or an alternative solution to providing the service.

A.6 Value over the life cycle

The value derived from assets and asset systems can change over the life of the assets. Supporting the current value and future value are likely to be the objective of different parts of the organization. There are several factors which influence value generation over the life of the assets, for example:

a) during the investment or acquisition stage, assets under construction are only incurring cost to the organization, but have value that can be generated once in operation, i.e. start generating a return (note that when both are brought together, they give a whole-of-life-based return on investment); tension can arise when those responsible for asset acquisition seek to compromise the future value generation capability of the asset in order to meet short-term capital cost or project management performance targets; e.g. by substituting a cheaper component that has a shorter expected life or is less reliable;

b) some assets can have a time delay before generation of value, e.g. a tree plantation should have an increasing value as the trees grow, but, until it becomes productive, the organization incurs increasing costs;

c) at times, circumstances can lead private organizations to price outputs at a price point that ignores the original acquisition cost, i.e. pricing only to cover operation and maintenance; this marginal cost pricing is obviously not sustainable beyond the life of the existing assets used to manufacture or generate the outputs, but can keep the organization afloat until the market price recovers;

d) in many organizations, and for many assets, functional obsolescence due to changes in technology or changes in organizational objectives can mean that an asset will change its value to the organization; for example, peak efficiency and effectiveness in manufacturing and use of valve-based electronics occurred at the same time as transistors were invented, making the whole technology effectively obsolete.

A.7 Multi-criteria representations of value generation

A matrix of stakeholders and their influence, wants and needs, can be constructed to represent stakeholder value. This matrix can be quantified through multi-attribute decision-making processes, or be reduced to a single number signifying stakeholder value. The multi-attribute decision-making

processes may include weighting methodologies, to enable prioritization of what are perceived to be more important factors.

A.8 Cost, risk, performance and value

ISO 55000:2014, 3.3.1, identifies the need to balance cost, risk and performance in the generation of value. Cost, risk and performance relate differently to value.

Cost usually needs to be controlled in order to generate value for the organization. If the financial cost to the organization is in excess of the financial value generated by the organization, the organization is not going to be financially viable; this is regardless of the value to the customer. Maintaining financial viability is a requirement for all organizations. Time shifting of either costs or value generation can play a major role in managing financial viability and the relationship with equity and debt availability is a complicated process to manage and understand.

For example, some public service providers cross-subsidize services by using revenue from high-density population areas to help fund services to what would otherwise be unviable sparsely-populated areas (or they could receive grants of support funding from government, if the government views the provision of the service to the sparsely-populated area as a social obligation). While cost is often thought of purely in financial terms, some costs can be non-financial (e.g. the extent of environmental damage caused by asset acquisition and/or operation).

For risk, the reduced likelihood or consequence of a threat (or increase in likelihood or consequence of an opportunity) can be considered as having, or being of, positive value to both the organization and its stakeholders. The opposite is also true.

Performance can be considered a measurement of the success (or otherwise) in generating value or meeting the asset management objectives. At the simplest level, an asset's performance can contribute to value generation through operating reliably or efficiently. While there might not be a direct numerical relationship between the asset performance measure and the organization's specification of value at the top level, an understanding of the hierarchical connection or relationship is needed. Return on assets, or meeting a quality or quantity target, can be considered as intermediate level performance measures.

Annex B
(informative)

Scope of an asset management system

B.1 Overview

B.1.1 The scope of an asset management system drives the design, functions, activities and other factors of the asset management system for fulfilling the ISO 55001 requirements, including contributing to the setting of the asset management objectives. Defining the scope of the system is therefore one of the first activities undertaken in implementing an ISO 55001 management system. An iterative process can be used to validate the alignment of the asset management objectives, the scope, the context and the SAMP.

B.1.2 The boundaries and applicability of an organization's asset management system is captured in a statement of scope that is included as part of the documented information for the SAMP. The statement of scope should be appropriately communicated to relevant stakeholders, both internal and external to the organization, so that they can understand the extent, limits and purpose of the asset management system.

B.1.3 The organization should ensure that it describes the rationale and assumptions for the setting and ongoing management of the scope (including changes), in order to ensure the integrity and sustainability of the management system and to provide the ability to ensure and validate the management system is fulfilling its intended purpose.

B.1.4 The scope will be influenced by the size of the organization (for small businesses, see Annex G), the criticality and/or value contribution of the assets to the organization, and the complexity of:

a) the organization's structure and outsourcing arrangements;

b) the functions and activities being undertaken;

c) the asset portfolio.

How the asset management system and related asset management processes, practices and procedures are to be managed (and who is responsible), should be defined in documented information. Some can be owned and managed within the asset management system framework, but others can be provided by either internal or external service providers. Where provided by service providers, the system boundary conditions (such as in a scope of contract) form part of the scope to demonstrate adequate control, risk management and assurance.

B.1.5 Where there are other assets, systems, processes or functional areas that might be considered critical for the organization's performance, but not included in the scope, there should be a statement of boundary conditions given in documented information that describes:

a) asset management system objectives, performance needs and requirements;

b) the required interactions;

c) relevant protocols.

NOTE In this case "protocol" refers to, for example, the rules around a spare parts warehousing function obtaining approval from the asset management or maintenance manager for disposal of stocks of spare parts. A tool the organization can use to design this approval structure is a responsibility assignment matrix (also known as a responsible, accountable, supportive, consulted and informed, or RASCI, matrix) or linear responsibility chart. This describes the participation by various roles in completing tasks or deliverables for a project or business process.

B.2 Setting boundary conditions

B.2.1 General

There are multiple types of boundaries or issues that require specification of boundary conditions for the asset management system, including:

a) responsibilities and the organization's structure;

b) support function relationship interfaces;

c) outsourcing arrangements;

d) functions and activities;

e) geographical factors;

f) decision-making power or governance with regard to functions and activities;

g) relationship of asset portfolio structure to arrangements for managing them;

h) interaction with other management systems;

i) influence of factors outside the scope of the management system;

j) assurance and validation;

k) management of change.

These issues are discussed in more detail in B.2.2 to B.2.12.

B.2.2 Responsibilities and the organization's structure

Establishing the asset management system scope should be done within the context of the following specifics described in ISO 55000:

a) an organization is defined in ISO 55000:2014, 3.1.13, as a person or group of people that has its own functions with responsibilities, authorities and relationships to achieve its objectives;

b) ownership of an asset is not a determinate of the ability of an organization to develop an asset management system for that asset that addresses all the requirements of ISO 55001 (see ISO 55000:2014, 3.2.1, for a definition of "asset" and ISO 55000:2014, 3.3.1, for a definition of "asset management");

c) in ISO 55000:2014, 3.4.2, Note 3 to entry, it is stated: "the scope of a management system may include the whole of the organization, specific and identified functions of the organization, specific and identified sections of the organization, or one or more functions across a group of organizations."; therefore, an organization has a unique identity, set of organizational objectives and ability to define and derive value, structure and its own function(s) and activities that constitute, in whole or in part, the way it will manage the assets defined in the scope of its asset management system.

The organization should be able to demonstrate responsibility for delivering performance against one or more asset management objectives, and the effective control and governance of asset management related function(s) and activities it is carrying out, in order to generate the value from the assets defined in the scope of its asset management system. There can be multiple organizations, each with their own

asset management system (and related scope) deriving their own (attribute/definition of) value from the same asset.

An organization also should provide or make available the resources required for meeting the asset management objectives and for implementing the activities specified in the asset management plan(s). The resources provided and the value that organizations can derive from assets can be of different types; for example, an asset owner could provide money to maintain the asset to meet its performance requirements and generate income (value) from its customers. Using this money, a service provider could then provide equipment and people to carry out the maintenance. The service provider realizes value by making a profit from providing the equipment and people and from doing the maintenance. The impact on the scope of the asset management system is clarified in B.2.3 to B.2.12.

B.2.3 Support function relationship interfaces

There are many functions and activities within an organization that are necessary for an asset management system to function, however, they are not always considered to be within the asset management system or managed within the asset management system. These include functions such as: human resources (HR), information and communications technology (ICT), procurement, and the supply chain (noting that logistics management in some industries is part of the asset management system scope and tools).

The asset management system requires these support functions and activities to meet its needs, which should be specified; conversely, the support function can need outputs from the asset management system in order to deliver what is required by the system.

It should be noted that some of the organization's functions, such as finance, HR and ICT can also prescribe procedures and specify unchangeable (internal) directives that the asset management function has to comply with. These can be considered to be internal stakeholder requirements; for example, financial (reporting) procedures, HR procedures on recruitment or competence development, ICT security and data protection procedures. The inability to influence these requirements can limit or constrain the design options actually available to the designers of the asset management system or asset management processes and practices.

B.2.4 Outsourcing arrangements

The relationship between a service provider and client organization (which can be an asset owner, or can be a higher level, or prime, service provider), should be defined with a set of "boundary conditions". For example, for a service provider, the scope of contract can define the roles, responsibilities, authorities, decision-making power and information transfers (see ISO 55001:2014, 8.3). Therefore, regardless of the owner's adherence to the requirements of ISO 55001:2014, the service provider may hold or progress to certification. This will consequentially drive elements of the service provider's asset management system, such as its asset management objectives, (risk) awareness, performance monitoring and reporting, information management framework, management review and continual improvement processes.

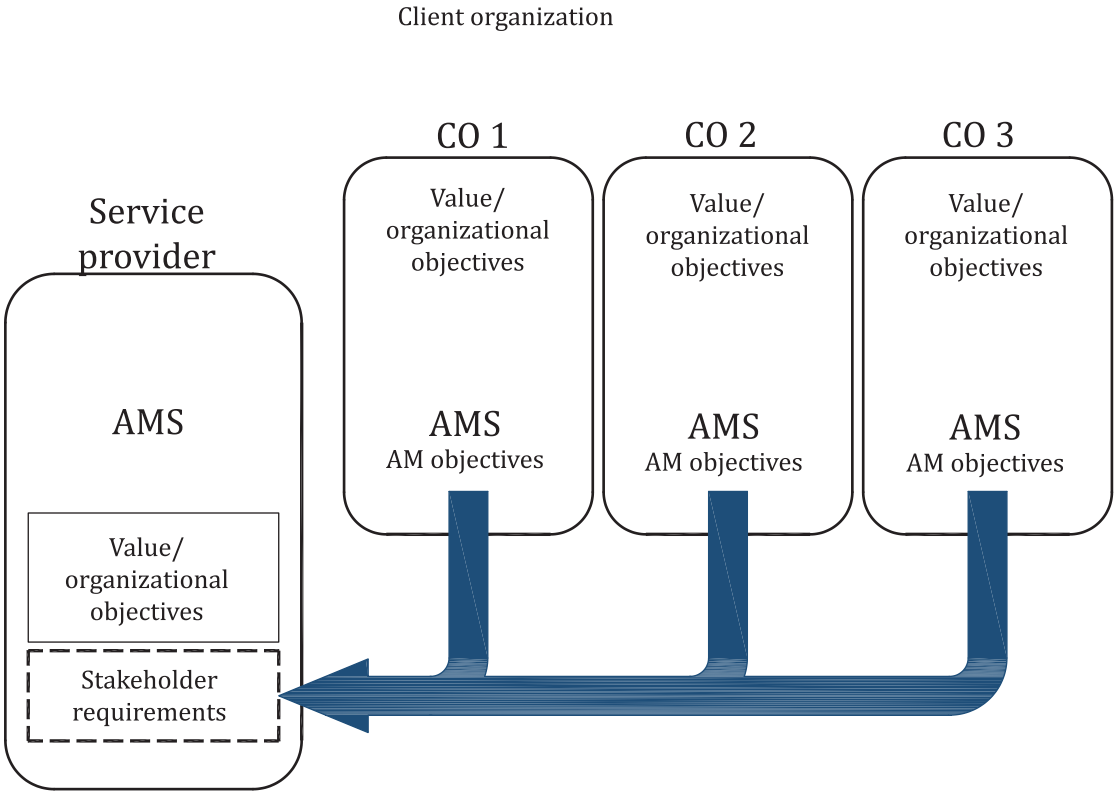
The relationship between the client organization and the service provider defined at the boundary will dictate whether the service provider or client organization (or both) can demonstrate they are individually addressing all the requirements of ISO 55001.

A relationship defined by a contract that is "buying outcomes", i.e. where the service provider has full internal control of how they deliver the outputs or outcomes required, is the most likely model in which the service provider can demonstrate it is addressing all the requirements of ISO 55001.

A relationship where the client organization is "buying resources" (e.g. a unit rate or fee for a service type contract) means there is no devolved planning, decision-making power or governance of asset management system functions and activities, so that the service provider is unlikely to be able to demonstrate it is addressing all the requirements of ISO 55001.

The service provider organization has its own organizational objectives and asset management objectives, value generation and risk management needs. The requirements, needs, organizational

objectives, asset management objectives, and value generation of the client organization become the stakeholder needs and requirements of the service provider, see Figure B.1.



Key

AM asset management
AMS asset management system
CO client organization

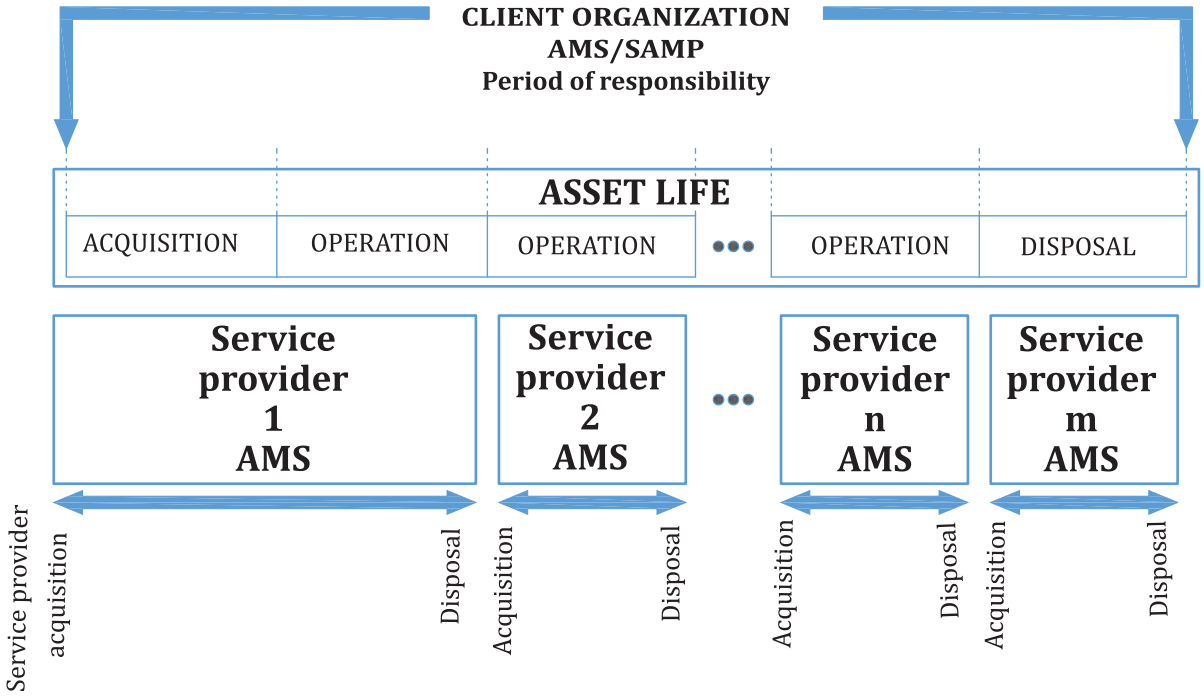
Figure B.1 — Example of a service provider model

Examples of organization and service provider relationships include:

a) an industrial site with several companies owning individual industrial plants where they utilize a common service provider for asset management of their (collectively owned) roads, railways, pipelines and cables that are on the site;

b) different asset owners in different locations, whose assets are managed by one service provider working with standardized methodologies within the framework of the service provider's own asset management system, which takes into account the asset management objectives of each of the asset owners within the service provider's consideration of its stakeholder needs.

It is possible for a service provider to have a different period of responsibility for an asset than the asset owner or client organization. The client organization/asset owner period of responsibility starts with the planning for asset acquisition and ends with the extinguishment of liability from owning or operating the asset. The service provider can acquire an opportunity to derive value from the asset through responding to a tender and entering into a contract and can dispose of the opportunity to derive value from the asset through contract termination; this is represented in Figure B.2.



Key

AMS asset management system

SAMP strategic asset management plan

Figure B.2 — Example of a period of responsibility model

B.2.5 Decision-making power or governance with regard to functions and activities

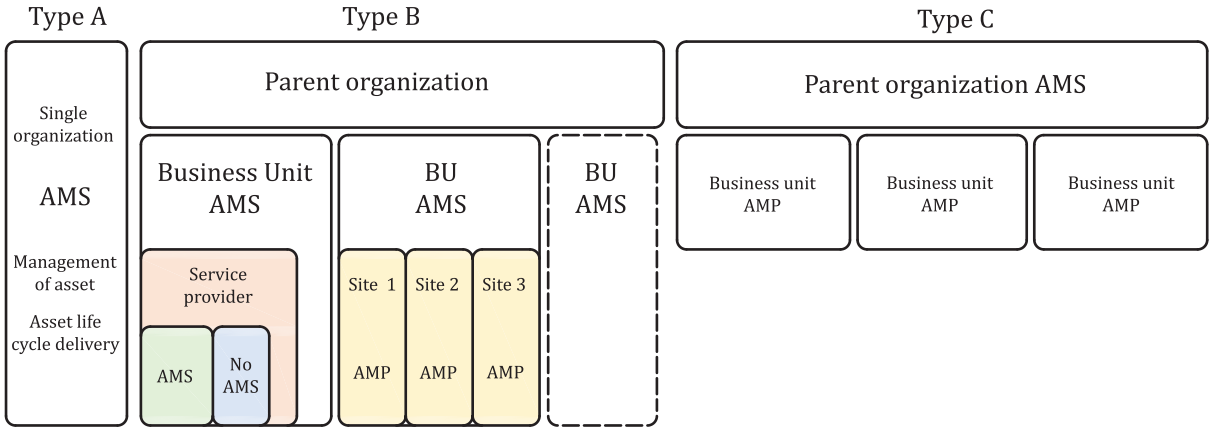
The extent of roles, responsibilities, authorities and decision-making powers allocated to the service provider or internal business unit by the client/parent organization will dictate the ability of the service provider or business unit to address all the requirements of ISO 55001.

A client organization can manage, or demonstrate adequate control, of its risks by conducting the functions and activities itself, or by putting in place appropriate assurance and validation requirements in its contract specification with its service provider.

Under joint venture or alliance arrangements the collective capability allocated by the parent organizations to managing the assets of the joint venture or alliance can mean the joint venture or alliance addresses all the requirements of ISO 55001; however, the parent organizations in isolation might not be able to address all the requirements of ISO 55001. In such a situation the scope of the asset management system may be confined appropriately to only the joint venture or alliance "organization".

Recognizing that an asset management system is part of asset management, there are several ways in which multiple organizations (or parts of an organization) can contribute to the asset management of a single asset, asset type, asset network/system/facility or asset portfolio through setting up individual, but coordinated, asset management systems.

In considering how multiple asset management systems, organizations, functions or activities can be brought together and coordinated, it should be recognized that the functions, activities and responsibilities need to be discrete. For example, a client organization can have an asset management system for managing its network, complex system or facility, while individual business units or service providers have asset management systems for managing individual assets, functions or activities within the network (see Figure B.3).



Key

AMP asset management plan

AMS asset management system

BU business unit

NOTE Whether or not an asset management system is required is determined by the extent of the contract (in the case of a service provider) or allocation of responsibilities and the nature of the organization's structure (in the case of a business unit).

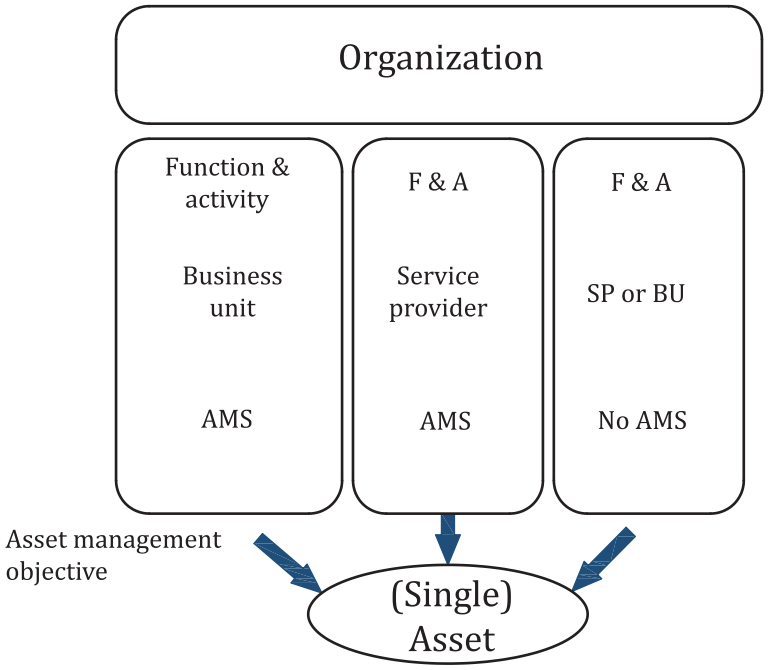
Figure B.3 — Example of business unit models

B.2.6 Functions and activities

Linking functions and activities to an identifiable asset, asset type or group is an important task for the organization. ISO 55001 has several requirements specific to demonstrated performance (or generation of value) of the asset to be planned, managed, monitored, reported and reviewed, while requiring predictive activities and continual improvement to be applied. Without an identified asset, these requirements cannot be met.

When applied, the definitions in ISO 55000:2014, 3.4.2 and 3.4.3, for management system and asset management system, permit different asset management systems for different functions or activities to co-exist or work together. These systems coexist, whether they are within the organization, where there are multiple organizations delivering individual functions or activities in order to derive value, or whether these are applied to different assets or the same asset (see Figure B.4).

For example, a specialist service provider can be tasked with the responsibility for a specific activity in order to meet an asset management objective that is dependent on the activity or service it provides. Specifically, a service provider who provides corrosion management services can be given a lump sum contract to manage asset corrosion in order for the asset to reach its required life. The contract leaves the corrosion protection options to be utilized, to the discretion of the service provider, as long as the asset life target of the client is met.



Key

AMS asset management system
BU business unit
F & A function and activity
SP service provider

NOTE Whether or not an asset management system is required is determined by the extent of the contract (in the case of a service provider) or allocation of responsibilities and the nature of the organization's structure (in the case of a business unit).

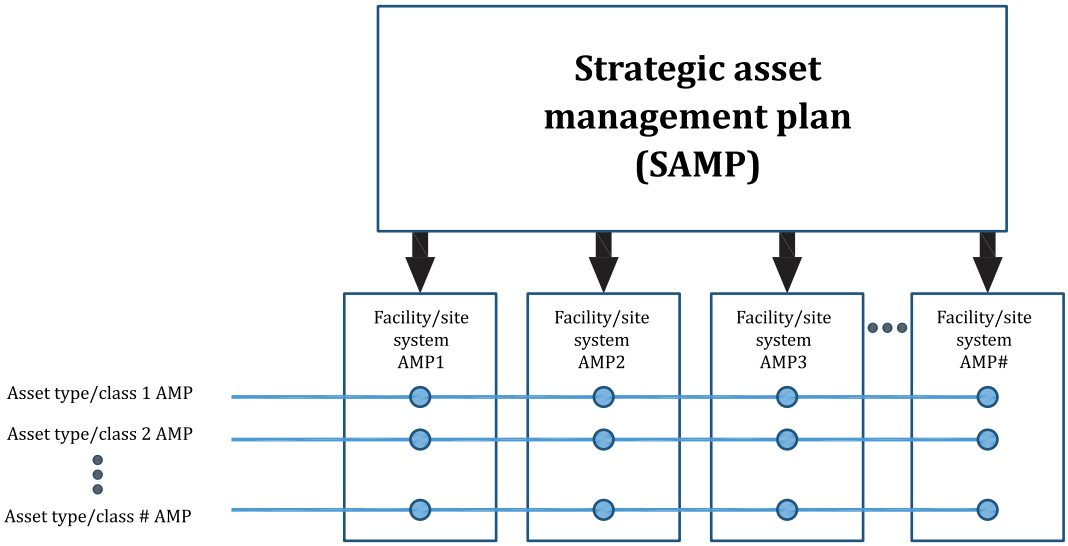
Figure B.4 — Example of a function and activity model

B.2.7 Geographical factors

Asset managers might need to develop and specify inter-relating asset management plans to address, for example, a common asset type (requiring it to be managed as an asset type) based at multiple sites (requiring the managing of all assets within it as an integrated group, maybe to different levels of criticality, legal and regulatory requirements, performance, etc.), see Figure B.5.

For example, a multi-national organization that owns and operates wind-farms can have different asset management plans in each country it operates in.

Alternatively, for a water utility, the different criticalities of its different water treatment facilities that collectively feed its water distribution system can lead to the decision to manage each facility differently. The component asset types still need to be managed to maintain their integrity and function.



Key

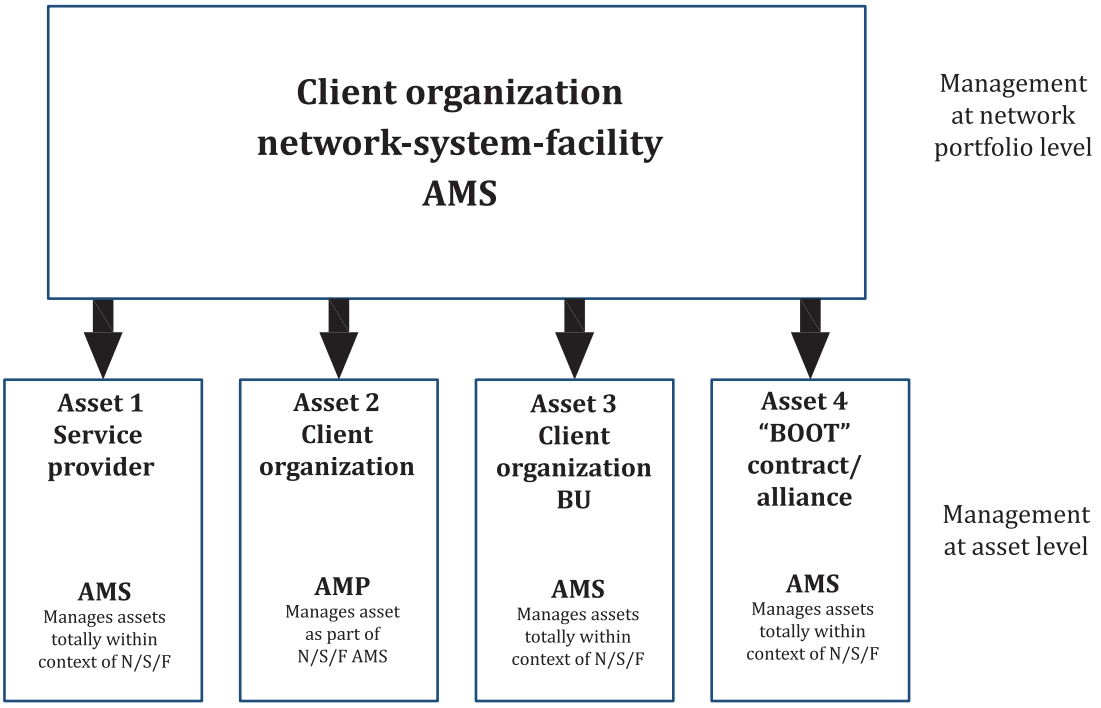
AMP asset management plan

NOTE The way in which an asset type is managed is determined by the interaction of the criticality of the asset type, the asset within the type specification and the criticality of the facility, site or system it is part of.

Figure B.5 — Example of an integrated asset type management model

B.2.8 Relationship of asset portfolio structure to arrangements for managing them

Asset managers can manage different "levels" of asset grouping, type or family (such as a utility managing a transmission/distribution network or production line as an "asset") with service providers managing specific assets within them (see Figure B.6).



Key

AMP asset management plan
AMS asset management system
BU business unit
N/S/F network-system-facility

NOTE The asset management system can fully address all the requirements of ISO 55001.

Figure B.6 — Example of a vertical integration model

B.2.9 Interaction with other management systems

Interaction with other management systems can be related to other systems of the organization itself, such as a framework for social responsibility (ISO 26000), a quality management system (ISO 9001), an occupational health and safety management system (ISO 45001), an environmental management system (ISO 14001) or a service provider's asset management system.

The specification of how the management systems integrate with each other is also an asset management system boundary condition issue. The allocation of roles, responsibilities and accountabilities between the systems and how the different systems support each other should be detailed in documented information (see B.2.3 on support function relationship interfaces).

A key issue for consideration is that ISO 55001 requires that a set of decision-making criteria be set. The need to carry out improvement activities within financial, accounting, environmental, safety, quality and other management systems that are asset-related decisions will all compete for funding or resource allocation with each other. How the organization prioritizes these actions in combination with actions specifically driven by ISO 55001 requirements (such as a renewal) will require an appropriate decision-making framework that permits appropriate integrated evaluation (see Annex D for more detail).

B.2.10 Influence of factors outside the scope of the management system

There are several characteristics of the organization that are driven from both inside and outside the asset management system; consequently, the asset management system should have a clear specification of what it needs from these characteristics. Internal characteristics include leadership

and culture, motivation, behaviours, incentivization schemes, collaboration. External characteristics include context, government, community and PESTLE issues.

B.2.11 Assurance and validation

Where an organization's asset management system is dependent on the performance of functions or activities conducted by others (particularly as ISO 55001:2014, 8.3, requires "…the organization shall ensure that… the performance of the outsourced activities is monitored in accordance with 9.1"), the boundary conditions will need to be designed within the context of the organization's need to ensure the requirements and effectiveness of the asset management system, asset management and assets are being fulfilled.

B.2.12 Management of change

Where multiple organizations or parts of the organization are responsible for functions and activities that can result in changes to how the asset management system, asset management or assets perform or need to be managed, there is a need to maintain the integrity of the system, asset performance and risk management. Setting appropriate boundary conditions enables applicable information to be effectively communicated and all impacted functions, activities and assets to be adjusted or changed accordingly.

Annex C
(informative)

Strategic asset management plan (SAMP)

C.1 Overview

The strategic asset management plan (SAMP) is defined in ISO 55000:2014, 3.3.2, as "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".

The SAMP is a key piece of documented information used in translating organizational objectives into asset management objectives and providing the framework for planning, prioritizing and decision making for the implementation of all other asset management activities to ensure alignment. Aligning the asset management objectives with the organizational objectives, as well as linking asset portfolio plans to financial plans, can improve the organization's effectiveness and efficiency, and inform the long-term funding needs of the organization.

The requirements for the SAMP are spread over these various subclauses of ISO 55001:2014, 4.1, 4.3, 4.4, 5.1, 5.3, 6.2.1 and 6.2.2.

The SAMP can have a timeframe that is sufficiently long to address the complete life of the assets which could extend beyond the organization's own business planning timeframe. This approach can allow the organization to plan how it is going to meet its organizational objectives within its period of responsibility for the asset portfolio, while also enabling contextualisation of short-term decisions with long-term or asset life needs.

The target audience for the SAMP is intended to be top management, key stakeholders and those involved in the development and implementation of the SAMP and the asset management plans.

It is anticipated that organizations will start with a basic SAMP and progressively mature this to address the areas recommended in this annex.

C.2 Purpose of a SAMP

Consistent with the definition in ISO 55000 and the requirements in ISO 55001, the SAMP should fulfil a number of purposes:

a) to detail in documented information the role of the assets, asset management and the asset management system in supporting achievement of the organizational objectives and to provide clarity and direction for everyone in the organization from top management to delivery teams;

b) to translate organizational objectives into strategic asset management objectives and reconcile these with other strategic objectives which can have an impact on the assets and asset management;

c) to guide the approach for developing the asset management plans and the asset management system, while applying the asset management policy to ensure alignment;

d) to document the decision-making criteria (see Annex D) that enable the definition of value realization for the organization and its stakeholders and the coordinated approach for performance evaluation;

e) to present a consolidated plan at the asset portfolio level for achieving the strategic asset management objectives and linking these to the organization's financial plans;

f) to present the plan for creating or improving the asset management system in order to ensure the required capabilities and resources are available to achieve the asset management objectives.

C.3 Relationship between asset management objectives, SAMP and the asset management plans

The relationship between a SAMP and the asset management plans is shown in Figure C.1.

The SAMP includes:

a) the plan for the asset portfolio, i.e. the high-level activities to be undertaken on the assets to enable the delivery of organizational objectives;

b) the plan for the asset management system, i.e. the enhancements needed for the processes, resources and other capabilities necessary for the effective implementation of the SAMP and the asset management plans (AMPs).

In Figure C.1, the SAMP is shown in two linked boxes to highlight this distinction.

In a large organization, the asset portfolio can include several facilities or asset systems at multiple sites which are managed by different business units or entities. The asset portfolio may include several asset systems with many different asset types. In such circumstances the organization would need to develop asset management plans for groupings of assets (e.g. those managed by a business unit, assets at a site/facility, or a complex asset system), which provide the specific activities to be undertaken on the assets within a particular group.

The structure and hierarchy of the asset management plans and their interrelationships should be defined by the organization in the SAMP after considering factors such as:

a) its divisional/departmental structure, with objectives and accountabilities defined for the different units;

b) the groupings of assets managed by these units;

c) the geographical spread, size, complexity and criticality of asset systems;

d) the number of assets within each asset type.

The strategic asset management objectives should be developed for the entire asset portfolio after considering the asset management policy, organizational objectives, stakeholder expectations and external and internal factors influencing the organization and its asset management system (see 4.1, 4.2 and 6.2.1). The strategic asset management objectives should be cascaded down to the level at which separate asset management plans are developed and should relate to required performance targets for asset systems and individual assets, see 6.2.1.

The SAMP also provides the direction and approach [including the policy, principles, assumptions, common parameters and decision-making framework (see Annex D), etc.] for the development of the asset management plans. The two downward arrows in Figure C.1 illustrate this cascading action and direction.

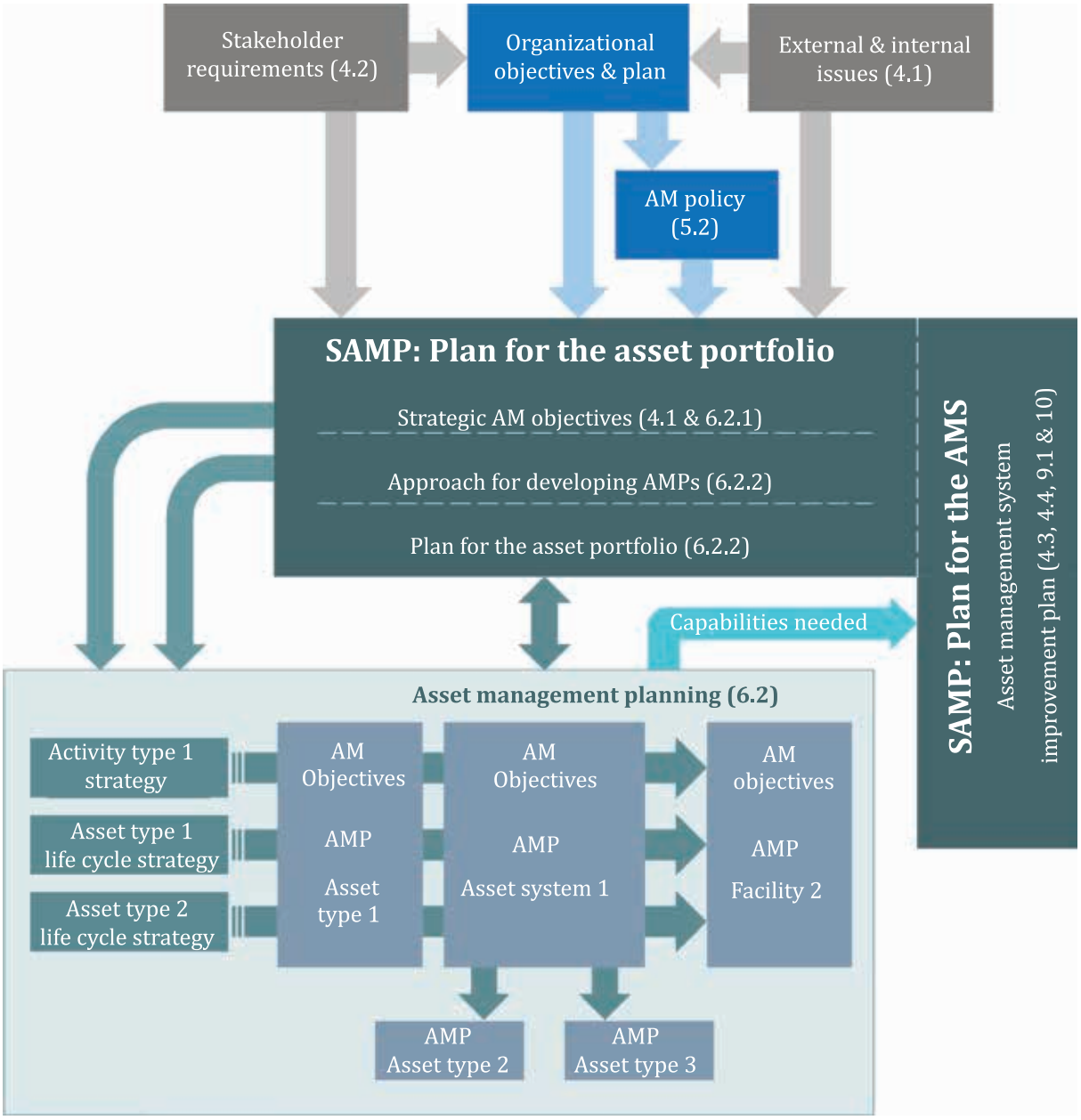
When all the asset management plans are developed, using an iterative top-down and bottom-up process (see 6.2), the outputs from these plans should be:

— aggregated at the portfolio level;

— prioritized using the decision-making framework, while being balanced with the available funding and other resource constraints (see Annex D).

In developing any time-bound and resource constrained asset management plans for an individual asset, or a grouping of assets (by asset type, asset system, facility, or unit in the organization), it is important that certain common methods/strategies are applied to ensure consistency and cohesiveness

in achieving the overall strategic asset management objectives. These strategies can be developed in advance in terms of asset life cycle strategies for the different asset types or strategies for generic activity types (asset creation/acquisition, utilization/maintenance, renewal/disposal, etc.) and applied in developing the asset management plans, as shown by the horizontal arrows going from left to right in Figure C.1.



Key

Refs The clause numbers in Figure C.1 relate to ISO 55001.
AM asset management
AMP asset management plan
SAMP strategic asset management plan

Figure C.1 — SAMP concept diagram

C.4 Contents of a SAMP

It is intended that the SAMP should be executive-level documented information which presents a narrative on *why* and *what* the organization plans to do in managing its asset portfolio and developing its asset management capability, in order to enable the achievement of the organizational objectives; it can also provide references to other documented information, for detailed information or guidance.

The need for documented information that provides the rationale, approach, processes, procedures and methods used for developing the SAMP as part of the organization's asset management system should be determined in accordance with the requirements of ISO 55001:2014, 7.5 and 7.6.1.

The organization should determine the areas to be addressed and the level of detail for the SAMP to meet its specific needs. A list of key areas that can be addressed in a SAMP to meet the purposes given in A.2 is recommended in the following (the areas required to be addressed by ISO 55001 are noted in brackets):

a) an executive summary that gives the key issues, rationale and highlights of the SAMP for top management and other key stakeholders;

b) an overview of the organization's context, i.e. external and internal issues (see ISO 55001:2014, 4.1), stakeholder needs and requirements (see ISO 55001:2014, 4.2) and a summary of the organizational plan;

c) the role of the asset management system in enabling the achievement of asset management objectives, and in turn organizational objectives, described in terms of (see ISO 55001:2014, 4.4):

   1) how the assets contribute to the organization's activities; for example, in delivering products and services to its customers;

   2) how the asset management activities realize value from assets in enabling the achievement of organizational objectives;

   3) how the asset management system enables coordination, control, performance measurement, review and continual improvement;

   4) the importance of leadership, clarity of roles and responsibilities, culture, communication and cross-functional collaboration, including reporting requirements for financial and non-financial information;

d) a high-level overview of the composition of the current asset portfolio and its overall capability, performance, challenges, risks and opportunities, while considering future demand;

e) strategic asset management objectives derived from organizational objectives: these should be reconciled with other strategic objectives, such as for safety, environment, quality, financial, human resources, growth, etc., which can have an impact on assets and asset management; the approach used in translating the organizational objectives to strategic asset management objectives should be clearly described (see ISO 55001:2014, 4.1 and 6.2.1);

f) strategic asset management objectives (e.g. at portfolio-level) and how these are cascaded down to lower levels; for example, for an individual asset or a grouping of assets by asset type, asset class or asset system to enable asset management plans to be developed; these objectives can be both quantitative and qualitative;

g) the approach for implementing the asset management policy and, as appropriate, asset management fundamentals (see ISO 55000:2014, 2.4.2), in developing the asset management plans and the asset management system;

EXAMPLE 1 A commitment in the asset management policy for adopting a life cycle approach will be applied in choosing asset creation options that maximize asset performance over the life cycle.

EXAMPLE 2 The "leadership" fundamental [see ISO 55000:2014, 2.4.2 c)] emphasizes the need to manage effective leadership, culture, motivation, collaboration aspects that are critical for successful asset management.

h) the decision-making criteria (see Annex D and ISO 55001:2014, 4.2);

i) the scope of the asset management system (see Annex B and ISO 55001:2014, 4.3);

j) the approach for achieving the strategic asset management objectives collectively at the portfolio level, to enable the organizational objectives;

k) the approach, assumptions and parameters (e.g. growth rate, discount rate) for:

   1) developing asset life cycle plans for an asset type or group of assets covering all life cycle activities (e.g. creation/acquisition, utilization/maintenance, renewal/disposal) and other functional plans (e.g. capital investment plan, energy management plan);

   2) developing asset management plans (which should be detailed in separate documented information); their structure and interrelationship to achieve the (lower-level) asset management objectives (see Figure C.1);

l) the asset portfolio-level plan, and the associated financial plan, to achieve the strategic asset management objectives; which would be developed by aggregating and balancing the various asset management plans through an iterative top-down/bottom-up process;

m) critical capabilities of the organization and resources (human, financial and other) needed to deliver the SAMP (and the asset management plans); and plans for developing new or enhanced capabilities (e.g. leadership, people competences, knowledge, processes, information, technology), including the consideration of asset management-related risks and financial implications;

n) plans for creating or improving the asset management system to achieve the asset management objectives (see ISO 55001:2014, 4.4);

o) the approach for monitoring progress in implementing the SAMP and its effectiveness in achieving the strategic asset management objectives, with reference to the performance monitoring framework that is detailed in documented information as part of the asset management system (see ISO 55001:2014, 9.1);

p) risks, opportunities, assumptions, issues and dependencies in delivering the SAMP; risks and opportunities can arise from changes in external environment, lack of availability of key resources, increase/decrease in costs and timescales, etc.;

q) roles and responsibilities for the creation, updating and implementation of the SAMP (see ISO 55001:2014, 5.3), if not given in separate documented information;

r) arrangements for the review, update and improvement of the SAMP; provisions should include ongoing review of the effectiveness of the SAMP and triggers/periodicity for updates of the SAMP, if not given in separate documented information.

Annex D
(informative)

Asset management decision making

D.1 Overview

Asset management decisions are made across all levels within an organization, i.e. at strategic, tactical and operational levels. It is important for the organization to establish a decision-making framework that comprises decision-making processes and decision criteria, to ensure consistency and alignment between its decisions.

The purpose of a decision-making framework is to facilitate decision making by:

a) incorporating a risk-based approach (see Annex E);

b) ensuring alignment with asset management objectives, organizational objectives and the value assets provide to the organization and its stakeholders;

c) ensuring the organization's resources and efforts are targeted at achieving organizational objectives and realizing value;

d) taking into account cost effectiveness of decisions.

D.2 References to ISO 55001 and this document

The decision-making criteria are introduced in ISO 55001:2014, 4.2, in order to take account of stakeholders' needs and expectations.

ISO 55001:2014, 6.2, requires linkage between the organizational objectives, decision-making criteria, the asset management objectives and planning to achieve the objectives, see Figure D.1.

In addition, 6.1 (in this document) recommends that the decision-making framework detailed in this annex is used to establish the risk assessment criteria.

Performance evaluation (see ISO 55001:2014, Clause 9) and continual improvement (see ISO 55001:2014, Clause 10) help the organization to assess and improve the validity of the criteria used for decision making.

D.3 Decision-making framework

The decision-making framework should:

a) facilitate adherence to the asset management fundamentals of value creation, alignment, leadership, and assurance (see ISO 55000:2014);

b) be dynamic, and responsive to potential changes in the internal or external context;

c) enable decision-making criteria to be applied in developing the SAMP, the asset management plans, risk management, operational planning, implementation of asset management plans and other asset management activities, in a coordinated and consistent way;

d) enable decision-making processes to be tailored to the complexity, urgency, risk/criticality and/or the importance of the decision, i.e. its impact on the fulfilment of objectives;

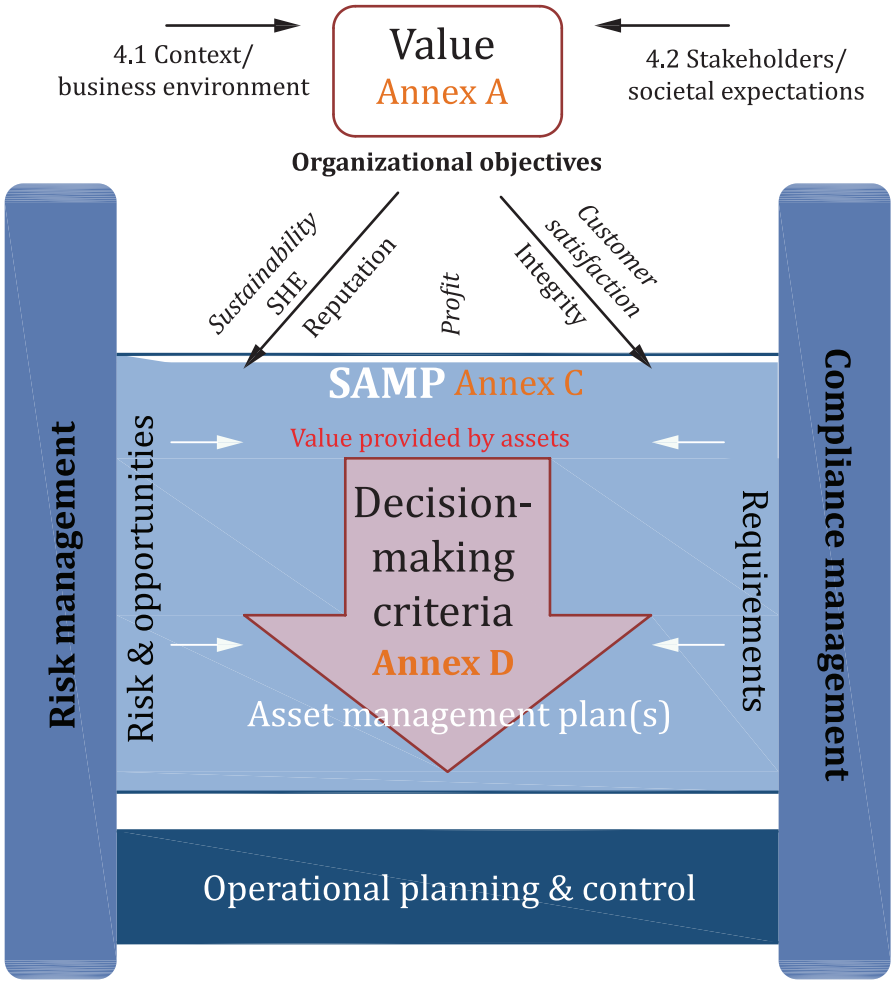
NOTE Special attention is given to complex decision problems where there are dependencies on other decisions, uncertain inputs, incomplete or conflicting data, etc. In such cases, techniques such as scenario analysis, sensitivity analysis, probabilistic modelling, etc. can be used.

e) be assessed for effectiveness and suitability by appropriate performance metrics; definition of the metrics should make sure that vertical (across the levels of the organization) and horizontal (internal and external stakeholders) alignments are addressed.

Figure D.1 shows the vertical alignment from context and stakeholders' expectations to operational planning and control, as well as the horizontal influences of risk and constraints of compliance which modify planning through the decision-making criteria. The decision-making framework should be tailored to the needs of the organization. Alignment between decision levels (vertical alignment) is required to allow aggregation of information between different levels of the organization (e.g. operational and corporate levels). This alignment should consider the decision-making autonomy of the different levels within the organization and also the organization itself in addressing external stakeholder issues.

Any deviation from the decision-making framework or its elements should be managed through management of change (see 8.2).

Information requirements for decision making should be accurately defined in documented information, in order to ensure the appropriate application of the decision-making framework. The method and criteria for decision making should be detailed in documented information, communicated within the organization, and to appropriate stakeholders (see ISO 55001:2014, 7.6).



Key

SHE safety, health, environment

Figure D.1 — Decision-making framework for asset management

D.4 Decision-making process

The organization generates needs for activities. It should prioritize and decide upon how to perform these activities (who, what, where, when and why). In order to respond to multiple functions and disciplines with different priorities and requirements, a consistent decision-making process should be applied.

The organization should establish the decision-making process considering:

— the decision-making criteria and metrics to be applied;

— the information required;

— the nature, level of complexity, and impact of this decision on objectives;

— time constraints.

The decision-making process should:

a) be detailed in documented information, to account for transparency and traceability;

b) clearly describe information requirements;

c) define and provide clear guidance on selecting the decision-making method(s) (e.g. qualitative or quantitative methods, discrete event simulation);

d) provide guidance on evaluating life cycle impacts of the decision on maximizing the value;

e) enable consideration of the risks and opportunities to achieve the asset management objectives;

f) enable consideration of multi-functional alignment (e.g. project, finance, maintenance, procurement);

g) enable consideration of requirements.

During the decision-making process, alternative scenarios can be produced, so as to be able to evaluate and compare different options and to address uncertainty in the input data (e.g. market conditions, regulations, technology advances). A possible baseline scenario would be the continuation of present conditions and practices, against which alternative scenarios can be compared.

The output of the decision-making process should be the identification of the best option. The organization should ensure that the decisions are implemented (see Clause 8) and the effectiveness of the decisions are monitored (see Clause 9).

Annex E
(informative)

Risk management in the context of ISO 55001

E.1 Risk management in the context of key terms in asset management

E.1.1 General

Uncertainties can be divided into risks and opportunities. Risks are negative effects and opportunities are positive outcomes that can potentially affect the achievement of objectives. Risks and opportunities can affect the organization, asset management, the asset management system and the assets within the portfolio.

Risk management is essential in developing asset management objectives and plans, and ensuring decision making is in line with organizational objectives and stakeholder requirements. The guidelines given in ISO 31000 and IEC 31010 can be applied to defining and establishing a risk management approach that conforms to ISO 55001.

Based on the risk attitude of the organization's top management, asset managers should establish a framework, including decision-making criteria, to illustrate the relationship between this risk attitude and value creation within the risk management approach.

The asset management system should enable risk and opportunity identification, assessment and treatment for asset management, the asset management system and the asset portfolio. Contingency planning and business continuity should be established for risks that cannot otherwise be treated.

E.1.2 Asset management

Risks and opportunities related to asset management can include:

a) leadership that inhibits or promotes asset management activities that achieve the organizational objectives;

b) misalignment between organizational and asset management objectives and plans, through inappropriate use or neglect of the organization's decision-making criteria;

c) value decrease or increase resulting from asset management decisions that affect the financial status (e.g. cash-flow, equity structure, grade of debt, bond liabilities, insurance policy);

d) value decrease or increase resulting from asset management decisions that affect the non-financial value defined by the organization (e.g. reputation, customer satisfaction index, safety metrics);

e) inefficient or improved processes for ensuring effective business governance.

E.1.3 Asset management system

Risks and opportunities related to the ability of the asset management system to deliver its intended outcome can include:

a) planning and scheduling of activities, e.g. creating potential conflicts in resources or improving alignment;

b) communication between functions and levels, e.g. incomplete information fails to convey awareness of a risk situation while the opposite improves managing of risks;

c) shortcomings or possibilities in performance evaluation causing neglect or awareness of necessary corrective and improvement actions.

E.1.4 Asset portfolio

Risks or opportunities related to the asset portfolio should be used as parameters in achieving organizational objectives and can include:

a) value creation across specific time horizons and life stages of the asset(s), e.g. costs, investments and revenues, and non-financial value defined by the organization;

b) level of service delivery versus costs or investments;

c) health, safety and environmental impacts;

d) process safety.

Risks with unacceptable consequences can be treated and mitigated "as-low-as reasonably practicable" given the operational context.

E.2 Risk management throughout the asset management system elements

E.2.1 Context of the organization

Risks and opportunities arise from a wide variety of areas and vary according to differing organizational contexts. As a result, asset managers in the organization should develop an understanding of the main drivers that affect the risk exposure, both internally and externally.

E.2.2 Leadership

Top management should align the risk management approach within asset management to the organization's overall risk management approach, considering:

a) incorporating the risk attitude in the decision-making criteria;

b) a reporting and communication process for ongoing risk-treatment actions and updates on new or changed risks and opportunities;

c) managing risks at the appropriate level of responsibility in the organization, wherever a risk is identified.

E.2.3 Planning

When planning to manage risks, the organization should consider adopting a structured process. An example method is provided below:

a) prepare a list of the asset portfolio(s) and their constituent assets (and asset components) and gather relevant information;

b) identify risks and opportunities;

c) analyse and assess criticality of risks and opportunities;

d) identify, analyse and determine risk treatment or opportunity action-plans;

e) assess the potential change of risks and opportunities over time.

E.2.4 Support

When establishing the support requirements for risk management within asset management, asset managers in the organization should consider the following:

a) ensuring enough resources are assigned for risk-management;

b) human resources should have the required competence for the risk management task;

c) persons under the organization's control are aware of the risks and opportunities they can impact or are exposed to;

d) data and data management requirements and information to support risk management activities.

E.2.5 Operation

When the asset managers in the organization operate the asset management system, they should consider the following in relation to risk management:

a) managing risks related to the execution of plans, for example project risk management;

b) change imposes risks on the organization;

c) risks change over time, e.g. price forecasts, alternative political decisions and competitors' outlook;

d) risk transfer occurs when outsourcing activities; the level of risk to be transferred should match the level of asset management maturity and contractual obligations of the contracted organization;

e) avoiding skewed or biased risk assessments;

f) ensuring the risk treatment and opportunity action plans are incorporated into asset management planning.

E.2.6 Performance evaluation and improvement

Monitor the performance of the risk management approach to determine deviations from expected or required outcomes for the purposes for improvement.

Annex F
(informative)

Relationship between financial and non-financial functions in asset management

F.1 Overview

The organization should understand the relationships between its financial and non-financial functions for asset management. It should establish alignment between individuals, departments having different responsibilities and authorities, as well as with the underlying processes and activities. The financial functions refer to processes and activities, such as accounting, budgeting, financing, valuation, taxation, and financial reporting relating to the assets, whereas the non-financial functions can be deemed to be everything else pertaining to the life cycle management of the assets. This alignment should also address the need for cross-functional understanding of technical or discipline based terminology and definitions.

Asset management is not exclusive to any one part of the organization, but should be seen as multifunctional and multidisciplinary. Financial planning, decision making and reporting is critical to the success of asset management and, conversely, asset management has major impacts on financial planning, decision making and reporting.

Closer collaboration between the financial and non-financial functions can contribute to better meeting the organization's objectives for the benefit of the organization and its stakeholders (see ISO 55001:2014, 4.2, 6.2.1, 6.2.2, 7.5, 9.1 and 9.3). A consistent application of these requirements is explained in F.2 to F.6.

F.2 Interaction between financial and non-financial functions

When an organization's financial and non-financial functions are isolated or have little interaction, the organization's asset management focus tends to be limited by the differing functional perspectives. Organizations that have developed links between these functions, for example, through common or highly-linked platforms for financial and non-financial data, are in a better position to make sound information-driven decisions. The financial specialists gain insight into the technical decision making that uses financial data, while the technical specialists gain insight into the total cost of ownership and the financial implications of their technical decisions. This development potentially benefits the entire organization.

An effective and efficient interaction between the financial and non-financial functions will generally result in improved internal controls, more transparent and complete reporting, commonly-agreed terminology relating to assets, a more efficient measurement of performance and enhanced availability of information. These improvements will contribute to the achievement of organizational objectives.

F.3 Financial aspects of asset management planning

Reporting relationships and functional alignment are important to the effectiveness and efficiency of the organization's activities. To promote the achievement of the organization's objectives (see 6.2.1 and 6.2.2), it is essential that there is interaction between the financial and non-financial functions in asset management planning. The financial and non-financial teams need to work together to create and agree aligned (top down, bottom up) budgets and longer-term financial plans that are consistent with the organization's objectives. In doing so, they need to consider the balance between cost, risk, performance and value generation (revenue or other type of value generation).

One key outcome of asset management planning should be to communicate the funding required to provide and maintain the required levels of service, or products to be delivered, and value to be derived from the assets, both in the short and longer-term. Where services are provided on a fee-for-service basis, the financial and non-financial functional areas need to work together to determine all relevant annual costs as input to fixing appropriate pricing for the services, taking into account any regulatory direction on pricing. An asset management plan can contain asset data held for both financial and non-financial purposes in the linked asset registers, including replacement value, remaining useful life, condition rating and risk information. It can also identify "projected" expenditure required on maintenance and renewal of existing assets. The objective is to make information-driven decisions that seek to obtain the most value from the asset at an acceptable level of risk.

Asset management planning should seek to identify and optimize the actions that will provide expected asset performance over a defined future period. Optimal planned actions include the estimation and forecast of asset performance under different maintenance, renewal, budget and risk tolerance strategies, over the period of the asset's life cycle for which the organization is responsible. Optimal planning solutions involve the estimation and forecast of asset life cycle costs, to be incurred over the life of the assets. These include, but are not limited to:

— acquisition costs;

— operating costs;

— maintenance costs;

— rehabilitation costs;

— replacement costs;

— expansion costs;

— disposal costs.

In addition, there can be "non-asset-solution"-related costs that should be identified through an asset management planning process. Examples include:

a) increased asset utilization rates through improved training or optimized shift scheduling;

b) insurance options that change the cost of risk in owning the asset;

c) efficiencies that assist in lowering costs and/or increase the remaining service life of the asset such as integrated asset planning, demand management, process optimization and managed failures.

All of these costs contribute to both the capital expenditures and operating expenditures of an organization. Accordingly, these data are an essential input to the preparation of the annual financial reporting of the organization, such as for the balance sheet, profit and loss statement, and cash flow statement.

The SAMP should identify the responsibilities, authorities and reporting requirements (both information reporting and chain of command reporting) for financial and non-financial functions for each business area within the scope of the asset management system.

F.4 Information requirements

Asset data are required to inform the financial asset registers, which should form part of the chart of accounts for the organization. While the accounting functions in the organization should be driven largely by the requirements to meet the applicable accounting and reporting standards, there should be a demonstrable link between the data used for accounting and that for asset management.

Non-financial functions of the organization often need asset data that is more detailed than the data needed for the financial function. However, this more detailed data can be relevant to the decision process for expending funds to maintain, repair, renew or replace an asset. Levels of detail and linkages

between the asset registers, allows costs to be aggregated for accounting needs, while the more detailed data are required to make informed technical decisions.

Consistency and traceability between the financial and non-financial data and information requirements across the organization (see 7.5) are crucial to providing assurance and delivering the organization's objectives. For example, the assets acquired by the organization over time are likely to have been subject to different accounting systems, rules and information and communication technology (ICT) systems, resulting in the potential loss or inaccuracy of data. A management system approach that includes alignment of the financial and non-financial data and deals with retention of data can help avoid these problems.

There are at least two commonly required elements for all assets, whether acquired by purchase, construction or as "donated assets" (see the example below): identification and basic description. These should be common and shared across all databases of all kinds in the organization. The purpose of having those common attributes is to allow the identification of each asset in a unique way. Based on those common attributes, an organization would be able to link information on assets in each database. In addition, each department should define and implement additional attributes (as appropriate for their function) that are necessary to achieve their part of the organization's objectives. These additional attributes may reside in a common database shared across the organization, or in departmental databases, as long as they are linked to all other databases by means of their common attributes.

The organization should balance the cost and complexity of managing asset attribute data against the value of the information.

EXAMPLE An example of a donated asset is where a developer of a housing estate constructs all the common infrastructure, such as roads, water system, etc., and then gives or donates them to the local council or water utility for ongoing operation, management and renewal.

F.5 Key performance indicators for asset management

The degree to which financial and non-financial functions are participating as desired in the asset management system can be measured using key performance indicators (KPIs). Such KPIs should be developed to measure at least two dimensions:

a) participation across all required actions;

b) participation within each required action.

This can inform the organization as to the degree to which the asset management system is effective, and provides a feedback mechanism to identify necessary changes.

When developing performance measures, the organization should consider the inter-dependencies between financial and non-financial performance (see 9.1) and the long-term implication of short-term performance targets at the appropriate levels. In order to assess performance against organizational objectives, appropriate financial and non-financial measures should be established for assets, asset systems and the asset management system.

Financial sustainability ratios are an example of KPIs. For infrastructure-managing organizations one such ratio is the measure of funding provided in the long-term financial plan for asset renewals against the expenditures identified for such renewals in the asset management plans. Other ratios include (but are not limited to) the operating surplus ratio and net financial liabilities ratio, return on investment, return on invested capital (ROIC), etc.

As the organization learns from experience, continual education and training, improvements to KPIs should be implemented as part of the continual improvement process.

NOTE Return on invested capital (ROIC) = (net income – dividends) / total capital.

F.6 Management review of financial reporting on asset management

By regularly reviewing the financial reporting, top management can assess the suitability, adequacy and effectiveness of its asset management. Analysis of financial reported information at different levels within the organization can enable managers to assess whether the asset management objectives are being achieved. This analysis should allow top management to identify, for example, any large deviations between approved investment plans and executed investment plans, thus enabling them to take appropriate actions.

Annex G
(informative)

Scalability — ISO 55001 for small businesses

Small business forms the world's largest share of businesses. More than 95 % of the world's enterprises are small to medium-sized and many countries look to small and medium enterprises (SMEs) to power economic growth and employment. Therefore, ISO 55000, ISO 55001 and related International Standards for asset management need to assist SMEs just as much as they do global enterprises, government and society at large. In particular, SMEs that use (physical and non-physical) assets should be able to share in the gains in efficiency and effectiveness offered by these International Standards. These International Standards can also be used by enterprises both large and small, in public and private sectors, by manufacturers and service providers, in all sectors of activity; however, there are issues of scale that need to be addressed:

a) for risk, size might not be the decisive criterion; for example, a small pharmaceutical or chemical facility can have a greater need to undertake asset management than the world's largest sawmill;

b) complexity needs to be viewed as a risk driver and has different perspectives for assets, processes, products, systems, etc., each of which can have impact; moreover, complexity has several dimensions, such as level of automation, chains of processes, logistics, etc.;

c) there can be external requirements that prescribe asset management activities that prevent the ability to scale.

The requirements in ISO 55001 are described at a high level of abstractness which does not make it straightforward to translate the requirements to the day-to-day activities of a small or low-complexity business; however, an organization can benefit from being small, such as a simple structure for the organization, clear lines of control and direct communication.

The complexity of an organization can be measured in terms of the differentiation of tasks to deliver products and/or provide services and its asset portfolio.

As there are many relatively low complexity organizations of varied sizes and types, and around 200 individual requirements in ISO 55001 needing to be met, it is outside the scope of this annex to address all these combinations. The way a requirement can be fulfilled can be easy in relation to many clauses in ISO 55001 because of the relatively straightforward structure of a small organization and associated clearly-drawn roles; however, other clauses would need around the same effort as a large company (e.g. for topic areas such as risk management for a nuclear facility, technical specifications for hazardous waste, or strategic asset management plans for the whole life cycle of physical assets).

Scaling down the requirements will need to be a tailor-made process for specific organizations, situations and asset portfolios, and will differ across the individual clauses in ISO 55001. A practical analysis for a specific organization can be done quickly and without long evaluations and discussions.

EXAMPLE When considering two different-sized water distribution companies, one in the mountains with only a limited number of users, and one in a large urban area with its own water supply, the following aspects can illustrate the difference in approaches.

a) The small water distribution company has no water treatment and pumps, as clear water is readily available and the height is sufficient to transport the water to the customers and users; the organization's structure is simple with only a few managers that are close to the operational work;

b) The large water company has its own water treatment and water transport pumps, as well as many types of customers with different connecting pipelines and a network that includes different pipeline materials and diameters, crossings of rivers, roads, etc., valves, and other special assets; the organization's structure will consist of several managerial and operational levels.

This situation results in the following:

— understanding the needs and expectations of stakeholders (4.2) is more or less similar for both companies; both have stakeholders such as customers and users, regulators, municipalities, employees, etc.

— the organization's roles, responsibilities and authorities (5.3) are more straightforward for the small company, with "top management" responsibilities and accountabilities clear and known to everyone in the company; the cascading of these responsibilities is also not complex as the organization is simple and can be readily described.

— the requirements for documented information, from many clauses in ISO 55001, can be scaled down for an SME by combining several of the needed types of documented information, including the organizational objectives, the SAMP and the asset management plans.

Sources of advice and reference include:

— industry or professional associations;

— associations for quality;

— government departments, particularly those that specialize in small enterprise affairs and organization development units;

— internet web pages, including the ISO website (www.iso.org) and internet forums about quality.

Annex H
(informative)

Information on asset management activities

Relevant asset management subject areas addressed by other published international, regional, or national standards include, but are not limited to, the following:

— data management;

— condition monitoring;

— risk management;

— quality management;

— ICT asset management;

— environmental management;

— systems engineering;

— software engineering;

— life cycle costing;

— dependability [availability, reliability, maintainability, supportability (maintenance support and logistics)];

— configuration management;

— tero-technology;

— sustainable development;

— inspection;

— non-destructive testing;

— pressure equipment;

— financial management;

— value management;

— shock and vibration;

— acoustics;

— qualification and assessment of personnel;

— project management;

— property and property management;

— facilities management;

— equipment management;

— commissioning process;

— energy management.

Users of ISO 55000, ISO 55001 and this document should refer to such standards to ensure consistent delivery of asset management throughout their organization.

Bibliography

[1] ISO/TS 8000-1, *Data quality — Part 1: Overview*

[2] ISO 9000, *Quality management systems — Fundamentals and vocabulary*

[3] ISO 9001, *Quality management systems — Requirements*

[4] ISO/TS 9002, *Quality management systems — Guidelines for the application of ISO 9001:2015*

[5] ISO 9004, *Quality management — Quality of an organization — Guidance to achieve sustained success*

[6] ISO 14001, *Environmental management systems — Requirements with guidance for use*

[7] ISO 14224, *Petroleum, petrochemical and natural gas industries — Collection and exchange of reliability and maintenance data for equipment*

[8] ISO/IEC/IEEE 15288, *Systems and software engineering — System life cycle processes*

[9] ISO 15489-1, *Information and documentation — Records management — Part 1: Concepts and principles*

[10] ISO 15663-1, *Petroleum and natural gas industries — Life cycle costing — Part 1: Methodology*

[11] ISO 15686-2, *Buildings and constructed assets — Service life planning — Part 2: Service life prediction procedures*

[12] ISO 16175-3, *Information and documentation — Principles and functional requirements for records in electronic office environments — Part 3: Guidelines and functional requirements for records in business systems*

[13] ISO/IEC/TS 17021-5, *Conformity assessment — Requirements for bodies providing audit and certification of management systems — Part 5: Competence requirements for auditing and certification of asset management systems*

[14] ISO 17359, *Condition monitoring and diagnostics of machines — General guidelines*

[15] ISO 19011, *Guidelines for auditing management systems*

[16] ISO 19600, *Compliance management systems — Guidelines*

[17] ISO/IEC 19770-1, *Information technology — IT asset management — Part 1: IT asset management systems — Requirements*

[18] ISO 20815, *Petroleum, petrochemical and natural gas industries — Production assurance and reliability management*

[19] ISO 21500, *Guidance on project management*

[20] ISO 22301, *Societal security — Business continuity management systems — Requirements*

[21] ISO 22320, *Societal security — Emergency management — Requirements for incident response*

[22] ISO 26000, *Guidance on social responsibility*

[23] ISO/IEC 27001, *Information technology — Security techniques — Information security management systems — Requirements*

[24] ISO 30301, *Information and documentation — Management systems for records — Requirements*

[25] ISO 31000, *Risk management — Guidelines*

[26] ISO 37500, *Guidance on outsourcing*

[27] ISO 45001, *Occupational health and safety management systems — Requirements with guidance for use*

[28] ISO 55001:2014, *Asset management — Management systems — Requirements*

[29] ISO Guide 73, *Risk management — Vocabulary*

[30] IEC 31010, *Risk management — Risk assessment techniques*

[31] IEC 60300-1, *Dependability management — Part 1: Guidance for management and application*

[32] IEC 62508, *Guidance on human aspects of dependability*

[33] IEC 62740, *Root cause analysis (RCA)*

[34] EN 1325:2014, *Value Management — Vocabulary — Terms and definitions*

[35] Association of Local Government Engineers of New Zealand, National Asset Management Steering Group and Institute of Public Works Engineering Australia. *International infrastructure management manual.* 4th edition. National Asset Management Steering (NAMS) Group, Wellington, N.Z., 2011, ISBN 978-0-473-10685-0

[36] ASTM E2132, *Standard Practice for Inventory Verification: Electronic and Physical Inventory of Assets*

[37] ASTM E2279, *Standard Practice for Establishing the Guiding Principles of Property Management*

[38] ASTM E2608, *Standard Practice for Equipment Control Matrix (ECM)*

[39] BSI PAS 55, *Asset Management — Part 1: Specification for the optimized management of physical assets*

[40] NEN NTA 8120, *Assetmanagement — Eisen aan een veiligheids-, kwaliteits- en capaciteitsmanagementsysteem voor het elektriciteits- en gasnetbeheer (Asset management for electricity and gas networks)*

[41] Barnard I. *Engineering Asset Management: An Insurance Perspective*. Reliabilityweb.com, 2009, ISBN: 987-0-982-51630-0

[42] Mitchell J.S. *Physical Asset Management Handbook*. 4th edition. Reliabilityweb.com, 2012, ISBN: 978-0-985-36193-8

[43] Moore R. *Making Common Sense Common Practice: Models for Operational Excellence.* 5th edition. Reliabilityweb.com, 2017, ISBN: 9781941872666

[44] Wireman T. *Maintenance Work Management Processes: Maintenance Strategy Series*. Reliabilityweb.com, 2008, ISBN: 978-0-98322-586-7

[45] Gulati R. *Maintenance and Reliability Best Practices*. 2nd Edition. Industrial Press, NY, USA, 2009, ISBN 970-8-311-3434-1

[46] Porter M.E. *Competitive Strategy: Techniques for Analyzing Industries and Competitors*. The Free Press, 1998, ISBN 978-0-684-84148-9

[47] Van Hardeveld T., Kiang D. *Practical Application of Dependability Engineering*. ASME Press, New York, 2012, ISBN 978-0-7918-6001-4

This page deliberately left blank

British Standards Institution (BSI)

BSI is the national body responsible for preparing British Standards and other standards-related publications, information and services.

BSI is incorporated by Royal Charter. British Standards and other standardization products are published by BSI Standards Limited.

About us

We bring together business, industry, government, consumers, innovators and others to shape their combined experience and expertise into standards -based solutions.

The knowledge embodied in our standards has been carefully assembled in a dependable format and refined through our open consultation process. Organizations of all sizes and across all sectors choose standards to help them achieve their goals.

Information on standards

We can provide you with the knowledge that your organization needs to succeed. Find out more about British Standards by visiting our website at bsigroup.com/standards or contacting our Customer Services team or Knowledge Centre.

Buying standards

You can buy and download PDF versions of BSI publications, including British and adopted European and international standards, through our website at bsigroup.com/shop, where hard copies can also be purchased.

If you need international and foreign standards from other Standards Development Organizations, hard copies can be ordered from our Customer Services team.

Copyright in BSI publications

All the content in BSI publications, including British Standards, is the property of and copyrighted by BSI or some person or entity that owns copyright in the information used (such as the international standardization bodies) and has formally licensed such information to BSI for commercial publication and use.

Save for the provisions below, you may not transfer, share or disseminate any portion of the standard to any other person. You may not adapt, distribute, commercially exploit, or publicly display the standard or any portion thereof in any manner whatsoever without BSI's prior written consent.

Storing and using standards

Standards purchased in soft copy format:

- A British Standard purchased in soft copy format is licensed to a sole named user for personal or internal company use only.
- The standard may be stored on more than 1 device provided that it is accessible by the sole named user only and that only 1 copy is accessed at any one time.
- A single paper copy may be printed for personal or internal company use only.
- Standards purchased in hard copy format:
- A British Standard purchased in hard copy format is for personal or internal company use only.
- It may not be further reproduced – in any format – to create an additional copy. This includes scanning of the document.

If you need more than 1 copy of the document, or if you wish to share the document on an internal network, you can save money by choosing a subscription product (see 'Subscriptions').

Reproducing extracts

For permission to reproduce content from BSI publications contact the BSI Copyright & Licensing team.

Subscriptions

Our range of subscription services are designed to make using standards easier for you. For further information on our subscription products go to bsigroup.com/subscriptions.

With **British Standards Online (BSOL)** you'll have instant access to over 55,000 British and adopted European and international standards from your desktop. It's available 24/7 and is refreshed daily so you'll always be up to date.

You can keep in touch with standards developments and receive substantial discounts on the purchase price of standards, both in single copy and subscription format, by becoming a **BSI Subscribing Member**.

PLUS is an updating service exclusive to BSI Subscribing Members. You will automatically receive the latest hard copy of your standards when they're revised or replaced.

To find out more about becoming a BSI Subscribing Member and the benefits of membership, please visit bsigroup.com/shop.

With a **Multi-User Network Licence (MUNL)** you are able to host standards publications on your intranet. Licences can cover as few or as many users as you wish. With updates supplied as soon as they're available, you can be sure your documentation is current. For further information, email subscriptions@bsigroup.com.

Revisions

Our British Standards and other publications are updated by amendment or revision.

We continually improve the quality of our products and services to benefit your business. If you find an inaccuracy or ambiguity within a British Standard or other BSI publication please inform the Knowledge Centre.

Useful Contacts

Customer Services
Tel: +44 345 086 9001
Email (orders): orders@bsigroup.com
Email (enquiries): cservices@bsigroup.com

Subscriptions
Tel: +44 345 086 9001
Email: subscriptions@bsigroup.com

Knowledge Centre
Tel: +44 20 8996 7004
Email: knowledgecentre@bsigroup.com

Copyright & Licensing
Tel: +44 20 8996 7070
Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

bsi.