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

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Foreword

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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).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is Project Committee ISO/PC 251, *Asset management*.

Introduction

This International Standard 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 International Standard contains explanatory text necessary to clarify the requirements specified in ISO 55001 and provides examples to support implementation. It does not provide guidance for managing specific asset types.

This International Standard provides guidance for use by:

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

— those involved in delivering asset management activities and service providers.

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

Annex A provides additional information on areas related to asset management activities.

Annex B shows the relationship between key elements of an asset management system.

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

1 Scope

This International Standard provides guidance for the application of an asset management system, in accordance with the requirements of ISO 55001.

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

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

NOTE 2 This International Standard does not provide financial, accounting or technical guidance for managing specific asset types.

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

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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*

ISO 55001:2014, *Asset management — Management systems — Requirements*

3 Terms and definitions

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

4 Context of the organization

4.1 Understanding the organization and its context

4.1.1 Overview

4.1.1.1 The asset management system forms an integrated part of the organization's management system and has a prescribed structure. It should fit in and result from:

— the organizational objectives;

— the organizational plan.

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), which are implemented in:

— operational planning and control;

— supporting activities;

— control activities;

— other relevant processes.

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

The scope of an organization's asset management system and the outputs from its asset management activities should be used to set out the approach to enable the delivery of its organizational objectives. The requirements for the scope and context of an organization's asset management system are given in ISO 55001:2014, Clause 4.

The organizational objectives provide the overarching context and direction to the organization's activities, including its asset management activities. The organizational objectives are generally produced from the organization's strategic level planning activities and are documented in an organizational plan.

NOTE 1 The organizational plan can be referred to by other names, e.g. the corporate 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 documented in a strategic asset management plan (SAMP).

NOTE 2 A strategic asset management plan can be referred to by other names, e.g. an asset management strategy.

The SAMP should document the relationship between the organizational objectives and the asset management objectives, and should define the framework required to achieve the asset management objectives.

The links between the organizational plan and the SAMP should be two-way, and 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. Asset capability and performance, as well as the outputs from asset management activities (e.g. the asset management plan(s)), are key inputs into establishing realistic and achievable organizational objectives.

4.1.1.2 In developing its SAMP, the organization should:

a) consider the expectations and requirements of stakeholders;

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

c) clearly document the processes to establish its asset-related decision-making criteria.

The SAMP should be a high level plan that contains the asset management objectives. It should be used to develop the asset management plan(s), which should set out the asset level activities. The asset management plan(s) can be cascaded in large organizations or in organizations with complex asset portfolios.

4.1.1.3 All parts of the asset management system should be scalable, e.g. for small organizations, the organizational plan could be a single document that includes separate sections for:

a) the organizational objectives;

b) the SAMP;

c) the asset management plan(s).

Alternatively, the organizational plan could be kept separate from the SAMP, which could include the asset management plan(s) as a sub-section, or all three plans could be kept separately. 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 documents for each.

The concept of ensuring alignment and consistency between the organizational objectives, the asset management policy, the SAMP, the asset management objectives and the asset management plan(s), should reinforce within the organization that asset level activities support the delivery of the organizational objectives. It is important that this alignment is communicated to ensure that stakeholders at all levels understand why asset activities and asset management activities are implemented.

4.1.2 Understanding the organization and its context

4.1.2.1 When establishing or reviewing an asset management system, it is important to ensure that the approach is consistent and aligned with the external and internal contexts of the organization, since these can significantly influence the design and scope of the asset management system.

4.1.2.2 Evaluating the organization's external context can include, but is not limited to, the following issues:

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

b) key drivers and trends having impacts on the objectives of the organization;

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

4.1.2.3 Evaluating the organization's internal context can include, but is not limited to, the following issues:

a) governance requirements;

b) organizational structure, roles, accountabilities and authorities;

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

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

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

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

g) the organization's culture;

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

i) the form and extent of contractual relationships;

j) risk management plans;

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

l) integrity and performance of the assets and asset systems;

m) feedback from the investigation of previous asset and asset system failures, incidents, accidents and emergencies;

n) assessing the ability of the asset management system to achieve the intended outcomes of the organizational objectives;

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

4.2 Understanding the needs and expectations of stakeholders

4.2.1 The organization should identify and review the stakeholders that are relevant to asset management and the needs and expectations of these stakeholders.

4.2.2 Internal stakeholders can include the following:

a) employees within the organization;

b) groups within the organization, i.e. functional groups (e.g. engineering, accounting, maintenance, operations, purchasing, receiving, logistics) or other groups (e.g. safety delegates);

c) shareholders, management consortiums, owners.

4.2.3 External stakeholders can include the following:

a) customers, users, suppliers, service providers and contractors;

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

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

d) investors or taxpayers;

e) local communities;

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

g) financial institutions, rating agencies, and insurers;

h) employee representatives.

4.2.4 Stakeholders' needs and expectations should be documented and communicated. This may be captured in a statement of stakeholders needs within the SAMP and should reference any mandatory requirements, as well as the expectations of different stakeholder groups. The organization should consider a means of tracking how current the information 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 contexts given in 4.1.2 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 analyse these against the requirements 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 judgments 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.

Understanding how asset-related decisions are made is 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. 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. Decision-making 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 documented.

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 and on the complexity of the assets being managed. The detail should only disclose proprietary information as appropriate for the stakeholders receiving the information.

Stakeholders generally need to be informed about the decisions that can affect them and might need 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, and in accordance with legal requirements, where applicable. This is particularly necessary when communicating financial information.

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.

The boundaries and applicability of the asset management system should be captured in a statement of scope (which may be included in the SAMP). It should be communicated to all relevant stakeholders, both internal and external to the organization. The detail will be influenced by the size of the organization and the scale and complexity of the asset portfolio covered by the asset management system. It should clearly show what is considered inside and outside scope.

The scope should consider:

a) the assets, asset portfolio(s), their boundaries and interdependencies;

b) which other organizations are involved in meeting the organization's asset management system requirements (including the requirements of ISO 55001), e.g. through the outsourcing of asset management activities or activities related to life cycle stages;

c) the organizational aspects, e.g. which parts or functions of the organization are involved;

d) the organization's period of responsibility (e.g. where the management of assets is contracted out for a set period of time), including its residual liabilities beyond the operation or use of the asset (e.g. where an organization remains accountable for risks beyond its use of an asset, such as a chemical plant asset owner that retains liability for ground contamination);

e) the interactions with other parts of the organization's management system (e.g. for quality or environmental management), which can require defining the boundaries, functions, and responsibilities of each part of the management system.

4.4 Asset management system

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

The asset management system should not stand alone. A factor of successful asset management is the ability to integrate asset management processes, activities and data with those of other organizational functions, e.g. quality, 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 need to be clearly communicated to all involved.

Consideration should be given to how to prioritize what to develop first, 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 is 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.

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.

Compliance with all 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.

5 Leadership

5.1 Leadership and commitment

Asset management leadership can be demonstrated by top management through positively influencing the organization (and in its execution of all the requirements of ISO 55001, and specifically the requirements of ISO 55001:2014, 5.1). 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 ownership and accountability for asset management remains at the top management level.

Top management commitment to asset management can be demonstrated by:

a) making reference to asset management principles in communications;

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

   — by setting priorities for these objectives;

   — 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 asset management related decision-making criteria for capital expenditures and other decisions;

e) supporting asset management related improvement activities;

f) supporting a management-development track that encourages and rewards time spent in roles associated with asset management and 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) assuring that asset management is considered at the same level of importance as safety, quality, environment, etc.;

i) addressing asset related risks and incorporating them into the organization's risk management processes;

j) aligning asset management and the asset management system to other organizational functions through collaboration on achieving the organizational objectives;

k) aligning asset management and the asset management system to other organizational practices and management systems, e.g. including the organization's approach to risk management.

5.2 Policy

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 be authorized by top management and thereby demonstrate commitment to asset management.

The policy should set out the organization's commitments and expectations for decisions, activities and behaviour concerning asset management. It should be aligned to and demonstrate support for the organizational objectives. For example, an organizational objective to reduce capital investment could result in an asset management policy statement for adopting risk-based approaches to capital investment.

Examples of asset management policy principles may include commitments for:

a) guiding principles for asset management activities, e.g. service delivery objectives are to guide asset management practices and decisions;

b) adherence to applicable laws, legislation and regulations;

c) the provision of resources to deliver on asset management objectives and the structure or working of the organization to achieve the organizational objectives, e.g. asset planning and management is to be integrated with corporate and business planning, budgetary and reporting processes;

d) the decision-making criteria to be used, e.g. asset management decisions are to be based on evaluations of alternatives that take into account life cycle costs, benefits and risks of the asset;

e) reporting on asset and asset management performance;

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

g) continual improvement of the asset management system.

It is not necessary for the policy to be captured in a discrete document; it can be contained in other high level organizational policies or documents, e.g. it may be included in the SAMP. The important point is that it is communicable to the organization. If this can be demonstrated, a separate asset management policy document may not be required.

There should be processes in place to review and update the asset management policy, and to ensure that if the organization's external or internal context changes, the actions necessary to update the policy are also triggered.

5.3 Organizational roles, responsibilities and authorities

The responsibilities and authorities of key functions should be defined (see ISO 55001:2014, 5.3). This should include both internal and outsourced roles and responsibilities. The interfaces between organizational functions should be clearly established. This becomes more important in an outsourced environment.

It should be clear which role is responsible for which activity. This can be achieved through the development of job descriptions, or through including asset management responsibilities in existing job descriptions, or through the production of a documented organizational chart.

When assigning internal roles, consideration should be given to the following:

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

b) support for the role through training and mentoring;

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

d) the individual being able to demonstrate an understanding of what the responsibilities mean in the context of their role (e.g. this can be achieved through the signed acceptance of a job description).

In small or medium-sized organizations, multiple asset management functions may be assigned to one individual. This does not change the need to communicate this 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 documented in the scope or elsewhere in contracts.

6 Planning

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

The organization should determine the actions that are necessary for addressing risks when planning for its asset management system (see also ISO 55001:2014, 6.1). In this International Standard, it is assumed that the term "risk" also includes opportunities (see ISO 55000:2014, 3.1.21). The overall purpose is to understand the cause, effect and likelihood of adverse events occurring, to manage such risks to an acceptable level, and to provide an audit trail for the management of risks. The intent is for the organization to ensure that the asset management system achieves its objectives, prevents or reduces undesired effects, identifies opportunities, and achieves continual improvement.

When addressing risks in the asset management system, the organization should determine the risk assessment criteria (e.g. likelihood and consequence, and risk attitude) within asset management decision making for its asset management system (see 4.2). A risk matrix may be used as part of this process.

The approach of managing risks associated with the asset management system should be aligned with the organization's risk management approach and, where appropriate, this may include business continuity planning and contingency planning. The organization should consider how managing risks in its asset management system relate to other risk management processes in the organization (see 4.3).

The organization should determine and plan actions, and provide adequate resources, to address its asset management system risks. For example, asset management risks could be incorporated into an organization's divisional and project risk registers, with appropriate escalation mechanisms if they cannot be addressed at the level at which they are raised.

The organization should integrate the actions identified to address these risks into the implementation plan for the asset management system.

The organization should be able to demonstrate how it has evaluated the effectiveness of the actions that it has taken to manage the risks identified in relation to the organizational objectives and decision-making criteria.

6.2 Asset management objectives and planning to achieve them

6.2.1 Asset management objectives

6.2.1.1 The asset management objectives, derived as part of the SAMP, provide the essential link between the organizational objectives and the asset management plan(s) that describe how those objectives are

going to be achieved. The asset management objectives transform the required outcomes (product or service) to be provided by the assets, into activities typically described in the asset management plan(s).

The asset management objectives should be tailored to suit each organization's needs, which may include addressing subsets of objectives (e.g. for the asset management system, asset portfolios, the asset system and at asset level), and can vary for different functions carried out to meet stakeholder requirements. The organization should consider information or data from sources internal and external to the organization, including contractors, key suppliers, regulators or other stakeholders.

Asset management objectives should be specific, measurable, achievable, realistic and time-bound (i.e. "SMART" objectives). They can be both quantitative measurements (e.g. mean time between failure) and qualitative measurements (e.g. customer satisfaction).

The organization should consider the monitoring, measuring, analysing and evaluating needed to drive and support its decision making on improvement actions. When deciding what to measure, how to measure, what to analyse, etc., it is important for the organization to understand what type of behaviour and actions it wants to achieve from the asset management objectives before implementing them. The asset management objectives should be aligned to the organizational objectives and should promote collaboration with stakeholders.

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

a) review risks, including the potential impacts from the failure of

   — assets, or

   — the asset management activities on achieving asset management objectives, individually or in combination;

b) review the importance of assets related to their intended outcomes, objectives and product or service requirements;

c) check the applicability of the asset management objectives during the asset management planning process.

6.2.1.3 Typical issues, amongst others, that are addressed by objectives include the following:

a) for asset management:

   — total cost of ownership;

   — net present value;

   — return on capital employed;

   — performance against plan;

   — certification of the asset management system, or the assessment of asset management maturity (by benchmarking);

   — customer satisfaction scores;

   — society or reputation survey results;

   — environmental impact, e.g. carbon costs;

   — level of service;

b) for asset portfolios:

   — return on investment (or return on capital employed, or return on asset);

c) for asset systems:

— asset system availability;

— asset system performance (e.g. uptime, efficiency);

— unit cost of product or service;

d) for assets:

— reliability (mean time/distance between failures);

— asset condition, performance, or health score;

— life cycle costs;

— life expectancy;

— asset energy performance.

For large or complex asset management systems, the organization might also need to establish objectives for the asset management system itself.

6.2.1.4 Monitoring the performance of the organization's asset management, in terms of how well the asset management objectives and hence the organizational objectives are being met, is an important part of the asset management system (see 9.1). Deviations in performance should be used as inputs to revise the asset management objectives.

Asset management objectives should be subject to regular management review (see 9.3) and such reviews should inform the continuous improvement process (see 10.3).

6.2.2 Planning to achieve asset management objectives

6.2.2.1 The organization should develop an asset management plan(s) to define the activities that will be implemented and the resources that will be applied to meet the asset management objectives and consequently the organizational objectives. An asset management plan(s) provides the direction to, and expectations for, an individual asset or for a portfolio, group or class of assets.

An asset management plan(s) should be documented at a level that is appropriate to the organization and the degree of sophistication in its asset management approach. There is no set formula for what should be included or how it should be structured, however, it is common practice for such an asset management plan(s) to contain a rationale for asset management activities, operational and maintenance plans, capital investment (overhaul, renewal, replacement and enhancement) plans, and financial and resource plans, often based on a review of earlier achievements.

For some organizations, this may be captured in a single document, while for other organizations, multiple asset management plans may be appropriate. For example, a small municipality may produce one asset management plan for all of its assets, whereas a large rail organization may provide multiple plans for each asset class (e.g. stations, track, infrastructure), or a utility may provide multiple plans for different locations.

Asset management plan(s) should be developed to appropriate time horizons for the organization. The time horizons should meet the organization's needs and take account of the organization's period of responsibility and the life of its assets.

There can be benefits in developing the first asset management plan(s) as an interim plan as quickly as possible, using existing information. It helps the organization to understand the strengths and weaknesses of current asset management practices and to identify priorities for the development of future plan(s). It can also help avoid embarking on ambitious data collection exercises before needs are fully understood.

It is important for the organization to commit the resources that are identified in the asset management plan(s) as being necessary, in order to achieve its planned objectives. Implementation of the asset management plan(s) is an iterative process that involves resolving conflicts between what is planned and what can be afforded in terms of financial constraints. Once the financial implications arising from the asset management plan(s) have been quantified, linkages need to be established between the asset management plan(s) and the financial plans of the organization, and decisions should be made jointly about financial allocations.

Asset management plan(s) should be reviewed periodically to ensure continual alignment with the asset management objectives. Planning should also consider solutions that do not require additional assets to achieve the organizational objectives (e.g. it can be preferable to change demand for products or services by changing pricing rather than building new assets or providing more services).

There should be a regular assessment of the ability of the SAMP to support the achievement of the asset management objectives. The intent is to determine what the mismatch or gaps are and where they exist. This analysis should be used as input to management review and to an improvement process for the asset management system.

A risk ranking process can determine which assets have a significant potential to impact on the achievement of the asset management objectives, i.e. which are the critical assets.

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

a) who should be responsible for developing and implementing the asset management plan(s) and their continual improvement: writing the asset management plan(s) internally is useful for ensuring better commitment to the asset management planning process, however, resources and capabilities can be such that external support is required; it is important that staff are familiar with the objectives and approach, and have the opportunity to learn from the project when external resources are used;

b) who will read the asset management plan(s), what they will want to know and need to know: a tiered approach to asset management plan development can assist in targeting several user groups, e.g. the executive summary aimed at top management and the general public, the main body of the plan at top management and key stakeholders, and appendices for more technical information for service providers;

c) the environments in which the assets are operating or are intended to operate and the activities that are being performed either on individual assets, on various components, where inter-dependencies exist or combinations of activities occur on the same asset, or on multiple assets (i.e. whether this activity on this asset is worthwhile and, if so, when);

d) activity program requirements, which will typically also involve operational planning activities and implementation (see Clause 8);

e) the performance of the assets and the intended outcomes expected from implementation of asset management plan(s) in enabling the organization to achieve its asset management objectives;

f) whether appropriate resources and funding is available;

g) applicable standards.

6.2.2.3 The organization should ensure that its assets are capable of delivering the required products or services and achieving its organizational objectives.

The organization should be able to create and demonstrate a link between the actions that address the risks and the organization's approach to risk management and business continuity planning.

When planning processes to manage risk in the asset management system, the organization should consider adopting a structured method for identifying, analysing and evaluating risk (see 6.1). An example method is provided below.

a) Classify assets and define the scope: prepare a list of asset systems and their constituent assets, and gather information about them, including the management and control activities which affect the assets' performance; define the scope and limits of the individual asset risk assessments (see 4.3).

b) Identify risks: create a table of potential events and their causes, ensuring that the identification process includes risks to the delivery of the organizational objectives.

c) Identify risk controls that exist (or are proposed for planned assets and planned activities).

d) Analyse risks using appropriate process.

e) Evaluate the level of risk: estimate the likelihood and consequences for each potential event, based on the asset management decision-making criteria (see 4.2) and the risk management criteria (see 6.1). The effectiveness of any existing risk controls, and the likelihood and consequences of their failure, should also be considered.

f) Evaluate the level of risk over time: where appropriate, establish whether the identified risks will change over time, and how this will affect their consequences.

g) Evaluate the tolerability of the risks: decide whether planned or existing controls (if any) are sufficient to keep the risks under control and to meet any legal, statutory and other asset management requirements.

h) Determine the treatment of the risks: establish whether the risks will be treated by addressing them directly, avoiding, reducing, tolerating or transferring them.

6.2.2.4 The organization's method to identify, analyse and evaluate risk in the asset management system should be documented appropriately (see 7.6). The documentation of the risk management process in the asset management system may include the completion of a risk register, or another recording mechanism appropriate to the organization's risk management approach.

The organization should document the risks associated with asset management and incorporate risks critical to the achievement of the asset management objectives in its risk register. Larger organizations may need to use divisional or project risk registers, with appropriate escalation mechanisms if the risks cannot be addressed at the level at which they are raised.

The organization should establish governance arrangements for risk management in the asset management system (see 6.1). This includes audit of the risk management approach (see 9.2), and the review of risks by top management (see 9.3).

Where asset life cycle activities or asset management activities are outsourced as part of the organization's asset management approach, the organization should ensure that the asset management system includes control and management of risk (see 8.3).

Asset management plan(s) should consider the risks during the organization's period of responsibility, including any residual liabilities beyond the period of operation or use of the asset.

In the process of continual improvement, the organization should consider the risks that can change with time and how these could impact the asset management system in the future and plan to manage them. For example, asset deterioration related risks can change the asset management risks over time (e.g. corrosion of a pipeline), or currency exchange related risks can impact capital investments.

Standard risk management practices tend to overlook events that are very low probability/high consequence as not worth considering in detail. For example, extreme weather events do not occur often, but when they happen, asset managers tend to be inadequately prepared.

It is important that there be an additional dimension in the risk analysis to include the capability of the asset system to monitor and continually assess the probability of these rare, but potentially catastrophic, events. While the probability of such events can be very low, the organization should establish systems of monitoring indicators to identify when circumstances change abruptly, so that it can implement processes early to mitigate against them.

The organization should apply a common methodology for determining the financial implications of the asset management plan(s). Asset management planning should take into account the difference between the economic and technical aspects of assets.

Life cycle cost, which may include capital expenditure, financing and operational costs, should be considered in the decision-making process (see 4.2). The development of an asset management plan can involve making decisions that have short- and long-term effects. It can also involve consideration of all the asset's life cycle stages, and the potential impacts of a decision at one stage on a later stage.

When making asset management decisions, the organization should use a methodology that evaluates options of investing in new or existing assets, or operational alternatives (which could include, for example, financial solutions that do not require assets). Consideration should be given to the different effects of capital expenditure, operational expenses and any resulting pricing impacts upon the organization's products and services.

NOTE See ISO 31000 for further information on risk management and IEC 31010 for guidance on risk assessment techniques.

7 Support

7.1 Resources

During the development and implementation of the asset management system, including the asset management objectives and asset management plan(s), the organization should determine the required resources. The organization should map its available resources to its planned activities to determine any gaps. This gap analysis can be used as an input to determining options for resourcing the activities. This analysis applies across all asset management activities, could be extensive and can require prioritization and programme planning of many projects to close these gaps.

It is possible that a resourcing analysis, for the reconciliation of available budgets with funding, could determine that not all proposed asset management activities can be resourced as proposed. An iterative process to reconcile proposed activities with available resources should be used, and the criteria and processes for prioritizing asset management activities should be decided and the asset management plan(s) be revised to reflect the available resourcing and the timing that the resource is assigned.

In determining options for resourcing the activities, the organization should consider both internal and external resources. For human resources, options available can be affected by organizational policy and strategic plans on human resources, contracting-out or outsourcing. For non-human resources, availability of resources should include consideration of procurement options (e.g. lease, hire, purchase or otherwise acquire). Both human and other resourcing needs can be influenced by the nature and duration of the activities (e.g. one-off versus on-going).

In some organizations, these activities can require that other parts of the organization provide additional resources in order to support the primary asset management activity (e.g. additional staff). Those responsible for implementing the asset management activity should ensure that they have coordinated effectively, so that all parts of the organization are resourced appropriately.

Any tools, facilities or equipment that are required for the delivery and control of asset management activities should be defined and managed as assets, at a level of detail appropriate to their function and purpose.

7.2 Competence

7.2.1 Competency in asset management should be addressed at all levels of the organization in a way that ensures alignment between roles and levels and not just for those considered to be asset managers. For example, a competent trades person should be able to demonstrate clear competency in specific asset management related tasks (e.g. condition rating) and also have an understanding of the relationship of what they do to the asset management activities others undertake (e.g. the input of the condition rating activity into the determination of remaining useful asset life).

7.2.2 The organization should determine the competences required for all asset management roles and responsibilities, and the awareness, knowledge, understanding, skills and experience needed to fulfil them. The organization should map its current competences to its required competences to determine any gaps. This gap analysis can be used to develop asset management competency improvement and training plans, and enable the organization to incorporate specific asset management competences into its organizational competency framework, as considered appropriate.

For example, the gap analysis and the resulting competency improvement and training plans may include the following:

a) the assessment of competences for the role(s), responsibility(ies) and accountability(ies) to be undertaken for all stakeholders;

b) alignment to the organizational objectives as well as its asset management policy, asset management objectives, SAMP and asset management plan(s);

c) the creation of personal development programmes that identify the training, education, development and other support needed to attain the required competence;

d) the provision of training and mentoring, including the selection of suitable methods and materials;

e) knowledge and job sharing;

f) succession and knowledge management plans;

g) the hiring or contracting of competent persons;

h) the training of target groups;

i) documentation and monitoring of the training received;

j) the evaluation of the training received against defined training needs and requirements, in order to verify conformity with asset management system requirements.

All persons assigned roles and accountabilities within the organization that can have an impact on the asset management system should have those roles and accountabilities communicated to them, be provided with the training, education, development and other support needed to perform their role, and be able to demonstrate the competences required.

7.2.3 The organization should recognize that there is interdependency between its asset management competences, its organizational design and business processes. When undertaking a competency gap analysis, it should also consider undertaking a gap analysis of its organizational design and business processes and develop appropriate improvement plans, as necessary. For example, the organization could find it has competent asset managers that are disconnected from its business planning and budgeting function, which could impede its long range planning and investment decision making. Alternatively, the organization could discover that the majority of its asset management competences exist within one

individual, with no effective succession and knowledge management plans (a situation requiring urgent remedial action).

The organization should:

a) establish appropriate and effective processes for managing the competence of persons undertaking asset management work that affects its asset and asset management performance;

b) consider linking these processes to its existing human resource management and competency improvement processes;

c) establish processes to periodically review and update the asset management competency improvement and training plans.

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 competency against the required activities. The organization should, depending on the criticality of the activity, validate claims of competency, and have a process to ensure that any third party resource provider continues to provide competent resources.

7.3 Awareness

7.3.1 Persons working under the organization's control should have appropriate awareness of the organization's asset management system and activities. Such persons can include staff, contractors, internal or external service providers, and suppliers. They should be aware of the asset management policy and the following:

a) why asset management is important to the organization;

b) the implications of changes in the operation of the organization (e.g. if the organization makes changes to its operational processes or performance objectives, those persons with accountability for the asset management system should be aware of any resulting impacts);

c) their contribution to the effectiveness of the asset management system, including the benefits of improved asset management system performance;

d) asset management related risk consequences (actual or potential) of their work activities, their behaviour, and the asset management benefits of improved personal performance and how they relate to each other;

e) their roles, responsibilities and authorities as well as the importance of their contribution in meeting the requirements of the asset management policy and the asset management system;

f) how well the organization is performing in meeting its objectives.

The specific awareness needs of any stakeholder should be determined by their role and its relationship to the organization meeting its asset management objectives. The need for awareness of some areas can apply to only a limited group of individuals, e.g. those directly involved in a particular function, such as plant maintenance.

7.3.1 The level of organizational awareness can be improved, for example, by the following:

a) a consultation process with staff throughout the organization concerning the establishment, operation, improvement and changes to the asset management system;

b) discussion of asset management in the organization's newsletters, briefings, introduction programme or journals (including new employee orientation);

c) inclusion of asset management articles on relevant web pages;

d) inclusion of asset management as a topic in staff and management team meetings;

e) briefings for top management;

f) briefing key suppliers and distributors on the organization's asset management arrangements.

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 activity and asset management system.

7.4.2 Communication plan

The organization should develop communication plan(s) with consideration of:

a) building awareness of the asset management requirements and expectations;

b) developing an understanding of how the implementation of the asset management system can impact stakeholders;

c) promoting engagement with stakeholders to embrace transparency and create accountability for the asset management system;

d) managing, informing and influencing stakeholders who can directly impact the asset management plans and the achievement of the asset management objectives.

7.4.3 Communication plan content

The content of the communication plan(s) may include the following:

a) the benefits of implementing an activity, project, programme, or asset modification or augmentation, and how these improvements are expected to collectively or individually impact stakeholders and the organization;

b) any improvement schedules, including key milestones, who will be involved, and for how long;

c) any resource specific communications, including statements of the asset management system expectations;

d) the who, why, when and what of communicating, including how well the organization is performing against its organizational objectives and the contribution asset management is making to this performance;

e) if appropriate, what external and internal knowledge is needed for the stakeholders to make informed contributions or decisions, or provide informed feedback;

f) the representative who is best suited to deliver specific communications;

g) the format to be used for the communications;

h) the feedback and reporting processes.

7.5 Information requirements

7.5.1 The organization should determine the information needs related to its assets, asset management and its asset management system.

The organization should use a systematic approach to identify the necessary asset information and establish the appropriate information repositories. For example, the organization should undertake a

needs analysis, establish priorities, review system development options and data collection strategies, plan the creation of information repositories and data collection, then implement as appropriate.

NOTE ISO 55001 addresses information-related requirements in the following three subclauses:

— ISO 55001:2014, 7.5, which addresses the determination of required information;

— ISO 55001:2014, 7.6, which addresses the requirements for control over information;

— ISO 55001:2014, 9.1, which addresses the determination of requirements for information needed for performance reporting and evaluation.

7.5.2 In general, the organization should consider its asset information requirements related to the following areas:

a) strategy and planning (e.g. corporate service levels and objectives, asset strategy(ies), demand management strategy and plans);

b) process (e.g. process performance objectives and indicators, asset related processes and procedures);

c) technical and asset physical properties (e.g. asset attributes, ownership, design parameters, vendor information, physical location, condition, in service dates);

d) service delivery and operations (e.g. service levels, performance objectives, asset performance characteristics, future operational requirements, demand management objectives);

e) maintenance management (e.g. historical asset failures, betterment or replacement dates, future maintenance requirements);

f) performance management and reporting (e.g. asset performance data, continuous improvement objectives, regulatory reporting);

g) financial and resource management (e.g. historical cost, depreciation, asset replacement value, date of acquisition, materiality, capitalization rules, asset classification/hierarchies, life cycle costing analysis, useful lives of assets, residual value and any residual liabilities);

h) risk management;

i) contingency and continuity planning;

j) contract management (e.g. asset related contractual information, vendor information, service objectives, third party agreements).

7.5.3 When determining its information requirements the organization should consider:

a) the value of the information to enable decision making and its quality relative to the cost and complexity of collecting, processing, managing and sustaining the information;

b) the need to align its information requirements to suit the level of risk that an asset, or managing it, poses;

c) the participation of relevant stakeholders to determine the types of information required to support decision making as well as to ensure the completeness, accuracy and integrity of the necessary information;

d) the establishment and continual improvement of controls, specifications and level of accuracy for data;

e) the determination, assignment and periodic review of accountabilities for the stewardship of specific information;

f) the establishment of competences required to collect, interpret, utilize and report information;

g) the alignment of information requirements for different levels and functions within the organization: this includes the ability to have vertical alignment of the information from top management down into the operational areas, as well as horizontal alignment between asset management, financial management and risk management functions, by using a common terminology for financial and non-financial information;

h) the alignment of financial and non-financial terminology (it should be recognized 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 achievable, however, conflicting terminology should be resolved where possible and documented);

i) 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, is achieved through employing identifiable and auditable accounting records that are linked to the technical asset records);

j) the establishment of data collection processes from internal and external stakeholders (including contracted service providers);

k) the data flow and integration of information sources to planning, operational and reporting technology systems, appropriate for the size, complexity and capability of the organization (e.g. in more sophisticated asset management technology systems, specific data may be kept in separate asset registers);

l) its ability to maintain the appropriate quality and timeliness of the information (as the collection of data can be costly, the organization should prioritize data that is identified as strategically or operationally important).

7.6 Documented information

In establishing its documented information needs, the organization should consider the identification and definition of documented information that will be managed and maintained over the life cycle, taking into account its period of responsibility for the assets. The organization should also consider the requirement to maintain this documented information for any defined period beyond the disposal of the assets, in accordance with its business, legal and regulatory requirements. The controls put in place should be adequate for the type of information in supporting the asset management activity.

The organization should determine the documented information required to ensure effectiveness of its asset management system and asset management activity. Different types of documented information can address elements of the asset management system, asset management or a specific asset. The information required can differ from one organization to another and should be proportional to the complexity of the assets and the asset management activity.

When creating and updating documented information, an organization should determine if appropriate controls are in place to ensure that the information is appropriate; these controls are necessary to ensure that the personnel supporting the asset management activity are using the approved, accurate, most up to date information.

8 Operation

8.1 Operational planning and control

8.1.1 The organization should establish operational planning and control processes in order to support the effective delivery of the activities contained within the asset management plan(s). The processes should identify who is responsible for the planning and how the defined activities will be executed, including how risks arising during the planning and execution will be managed and controlled. (ISO 55001:2014,

Clause 8, defines the requirements for the operational planning and control of both asset management and the asset management system).

8.1.2 In implementing the processes and actions, the following criteria, amongst others, should be considered:

a) roles and responsibilities;

b) procedures;

c) resource allocation;

d) competency development.

8.1.3 Control mechanisms for the processes and actions can include elements such as the following:

a) process performance measures;

b) internal audit criteria and schedules.

The implementation of the processes and actions should produce documentation to enable verification that the process steps were followed as designed and the expected output of the process is achieved, e.g. this could include signed completed work orders.

8.1.4 The organization should implement those processes and actions needed to address its risks (see 6.2). This should be done by establishing the criteria for risk management processes, controlling implementation of these processes based on the defined criteria, and keeping documentation that demonstrates the risk management processes have been executed as planned.

The organization should have the capability to determine emerging risks and to consider their impacts on its asset management objectives. The asset management system should enable the organization to consider and plan changes that affect its assets or asset management with sufficient time to act if required.

Implementation should involve an iterative process to achieve a balance between cost, risk and performance, to resolve conflicts between what is planned and what can be achieved, while taking into account the constraints faced by the organization.

8.2 Management of change

8.2.1 Internal or external changes affecting assets, asset management or the asset management system can impact on the organization's ability to achieve its asset management objectives. These changes should be evaluated and mitigating actions should be taken prior to implementation. The organization should review the consequences associated with both planned and unplanned changes and take the necessary action to mitigate any foreseen adverse effects.

8.2.2 The organization's considerations should address changes that include, but are not limited to, the following:

a) organizational structures, roles or responsibilities;

b) asset management policy, objectives or plans;

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

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

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

f) supply chain constraints;

g) demands for products and services, contractors or suppliers;

h) demands on resources, including competing demands.

8.2.3 The organization should have the capability to make evidence-based decisions on proposed changes and the ability to consider scenarios systematically across the entire organization.

Risks associated with a change should be considered in relation to their impact on asset management and the asset management system. This should include unintentional consequences that occur to other parts of the organization, as a result of a change, e.g. the impact of resource constraints due to changes in service delivery requirements.

8.3 Outsourcing

8.3.1 Outsourcing is a common method for an organization that prefers to perform certain asset management activities not by itself, but by an external or internal service provider. When these activities influence the achievement of the asset management objectives, these should be part of the asset management system, and should be documented.

8.3.2 The organization should formalize the relationship (e.g. through a contract, service level agreement or other appropriate commercial mechanism) for:

a) the governance of the outsourced activities, including responsibilities and authorities within the organization for managing the outsourced asset management processes and activities;

b) the processes and activities that are outsourced, with a description of the scope and boundaries, their interfaces with the organization and its control, quality, timelines, consultation requirements, financing, feedback and improvement opportunities;

c) the processes for the (bidirectional) exchange of information, knowledge, people, processes and technology at the start of the agreed period;

d) the processes for monitoring the activities of the assigned service provider(s);

e) the processes for sharing of knowledge, information and data, between the organization and its service provider(s);

f) the process of handing back the asset management activity from the service provider(s), including the required state of the asset and associated information.

8.3.3 Any asset management objectives, processes and activities that are outsourced should be controlled by the organization to provide assurance that performance is as planned. The performance of outsourced activities should be subject to a regular management reviews to ensure that they are adequately controlled.

The more extensively an organization chooses to outsource the delivery of its asset management, the greater will be the degree of control and integration into the asset management system that it will need to exert over the service provider(s), in order to give assurance that delivery of the SAMP will be achieved. The extent of outsourcing could require a service provider to establish its own asset management system that is aligned with the organization's asset management objectives.

8.3.4 The organization should consider the ownership and protection of intellectual property and corporate knowledge (including that generated during the outsourcing) when outsourcing asset management activities.

When outsourcing any life cycle activities and asset management activities, the organization should consider the risks and impacts on its assets, asset management and asset management system.

The organization should consider what potential risks cannot be transferred, even if the related asset management activities are transferred (e.g. damage to its reputation). A corresponding control over those risks should be maintained within the organization.

9 Performance evaluation

9.1 Monitoring, measurement, analysis and evaluation

9.1.1 General

9.1.1.1 The organization should develop processes to provide for the systematic measurement, monitoring, analysis and evaluation of the organization's assets, asset management system and asset management activity on a regular basis. In the development of these processes (and any associated procedures) the following should be taken into account:

a) setting of performance metrics and associated indicators, e.g. condition or capacity indicators;

b) confirmation of compliance with the requirements;

c) examination of historical evidence;

d) the use of documented information to facilitate subsequent corrective actions and decision making.

9.1.1.2 The processes should also reference the asset management policy and objectives.

More specifically the processes for monitoring performance should address:

a) the setting of performance metrics, including qualitative and quantitative measurements (financial and non-financial) that are appropriate to the needs of the organization;

b) the extent to which the organization's asset management policy and objectives are met;

c) the evaluation of compliance with legal and regulatory requirements, and any other requirements to which the organization subscribes;

d) identifying when the monitoring and measuring should take place;

e) the ability to aggregate and report information to those accountable for the asset management system and asset activities (see 7.5, bullet g));

f) the quality, reliability and completeness of the financial and non-financial asset information;

g) enabling top management to make statements on the organization's ability to manage its assets (see 4.2);

h) the performance of activities outsourced to external providers;

i) assessing the performance of the asset management processes, procedures and functions;

j) proactive indicators that are related to performance of the assets, asset management system, and activities (e.g. capacity or condition indicators);

k) reactive measures of performance to monitor failures, incidents, non-conformities (including near misses and false alarms) and other historical evidence of deficient asset management system and activity performance;

l) recording the data and results of monitoring and measurement, sufficient to facilitate subsequent corrective action analysis.

9.1.1.3 A set of performance indicators should be developed to measure the asset management activity and its outcomes. Measurements can be either quantitative or qualitative, financial and non-financial. Indicators should provide useful information to determine both successes and areas requiring corrective action or improvement. The organization should consider the relationship and alignment between performance indicators.

9.1.1.4 The asset management system should employ data from monitoring and measurement to identify patterns and obtain information regarding its performance. These data should be used to evaluate whether the organization's policy and objectives are being achieved, as well as identifying corrective actions and areas for improvement.

Documented information on all periodic evaluations and their results should be maintained.

The organization should analyse and, at planned intervals, evaluate the outcomes from the monitoring and measurement.

The performance of activities outsourced to external service providers should be monitored and be based on the evaluation of reported results, audits performed by the organization, or independent auditor's reports.

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

9.1.2.1 The organization should conduct evaluations of its assets and asset management activity 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.

Evaluations can take the form of internal or external audits, or self-assessments. The frequency and timing of evaluations should be determined by the organization or can be determined by laws and regulations, depending on the size, nature and legal status of the organization. When setting the frequency of condition or performance monitoring and the parameters for measurement, the organization should consider, at a minimum, the costs of monitoring, the risks of failure or nonconformity, and potential deterioration mechanisms and deterioration rates. They might also be influenced by the requirements of stakeholders.

9.1.2.2 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 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 clearly defined, documented and effectively implemented and complied with;

e) there are processes for on-going 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 faced by the organization;

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.

9.1.2.3 Outcomes from the evaluation should include evidence of whether:

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

b) people are trained and competent;

c) there is operational planning and control of asset management;

d) the organization's asset management activities are in compliance with its processes;

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

Documented information relating to all periodic evaluations and their results should be maintained as evidence.

9.1.2.4 In the context of continual improvement, the organization can acquire knowledge on new asset management technology and practices, including new tools and techniques (e.g. development of reliability and predictive technologies during the procurement of new assets or the design of modified assets). This should be evaluated to establish its potential benefit to the organization.

9.1.2.5 To ensure that reported information used for monitoring has the same meaning with respect to different functions in the organization, common financial and non-financial terminology should be used in reports. Because cost plays such an important role in reflecting asset related performance, it may be useful to have a shared set of classification systems, hierarchical structures, and a common understanding of how asset portfolios, asset systems and individual assets are broken down for life cycle management purposes.

The change in future value of the assets and the risk profile should be evaluated in both a financial context and a non-financial context. The evaluation team should include stakeholders from relevant disciplines.

9.1.2.6 Monitoring should ensure that there is consistency and traceability between technical asset information and accounting records. In addition, monitoring should address the following key aspects of the data registration process.

a) a uniform technical, operational and financial glossary;

b) a technical, operational and financial linkage, which is consistent and traceable to the assets and their components 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 financial reporting.

This monitoring in the financial reporting system should be done at a level suitable to the risk, complexity and value of the assets. 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 the value of the components in relation to the asset, and to determine the differences between the technical and economic lives of the components.

9.2 Internal audit

9.2.1 The organization should conduct internal audits at planned intervals to ensure the asset management system conforms to its requirements (and to the requirements of ISO 55001).

It is essential to conduct internal audits of the asset management system, particularly in relation to critical assets and asset systems, to ensure that the asset management system is achieving its objectives and plans and is identifying opportunities for improvement. Internal audits of the asset management system should be conducted at planned intervals to determine and provide information to top management on the appropriateness and effectiveness of the asset management system, as well as to provide the basis for setting objectives for continual improvement.

9.2.2 The organization should establish an audit process to direct the planning and conduct of audits, and to determine the audits needed to meet its objectives. The process should be based on the organization's activities, its risk assessments, the results of past audits, and other relevant factors.

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 may be divided into smaller parts provided the audit programme ensures that all organizational units, functions, activities and system elements and the full scope of the 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 and help to objectively reassess the risk areas.

The results of an internal audit of an asset management system can be used to correct or prevent specific nonconformities, as an input for continual improvement, and to provide input for management review.

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. In smaller organizations, auditor independence can be demonstrated by an auditor being free from responsibility for the activity being audited.

Audits should support learning and improvement of the asset management system. To achieve this, the audits should focus on the performance of the asset management processes, as opposed to the performance of persons within the processes. Attention should be paid to examples of good practice and improvement opportunities. At the same time, audits should also determine system deficiencies, by checking conformity of practice and the asset management system with each other and to the requirements of ISO 55001.

9.2.3 Self-assessment can be helpful in driving continual improvement. Self-assessments should evaluate the viability and suitability of the asset management policy, objectives and plans to ensure they are consistent with each other, suitable, adequate, and achievable. This requires assessment of the following:

a) assumptions related to the organization's asset management;

b) the organization's process(es) and procedure(s), methods, tools and techniques;

c) the availability and allocation of funds and resources.

The self-assessment process should encourage participants to identify opportunities for continual improvement. Active participation, understanding and support of the organization's employees are important in conducting a self-assessment review.

9.3 Management review

9.3.1 Top management should review the organization's assets, asset management system and asset management activity, as well as the operation of its policy, objectives and plans, at planned intervals, to ensure their suitability, adequacy and effectiveness.

The review should also consider whether the asset management policy continues to be appropriate for the organization's purpose. It should establish new or updated asset management objectives for continual improvement, appropriate to the coming period, and consider whether changes are needed to any elements of the assets, asset management processes and the asset management system.

9.3.2 Inputs to management reviews should include:

a) the status of actions from previous management reviews;

b) changes in external and internal issues that are relevant to the asset management system, including changing circumstances (including developments in legal, regulatory and other requirements related to asset management), changes in technology, and changes in market requirements;

c) information on the asset management performance, including trends in:

   1) nonconformities and corrective actions, including evaluations of performance in addressing incident investigations, corrective actions and preventive actions;

   2) monitoring and measurement results including:

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

      ii) the performance of the assets, asset management processes and the asset management system, including trends apparent from nonconformities and corrective actions, the results of monitoring and measurement, and audit findings;

      iii) the results of other evaluations of the assets or asset management system, e.g. condition or capacity;

      iv) evaluations of compliance with applicable legal and regulatory requirements and with other requirements to which the organization subscribes;

      v) audit results;

d) asset management activities;

e) opportunities for continual improvement;

f) changes in the profile of risks and opportunities;

g) asset performance and condition.

9.3.3 Management reviews provide top management with an opportunity to evaluate the continuing suitability, adequacy and effectiveness of the assets, asset management, and asset management system. The management review should cover the scope of the asset management system and the asset management activity, although it is not necessary to review all elements at once and the review process may take place over a period of time.

Reviews of the implementation and outcomes by top management should be regularly scheduled and evaluated. While ongoing system reviews are advisable, formal reviews should be structured and appropriately documented and scheduled on a suitable basis. Persons who are involved in implementing the asset management system and allocating its resources should be involved in the management reviews.

9.3.4 The outputs from management reviews should include decisions and actions relating to improvements in asset management system and activity including:

a) variations to the scope, policy and objectives;

b) criteria for asset management decision making;

c) updates to performance requirements;

d) resources including financial, human and physical resources;

e) changes to controls and how their effectiveness is measured, including roles, responsibilities and authorities.

9.3.5 The organization should retain documented information as evidence of the results of management reviews and should communicate the results of management reviews to relevant stakeholders. It should also take appropriate action based on the results, while managing any changes (see 8.2).

Management reviews should also cover aspects of the asset management system and activities, if any, that are outsourced to external service providers. Relevant information from management reviews should be communicated to specific employees, external service providers or other stakeholders.

Relevant outputs from management reviews should be used by top management during reviews of the organizational plan.

10 Improvement

10.1 Nonconformity and corrective action

10.1.1 General

The organization should be aware that nonconformities (including failures) can occur in its assets, asset management activity and asset management system. 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 documenting and reviewing past nonconformities, evaluating how the consequences were dealt with, and by determining methodologies to prevent future nonconformity.

Corrective actions are actions taken to address the root cause(s) of identified non-conformances, 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:

a) the identification and execution of corrective measures, both for the short term and the long term;

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

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

10.1.2 Processes for the investigation of asset-related nonconformities and incidents

The organization should establish, implement and maintain process(es) (and their associated procedure(s)) for the handling and investigation of nonconformities, functional failures, and incidents associated with assets, asset systems and the asset management system. These process(es) should define the significant criteria for the investigation of non-conformities or incidents and the necessary responsibilities and authorities (for all the actions listed in ISO 55001:2014, 10.1).

10.1.3 Processes for implementing corrective actions

The organization should establish, implement and maintain process(es) for instigating corrective action(s) for eliminating the causes of nonconformities or incidents identified from investigations, evaluations of compliance and audits, to avoid their recurrence.

Any corrective actions taken and their timings should be commensurate with the risk(s) encountered. Where a corrective action identifies new or changed risks, or the need for new or changed process(es), procedure(s) 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 close-out or completion and the effectiveness of the corrective action(s). Documented information should be kept on the corrective actions taken.

The organization should ensure that any necessary changes arising from corrective actions are made to the asset management system (see 8.2).

10.2 Preventive action

Preventive actions, which may include predictive actions, are those taken to address the root cause(s) of potential failures or incidents, as a proactive measure, before such incidents occur. The organization should establish, implement and maintain process(es) for initiating preventive or predictive action(s). Elements to be considered in establishing and maintaining preventive action processes include:

a) the use of appropriate sources of information;

b) the identification of any potential failures;

c) the use of an appropriate methodology;

d) the initiation and implementation of preventive action;

e) the recording of any changes in processes and procedures resulting from the preventive action;

f) assessment of the preventive action;

g) the input to the asset management plan(s) from preventive actions;

h) the need to keep documented information on the preventive or predictive actions.

10.3 Continual improvement

10.3.1 Opportunities for improvement should be identified, assessed and implemented across the organization as appropriate, through a combination of monitoring and corrective actions for the assets, asset management, or asset management system. Continual improvement should be regarded as an ongoing iterative activity, with the ultimate aim of delivering the organizational objectives. It should not be interpreted as cyclic (e.g. annual) improvement in asset performance parameters just because they can be achieved.

10.3.2 Continual improvement can be organized as a top-down or bottom-up process, or as a combination. The organization should establish, implement and maintain process(es) for determining opportunities and assessing, prioritizing and implementing actions to achieve continual improvement and reviewing their subsequent effectiveness. These processes may include:

a) non-conformity and corrective action (see 10.1), in particular failure and incident investigation (see 10.1.2);

b) preventive action (see 10.2);

c) trends in performance (see 9.1);

d) evaluation of compliance (see 9.1.1);

e) internal and external audits (see 9.2);

f) management review (see 9.3);

g) stimulating employees to come forward with suggestions;

h) management of change (see 8.2).

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

a) active participation in professional bodies and industry associations;

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

c) benchmarking and technology transfer initiatives, and competitor check-ups;

d) engaging specialist organizations;

e) research and development;

f) consultation of suppliers and clients.

10.3.4 Although the opportunities for improvement can be widely different in size 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 (see 8.2) aspects;

e) links with decision-making criteria (see 4.2);

f) selection and execution;

g) tracking of outcomes and review.

Annex A
(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;

— environmental management;

— systems and software engineering;

— life cycle costing;

— dependability (availability, reliability, maintainability, maintenance support);

— 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;

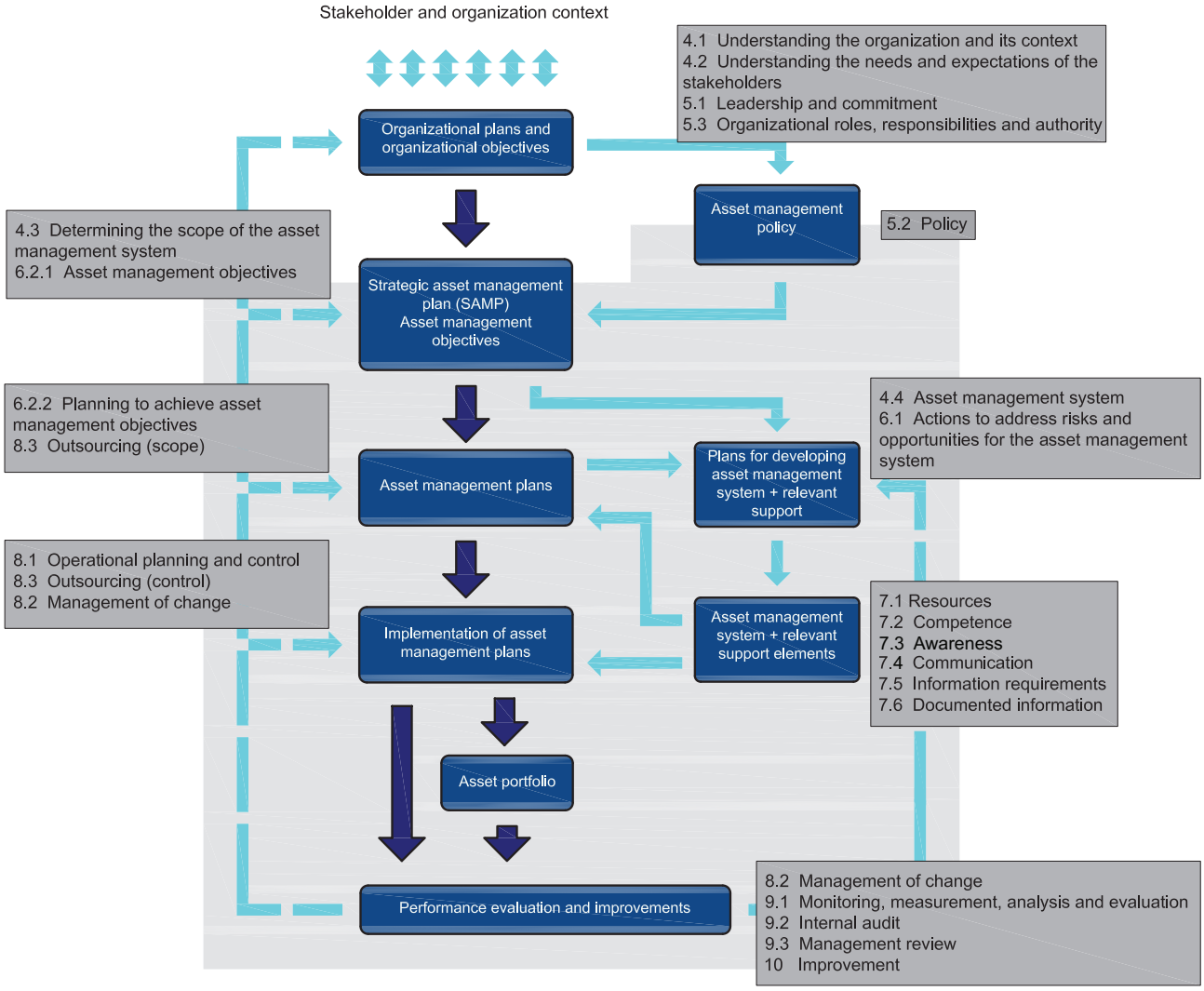
— energy management.

Users of ISO 55000, ISO 55001 and this International Standard should also refer to such standards wherever possible, to ensure consistent delivery of asset management throughout their organization.

Annex B
(informative)

Relationship between key elements of an asset management system

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

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