

Asset Management – an anatomy

Version 4

July 2024



Asset Management – an Anatomy

Anatomy = the study of the structure or internal workings of something for the purpose of examining and analysing its parts

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The Institute of Asset Management (the IAM) is a not-for-profit, professional body. We are owned and controlled by our Members and committed to remaining independent from commercial and trade associations. We exist to advance the discipline of asset management, not only for people and organizations involved in the acquisition, operation and care of physical assets but also for the benefit of the general public. Our priorities are to promote the generation and application of knowledge, training and good practice and to help individuals become demonstrably competent.

Acknowledgments

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Foreword

About this Document

We know that previous versions of the Anatomy have been read and used by a wide range of individuals across business, academia, government (central and local) and not-for-profit organizations in many countries. The first version was published in 2011 and revised in 2014 and 2015. Version 4 reflects feedback from many users and we invite further comment.

We developed the Anatomy to provide an appreciation of asset management: what it is; what it can achieve; the scope of the discipline and a description of the underlying concepts and philosophy. It also describes the knowledge, skills and attitudes that support it.

Using the Anatomy

We encourage you to read the entire document. But, if your time is limited, it is important to understand the key points, returning to read the rest as time permits.

Start with Sections 1 & 2 'Introduction' and 'Executive Summary'. This will cover the basic concepts, identify the breadth of asset management activities - and should demonstrate that this is a discipline worth exploring.

Then read Sections 3 & 4 'What is Asset Management?' and 'Why does Asset Management matter?'. Sections 5 & 6 'Asset Management Models' & 'Doing Asset Management' explain more about concepts and structure as well as the implications for both organizations and people. We also outline the concept of the 'Journey' towards capability for both and what it means to become excellent.

The management system for asset management (ie not the management system for assets) is addressed in Section 6.5. ISO 55001¹ specifies the requirements for those aspects that can be captured and documented in a management system. But the discipline of asset management is much broader than this. So the Anatomy places the management system for asset management in the context of the wider discipline.

Section 7 'The Asset Management Subjects' describes the breadth and integration offered by Asset Management. You may initially think that some Subjects are not relevant to you or your business – but you are likely to get more value than you may anticipate! And you can explore Section 7 in any order; the Subjects are described as self-contained sections but, please remember that Asset Management is the integrated whole.

Of course, we would not have included the other material unless it had value.



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1 Introduction

1.1. Life Can Be Messy!

Urgent and short-term matters can distract us from important activities that can deliver more value, especially long term. Organizations are no different; made worse by the necessary division of responsibilities, which can easily create ‘silos’¹ and loss of alignment. Yet we know that strategic success comes from everyone consistently working towards the right goals: ‘together as one!’.

Stakeholder needs are sometimes seen differently by various departments. Short-term financial constraints can cause waste. There are also diverse perspectives of people and business units separated by geography, markets or professions. These can cause friction because their decisions and actions do not appear

sensible to others. In this fragmented environment, priorities and performance metrics can conflict, causing the opposite of effective teamwork!

In real life, despite good procedures: finance or commercial colleagues talk a different ‘language’ to operations, maintenance and engineering; hard data can be difficult to obtain (or confusing); there are too many ‘surprises’ or incidents requiring ‘fire-fighting’; risk management is inconsistent; investment is needed but there is no consensus about what is most valuable; in fact, there is no single, accurate source of ‘the truth’ anyway. Whether private or public sector, this can lead to reputation damage and inefficiencies, waste and lost opportunities.

If any of this sounds familiar, then reading our *Anatomy* is worthwhile use of your time...



¹. Used in asset management to describe isolated groupings, departments, etc, that function apart from others especially in a way seen as hindering communication and cooperation – increasingly common usage

1.2. Purpose of the Anatomy

The '*Anatomy*' is a good introduction for people seeking to understand asset management. It is intended to:

- Explain the asset management approach and introduce the Asset Management Subjects;
- Help individuals see how asset management can assist their professional development, and integrate their contribution with the work of colleagues and other teams; and
- Help organizations decide whether to adopt asset management or how to improve their asset management capabilities.

Many textbooks and training courses are also available (see Section 8 & 9).

1.2.1. The Anatomy, Landscape and ISO 55000

The Anatomy differs from two other well-known publications in content and application.

- ISO 5500x is the suite of international standards for asset management.² This includes ISO 55001:2024 for management system requirements - against which your organization can be assessed for conformance. Such certification can provide assurance for some stakeholders. ISO standards can help in the early stages of aligning activities to reduce waste and error. But - standards 'language' can be difficult for some readers.
- The Anatomy is aligned with Edition 3 of the Landscape, published by the Global Forum on Maintenance & Asset Management³ to demonstrate the breadth of asset management subjects. (See Section 7)

ISO55001 and the Landscape describe 'what' you need to include in your management system for asset management and define the scope of the subjects that comprise asset management.

1.3. Why an '*Anatomy*'?

The document name is a medical analogy. All doctors should know basic anatomy - as well as developing deeper knowledge and expertise in a chosen specialty. This is similar for asset management. Individuals should be aware of all the Subjects - but the degree to which they need specialist knowledge and expertise depends on the role they perform.

Like the body, an organization is a system, with many interacting parts. So asset management, like medicine, can only be successful through considering all the aspects described in this document. The whole is greater than the sum of the parts!

The Anatomy gives organizations a common language and understanding of asset management. It will also help them to appreciate how they can develop their capabilities and where they are in their own development journey (see Sections 6.2 & 6.4).

Those not familiar with asset management terminology will find the Glossary a helpful resource.



2. ISO – International Standards Organization www.iso.org

3. The IAM has always been a member of the Global Forum on Maintenance & Asset Management (www.gfmam.org) and was a significant contributor to the original Landscape and its revision projects.

2 Executive Summary

Discussing football with someone who has never seen a game, let alone been to a match or tried to play it, can be quite challenging. With something as abstract as asset management, this is even harder. This document describes what asset management is (and what it is not), gives some context about its evolution, and sets out its key principles and ideas. We then consider why it matters and the implications and benefits of adopting this approach. We consider some models and what they represent before discussing what it means to adopt asset management in real life.

2.1. It's Not Just About the Assets

Unless it is a thing of beauty, an asset is just a means to an end. In other words, value comes **from** assets – **IF** you treat them right. Assets can also quickly become liabilities (more later). Asset management is about using assets to deliver value and achieve the organization's objectives.

Value is whatever matters **to your organization**. And this means that we think of assets as, literally, anything that is, or could be, valuable to the organization. These include brand or reputation, intellectual property, know-how and people, natural resources, as well as money or physical or manufactured things. All the '**Outcomes**' of the organization's activities are relevant, including perceptions as well as measured outputs. (See Section 3.4.1 for more about **Outcomes** as distinct from **Outputs**.)

To be useful, 'value' needs to be a single, organizational consensus, that recognizes and manages the contradictions and trade-offs. It is important to think more widely than money - and we recommend '*The 6 Capitals*⁴' because that is becoming the accepted framework for Integrated Reporting. The alignment with the IAM's 10-box Capabilities Model is described in Section 5.

...a strategic, long-term, and integrated approach, which is essential to address multi-dimensional problems, such as Sustainability...

2.2. It's Bigger than Just the Technical Activities

To realize value from assets means selecting, and caring for, the right ones. We need to consider the whole asset life cycle (including repurposing / disposal / recycling – see Section 3.5.3) so that we consider the total cost and benefits of ownership. We call these activities the Management of Assets⁵ (MofA) or just 'Managing the Assets'. Such a structured approach is rarely applied consistently, so Managing the Assets better can bring large savings and other benefits.

But spending more to have better assets may bring no business benefit. The only way to know is to understand the organizational goals and compare the impact of different MofA. This requires integrated thinking and holistic decision-making - to optimize expenditure, outcomes and value - along with a range of critical 'enablers'. This broader, deeper approach is 'Asset Management'.

Asset Management is truly strategic: the organization cannot sensibly set goals without understanding what resources (assets) are necessary. Therefore, organizational objectives need to be derived iteratively, to determine which assets and costs⁶ are worthwhile. Value Chain thinking, Operational Excellence and similar techniques align nicely with the 10-box Model.



4. Search Integrated Reporting or 6 Capitals or see <https://integratedreporting.ifrs.org/what-the-tool-for-better-reporting/get-to-grips-with-the-six-capitals/>

5. See also ISO TC251 Article "Managing Assets in the Context of Asset Management" <https://committee.iso.org/sites/tc251/social-links/resources/guidance.html>

6. 'Costs' here means Expenditure i.e. both 'operational expenditure' (OPEX) and 'capital expenditure' (CAPEX).

2.3. Coordinated Activity – it's Teamwork!

Successful asset management requires the active participation of many individuals within an organization (AND its partners and supply chain). It requires the understanding and support of internal and external stakeholders (such as shareholders, regulators and customers) who may wish to exert influence. Asset management is delivered by cross-functional teams at all levels of the organization; and the choice of strategic outcomes requires steering from leaders.

Have you ever wished that every colleague understood the organization's aims and priorities as well as you? Or that, in your absence, everything went the way you would wish it? The structured approach of Asset Management, with the right culture, can transform performance and outcomes AND sustain this success. But, permanent transformation requires resources and persistence! This is **not a quick project** and the organization will need time to improve its asset management capabilities. This is not something to be undertaken lightly. (You may find a popular 9 minute video helpful: The Big Picture⁷.)

In addition to outputs and KPIs, a good reason for adopting asset management is the increased assurance that your organization will achieve its goals⁸ (assuming your strategy has come from an asset management approach). In the face of a world of increasing uncertainty, this is valuable!

...a framework for gathering and integrating reliable information – a single source of truth across finance, assets, people, risk-data of all kinds...

2.3.1. Management Systems, Integration and Silos

Although we are focusing on philosophy and ideas, these transformative changes work best when underpinned by a management system for asset management. We advocate taking the requirements of ISO55001 into your organization's existing management system(s) rather than introducing a standalone system⁹.

Asset Management is an integrating influence. It reduces silo boundaries and ensures better collaboration and engagement of all professionals. This helps align the organization's priorities and activities. Compromises will be transparent, conscious, multi-disciplinary and less misunderstood. There will be fewer 'U-turns' and frustrating changes of policy. This is especially beneficial for capabilities (like know-how or culture) as well as long-lived physical assets – they all need consistency. Similarly, asset management should not be a new silo! There may be benefit in developing a small group of experts – 'coaches', to extend the football analogy. But everyone should 'do' asset management and be part of the 'Line of Sight' (Section 3.4.3).



7. www.theIAM.org/BigPicture

8. See Section 3.5.1

9. But, if no management systems are in place, ISO55001 is a good way to start.

2.4. Linking Assets to Value and Income

You can only effectively manage assets as costs if you also know how they contribute to revenue or outcomes. Investing to make assets better or more reliable is pointless unless this has value. So, asset expenditures should not be cut without knowing what potential harm you are doing to future liabilities, risks or performance. This seems obvious but surprisingly few businesses or governments do this rigorously!

What is the value to a university of a shiny, **empty** lab? Maybe a great deal if it attracts the right researcher who brings funding! Which assets are critical, not just performance but their income stream? Why manage construction as a project when there is no income until the asset is in use – and then: how maintainable is it / does it attract income / does it achieve net zero and so forth? Can a little extra preventive maintenance defer a Capex renewal – so why are Capex / Opex budgets often separate? Indeed, what is the total cost of ownership (probably not so novel these days) – but what is the total value over the life cycle?

Asset management enables everyone concerned to contribute to: options, opportunities, insights, innovation and so on. It is the context and perspective for handling trade-offs, and the means by which assets can then best be managed.

People have managed assets for centuries, sometimes better than others, whether financial assets or any other kind. In the last century or so, profits have dominated the consumption of natural and other assets, without counting or reporting the damage and outcomes. ESG¹⁰ / sustainability is really important to most people and can best be achieved with a structured approach. Asset management provides the means to deliver this.

... a consistent decision-making framework to optimize Capex/Opex incorporating outcomes (value) such as the 6 Capitals...

2.5. Summary

Asset management is concerned with making better use of resources, with outcomes. This makes it useful for combatting climate change, raising living standards or whatever goals you have set.

It provides a whole-life / whole-cost perspective and a structured approach to investment appraisal, setting strategies, defining programmes of works, evaluating and forecasting benefits and performance. At its best, it engages stakeholders, trades-off short-term sacrifices for long-term gains, benefits communities and commercial interests.

Asset management is strategic: 'the way that you do things' not additional things to be done. It is sometimes presented as complicated (by people with vested interests) but much of it is relatively straightforward. However, it requires change and practice¹¹, which takes time, consistency and commitment. Do you know any instant solutions that return value **over the long term**?

The five Principles are intended to be memorable – and a touchstone for checking what the organization does in more formal ways, for example procedures or the AMS¹². Memorable phrases like 'the Line of Sight', 'Guiding Mind' or 'Single Source of Truth'¹³ are reminders to everyone of why and what – and, most of all, how - the organization should be doing its work.

You might be surprised that we are highlighting 'soft' issues rather than technical process and procedures. Asset management is a mindset or paradigm¹⁴, and your organizational culture will either foster or destroy it. Consider a budget meeting: are people competing for 'their share', or considering the overall allocation of resources (all 6 Capitals) to achieve the best result for the organization?

We hope this short summary has whetted your appetite to read a bit more...

10. Acronym: Environmental, Social & Governance.

11. See Section 6 for more about Excellence & Maturity in Asset Management

12. AMS – the Asset Management System (for asset management not the assets directly)

13. Single source of truth – from integrated data and decision-making (removing 'fake facts' and argument)

14. A set of assumptions, concepts, values, and practices that constitutes a way of viewing reality for the community that shares them, especially in an intellectual discipline.

3 What is Asset Management?

Throughout the Anatomy, we consider not only asset management (the philosophy or approach) but also assets and an underpinning asset management system¹⁵.

Asset management is about more than the assets themselves – it is about all the activities and behaviours of an organization. In fact it is defined as: “the coordinated activity of an organization to realize value from assets”.

Asset management is relevant to all organizations, whether they are large, small, private, public, government or not-for-profit. It applies to every person involved in that organization (and also outsourced or partner organizations).

3.1. Asset Management is a Mindset

The perspective of Asset Management is holistic and long-term. There are two important aspects. Firstly, **value is subjective** and needs to be carefully targeted (before strategies, plans and action!); and, secondly, the aim is to **realize that value** from the choice, use and care of assets.

Furthermore, value should be holistic, having forms that are separate and not comparable, e.g., manufactured, intellectual, human, social and relationship, and natural - as well as financial¹⁶.

We recognize that judgments and compromises must be made. In the early days, this was often summarized as juggling cost, risk and performance over the long term. But there is now a wide range of good practice and techniques to address a range of subtleties.

We aim for perspectives that encompass: whole-life costs and value; the needs of all stakeholders (not only customers); and, vitally, to avoid the short-termism that erodes long-term value. This is particularly important for assets that outlive ‘book value’ or indeed outlast successive managements and users, e.g. infrastructure. The actual owner is less important than ‘the guiding mind’, especially when

considering assets that may change ownership during their useful lives or may outlive a number of changes of manager. (See Section 6.7)

Asset management is successful when understood strategically, and when applied consistently by all involved. This requires the reduction or elimination of the many silos that exist in nearly every organization. The critical success factor will usually be the culture (and therefore the leadership) of the organization – and probably its partners and stakeholders. So the biggest challenge is to create the right culture¹⁷, manage perceptions and commit to longer-term value.

This is why adoption of an Asset Management approach represents an organizational transformation rather than just a project or introduction of some new tools and techniques.

3.2. Key terminology and Ideas

A web search for “asset management” will yield many results related to the management of investment and finance; as well as a confusing range of apparent variants related to physical assets and maintenance. For example, *strategic* asset management, *property* asset management, *facilities* asset management, *infrastructure* asset management, *enterprise* asset management and others seem to claim a special case or ‘difference’. These descriptors do not change the central philosophy, whatever the nature of assets to be managed.

Asset management is much more than just ‘Managing the Assets’, i.e. the hands-on activities done to (particularly physical) assets over their life cycle. It is about choosing and using assets to deliver value and achieve the organization’s objectives. It is about their cost and value initially but also overall. Managing assets is important (and we explain this in more detail later) but this needs to be done in the context of ‘Asset Management’¹⁸. Figure 1 demonstrates the scope of asset management¹⁹.

15. See Section 6.5

16. The 6 Capitals framework <https://integratedreporting.ifrs.org/what-the-tool-for-better-reporting/>

17. See Section 3.4.5

18. ISO/TC251 Article: “Managing Assets in the Context of Asset Management” <https://committee.iso.org/files/live/sites/tc251/files/stories/ISO%20TC251%20WG5%20IATFMO%20April%202017%20Rev3%20EN.pdf>

19. In a mature Asset Management organization the boundary between Asset Management and Managing the Organization blurs more and more – because the philosophy and approach is fully embedded throughout

The widely accepted definition of Asset Management is “the coordinated activity of an organization to realize value from assets”, where an asset is an “item, thing or entity that has potential or actual value to an organization”. Note that this can include literally **anything of potential or actual value**, including

non-physical things such as intellectual property, data, knowledge or reputation of the organization. It is useful to remember that our focus is not just about protecting or enhancing the value OF assets (what they cost, or could be sold for) but also realizing the value obtainable FROM the assets and their usage.

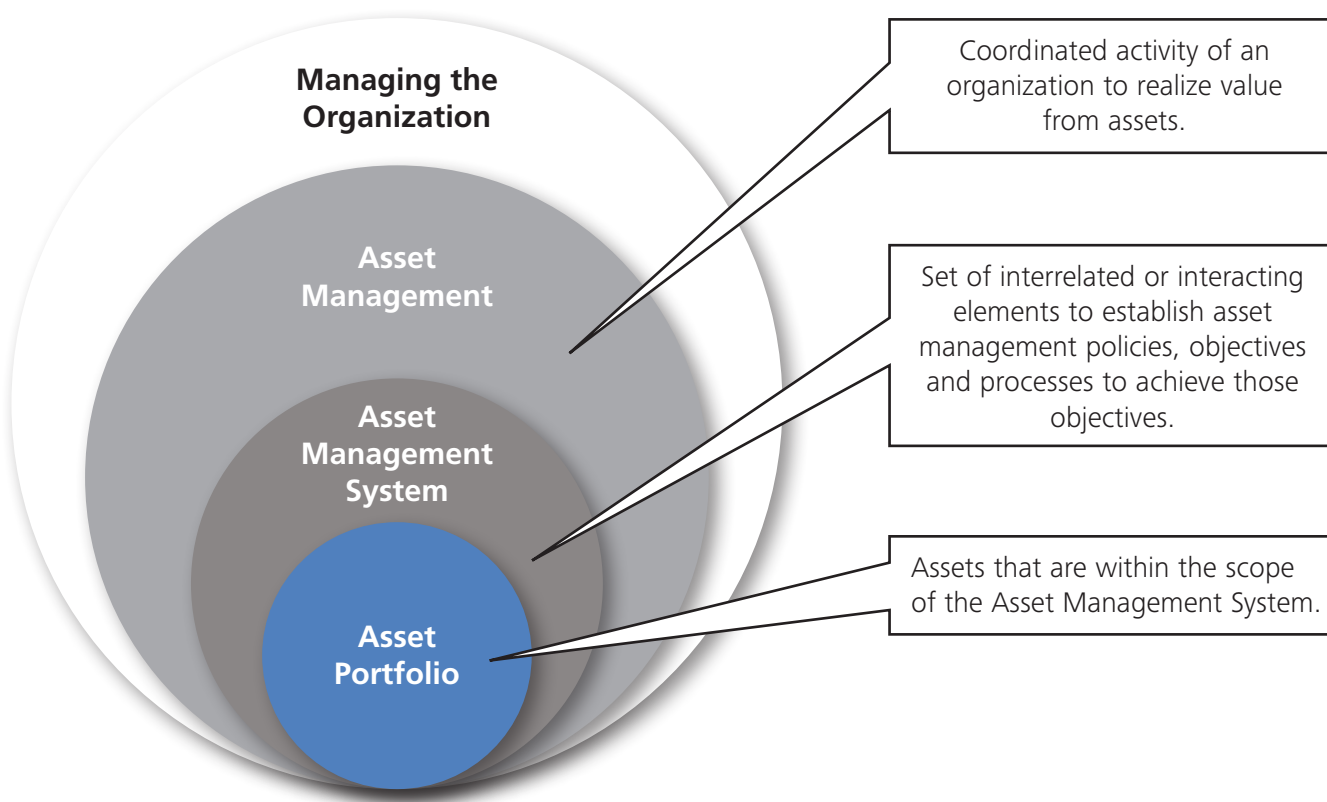


Figure 1: Relationship between Asset Management and other entities ('Onion Diagram')

Obviously, coordinating activities across a whole organization is a much bigger challenge than activities directly affecting a particular asset – hence alignment is of major importance (see Section 3.4.3). This requires a different approach and an holistic way of thinking. It follows that adopting asset management is not a simple change project; but a more fundamental and permanent transformation of organizational alignment and culture. (See Section 6.1)

In order to realize value, each organization **MUST** determine clearly what it considers value to be. It is not unusual for an organization adopting asset

management to need to revise existing strategies. Strategies that are derived from desired outcomes (and manage unintended outcomes) will enable clarity of purpose and better management and decision-making. This should integrate all forms of value (not only financial) and align with emerging requirements across the world for Integrated Reporting²⁰.

There is growing global recognition of, and support for, asset management. The urgent need for planetary sustainability²¹ will encourage organizations to implement asset management, because this improves consistent delivery of the necessary actions.

20. Integrated Reporting – see <https://integratedreporting.ifrs.org/>

21. NB Asset management also helps sustain the success of the organization itself, as distinct from the planet

3.3. Origins & Evolution of Asset Management

Asset management is not new - people and organizations have been managing assets for a very long time. However, it was not until the 1980s that the term 'Asset Management' started to be used in the private and public sectors in relation to physical assets in various parts of the world:

- In the UK, the North Sea oil & gas industry adopted the term in the era following the Piper Alpha oil platform disaster and the 1980's oil price crash. Radical change was needed, and it was found that the creation of small, dynamic, multi-disciplined teams managing each oil platform (the 'asset') with a full life cycle view led to innovation and a clearer focus on value, which resulted in big improvements in performance, safety and productivity.
- At about the same time, the public sector in Australia and New Zealand was facing falling levels of service, escalating costs and poor planning. This triggered a series of activities to establish much better strategic planning, prioritization and value-for-money thinking, with the first public sector 'Total Asset Management Manual'²² being published in 1993.
- In 1988, the US National Council on Public Works issued a landmark publication: '*Fragile Foundations: A Report on America's Public Works*'²³, which led to the adoption of federal asset management policies with an emphasis on achieving a desired level of service at the lowest life cycle cost. These policies have guided federal funding programs in transportation, water and wastewater for several decades.

Since then, there has been significant evolution in the understanding and principles of asset management, with a number of approaches, standards and models being developed across the world. The IAM is one of the bodies that has developed its own conceptual model of asset management to convey the core components and how they integrate. This process of exploring various, differing ways to describe the breadth and interaction of asset management activities has been very healthy for the development of the evolving discipline.

Since 1994, the IAM has worked in conjunction with many other organizations around the world to develop and refine the discipline of asset management. We have initiated and produced many globally accepted documents to explain the discipline. We have also encouraged convergence of global thinking on asset management, because we recognize the benefits of a collective view. This is especially valuable for organizations that: manage very diverse assets, operate in multiple countries, have complex stakeholder environments, or manage assets owned by others.

The most notable developments in this global convergence have been publication of:

- the IAM's BSI PAS 55:2004 'optimal management of physical assets' specification, updated 2008
- the GFMAM's 'Asset Management Landscape' published in November 2011, now in its third edition June 2024; and
- the ISO55000 series of asset management standards, first released in 2014, updated 2024



22. https://www.google.co.uk/books/edition/Total_Asset_Management_Manual/3kweNQAAIAAJ?hl=en

23. Catalog Record: '*Fragile foundations: a report on America's Public Works*' | Hathi Trust Digital Library

3.4. Principles of Asset Management

The following five Principles, taken together, establish a foundation for understanding asset management. They provide guidelines for applying asset management. Principles²⁴ may therefore be considered necessary inputs, rather than outcomes, of Asset Management. They are:

An Outcomes Focus

Responsiveness to the Organization's Context

Alignment throughout the Organization

A Whole-of-Life Perspective for Assets

The Right Culture and Leadership

3.4.1. An Outcomes Focus

Output is a well understood term. But we also use 'Outcome' because it includes the impacts and consequential effects of an output. Direct consequences are usually intentional and/or predicted but second-order and unintended consequences should also be considered. This leads us, of course, to consider outcomes 'for whom'? Whether or not results are as planned, they will affect different stakeholders in different ways. Satisfying the needs and expectations of stakeholders includes considering how these groups will be affected, sometimes long into the future.

Each organization should determine the outcomes it desires, taking account of the needs and expectations of its stakeholders - and then define its strategy explicitly to deliver these. It will then implement this strategy by setting appropriate objectives and planning the delivery activities. This requires organizations to consider value in all its aspects²⁵.

The organization's purpose and desired outcomes should be explicit, written and well publicized. Explaining the choice of desired outcomes promotes clarity of purpose and deeper understanding of the objectives. The process helps coordinate and align the organization's activities to achieve them. The organization cannot set realistic objectives without considering its capabilities and the assets required; and this needs to be an iterative process enabled by asset management.

Similarly, the monitoring and review of outcomes, and the value they represent, needs to be part of a continual improvement process. Therefore, outcomes should be defined such that they can be assessed and/or measured by routine audit.

Any unintended outcomes of the chosen strategy and activities must be recognized and mitigated as well as reported.

3.4.2. Responsiveness to the Organization's Context

The organization's choice of desired outcomes is unrealistic - unless it considers its context. This comprises not only its external business environment (competitors, regulatory, etc) but also its internal context (resources, capabilities, maturity, adaptability etc).

Both the context and the available resources are likely to be constantly changing, so successful organizations must foresee and adapt in good time. In some sectors this requires extreme agility, e.g. consumer technology whereas infrastructure is often more stable. Every organization needs appropriate 'horizon-scanning' arrangements, to ensure it becomes aware of relevant change early; and then must develop timely plans accordingly (which might mean changing its chosen outcomes, purpose, strategy and so on).

Some assets can quickly become liabilities in certain circumstances and these risks should be identified and monitored. Specifically, this means considering potentially 'stranded' assets as early as possible.

The organization should apply this approach throughout its organization and portfolio of assets. This includes its own capabilities; and it needs to prioritize those assets that take a lot of time and effort to create, acquire or adjust. An example is human capabilities which are hard to develop and can be lost quickly.

24. Principles must not be confused with 'Requirements' of any management system. Principles are broader in nature and express the philosophy underpinning Asset Management. Because this is about guidance and thought processes (not requirements), it is meaningless to attempt to certify or audit an organization against the implementation of Principles. See Section 6.2 & 6.3

25. For example, the 6 Capitals, already introduced

3.4.3. Alignment Throughout the Organization

Good asset management creates clear connectivity between the organization's desired outcomes, purpose, strategies and plans, which are delivered by its staff (and partners / outsourced activities). This vertical alignment (the 'line of sight') enables everybody to understand how they contribute to achieving success.

But there needs also to be horizontal alignment of all departments, professions, and specialists across the value chain, which addresses the well-known problem of 'silos'. The leaders and management systems of the organization need to be vigilant for problems arising from misalignment.

Note also that these lines of sight are bi-directional. It is vital that information and iteration of strategies and plans is both 'top-down' and 'bottom-up'. This requires senior management decisions, strategies and plans to take account of bottom-up, fact-based realities, i.e. asset capabilities, performance, opportunities and constraints.

The line of sight is important for giving staff direct visibility of the purpose of their work. It also helps to stimulate creativity and innovation. People who understand what is important (and why) can often identify new and better ways of achieving goals. There is more understanding now of the value of diversity and inclusion, and this integration of professions and perspectives, both vertical and horizontal, is valuable for the organization. Specifically, decision-making needs to consider the conflicting needs or aims of particular groups or departments and produce decisions that achieve the best outcomes.

Asset Management is a multi-disciplinary activity and everyone in the organization should have at least some understanding of its aims and the value it delivers.

3.4.4. A Whole-of-Life Perspective for Assets

Assets are there to deliver value throughout their life, by definition. There are appropriate measures of service²⁶ life, e.g. 'beyond economic repair'. The leaders of organizations with long-lived assets will change relatively frequently; but the assets benefit most from a continuity of care.

Assets may transfer ownership during their useful life; or may become valuable to the circular economy, once no longer valuable to their current owner. Typical 'book value' and cost accounting do not always include: disposal, residual costs, liabilities, and societal impact. Whereas the organization should do so, across the full range of potential value influences (e.g. 6 Capitals). Such consideration of overall value overcomes the narrow focus of CAPEX and OPEX (e.g. adjusting maintenance frequencies might defer renewals) and all consequences should be factored into decision-making.

A long-term, outcomes view allows the organization to optimize what is done to assets, and when. Without a whole-of-life and holistic perspective, organizations are prone to 'short-termism'. For example, cash difficulties may tempt management to cease staff training or have 'maintenance holidays' with no explicit acceptance of the inevitable long-term on-costs and other consequences.

Assets include physical and non-physical and a wide range of capabilities and resources. Some assets may have a short life whereas others, like knowledge, may have a less definable end. A whole-of-life perspective considers all assets appropriately, in the context of the organization's purpose and outcomes.

For practitioners, physical assets and systems can be complex and often interdependent. Their lifetimes can vary from a few years to hundreds of years, even within one system. Importantly, assets have no voice; so technical analysis is required to understand consequences of differing treatment. Capabilities may also be 'long-lead' and easier to destroy than create or acquire.

26. Typically - service life = useful life + mature life (where 'mature life' = maintenance no longer effective phase)

3.4.5. The Right Culture and Leadership

How people see things determines what they do; and this depends not only on their prior experience but the culture around them. Every organization has a culture, whether or not it has been chosen and engendered. In fact, most organizations have a variety of (potentially conflicting) cultures in different parts. Asset management helps align behaviours and objectives across the whole organization, thereby underpinning the teamwork desired by leaders. Asset management also needs the right culture to deliver most value.

A successful asset management organization ensures everyone understands why it does asset management, and the behaviours it expects of everyone. Leaders exist at all levels and are thereby aligned and can promote productive behaviour.

Asset management is the 'way' everybody does their job and the means by which the organization aligns everyone's work.

The choice of culture (including asset management perspectives and values) is the job of top management – and cannot be delegated. But, everyone can promote the right culture, especially to incomers and external partners, and thereby reinforce and perpetuate the clarity of purpose and values of the organization.

NB. There may be a small department of asset management specialists – particularly during initial adoption - that has specific expertise in asset management. But maximum value is gained by everyone appreciating the bigger picture²⁷.



27. www.theIAM.org/BigPicture

3.5. Other Distinctive Aspects of Asset Management

The Principles above are a useful aide-memoire for both asset management professionals and everyone else in the organization. But there are several other key ideas that are worth mentioning at this stage (although these ideas are developed in more detail later).

3.5.1. Assurance

One of the most important reasons for ‘doing’ asset management is the significant improvement in assurance that the organization’s purpose and chosen outcomes will be achieved.

Assurance is the combination of monitoring and auditing (of processes and outcomes) to confirm the assets, systems and processes are operating as intended. Good asset management embeds an effective framework for assurance, to ensure that both assets and asset management activities will fulfil their required purpose consistently and sustainably over time.

An assurance framework includes: policies, plans, business processes and information systems, along with competent resources to monitor and demonstrate assurance to the appropriate levels of management²⁸ and/or externally.

3.5.2. Value and Values

It is important not to confuse an organization’s ‘values’²⁹ with the value produced by its activities. An organization’s corporate values are part of its culture and act on its activities, as constraints or enablers.

Once it has been realized that value comes mainly from the correct choice and use of assets, it becomes

helpful to integrate this into the value chain for the organization. This may mean differentiating the different value (e.g. 6 Capitals) to various stakeholders in and outside the organization.

Three widely used approaches to conceptualizing value in an organization are:

- the Value Stream, which is an Operational Excellence concept, focusing on customer satisfaction;
- the Value Chain, which is a strategic business concept, focusing on competitive advantage; and
- the Value Framework.

A value chain describes how a defined set of activities combine within an organization to create value. The focus of the value chain is the ‘value proposition’ to the customer; whilst value to the organization is measured by: ‘profit’ in ‘for-profit’ organizations and ‘service’ for ‘non-profit’ organizations. Assets are aligned through the value chain to support the customer value proposition.

For example, sports and entertainment venues today focus on the “audience experience,” in their marketing campaigns. This experience includes stadium aesthetics as well as access to the stadium and pre / post game activities in the stadium area. The value chain allows capture of all the activities and assigns value to the assets that support each activity. Audience experience can be enhanced without rebuilding the stadium. The asset management perspective is that having the right assets in the right place at the right time (and working together) supports the organization’s value chain and is critical to success.

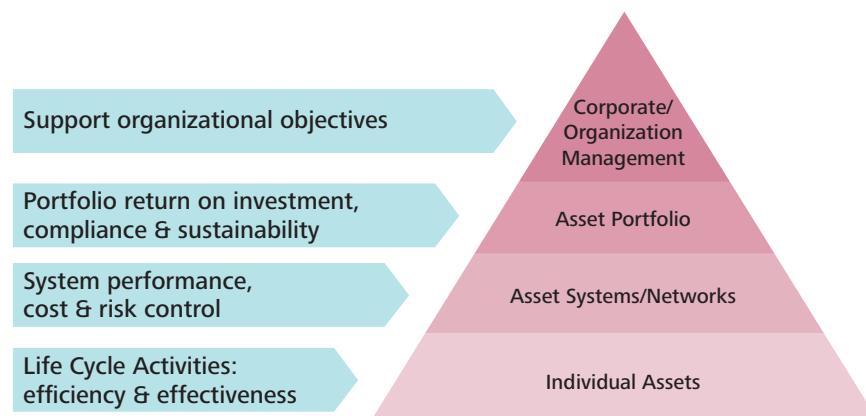


Figure 2: Hierarchy of assets within an integrated management system

28. For example, ISO 55001:2024 specifies a management system for asset management; and organizations may have integrated various management systems.

29. Values are the things that you believe are important – and determine your priorities

Examples of an asset system in a manufacturing organization would be a production line or, in transportation, a road or rail route. A railroad operating trains from station A to station B, is concerned with the condition of its tracks and rolling stock as contributors to customer satisfaction. On-time performance, comfort, aesthetics and safety may all be influenced by asset condition.

A larger entity would be a transportation system, which is concerned with moving people from area A to area B. The collection system and the transfer system needed to get passengers on the train may be more expensive, time-consuming and complex than the train itself, with ticket purchase and schedule / timetable information also being important parts of the transport system.

3.5.3. Life Cycle Activities

The concept of life cycle activities is easy to understand at the lowest levels of asset granularity, such as physical equipment components. However, as discussed above, assets usually contribute value in a systems context.

There are many variations for the descriptions used for the stages of the life cycle. The naming and number of the stages, and the activities under each stage, can vary in different industry sectors. But a common principle is that the life cycle includes all aspects of managing assets from the initial concept through to disposal. Figure 3 illustrates some examples. Section 7.7 identifies the life cycle stages used in the IAM's 10-box Model.

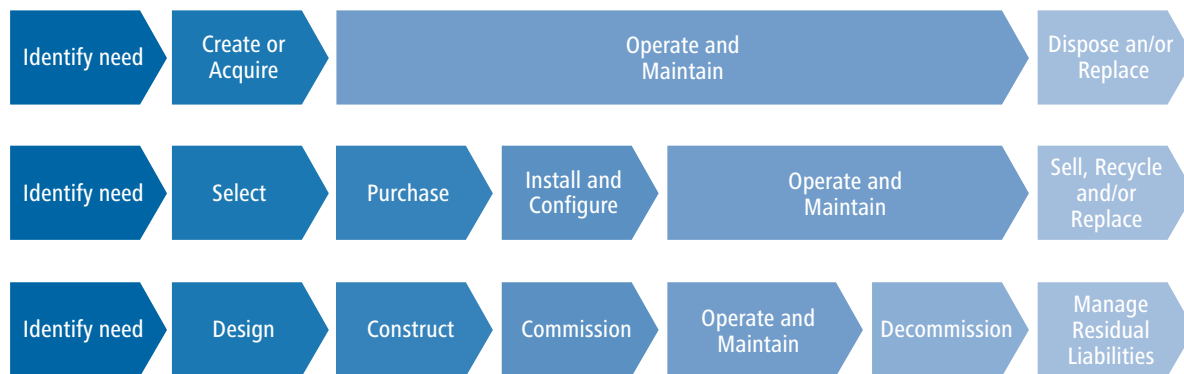


Figure 3: Examples of variations in the description of asset life cycle stages

The concept of the life cycle can become more challenging where:

- more complex asset systems are considered. These can have a finite or infinite 'functional life', depending on the continuing need for the asset system, and how renewal is managed. 'Patch and continue' maintenance strategies, component asset replacements, modifications, obsolescence, changing functional demands, recycling, repurposing and other options need to be considered for managing the asset system.
- an asset has a series of owners during its life, with different objectives, value criteria and planning horizons.

Asset management promotes integration of activities across the whole life cycle not just consideration of individual life cycle stages. This focus on integration particularly affects the design phase, which can

determine as much as 80% of the total life cycle costs of an asset, as well as a large portion of its environmental and social impact.

3.5.4. Asset Management Decision-making

Competent, consistent, optimal decision-making is a vital element underpinning successful asset management. In making asset management decisions, it is important to find the right compromise between competing interests. These might be asset utilization/performance versus asset care (maintenance), capital investment cost versus operating expenditures, or short-term benefits versus long-term sustainability.

It is also important that the approach applied is proportionate. Asset management decisions vary greatly in complexity and criticality, so it is inappropriate to apply the same level of

sophistication to all decisions. Simple, non-critical decisions can, and should, be made with (educated) common sense. Whereas higher impact decisions, with multiple influences, options, timings or inter-dependencies require systematic, multi-disciplined and auditable decision-making.

Organizations need to choose appropriate combinations of tools and techniques (e.g. Lean, Six Sigma, Total Productive Maintenance, Reliability Centred Maintenance) to support decision-making and improve asset management. This includes Operational Excellence (which builds upon continuous improvement methodologies such as Lean and Six Sigma), to bring a workplace focus to problem solving, teamwork and leadership, thus meeting customer needs.

The term 'optimizing' is often used in relation to asset management decision-making. It describes the process of establishing compromise, between a set of competing factors, for best value. This can range from a subjective, qualitative judgement to more sophisticated techniques.

3.5.5. Asset Management as Integration

Asset management draws on contributions and professionals from a range of disciplines (such as business, risk, finance, design, project management, maintenance, data / information and safety). Decision-making and activities (both asset and asset management) cross all stages of the asset life cycle and all levels of the asset portfolio.

Modern business understands the advantages of inclusion and diversity; and asset management, by its very nature, can integrate everyone's capabilities and work. It is this integration of effort and contributions that makes the practice of asset management so valuable.

This provides a career development path from any initial profession towards senior positions that are most effective when they have a holistic view. Anyone practising asset management no matter from what background or organizational function needs to understand the shared vision of asset management. This encourages an abiding interdisciplinary approach and helps the organization avoid the development of future silos.

3.5.6. Asset Management as a Field of Professional Practice

Asset management is now viewed as a professional practice. This practice includes strategy and cultural change to improve the value delivered by organizations. It also includes developing and implementing asset management programmes or systems, working in those systems, evaluating them, and improving them.

Individuals are likely to be working already in a wide range of technical and business professions. Those who aspire to senior roles, should be willing to work towards common outcomes across the organization. Irrespective of their primary discipline, a better understanding of asset management supports this professional development.

An asset management professional is of great value to an organization. They can help integrate the contribution of teams, provide an overview that supports the right priorities, and enable the organization to excel. This structured approach helps everyone do their work better with better results.

The IAM has been a major contributor to the development of asset management as a profession. There is a well-established Competences Framework and we offer public Qualifications that support professional development (see 6.4 The Individual Journey) as well as hosting the Register of Asset Management Professionals.



4 Why Does Asset Management Matter?

There are several ways to look at this question and understand the reasons why asset management matters.

For many organizations, asset management will be the next frontier in value creation and risk reduction. It also brings its own business case and management imperatives. Any organization, large or small, will find that one or more of the driving factors identified in this section, applies to them and supports their case for adopting asset management.

When we consider the global changes facing asset intensive organizations, these can seem insurmountable or in conflict with each other. Challenges such as climate change, resilience, sustainability, ESG or social well-being require organizations to address them. But these significant commitments are **in addition** to their original purpose.

Asset Management provides a framework and approach to look at all these challenges holistically, to determine the best way of addressing them – but in the context of the wider stakeholder needs and expectations.

4.1. Asset Management Benefits

Benefits can include, but are not limited to:

- Improved financial performance;
- Informed asset investment decisions;
- Managed risk;
- Improved services and outputs;
- Demonstrated social responsibility;
- Demonstrated compliance, e.g. environment and other regulatory / legal;
- Enhanced reputation;
- Improved organizational sustainability, coordination and communication; and
- Improved efficiency and effectiveness.

Some benefits can be directly assessed and quantified, for example reduced capital and maintenance costs, increased asset availability and reduced risk exposure. Other benefits can be much more difficult to measure but may be equally important in terms of revenue generation or overall business performance (such as improved reputation, and customer/stakeholder satisfaction). Also, although many benefits are realized over the short term, savings in whole-life asset costs may not be delivered for a number of years.



There is growing evidence from around the world that effective asset management is a differentiating capability for an organization and helps it:

- operate safely;
- meet its regulatory and statutory obligations;
- evaluate future business strategies for the delivery of differing performance, cost and tolerable risk profiles; and
- optimize the cost/benefit of assets throughout their lives.

4.2. The Business Case for Asset Management

The traditional business case for asset management has typically focused on cost savings through reduced operations and maintenance costs, along with improved productivity through increased reliability and availability.

These are important benefits, but there are many other potential elements in the business case which may prove equally or more important, e.g. improved coordination and communication:

- Effective management of value, risk and liability is also part of the standard business case. Good governance, and a good understanding and control of assets, can improve stakeholder confidence (e.g. customers and regulators acting on behalf of customers) and result in lower insurance premiums;
- Effective asset management improves both personal safety and process safety, reducing the risk of injury and catastrophic events;
- Assets contribute to the reputation and image of the organization, just as they contribute to its operation. Assets are often the front door to the enterprise, such as in hospitality and retail, and improved design contributes directly to increased visits;
- Asset management allows large organizations to standardize and simplify plants and equipment, reducing costs for spares and supplies, as well as training and support;
- Improved understanding of asset performance through improved data and analytics;
- The management of outsourced services is more effective when asset management is in place;
- In many organizations, the need to allocate operational expenditures and capital expenditures effectively across units and divisions is also an important driver;

- Asset management moves this allocation into the realm of quantitative management, based on objective evidence from data and information; and
- Safety, health and security programmes require current asset knowledge.

For many stakeholders, including senior executives, the case for asset management being a core activity to mitigate business risk, is established when a large proportion of the total assets on the balance sheet comprise property, plant and equipment. A key role of asset management is to assure the delivery of value, in line with:

- agreed performance / levels of service;
- Return on Investment (ROI);
- required residual risk profile (safety, asset reliability, reputation etc); and
- the projected profit and loss account and cash flow statement.

4.3. The Organizational Effectiveness Case for Asset Management

Within any organization, there will be supporters of asset management at all levels, as it provides a means to improve aspects of organizational effectiveness that they value, for example:

- Boards of Directors will use it as a tool for assuring that risks are in alignment with the Board's risk appetite, and for satisfying Regulators;
- CEOs (Chief Executive Officers) find it to be a powerful tool in resolving conflicts among divisions over resource allocation;
- CFOs (Chief Financial Officers) will use it to improve integration of technical and financial information and improved financial performance;
- Public Relations Officers expect to use it as a way to improve image and reduce or deflect exposure from incidents;
- Delivery managers will use it as a way to improve their influence through increased transparency of costs and risks;
- Operations and maintenance personnel will use it to help escalate and resolve operational issues and improve job satisfaction; and
- The majority of all employees favour sound environmental policies and practices related to assets.

4.4. Improved Management of Risk

The activities of all types and sizes of organization involve risk. The ISO55000 standards use the widely adopted definition of risk - 'effect of uncertainty on objectives'. The uncertainty can come from external or internal factors and influences.

An organization's approach to risk management will be determined by its risk appetite and tolerance. These will be influenced by its organizational context: its sector, stakeholders, culture and objectives.

An organization's assets are often the leading edge of its exposure to external risk. For example: buildings and other structures are exposed to environmental risks from weather and climate change; and transportation and utility infrastructure are exposed to increasing safety and security risks. All organizations are exposed to resource depletion or constraints, and changing economic conditions. Risk also arises from internal circumstances, including the construction, operation, maintenance and disposal of assets.

Asset management's risk-based approach supports organizations in strengthening their resilience to external risks. This enables better control and mitigation of risks that can arise from the management and operation of their assets. For example, where assets that have been under-utilized or neglected, these can often be more appropriately managed by systematically assessing and taking account of their potential risk to the organization. This approach can be particularly useful for assets nearing the end of their useful life: whereas traditional practices for managing assets may increase risk unintentionally, through a short-term priority to achieve least-cost maintenance. Understanding asset risk can be particularly important for asset investors. For example, pension schemes own assets but are distant from the management of these assets. These organizations are typically seeking a reliable return on investment with no unexpected call for funds for asset costs that had not been forecast. Understanding asset risks across the portfolio of assets owned will provide assurance, or otherwise, to these investors that future asset risks are being managed effectively.

4.5. Finding Value in Overlooked Resources

In an organization's goal to realize increased value from its assets, they may be repurposed or expanded to meet a changing context. In a manufacturing plant, making minor modifications to assets can allow production of products in higher demand. The warehouse turned into apartments is a common example. Or the airport waiting area, which used to be a cost of doing business, is now a profit-centre featuring dining, shopping and entertainment. In the infrastructure sector, corridor assets (e.g. for transport or energy) are particularly valuable, since once they are lost, it can be impossible to recreate them. These rights of way have always had external revenue potential and this is increasing with population density.

4.6. Supporting Compliance with Financial Reporting Obligations

A technically and financially integrated asset management system allows compliance with accounting principles, for example, Generally Accepted Accounting Principles (GAAP). In the International Financial Reporting Standards (IFRS), established by the IASB, some of the IFRS accounting principles or values are relevant, and important, for a technically and financially integrated asset management system. These include:

Fair presentation and compliance with IFRS:

This requires the faithful representation of the effects of transactions, other events and conditions, in accordance with the definitions and recognition criteria for assets set out in the IFRS framework. Events or transactions through the asset life cycle can include (but are not limited to): initial recognition; obligation to dismantle, decommission or restore; change in useful life; major inspection or overhaul; held for sale or disposal.

Accrual accounting: The accrual accounting methodology requires organizations to understand the relationship between their operational and capital expenditures (related to physical assets) and the delivery of the required value to that organization. It requires transactions to be recorded at the time they are agreed, rather than at the time that cash or cash equivalents change hands.

Materiality and aggregation: Every material class of similar items has to be presented separately. Items that are of a dissimilar nature or function have to be presented separately unless they are immaterial. In the case of plant, property and equipment the principle of component accounting is mandatory. This means that where a tangible fixed asset comprises two or more major components with substantially different useful economic lives, each component should be accounted for separately for depreciation purposes.

IFRS Valuation Rules: provide options on the methods for how assets are registered in financial reporting

Appropriate implementation of accounting

standards: This implies that the organization adheres to the principles of the following assertions regarding the registration of its transactions: completeness, existence, accuracy, valuation, obligations and rights and presentation (CEAVOP).

4.7. A Framework to Integrate Other Standards

Asset management is a broad and holistic perspective. It delivers most benefit when every individual has an appreciation that helps them understand their responsibilities and work in that context. This inclusive and aligning approach is a framework that adds value to the contributions of all disciplines. It is best understood as 'the way we do our work' rather than as an additional or free-standing set of requirements.

4.7.1. Harmonizing Management Systems

A large organization may need to use and apply thousands of technical standards, codes, and industry guidelines. There are very effective standards and guides for risk management, systems engineering, quality management, reliability engineering and so forth. The potential for asset management to be a framework for technical standards was recognized during the development of ISO55000. ISO itself has a project to harmonize management system standards but further detail is outside the scope of the Anatomy.

4.8. Infrastructure, ESG and Global Trends

In the understandable haste to take action on climate change, many organizations and governments have treated these initiatives as separate. But this cannot

be the best way to move forward. We see ESG (Environmental, Social & Governance) and targets such as 'Net Zero' as the outcomes that organizations should choose to incorporate in their objectives.

The role of asset management extends beyond the assets and life cycle activities that deliver function and services. It requires collaboration from many professionals, including economists, financial advisors, sociologists, strategists, technologists, and environmentalists. Asset management offers a structured way to optimize costs and risks and improve the certainty of achieving desired outcomes.

The IAM has identified several global trends:-

Sustainability. With 70% of global greenhouse gas emissions coming from infrastructure construction and operations, decarbonization comes down to sustainable asset strategies. Refocusing technical requirements can drive asset design, construction, and operation to minimize their contribution to climate change. Future investment should be based on 'circular economy' thinking to maximize the reuse, repair, and remanufacturing of assets – further minimizing the built environment's impact on the environment.

Future-proofing. Governments acknowledge the need for resilience plans for critical and social infrastructure - assessing the current state of assets, modelling exposures to climate change and determining best mitigation strategies. How we will deliver social and critical services in the future will continue to evolve – and with it, the assets necessary to provide those services will also need to change. Futureproofing is building assets today, with tomorrow's service provision in mind.

ESG. Sustainability, responsibility, and long-term thinking impacts project finance and insurance capital. Organizations with a mature approach to asset management have long-term strategies that consider sustainability. ESG assessment standards are still developing and are needed to support long-term decision-making. Asset strategies and investment planning metrics will be critical for government funding and accessing green bonds and private investment.

Equity and Social Justice. As we have seen over the recent years, there is a greater drive for organizations to be more purpose-led. An organization with well-developed asset management capabilities can adopt fairer equity practices by aligning investment priorities for assets. This can improve equality of access to services that allow equal access to opportunities, such as transit routes to support job creation. Activities across the life cycle including, maintaining performance, need to be prioritized to promote equity.

Societal Well-Being. Management can have a positive impact on health and well-being in two contrasting ways. The most obvious is related to customer services. Asset management professionals can improve the assets' safe use and resilience through a focus on risk and good planning. We can reduce the environmental impact to positively support health, e.g. deploy electric bus fleets to areas with poorer air quality. The less obvious angle is the positive impact on employees. Asset management is about a planned approach to achieving objectives, which means we can more positively impact well-being on employees.

Sustaining Delivery Capability. Investing in human capital is critical to delivering the services and infrastructure needed. Workforce attrition from the retiring post-WW2 generation and the lack of skills development over the last decade³¹ has had a significant impact. Also, the challenges we face require a different skillset (so younger people might bring much-needed skills), so widening the skills/

experience gap. Recent supply chain disruptions from the Covid-19 pandemic highlight the importance of supply chain resilience. Asset management practices can promote better performing supply chains (from aligned supplier objectives) and identify risks to service operations from disruptions (from structured understanding of assets).

Digital, Data Transparency and Disruptive Technologies. The use of digital twins³² enables organizations to better inform asset decisions, control assets, and optimize performance. Accurate data helps us anticipate, react and recover from infrequent but potentially devastating events, including direct shocks to infrastructure. Several sectors are starting to share data with their peers/competitors to understand their problems better. The data from one is a pond, but the data from many is an ocean. These alliances realize that by combining their data, they can be more effective. Technologies such as Building Information Modelling (BIM), Enterprise Asset Management (EAM), Internet of Things (IoT), machine learning (ML), artificial intelligence (AI), all contribute to digital twins and support data-driven decision-making and action.

Cyber and Physical Security. Increasingly, meeting asset service objectives requires the integration of operational and information technologies. There is an urgent need to thoroughly consider cyber and physical security as part of an organization's asset management strategies, policies, and procedures. Critical infrastructure is reportedly becoming part of the modern battleground.



31. At least in the Western world

32. A digital model of an intended or actual real-world physical product, system, or process



4.9. Trends in Infrastructure

Modern society is heavily reliant on physical assets in order to function. They play a critical role in sustaining human life, supporting economic growth, and providing security. With global challenges increasing in urgency, leaders are beginning to recognize that service provision is what matters to users, not just the concrete and metal. As well as economic value, societal value, and long-term value, there is more direct consideration of climate impact, resilience, and sustainability.

Critical infrastructure funding remains a common challenge. Many countries have experienced a steady decline in infrastructure spending, resulting in a significant backlog of overdue maintenance and an urgent need for investment. This is sometimes referred to as the 'Infrastructure Gap'.

Service requirements for critical infrastructure are also rapidly changing. Urbanization trends that existed before the pandemic appear to be reversing. As more people 'work from home', the need for investment in telecommunications and more resilient utility networks increases. Innovation in connected vehicles, smart infrastructure, the energy transition and other smart city technologies is challenging assumptions. This often means there is advantage in considering new work as adjustment to the existing infrastructure and not free-standing projects. This increases the number of stakeholders for almost any part.

Managing assets so they can provide products and services now, and into the future, is a core part of the discipline known as asset management.

5 Asset Management Models

The IAM takes the view that there is no single perfect model to describe asset management. Instead, it encourages organizations and individuals to explore a range of models and evaluate what works best for them. How well a particular model will work for an organization will depend on the nature of the organization and its context. It may also be necessary to modify elements of a chosen model to better meet the needs of the organization.

To explore asset management models, a good place to start is the IAM; or with models developed by other members of the GFMAM. Asset management will continue to evolve - so it is expected that such models will change over time and others will emerge.

5.1. The IAM's 10-box Capabilities Model

The discipline of asset management has evolved considerably since 2015, when Version 3 of the Anatomy was published. Many of our members had also developed their capabilities 'beyond compliance'³³ and wanted further guidance. The IAM circulated "Asset Management Maturity Scale and Guidance" at our 2015 Conference, to stimulate peer review (published 2016³⁴).

We have worked with GFMAM partners both then and in a subsequent GFMAM project to deliver three linked publications in 2020. These were: Asset Management Maturity - A Position Statement, Guidelines for Assessing Asset Management Maturity, and Specification for an Asset Management Maturity Assessor³⁵. We see global convergence as important.

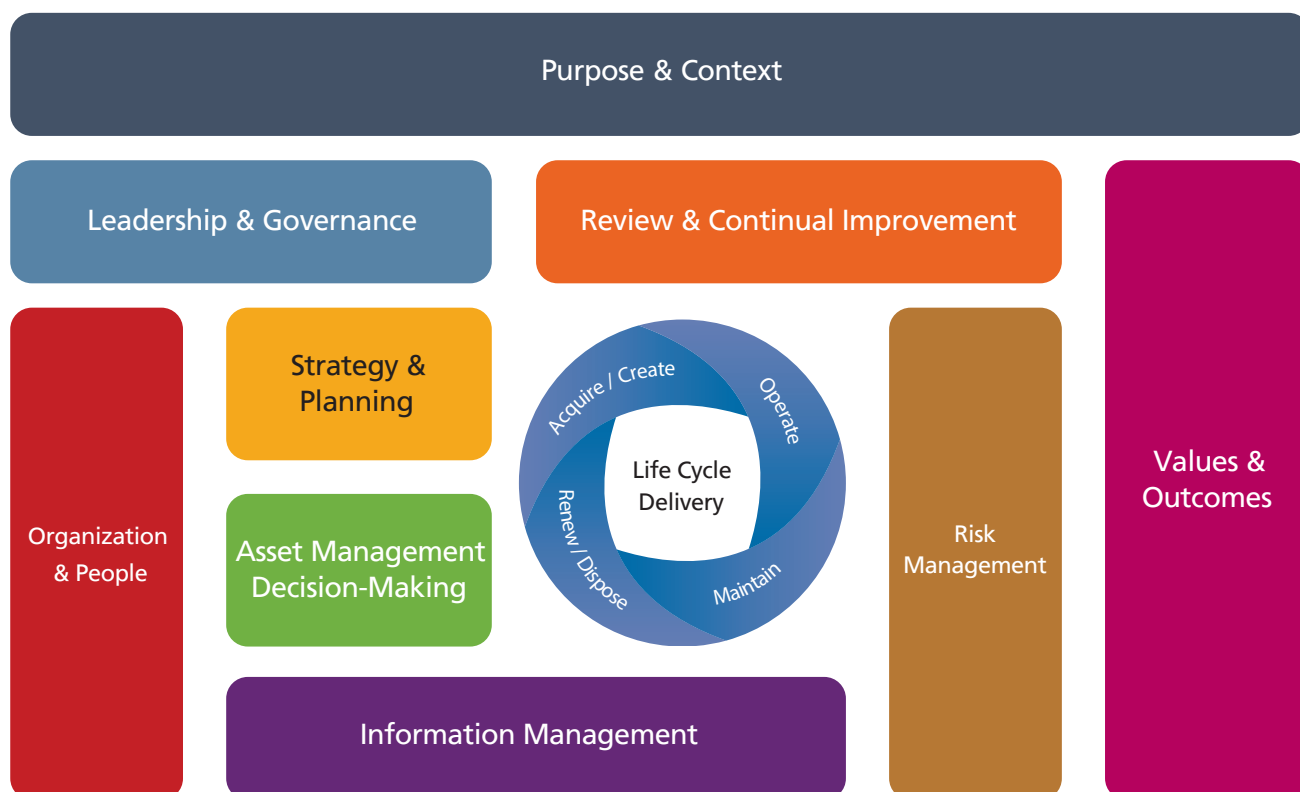


Figure 4: The IAM's 10-box Capabilities Model

33. At the time, this described any AMS better than the minimum requirements to conform to ISO55001. This phrase began as "Beyond PAS55", i.e. exceeding PAS55 requirements.

34. <https://theiam.org/knowledge-library/asset-management-maturity-scale-and-guidance/>

35. These are free to download at <https://gfmam.org/publications> and represent a GFMAM consensus.

This was followed by an IAM project ‘Excellence and Maturity in Asset Management’; and, in 2022, the IAM published The Pathway to Excellence in Asset Management: Maturity Scale and Guidance. This work also refined the well-established IAM conceptual model (see Section 5.4), introducing ten areas in which organizations need to develop their capabilities. We released this as the IAM’s 10-box Capabilities Model, Figure 4 (now well known as “the 10-box model”). You can find more information on our website and publications³⁶.

Many IAM members participated in the revision of the GFMAM’s Landscape and this was published in June 2024, as Version 3. So we have taken the opportunity, while preparing Version 4 of the Anatomy, to use the new list of Asset Management Subjects.

The IAM is now adopting the 10-box model across all levels of maturity, so Version 4 of our Anatomy uses our 10-box model. This means the IAM 6-box model will no longer be used in forthcoming IAM material. However it can still be used by any members or other organizations that have adopted it for use in their management systems or documents (Section 5.2). Existing IAM material will gradually be updated (Section 8).

More information on the individual asset management subjects is contained in Section 7 and the IAM’s suite of Subject Specific Guidance documents³⁷.



36. Start at www.theIAM.org/knowledge/

37. www.theIAM.org/knowledge/subject-specific-guidelines-ssg/

38. IAM Endorsed Assessors will continue to recognize the 6-box model.

5.2. Transitioning Between the IAM’s 6-box and 10-box Models

To smooth your transition between the IAM’s 6-box and 10-box capabilities models, this section outlines some capabilities that are familiar, some that have been refined and some that are new.

It is important to understand that the 6-box model is still correct. There is no need to try to update documents your organization has based on it. We suggest that you start to transition to our 10-box model in a timescale to suit your organization’s needs³⁸.

The familiar capabilities are:

- Organization & People (with roles, competencies, collaborative behaviours, culture, communications and organizational transformation),
- Strategy & Planning (with methods of integrating different horizons and degrees of commitment and flexibility),
- Decision-Making (with quantification and optimization of value, handling conflicting priorities, trade-offs and building consensus)

The refined capabilities are:

- Life Cycle Delivery, where some reformatting helps to recognize the overlapping and inter-dependent nature of the life cycle phases and activities.
- Risk Management and Review & Continual Improvement have been split to allow for greater clarity of two large and important asset management activities.
- Information Management recognizes the evolution from primarily considering data to the importance of managing information and knowledge.

The capabilities that are new or emphasized are:

- Purpose & Context, recognizes how the organization needs to understand its unique internal and external environments and maintain engagement with its stakeholders.
- Leadership & Governance stresses the importance of top-level management attention and the needs for coordination, control and assurance, through appropriate management systems.
- Value and Outcomes recognizes the need to demonstrate ongoing success, and that asset management is delivering maximum value, however manifested.

5.3. The Ten Capabilities

The ten capabilities will immediately feel familiar to users of the 6-box model. The layout of the model was developed carefully to be recognizable; but also to enable reinforcement of some important concepts and relationships. This enhances, rather than corrects, the 6-box model (and you should feel comfortable continuing to use the 6-box model if that is appropriate for your work).

We focused on the “line of sight” (or alignment) between organizational outcomes / goals and asset management activities; and included deliberately, Michael Porter’s Value Chain model and the Deming cycle of continual improvement.

The 10-box model also aligns well with the IFRS 6 Capitals model of Integrated Reporting. This was not by deliberate design: but it is extremely useful as the audit world moves forward into Integrated Reporting.

Each Capability contains asset management subjects that align with those of the GFMAM’s Landscape (see Figure 5). Mapping the asset management subjects to the ten capabilities supports a greater understanding of the breadth of activities within the scope of asset management (Section 7).



5.3.1. The 10-box Layout

There follows (for enthusiasts!) a brief explanation of the relationships and layout (but there are deliberately no arrows to be seen).

Line of Sight (alignment) is addressed by the ‘top down’ viewpoint. This runs from *Purpose & Context* via *Leadership & Governance* into *Strategy & Planning* and *Asset Management Decision-Making* - into *Life Cycle Delivery*. These are supported (‘bottom up’) by enablers of *People & Organization*, *Information Management* and *Risk Management* - with upwards flow through asset management activities, via *Review & Continual Improvement* into *Purpose & Context*.

A **Value Chain** theme is also present, with a left to right flow of resources (*People & Organization*) to processes (*Strategy & Planning*, *Decision-Making*), delivery (*Life Cycle Delivery*) and outcomes (*Value & Outcomes*).

The **Continual Improvement** (*Deming Cycle*) viewpoint is considered at three concentric levels of Plan-Do-Check-Act:

- **Life Cycle Delivery**, the innermost blue circle (clockwise) recognizes the need for continual improvement, both within and between the asset life cycle activities. Maintenance ‘learning’, for example, feeds into new asset procurement/ design.
- The second, less immediately evident, circle (anticlockwise) in the layout represents continual improvement of the management system. This takes in: direction (*Leadership & Governance*), planning, (*Strategy & Planning*), *Asset Management Decision-Making*, *Life Cycle Delivery*, *Risk Management*, *Value & Outcomes* and *Review & Continual Improvement*.
- The third, widest / anticlockwise circle, represents continual improvement in an organization’s overall growth (all asset management capabilities). This embraces the ‘enablers’: *Purpose and Context*, *People & Organization*, and *Information Management*.

5.3.2. Using the Ten Capabilities

The importance of individual capabilities to a specific organization will depend on its organizational purpose and context. This will also be influenced by its position on its Organizational Journey to Excellence & Maturity.

For individuals, the depth to which they may need or wish to develop specialist knowledge in particular subjects will depend on their career aspirations or their role within an organization or the organization(s) they are supporting. Even if individuals specialize in a particular area of asset management, it is important that everyone has an understanding of how their activities fit and interact with the other capabilities and the elements of the asset management system (AMS).

The IAM's 10-box capabilities model was developed in recognition that a management system standard for asset management would identify what is required to be in place for the management system, but would not address how asset management could be implemented. The Capabilities are intended to explain the asset management activities in greater detail.



Figure 5: Mapping the GFMAM Asset Management Landscape Subjects Against the Ten Capabilities (see Appendix A which also maps the subjects against the ISO55001 clauses)³⁹

³⁹. See Appendix A for a more readable list

5.4. The IAM's 6-box Model (previously "The Conceptual Model")

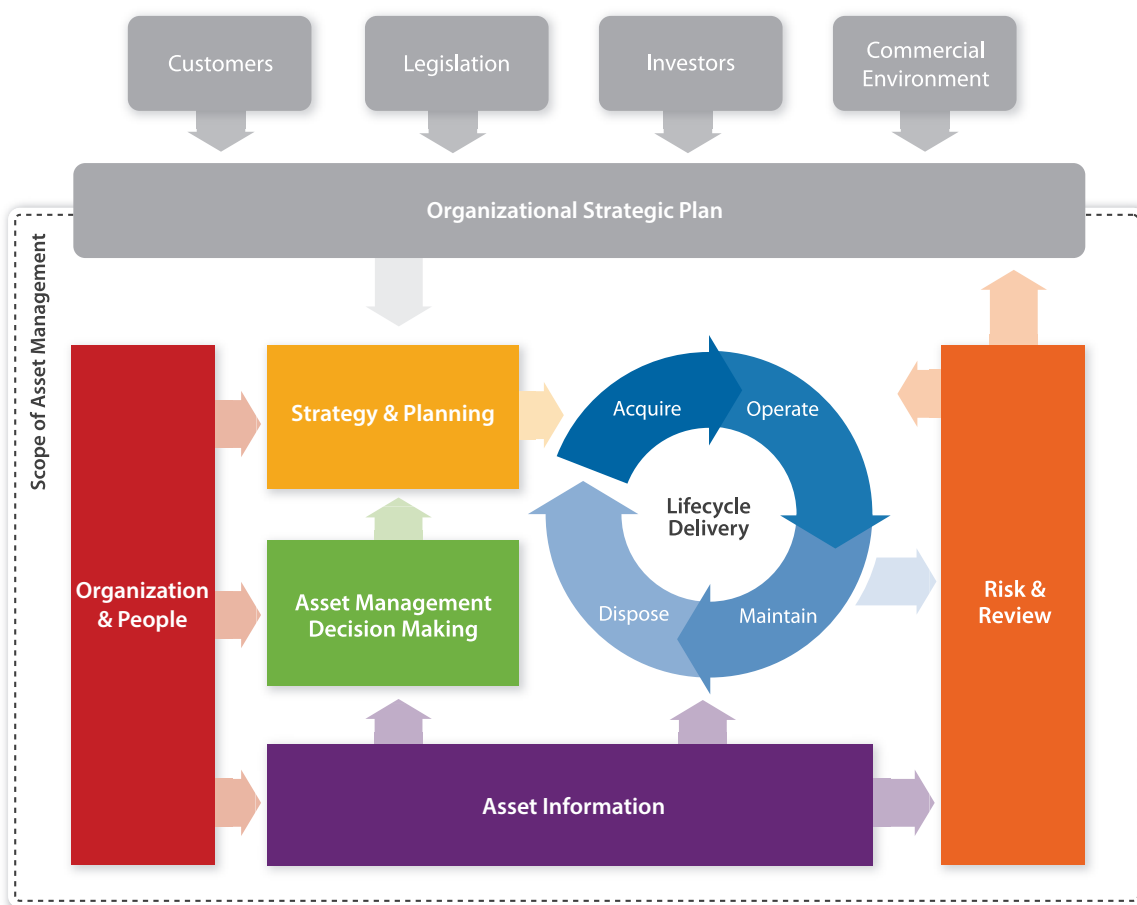
In earlier editions of the Anatomy, the IAM's conceptual model, a representation of primary areas of organizational capability, has been used to group and explain the full range of subjects relevant to asset management.

The IAM conceptual model contained six such capability areas (now referred to as the "6-box model"). There is an immense amount of material available both from the IAM and many other people who have used our material, so it is not described further here.

The 6-box model has been extensively used across the world by organizations in implementing asset management. It is also has been used throughout the IAM body of knowledge as a framework to organize, explain, and provide guidance on subjects that comprise the asset management discipline.



This has been extended, through feedback and consultation, into the current ten capability areas. We continue to welcome constructive criticism as input for our constant evolution.



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Figure 6: The IAM's 6-box Conceptual Asset Management Model

6 Doing Asset Management

It is vital to remember that people do asset management and therefore people, and their knowledge, competence, motivation and teamwork have a huge influence on outcomes (Figure 7). Tools and technologies are important: but the

engagement of everyone concerned, clarity of purpose, and collaboration between different departments and functions are the real differentiators of a leading asset management organization.

People do asset management

Knowledge, competence, motivation and teamwork have a huge influence on organizational outcomes

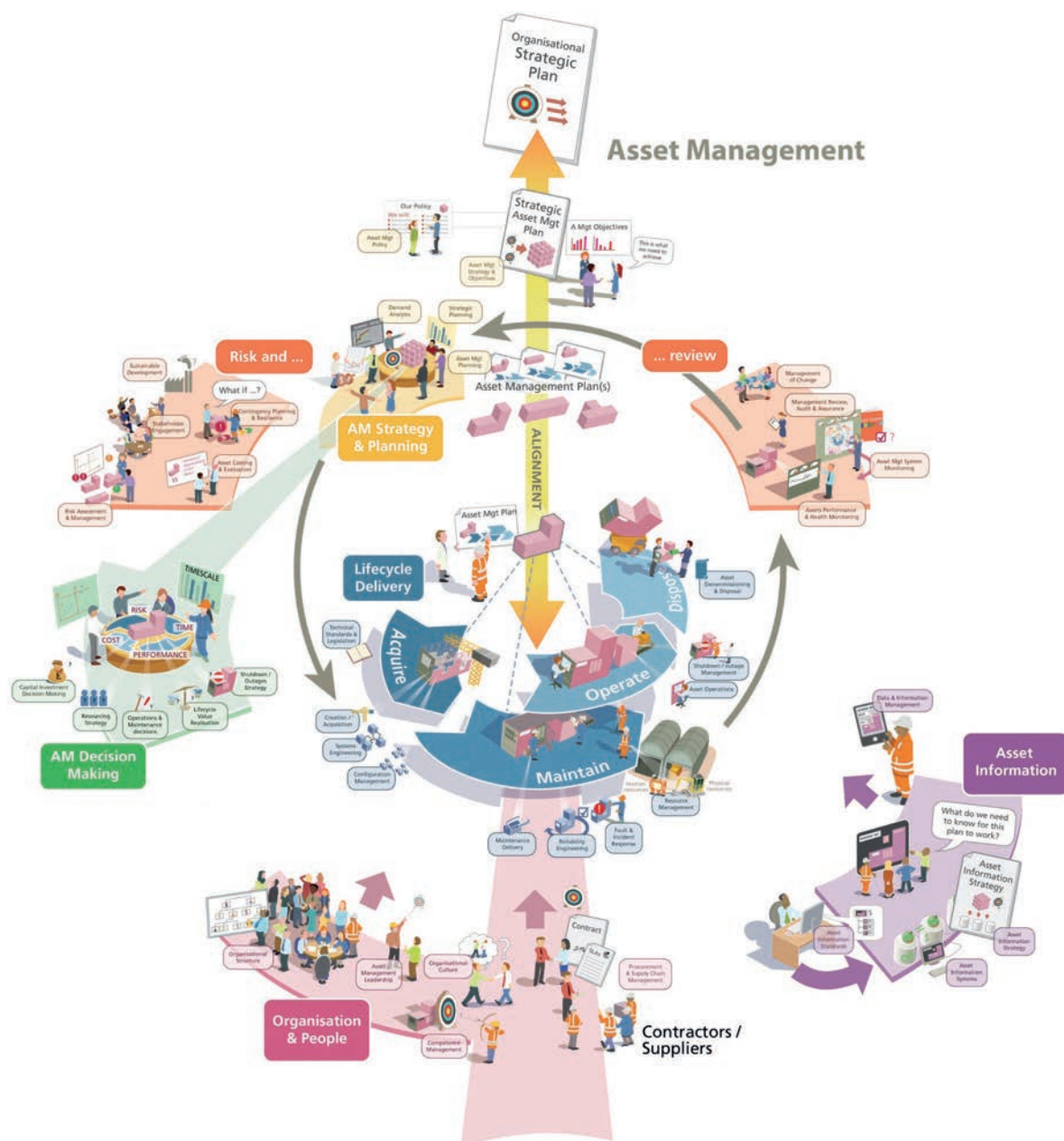


Figure 7: People Do Asset Management

Asset management engages at multiple levels within organizations (for example enterprise, division, manufacturing plant, or production line) and across supply chains and partners.

It creates an inclusive, multi-disciplinary approach by requiring people from different functions and professions to work more closely than they may have done. It includes contributions from every part of the organization, such as: business strategy, risk & insurance, finance, operations, maintenance, analytics, information systems, environmental awareness, quality, engineering, design, construction, safety and security. Each level and group brings its own expertise and expectations to decision-making and activities.

As inter-dependence between activities increases, teamwork and collaboration become increasingly critical and this is what asset management does. Asset management is a team effort.

At the enterprise level, this coordination requires executive ownership: 'together as one'. But this approach provides a broad base of knowledge and skill to support desired outcomes; and it enables a holistic perspective across asset life cycles and across all organization activities.

For some organizations, there are reasons for teams not being fully cross-functional. These can include, for example: logistics, geographical separation, or legal / regulatory issues. In smaller organizations the structure may be pared down with multiple levels, or contributing groups, being combined. No matter the size of the organization, the team should be representative of the organization and be aligned.

The concept of 'line of sight' means that everyone who touches or influences what happens to an asset is involved in asset management. Functional teams at the plant or production line level may well be multidisciplinary, for example, the concept of operator care (integrating operations and maintenance at the equipment level). Teams often include members from outside the core of the organization, including suppliers, consultants and, in some cases, customers.

An asset management system (AMS) can enable all of those involved in asset management activities to understand how their roles relate to those from other functions and/or levels that are covered by the management system.

6.1. The Right Culture

One of the most important elements of asset management is the role of organizational culture. It is a foundation of good asset management, and a key ingredient of its success – or failure.

Culture refers to a long-lived set of values, beliefs, attitudes and assumptions which are thought to affect behaviour and performance over the longer term. A popular and simple definition is: 'the way things are done around here'.

A management system, no matter how detailed and well implemented cannot specify, command or monitor all employee activities and actions. There is much that falls between the cracks, for which culture is the powerful antidote. Even well-designed processes usually have their biggest challenges across organizational boundaries or silos.

Building an organization with a healthy culture is a significant part of effective leadership. The organizational structure created by senior management can have a major influence on the culture of the organization and vice versa. Culture is less tangible than organizational structure and more complex in that there are many more variables at play. Creating an appropriate organizational culture is integral to achieving the level of integration between functions that good asset management requires.

There is no single correct organizational structure or culture for asset management - an organization's senior management need to ensure that the structure and culture are conducive to what they want to achieve. Sustaining cultural change requires consistent behaviours, especially from management (at all levels from boardroom to supervisors), continuous communication and reinforcement.



6.2. Asset Management Maturity

As identified earlier, there is now convergence of opinion on what 'good' asset management looks like; and it is surprising how consistent this can be across different industries / sectors and for different asset types and environments.

Many organizations choose to have their AMS assessed for conformance to the ISO55001 standard by independent third party assessors. Achieving a certificate of conformance demonstrates a level of competence and good practice in asset management.

Asset management maturity goes beyond conformance with ISO55001. There will be organizations that want to develop their capability beyond conformance in order to achieve their business objectives. The discipline of asset management is continually evolving through process innovations, new technology and learning. This constantly challenges the understanding of 'best' practice. Organizations also have widely different operational environments, constraints, cultures and opportunities. This means that what should be recognized as 'competent' or 'excellent' depends on the context of the organization. The features that would be regarded as 'excellent' in one sector, or set of circumstances, may not be the same as those that are applicable, or desirable, in another.

The IAM has developed a maturity scale and terminology to define asset management maturity. The maturity scale and associated guidance considers the maturity of:

- the management system (conformance with ISO55001, representing a 'competent' level of maturity); and
- an organization's asset management (the wider discipline, as characterized by the Subjects of the Asset Management Landscape)

The definitions and characteristics of the higher levels of maturity (that is, beyond 'competent') are context-dependent and temporary (as the leading edge attributes of 'excellence' continually move). A specific differentiator for the higher levels of maturity is organizational culture. For this, indicators of how well asset management is established include the level of embedded behaviours for learning and continual improvement.

Characteristics of organizational context that affect what is achievable and worthwhile in asset management fall into three categories:

- Asset systems criticality (the importance of managing the assets optimally);
- Scale and complexity of the asset portfolio (the difficulty of managing assets optimally); and
- Volatility of the business environment (the constraints / opportunities to manage assets optimally over their whole life cycle).

To explore these issues, please visit www.theIAM.org/Maturity

6.3. The Organizational Asset Management Journey

Well-implemented asset management has the potential to transform an organization's culture, integrate its management systems and provide greater value in delivering the goals of the business. The development and initial implementation of asset management is a multi-year journey. In a large organization, it will often take five or ten years to become embedded as a 'business-as-usual' activity for continual improvement (Figure 7).

In real life, this journey is unlikely to be smooth and can be complex and difficult. The initial enthusiasm may come from middle management and/or technical departments and take some time to become genuinely top-down. But, until there is a cross-functional perspective, progress will be intermittent and incomplete. It is important to see this as normal and not to lose heart!

Those involved need to be clear on why they are making it, and not settle for the status quo or simply pursuing tactical improvements in managing the assets themselves. For some, the perception may have been created that asset management is about software systems and it will be necessary to begin with completing an asset inventory. The ISO55000 standards have helped reinforce that asset management is much more than this. Most organizations know enough about their assets to begin implementing asset management without completing an inventory. In fact, developing an AMS will help an organization to define its requirements for asset knowledge, including the breadth and depth of information in the asset register.

Organizations often begin their asset management journey as a time-bound project (e.g. to implement an IT system), or programme of work (a group of related projects, e.g. implementing an IT system along with changes to processes to improve asset reliability). These typical journeys usually result in a realization that successfully implementing asset management is not quick and requires an integrated approach across a broader range of activities. Resources, such as those identified in Section 8, can help organizations starting their asset management journey.

Similarly, an organization will want to develop an asset management capability tailored to best suit its own circumstances. This can be accelerated by, and benefit greatly from, consideration of available asset management models and the capabilities which support them. These can provide information beyond that which is available within the ISO55000 documents, and where desired by organizations, help with developing higher levels of asset management maturity.

As asset management becomes established, one of the challenges for organizations can be maintaining alignment across departments. This risk can increase once asset management becomes business-as-usual and there have been significant changes over time of management or staff in the contributing departments and/or supply chain. Good change management and strong leadership with an understanding of, and focus on, maintaining alignment will be crucial to ensure the asset management journey stays on track.



6.4. The Individual Asset Management Journey

Given the relative youth and breadth of asset management, it is inevitable that people coming to the discipline have already demonstrated competence in another profession, such as engineering or finance - and may have significant specialist expertise in a field such as maintenance or auditing.

Particular challenges for individuals considering their own asset management journey include determining what competences they need to develop, and/or want to develop, and finding the training and learning materials they require to achieve this.

The IAM's Competences Framework (www.theIAM.org/CF) provides a good starting point to understand the competences required for generic asset management roles. One of the drivers for its development was to help individuals plan their training and professional development.

Once individuals have established the competences they wish to develop, there are many options to begin to acquire the associated knowledge, including:

- Asset management training courses, such as those delivered by IAM Endorsed Training Providers (www.theIAM.org/ET);
- Publications and on-line resources, such as ISO55000, the IAM's Subject Specific Guidance (SSG) documents, other GFMAM member resources, and published text books on asset management (see sections 8 'IAM Resources', and 9 'Further Reading');
- Asset management conferences;
- Working on projects / initiatives which will enable development of asset management knowledge in specific areas - for example, participating in IAM projects with other asset management professionals from across a range of industry sectors
- Taking part in IAM activities, including webinars, and chapter, branch and NxtGen events.

Individuals can test their asset management knowledge by examination and, if successful, gain an asset management qualification such as the Certificate or Diploma developed by the IAM (www.theIAM.org/Quals).

6.5. The ISO Management System for Asset Management

For most businesses, coordinating the many facets of asset management requires a system of direction and control – a management system.

The ISO55001:2024 describes a management system for asset management. The effectiveness of ISO management systems is often questioned - but when an ISO management system aligns with an organization's over-arching corporate management system, the results can be very effective. It is also the case that an ISO management system that is not aligned, and is just bolted on, cannot be expected to function effectively.

ISO55001 defines seven sets of requirements for a management system for asset management, with each supported by between 5 and 20 "shall statements" to provide the detail for each requirement:

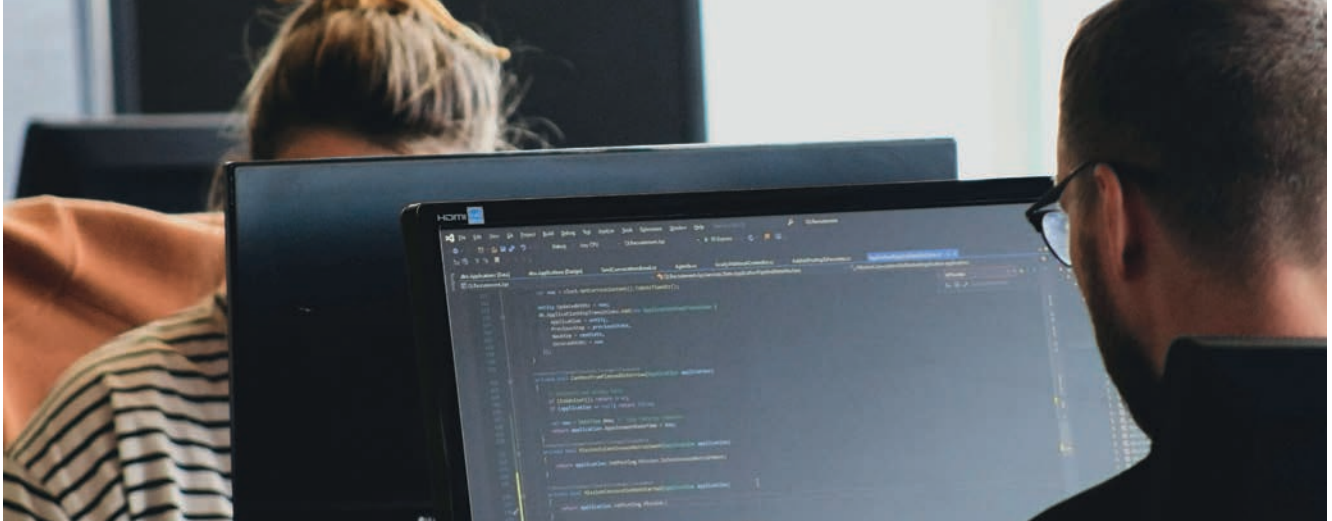
- 1) Defining the Organizational Context;
- 2) Leadership commitment and direction, and roles and responsibilities;
- 3) Multi-level Planning for assets and asset management;
- 4) Support for effective management: resources (including competence), tools and information;

- 5) Operational control of the management system and dependent asset systems;
- 6) Evaluation of the performance of the management system and dependent asset systems; and
- 7) Improvement, including correction and prevention in a quality-process environment.

The ISO55001 requirements create a combination of specific interacting elements that provide direction, alignment, coordination, control and continual improvement in the effective management of assets. The combined effect of these elements should deliver performance and assurance of a 'competent' level of asset management.

The ISO5500x standards do not, however, cover all aspects of the discipline of asset management. They consider the 'shall do' elements but intentionally do not address the 'should do' or 'could do' elements, nor do they address 'how to' implement asset management. They also do not consider whether there could be justification for developing capabilities beyond conformance to the requirements in ISO55001 - and what this might look like. Compliance with all the requirements of ISO55001 represents the **minimum** standard for an effective asset management system and should not be seen as the final goal.





6.6. Digital Transformation

The last decade has transformed the digital environment: for people, organizations and governments. This huge impact on organizations 'doing' Asset Management includes new technology like: smart sensors, machine learning, drones, increasingly cheap data storage, powerful analytics tools and so on.⁴⁰

Organizations are increasingly looking to deliver increased value to stakeholders, through the adoption of digital technology and better use of information. Many leaders feel pressure to tell stakeholders that they are 'digitizing' and there can be groupthink that makes managers feel that they are failing unless they do so. But there is so much to choose from – and technology on its own does not transform or benefit your business. Indeed most people are aware of high-profile IT projects that have cost many times more than the budget and may not have delivered anyway.

These technologies present enormous opportunities (especially to asset intensive businesses) but also present some significant risks, not least of unintended consequences. Most organizations are challenged by data and IT systems because it is difficult to achieve the right balance of spend and benefit. This uncertainty is made worse by rapidly emerging digital technologies such as Digital Twins and AI, bringing both technical and financial risks.

6.6.1. Readiness of the Organization

As Asset Management thinking has evolved, what it means to be excellent or mature has consolidated and evolved also. There is a need for the right maturity in culture and leadership to support the successful adoption of some techniques and technologies.

Most organizations report that they do not have the capability to choose and implement the right solutions. It is also clear that the success of even appropriate technology needs the right competence and change management to make it deliver.

In addition to purely technical knowledge and organizational development, the following aspects of Asset Management need to be sufficiently in place before attempting to digitize an organization's activities.

- **Culture and Leadership.** The right culture will hugely improve the choice of the right digital options and their exploitation. Leaders need to understand what the organization needs, and align their people and processes.
- **People & Skills.** The capabilities of your people need developing, not in digital technology only – but in exploiting and understanding its value and potential and talking across professional boundaries.
- **Implementing 'Digital Solutions'.** Digital is not a 'solution' until your 'business as usual' is aligned and you understand why and how much to spend on data and (the right) technologies. Once your processes are aligned, digitization can help enormously.

40. You may be interested in an IAM ongoing Digital programme of work – see www.theIAM.org/knowledge/hot-topic-programs/digital-group/

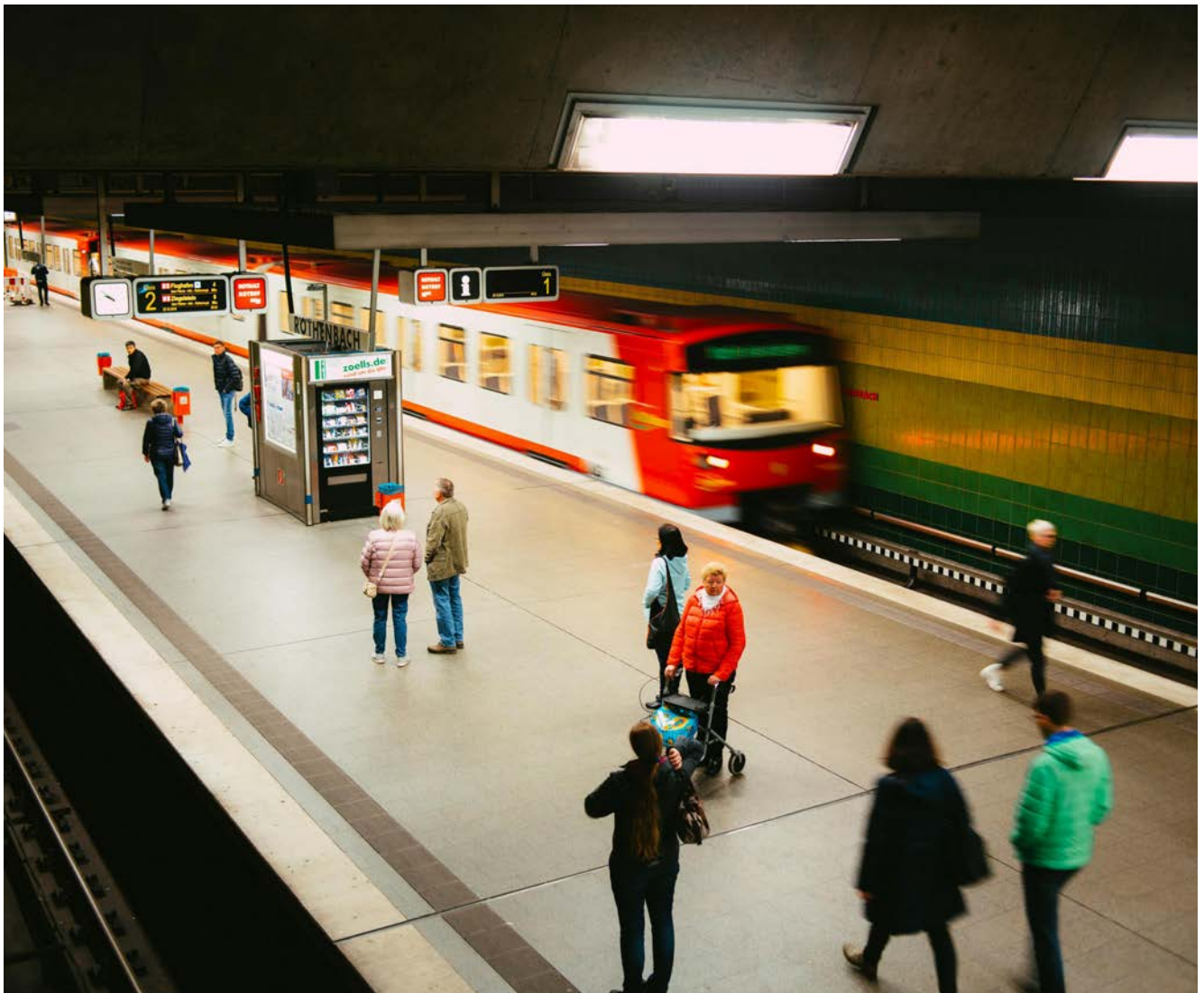
6.6.2. Data as an Asset

There is growing realization that Data, itself, is a valuable asset and enabler. Not many organizations have this value recognized on their balance sheets, but the costs are real enough – and recorded (whether or not capitalized). This skews decision-making about collecting, using and stewarding data⁴¹.

The right implementation of Asset Management concepts and processes can deliver significant value to organizations. A key aspect is to address Data as an Asset, i.e. it needs managing as an asset in its own right, over its life cycle. Good practice will include: how to manage the cost-benefit of data, the flow of data, information in and across organization boundaries, and the best way to create identifiable value for the organization, its stakeholders and

customers. This has implications for traditional concepts and 'IT'. Data needs to be owned and managed within the organization separately from the IT itself. In fact, some organizations have restructured themselves around data flow with significant benefits. Understanding Data and maximizing value from it is usually a big opportunity, and it is likely that organizations will increasingly wish to show its value on the balance sheet in one form or another.

It is also clear that a data-driven approach (to support decision-making - and much more) and some emerging technologies offer exciting ways to enhance this value. The cross-sector and cross-functional strengths of Asset Management are an important basis for the 'data-driven' approach.



41. ISO55013 addresses managing asset data and data as an asset.

6.7. Ownership and ‘The Guiding Mind’

In real life, ownership takes many forms, for example if you hold debt or a mortgage you do not truly own the assets. Banks and investment funds may be quite distant from day-to-day decision-making about assets. But some investors have become more ‘hands on’ in the last decade or so.

Also, the level at which assets are managed (particularly in mergers and acquisitions) may be at the level of a whole organization or group of organizations. Ironically, microsecond trading has meant that the time for which a given owner ‘owns’ various assets may vary from less than a second to many decades. All this means we need to be more nuanced about referring to owners and ‘top management’.

We use the term ‘Guiding Mind’ to identify where the key decisions are made about purpose, objectives and life cycle decisions affecting assets that support them (as distinct from ownership). This is ideally not a single person but the continuity and consensus of multidisciplinary teams.

6.7.1. Selling Assets as a Service (SAAS / Servitization)

Assets as a service (or servitization) is when organizations provide access to assets or their function as a service, rather than selling the assets themselves. Examples are selling thrust instead of airplane engines and heating instead of gas boilers.

This can be attractive to those buying the service who can access the latest technology without the cost and workload of owning the assets. They can also avoid asset stranding risks associated with long-life assets, where their requirements may change over the asset life – or where the context changes (e.g. climate change or Net Zero).

This can be attractive for organizations selling the service because they have a longer-term revenue stream, not just a one-off sale. They also learn more about the asset’s service life and can improve the design and manufacture.

The asset management considerations are different for both organizations when compared with a conventional asset supplier / owner model.

6.7.2. Managing Assets You Do Not Own (FM / Outsourced)

There are several reasons that organizations do not own the assets they manage, as mentioned above. But this can also be their core business, e.g. Facilities Management (FM). The scope and scale varies hugely, from the provision of highly-specified local cleaning tasks to responsibility for big organizations like NASA. In the former, it is very price sensitive and the Guiding Mind tends to be the owner / operator: in the latter, it is usually longer-term and requires deep expertise (the Guiding Mind is largely the contractor, with only the selection of that contractor being reserved to the ‘owner’).

There may also be partnerships between organizations and/or formal outsourcing of particular activities. Even with relatively simple contracts, like cleaning offices, it is worth considering Data. For example, when you rebid the contracts, who knows more about your assets – and if you change contractor what about the ‘lessons learned’ information?

Some of these aspects can be subtle and very individual for all parties. The reason for mentioning some of them is to make readers aware. But if these matters are relevant to you, you may want to research this or learn more elsewhere.





6.8. Concluding Thoughts

Before we look at the Subjects in detail, it is worth reviewing the previous sections.

It should now be clear that asset management is strategic, aligning the thinking and work done in an organization. It can be a powerful integrating influence and help dilute and remove silos, thereby enhancing coherence and engagement of every person. This holistic and longer-term perspective, supported by multi-disciplinary decisions enables better value and enduring success for the organization.

Most organizations will require an underpinning system to direct and coordinate the many facets of asset management – a management system. But this is mainly transformation of the way the organization behaves and works, not additional work.

The Principles of asset management are a good way for leaders to keep a mental check on everything they see. We have also addressed some misunderstandings and companion ideas. Whilst describing the ways asset management helps and why this matters (is valuable), we have emphasized

that value is what the organization must choose for itself – and demonstrated the power of thinking beyond finance.

You should now understand why we are transitioning to the 10-box Model. The IAM encourages you to look at the models and teaching of other GFMAM societies and use what is most helpful to you. But we hope that the very close alignment of the 6 Capitals models will support your transition to Integrated Reporting.

This section should have helped explain what the implications are of adopting asset management thinking (or indeed not doing so!). This mindset (paradigm / philosophy / approach – choose the term you like!) is self-evidently beneficial as long as it is implemented as transformation not a quick project. It will also help aspiring senior managers from many disciplines and departments prepare for strategic leadership.

The IAM offers a large knowledge base, and membership brings friendly events and colleagues should you wish to learn more. We hope you enjoyed reading this so far.

7 The Asset Management Subjects

The IAM has used all the Subjects from the GFMAM Asset Management Landscape without change. The definitions used in the following Tables are from the Landscape document.

But in the Sections that follow, we have provided some guidance on each Subject. These Sections (and Subjects) appear in the order according to the IAM 10-box model.

See Section 5 (and Fig 5) if you have not already read them.

Purpose & Context	
Organizational Purpose and Context	<p>The processes and activities used to design, implement, and sustain an approach to Asset Management should be aligned with the organization's purpose.</p> <p>This includes activities associated with defining the scope and boundaries of Asset Management and the organizational objectives that Asset Management needs to deliver and contribute to. These activities may make use of value from financial and non-financial assets.</p>
Stakeholder Management	<p>The structured and documented approach that organizations use to identify, engage, and manage all relevant needs and requirements of internal and external stakeholders, that drive value from and are affected by the organization.</p>
Leadership & Governance	
Asset Management Leadership	<p>Asset Management leadership is required to promote a whole Life Asset Management approach to delivering Organizational Strategic Plans and Asset Management objectives.</p>
Asset Management Policy	<p>The Asset Management Policy formalizes the organization's commitment to Asset Management, aligns its Asset Management principles with the organization's strategic vision, mission, strategic goals, and objectives.</p> <p>Further it provides a directional framework for all stakeholders in the development and implementation of the Asset Management strategic plan and the establishment of Asset Management objectives.</p>
Asset Management System	<p>A set of interrelated or interacting elements within an organization to establish, update, and sustain Asset Management, Asset Management policies, Asset Management objectives and processes to achieve those objectives. The processes and measures used by an organization to assess the on-going fitness and performance of its Asset Management System, including continuous improvement initiatives. The Asset Management System should recognize and integrate with other formal management systems.</p>
Asset Management Assurance and Audit	<p>An organization's structured processes for assuring and auditing the effectiveness of its assets, Asset Management and Asset Management system to ensure organizational and Asset Management objectives are being achieved and its assets fulfil their required purpose.</p>
Technical Standards and Legislation	<p>The process used by an organization to ensure all its activities, including Asset Management activities, are compliant with relevant technical standards, regulations, and legislation.</p>

Organization & People

Organizational Arrangements	Describes how an organization is arranged to facilitate an effective Asset Management culture and to acknowledge how Asset Management roles and responsibilities contribute to the achievement of Asset Management objectives.
Organizational Culture	Culture as it pertains to an organization is how its people think and behave in response to the organization's vision, mission, values as well as the documented and undocumented rules, including social norms. Culture as it pertains to an organization's Asset Management system is the processes that people follow to achieve Asset Management objectives.
Competence Management	The processes used by an organization to define, develop, and maintain an adequate supply of competent and motivated people who understand how to perform the activities needed to achieve its Asset Management objectives. This should include arrangements for managing competence from the boardroom to the workplace.
Organizational Change Management	Organizational change management is a structured approach for managing the people side of change. It supports individuals through changes to Asset Management processes, technology, organizational alignment, and culture, with planning, implementation, communication, and sustainment of change to achieve the desired outcome.

Strategy & Planning

Demand Analysis	<p>Demand analysis consists of knowing and understanding the variables that make up the requirements of interested parties and the economic, social, and environmental scenarios where the organization operates, to establish a forecast for Asset Management that generates value for the organization.</p> <p>Demand analysis consists of the processes that an organization uses to evaluate, analyze, and influence demands and to perform the evaluation and analysis of the capability of assets to meet demand.</p>
Sustainable Development	The holistic, interdisciplinary, collaborative method, including processes, used to ensure an enduring, balanced approach to economic activity, environmental responsibility, social governance, and progress to ensure all activities are sustainable over multiple timeframes while supporting the organization's purpose.
Asset Management Strategy and Objectives	The Asset Management Strategy is contained in the Strategic Asset Management Plan (SAMP). It translates organizational objectives into Asset Management objectives, defines the organization's Asset Management system and the approach to Asset Management and the organization's assets, and describes the strategies and actions to deliver on Asset Management objectives.
Planning	The activities involved in developing the relevant Asset Management planning artifacts that support strategic planning activities such as the Strategic Asset Management Plan. Asset Management planning specifies the detailed activities and resources, responsibilities, time horizon, and risks for the achievement of Asset Management objectives.

Shutdown & Outage Strategy & Planning	<p>An organization's processes for the identification, planning, scheduling, execution, and control of work related to shutdowns, turnarounds, or outages (STOs). Definitions vary across industries and organizations but generally involve lengthy planned production stoppages or reduction in operations to perform maintenance in the case of shutdowns, and refurbishment, refitting, rebuild, or upgrading in the case of turnarounds. Outages are generally unplanned interruptions of shorter duration due to factors such as power supply interruptions or equipment failures. An STO event is measured as the period commencing from safe system shut down, hand-over for maintenance, isolation, performing the required work, system hand back to operations, to safe system start-up and restoration of required service levels. In some industries, this may also require certification before hand-back to operation, and recalibration to a larger system or network.</p>
Contingency Planning & Resilience Analysis	<p>Contingency planning refers to the policies, plans, processes, and systems established by an organization to respond and recover from a hazard event, crisis, or disaster. This includes ensuring continuity of critical organizational functions, services, and assets during the crisis, as well as resumption of normal operations thereafter. Contingency planning is informed by the outcomes of both conventional risk management processes and resilience analysis.</p> <p>Resilience analysis is a risk-based process that assesses the ability of organizations and assets to withstand disruption and disturbance, deal with crisis, adapt to changing conditions and to prosper in the longer term. There are two equally important dimensions of resilience. Asset resilience refers to the ability of the asset or physical system to perform to an acceptable level during an event. Organizational resilience refers to the ability of an organization to plan, manage, respond, and recover from an event to achieve the desired resilient outcomes.</p>
Resource Strategy and Management	<p>Determining the strategies, management of activities and processes to be undertaken by an organization to engage people (internal and external), acquire and use assets (e.g., tools, equipment), materials and services to deliver its Asset Management Objectives and Asset Management Plans.</p>
Supply Chain Management	<p>Supply Chain Management is the process used by an organization to ensure the provisioning of all equipment, tools, and resources to perform Asset Management activities are aligned with the Asset Management objectives.</p>
Life Cycle Value Realization	<p>The activities undertaken by an organization to ensure the best total value from investments and benefits in different physical and non-physical asset acquisition, creation, operations, maintenance, improvements, renewals, and disposals across all asset life cycle stages.</p>
Asset Costing and Valuation	<p>Asset Costing is the organization's end to end process for defining, capturing, and utilizing the TOTEX (Total Expenditure) of physical assets or systems of assets throughout their life cycle. This includes the costs associated with planning, design, acquisition, construction, operation, maintenance, renewal, and disposal. Asset Valuation is the organization's end-to-end process for quantifying the financial value of assets in accordance with accounting standards.</p> <p>The application of cost and valuation methodologies generates information and intelligence that supports decision-making in areas such as asset investments, asset life cycle optimization, improvements in return on investment, and to exercise management control to balance risk, cost, and performance.</p>

Asset Management Decision-making

Decision-making	Decisions are choices made under conditions of uncertainty, complexity, and constraint. Decisions are the primary means of allocating and reallocating the organization's finite resources consistent with its value framework to achieve its strategic objectives. Investment decision-making comprises the policy, principles and criteria, decision-support techniques, information, and processes to address risks or opportunities. The development of alternatives and the selection of priority solutions across the full life cycle to deliver value to stakeholders.
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Life Cycle Delivery

Asset Creation and Acquisition	Asset Creation and Acquisition encompasses activities during the planning, acquisition, design, supply, change management, manufacturing, installation, and commissioning of assets and related systems as well as the transition through the stages of the asset life cycle.
Systems Engineering	Systems Engineering is an interdisciplinary, collaborative approach to derive, evolve, and verify a whole life cycle balanced system solution which satisfies stakeholder expectations and meets organizational outcomes and targets. Systems Engineering enables an assurance function and considers holistic requirements with consideration for technical system and sub-system level, and associated interoperability.
Integrated Reliability	<p>The reliability of an asset or system is its ability to perform and operate as intended for its projected life cycle, in a specific environment or under certain conditions.</p> <p>Integrated Reliability is a holistic collection of policies, principles, processes, and systems used to deliver, monitor, and improve reliability, Asset Management and life cycle delivery activities towards a system or asset. It is an approach that applies engineering principles and techniques to identify and mitigate potential failure modes, minimize downtime, and optimize performance throughout the whole life cycle.</p>
Asset Operations	Asset Operations encompasses the policies, processes, procedures used by an organization to operate their assets and achieve Asset Management strategic objectives.
Maintenance Delivery	Maintenance Delivery encompasses the management of maintenance work activities for tangible and intangible assets throughout their intended life cycle. This subject also considers the importance of asset data and information record keeping within the maintenance environment, and the periodic review of how asset maintenance strategies should be periodically reviewed and updated to reflect an asset's useful life and its criticality.
Incident Management & Response	Incident Management and Response is a structured approach for addressing incidents in a systematic manner, guided by the severity, risk or criticality of the incident. This a comprehensive approach that encompasses the entire incident life cycle, encompassing the stages of incident identification, escalation, reporting, response, investigation, remediation, and data gathering. This framework may draw upon pre-established contingency plans and resilience analysis documents. Its primary objectives are to safeguard the well-being of individuals, both on-site and in the broader community, ensure an effective response to protect the environment, to preserve assets, and to uphold the reputation of the organization.

Asset Repurposing & Disposal	Asset Repurposing or Disposal involves the processes used by an organization to decommission, retire, repurpose, reclaim, and dispose of assets. This could be due to deterioration, technology improvements, obsolescence, or changes in performance, legal, regulatory and/or capacity requirements.
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Information Management

Asset Management Data and Information Strategy	The strategic approach to the definition, collection, management, disposal, analysis, reporting and overall governance of Asset Management data and information necessary to support the implementation of an organization's Asset Management strategy and objectives.
Knowledge Management	Knowledge management in Asset Management refers to the dynamic process of identifying, capturing, organizing, and retaining knowledge, transforming tacit knowledge into explicit knowledge through socialization, externalization, combination, and internalization.
Asset Data and Information Standards	The specification of a consistent structure and format for the acquisition, maintenance and use of data and information required to support an organization's activities, including defining and reporting on its purpose, value to the organization, and its quality to ensure it is always fit for purpose.
Asset Management Data and Information Management	The processes required for the management and governance of all Asset Management data and information.
Asset Management Data and Information Systems	Asset Management Data & Information Systems support Asset Management activities and decision-making processes in accordance with the Asset Information Strategy and in support of all Asset Management processes in the GFMAM Asset Management Landscape.
Configuration Management	A management process for establishing and maintaining consistency of an asset's physical and functional attributes with its design and operational information throughout its life cycle. Configuration management provides knowledge of the current configuration of an asset and the relationship between that asset and the information relevant to its function within a system.

Risk Management

Risk	The management of uncertainties on Asset Management objectives through policies and processes for identifying, quantifying, mitigating risk and exploiting opportunities associated with existing and future organizational and Asset Management objectives.
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Review & Continual Improvement

Monitoring	<p>Monitoring is a dynamic process that relies on the effective use of data and metrics (financial and non-financial) to continuously evaluate the value realization of assets and their management throughout their life cycle.</p> <p>The core of this monitoring process is data-driven analysis that enables decision-makers to make informed choices about asset utilization, investment, and optimization. By having a clear understanding of the value realized by assets, organizations can fine-tune their strategies, leading to an improvement in asset performance and overall effectiveness.</p>
Continuous Improvement	<p>Continuous Improvement is an ongoing process of analyzing performance, identifying opportunities, and making incremental changes to increase the value generated by assets.</p>
Management of Change	<p>Management of Change is the systematic approach to an organization's processes for the identification, assessment, implementation, and communication of changes to processes and assets.</p>

Value & Outcomes

Outcomes & Impacts	<p>Outcomes and impacts processes that assess the extent to which the implementation of Asset Management activities achieve Asset Management objectives. They also assess to what extent the Asset Management objectives contribute to the achievement of the organizational objectives to meet stakeholder needs and expectations.</p> <p>Review of outcomes and their impact being delivered against the organizational and Asset Management objectives is also an aspect of outcomes and impacts. This enables adjustments to be made to objectives by an organization to ensure that the desired outcomes and impacts are achieved.</p>
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7.1. Relationships Between Capabilities and Subjects

Asset management is, by definition, holistic and integrative, so the number and boundaries of capabilities and subjects can be drawn in a number of different ways. Different industry sectors can hold differing views about the respective activities, a bit like the naming and number of the life cycle stages in Figure 3. Over the IAM Anatomy revisions, since their development in 2011, there have been several revisions to the titles and scope of the subjects in the 6-box conceptual model and now 10-box capabilities model.

It is misleading to treat any capability or subject as free-standing, as there are complex inter-relationships between most of them. In fact, if these relationships are drawn diagrammatically they can be confusing. The IAM strongly encourages individuals to develop an appreciation of ALL the asset management capabilities and subjects. This is essential to understand how best to obtain maximum value from applying asset management. Gradually this broad understanding also helps in understanding each capability and subject at a deeper level.



7.2. Purpose & Context

Purpose & Context

- Organizational Purpose and Context
- Stakeholder Management

7.2.1. Organizational Purpose and Context

Organizational Purpose and Context are the key starting points in creating and maintaining an Asset Management System and capability that will sustainably deliver the organization's objectives over the long term. It is by deliberate design that this is the first requirement clause in ISO55001 as it is vitally important that the organization fully understands what it is trying to achieve for its stakeholders in creating and protecting value and why and how this might change over time.

Asset Management leadership needs to appreciate all factors of the organization's operating environment, both now and in the longer term. This changing operating environment can present opportunities or risks to creating and protecting the value and plans need to be developed and executed to manage these proactively.

This subject area focusses on managing two key considerations:

Purpose

Understanding the organization's purpose and linking this explicitly to the asset management objectives that need to be in place and maintained is fundamental to maintaining alignment across the Asset Management System and all asset management activities.

This Purpose is often stated by the Executive of an organization within organizational goals or business plans. The fundamentals of how the asset management function supports or influences this purpose should be fully understood by top management and stated in an Asset Management Policy and SAMP and articulated into relevant asset management objectives.

It is good practice to validate the Asset Management Policy, SAMP, and asset management objectives with those who have set the organizational goals to ensure alignment.

Organizational Purpose will be a key factor in determining the scale and complexity of the Asset Management System. For example, if the organization is delivering an essential and safety-critical service over a wide geographical area, it will generally require a more complex and robust Asset Management System than an organization that is a local producer of non-critical products, although both Asset Management Systems may function in line with the same basic principles.

An important consideration for Management Review is to ensure that should any aspect of the Organizational Purpose change over time, the Asset Management System changes accordingly to ensure that it remains relevant and effective in supporting the organization in delivering its core purpose to its key stakeholders. These changes would usually be documented in the SAMP and the asset management objectives would be amended as required.

Context

All organizations work within a business or operational environment that has risks, opportunities and constraints. This sets the Context for the business and shapes the Asset Management System, decision-making and activities. There are many factors that can shape the Organizational Context. These factors can be external or internal to the organization and each organization will be different. These may include:

- **Socio-Political** – Such as, regulation, change of government or political direction, shifting demographics, international relations, culture or unionized workforce. An example might be a new local or national administration influencing the regulatory framework to focus on customer outcomes or asset health.
- **Commercial** – This could include competitors, the needs and expectations of investors and shareholders, customer willingness to pay, new markets and emerging trends.
- **Environmental** – Where organizations might be significantly impacted by climate change or weather events, such as electricity distribution operators. Or where infrastructure might carry a significant risk of causing environmental incidents, such as oil and gas producers and water companies.

- **Technological** – This could be driven by a business environment such as rapid evolution in technology, changing standards or ageing and obsolete legacy infrastructure. An example might be an environment where statutory asset standards are subject to potential change such as in the aviation industry with a globally mandated new standard for airport baggage screening scanners.

Some types of organizations may work in more dynamic contexts than others. For example, cycles of change and competition may be more rapid and less predictable in telecoms and tech companies than in more stable environments such as water or power utilities.

Top management and Asset Management leadership need to account for the dynamic nature of changes in Context and factor this into the Management Review process and update risk registers and key documented information such as the SAMP and asset management plans accordingly. The periodicity of these reviews should be appropriate for the potential rate of changes in Context.

Organizations that are demonstrating good practice will review the performance of the organization's Asset Management activities and Asset Management System periodically and appropriately to the rate and scale of change in the Purpose and Context. Good practice would include:

- Communicating widely with key internal and external stakeholders (see Stakeholder Management 7.2.2) to understand current Purpose and Context and risk assess future uncertainty and changes reflecting these in objectives and decision-making
- Ensuring that Purpose and Context are documented in the SAMP and shape the asset management framework and that alignment is maintained between Organizational Purpose and Context and asset management objectives, asset management plans and the delivery of asset management activities
- Carrying out proactive analysis on external factors that may introduce risk or opportunity against achieving asset management objectives, such as regulatory drivers, legislation change, demand analysis, review of peers in the sector and the commercial environment.
- Having effective Management Review that will analyze the opportunities and risks of any changes

in Purpose and Context and will update the Asset Management Policy and SAMP accordingly.

- Time horizons for strategy and planning activities will be appropriate to the Organizational Context and rate of change of the asset portfolio, or business or regulatory cycles
- Using analysis techniques such as SWOT and PESTLE to determine key factors that need to be considered. Risk and opportunity management should be appropriately employed to enable asset management planning to make best use of funding and resources to manage emerging risks and capitalize on opportunities.
- Assurance processes and internal audit include assessing the effectiveness of processes focused on reviewing and managing risks and opportunities driven by changes in Organizational Purpose and Context.

This good practice may affect the delivery of Asset Management Plans and other life cycle activities within the AMS or may lead to changes in organizational structure and roles. Any changes should be undertaken with appropriate governance and effectively communicated accordingly to all relevant stakeholders.

7.2.2. Stakeholder Management

Understanding the requirements and expectations of stakeholders who can have an impact on an organization's asset management activities is a critically important activity.

Stakeholder Management includes the activities of identifying, communicating and interacting with stakeholders. For some organizations this is becoming an increasingly formalized area of business. For example, in some parts of the utilities sector where Regulators are setting expectations for consultation with stakeholder groups.

Management activities within this scope include:

- Identifying key stakeholders, their level of influence and impacts, and their needs and requirements;
- Development of stakeholder strategies and plans (including consultation and communication);
- Planning and execution of stakeholder processes;
- Analyzing and understanding, monitoring and evaluating the effectiveness of stakeholder engagement.

Organizations typically engage with their stakeholders to:

- Establish which aspects of their activities matter most to them;
- Understand their risk appetite;
- Formulate performance measures in delivering asset management objectives
- Understand their willingness to pay for products and services.
- Ensure that key messages are effectively communicated ensuring stakeholders fully understand outputs

Stakeholder engagement activities are an important input to the strategic planning processes and developing the SAMP and asset management objectives. It can help the organization improve decision-making and accountability and can be used to articulate different scenarios within an organization's asset management plans to understand and reflect stakeholder priorities and select those scenarios that most closely meet their aspirations.

Stakeholders with an interest in an organization's assets and asset management activities can be internal or external to the organization and will typically include:

- customers;
- top management;
- governments;
- local community and neighbours;
- special interest groups
- owners, investors and shareholders;
- regulators;
- employees and key contractors;
- labour organizations; and
- vendors / suppliers of equipment and materials.

Each stakeholder can have an impact on how an organization performs. It is important for organizations to fully understand the significance of specific stakeholder groups in relation to their influence and interest in the asset management activities of an organization.

Influencing stakeholders can lead to positive outcomes; aligning goals, influencing legislation and regulation, shortening supply chains or improving products or reputation. Stakeholders themselves can also have adverse impacts on the organization in many ways, including:

- introducing defective equipment (supply chain);
- withholding a license to operate or imposing improvement actions (regulators);
- affecting operations through industrial action (labour organizations) or disruptive action by special interest groups;
- reducing the operating or capital budgets (finance providers);
- reducing the demand for the product (customers).

The relationships with each external stakeholder reflect their interactions with the organization. These interactions are measurable and can be used to monitor performance.

The strength of these stakeholder relationships determines how these stakeholders interact with an organization and how well they support the asset management strategy (SAMP) and objectives. Effective stakeholder management supports an organization's ability to manage assets effectively, efficiently, and reliably.

It may also be necessary to understand and manage conflicting expectations and requirements between groups of stakeholders such as customers and shareholders.

Effective and appropriate communication with stakeholder groups is essential in managing needs and expectations, and this is usually documented within a Stakeholder Management Plan, which might be within the Asset Management System, or part of a wider company management process as appropriate. The Management Review process should also ensure that all significant internal and external stakeholders are managed proactively. Stakeholder satisfaction should be monitored, risks and conflicts resolved, and desired stakeholder outcomes delivered in line with the organizational objectives.

By definition, many stakeholders are outside the direct control of an organization. However, stakeholder management is influenced by what an organization does internally to align the outcomes of these interactions with the organization's strategic objectives.

Organizations can change business processes, introduce and enforce policies and procedures, and develop incentives to drive employee behaviour to align with a vision of how that organization wants external stakeholders to perceive it.

Measuring the delivery of this vision provides visibility and a drive to do business differently redefining how the organization relates to its external stakeholders. It is important to understand that stakeholders and stakeholder expectations and requirements may change over time. This must be appropriately monitored and understood within the Management Review process to highlight and alert top

management to take action should stakeholder requirements, risks or opportunities change that might have an impact on delivering the Asset Management Objectives.

See SSG on Stakeholder Management for further information.



7.3. Leadership & Governance

Leadership & Governance

- Asset Management Leadership
- Asset Management Policy
- Asset Management System
- Asset Management Assurance and Audit
- Technical Standards and Legislation

7.3.1. Asset Management Leadership

Asset Management Leadership at all levels is crucial for an organization aspiring to deliver effective asset management. Leaders can be at any level in the organization and not are only the top management. This leadership sets the direction and priorities for the development of the asset management capabilities necessary to deliver the organization's overall objectives.

Leadership in this context goes beyond traditional management functions of planning, organizing, and controlling; it encompasses setting direction, challenging the status quo, fostering innovation, and driving the development and implementation of improved procedures and systems.

Effective asset management leaders exhibit a range of competencies and skills, including emotional intelligence, resilience, and effective communication. They encourage a transformational approach, inspiring creativity and innovation among team members, and motivating them to embrace positive changes that enhance the organization's Asset Management System.

Leadership within asset management can be formalized through designated roles within an organization or assumed by individuals striving to enhance organizational value. Great leaders "walk the talk", they don't just tell people to collaborate, they model what collaboration looks like. All asset management leaders do the following things well:

- Provide asset management direction to relevant parts of an organization and effectively communicate this direction
- Promote a whole-life approach to asset management so an organization can realize value from its assets
- Demonstrate the ability to make difficult decisions in ambiguous situations, especially when

these decisions have significant implications for individuals and the organization as a whole

- Instil confidence in stakeholders by showcasing the benefits of the chosen direction and the expected outcomes of asset management objectives
- Inspire and motivate staff to contribute to the organization's goals

Asset management leadership cultivates a culture where every individual understands their role in achieving organizational objectives and feels empowered to contribute effectively. Trust between leaders and staff is fundamental to this process, and it is built upon consistent fairness, accountability, and a willingness to take responsibility. By embodying these principles and practices, asset management leaders pave the way for organizational success and sustainable organizational growth.

7.3.2. Asset Management Policy

An asset management policy states the high-level principles and mandated requirements by which the organization undertakes its asset management. It is formally authorized by top management to demonstrate the organization's commitment to asset management.

An asset management policy is the foundation of an organization's approach to asset management. A key component of the 'line of sight' (or alignment), it provides a framework for translating the organization's strategic objectives into asset management objectives and principles that guide the development of the asset management strategy (SAMP).

ISO55001 sets out requirements for an asset management policy which are covered by the following areas:

- Consistency – with the organizational strategic plan and other organizational policies;
- Appropriateness – for the purpose of the organization and the nature and scale of the organization's assets and operations;
- Commitment – for the organization to satisfy all applicable requirements (e.g. legal and regulatory) and to continual improvement of the asset management system (AMS);
- A framework – for setting asset management objectives; and
- Communication – to managers and staff within the organization, key supply chain partners and is made available to stakeholders as appropriate.

It can be challenging to draft an asset management policy with the right balance for an organization's circumstances. The structure, length, and content of the asset management policy will vary from organization to organization, from a single document to a structured group of documents, possibly with a single page 'Asset Management Policy Statement' suitable for notice boards. No matter which format is used, it is essential that it outlines principles for the organization's asset management approach, system, strategy, and objectives, ensuring consistency with stakeholder requirements, organizational objectives, and other policies while requiring top management support, effective communication, periodic reviews, and a commitment to continual improvement.

The SSG on Asset Management Policy, Strategy and Plans provides additional guidance and examples for developing an Asset Management Policy.

7.3.3. Asset Management System

An Asset Management System (AMS) is composed of interrelated elements within an organization

designed to establish, maintain, and improve asset management policies, objectives, and processes. The aim is to systematically direct, coordinate and control asset management in order to achieve organizational objectives and to ensure continuous improvement.

ISO 55001 identifies the minimum requirements for a 'competent' management system for asset management. Whereas other management systems are seeking to achieve outcomes in terms of specific dimensions, such as quality and environmental impact, the AMS is more holistic, considering all such dimensions when guiding the organization to realize value. Such a system helps to establish and maintain the alignment between asset management policy, objectives, strategies, processes and activities, along with people, data/information and risk management, and other supportive capabilities.

A simplified view of the elements of an Asset Management System are shown in Figure 8.

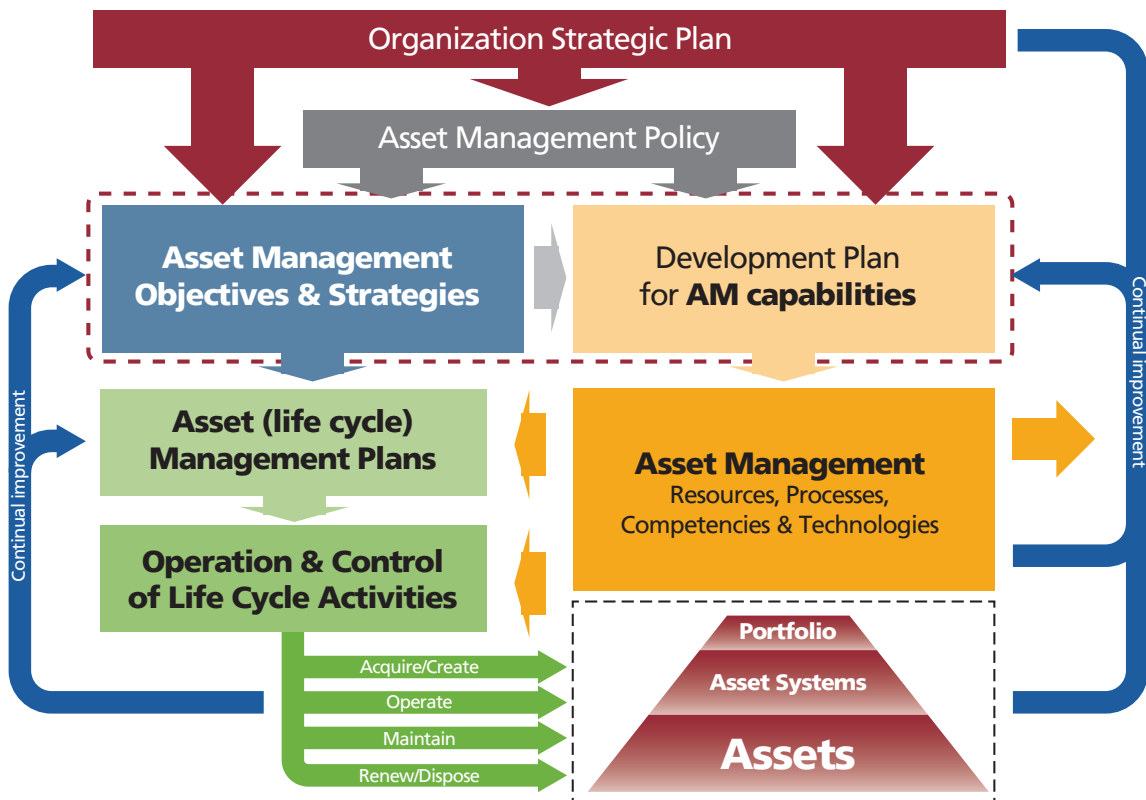


Figure 8: Simplified Asset Management System Elements

Asset Management Systems can be independently certified to ISO55001 but this is a choice each organization needs to make. Many organizations align their Asset Management Systems to the ISO55001 requirements and framework, but do not seek external certification. Whether or not an organization seeks certification, it is important to define the scope of the Asset Management System clearly – not just in terms of the assets but also the organizational boundaries of the system.

In some organizations, assets are owned by third parties (banks, superannuation funds, etc.) or leased to a franchisee, who manages the assets on behalf of the owner. The Asset Management System can be certified by the ‘guiding mind’ organization⁴² for the investment and maintenance of the assets over the lifetime of the assets.

An Asset Management System can be defined (and potentially certified) across multiple organizations. This requires **careful definition of the scope** of the Asset Management System, but it is technically possible. For example, if one of the organizations is a maintenance contractor, the certification may be invalid if the contractor is replaced. For that reason, most organizations limit the scope of the Asset Management System to the activities they directly undertake, and deal with outsourced maintenance (for example) under clause 8.3 of ISO55001 on outsourcing. In this case, the management of interfaces between organisations has increased importance.

Organizations often have more than one management system – each of which has its own strong advocates, and in many cases, the scope of these management systems overlap. Organizations should consider integrating their management systems to enable a consistent and efficient approach to activities across the organization.

The IAM publishes⁴³ a guide for organizations wishing to implement an asset management system; with comprehensive advice on implementing and improving an AMS (including examples and advice about integrating management systems).

Note: asset information systems are sometimes described as ‘Enterprise Asset Management System’ (EAMS) - and sometimes even promoted as ‘Asset Management Systems’. This can create confusion! These software solutions are primarily enablers to better data & information management, with some aspects of workflow and work control. They are **not** a management system as described here (and defined in ISO55001).

Asset Management Assurance and Audit (7.3.4) is key to developing and maintaining an Asset Management System.

7.3.4. Asset Management Assurance and Audit

Asset Management Assurance and Audit are delivered through an organization’s structured processes for assuring and auditing the effectiveness of its assets, Asset Management, and Asset Management System to ensure the organizational and asset management objectives are being achieved and its assets fulfil their required purpose.

The assurance of Asset Management Systems (AMS) is crucially tied to evaluating the performance of asset portfolios and overall asset management. This evaluation serves as a key input for improving the AMS, ensuring that the organization closely monitors factors that could affect realizing value from assets or hinder the achievement of asset management objectives. Key considerations include:

- Meeting stakeholder and other applicable (including legal and regulatory) requirements.
- Aligning with asset management objectives.
- Using consistent decision-making criteria and methodology.

It is important for the organization to maintain consistency and traceability among technical asset information, asset management information, asset management system information, and financial records.

Monitoring asset management performance should prioritize assessing whether the activities effectively realize the desired value from assets. This entails evaluating the effectiveness and efficiency of

42. The asset lifetime can exceed the period of a franchise, for example, if the organization can demonstrate that it is responsible. This must include determining and managing the strategies to achieve stakeholder requirements (for those assets) over the relevant period of time (in this case the franchise period).

43. Implementing and Improving a Management System for Asset Management.

decision-making processes in asset management. Monitoring asset management system performance is normally carried out as an input into Management Review and should address the following:

1. Assessing the organization's effectiveness in achieving its asset management policy, strategies, and objectives;
2. Identifying changes in internal and external factors and the associated risk profile relevant to the asset management system;
3. Evaluating the efficiency with which the organization's asset management policy, strategies, and objectives are realized;
4. Reviewing the performance of activities delegated or outsourced to external providers;
5. Implementing measures to track and monitor nonconformities;
6. Evaluating the effectiveness of corrective actions taken within the Asset Management System, including those stemming from previous reviews;
7. Ensuring compliance with the internal audit plan and the closure rate of audit actions.

Best practices suggest that outcomes from AMS monitoring, including identified risks and issues, should inform management reviews, ensuring continuous

improvement. Accountability for monitoring outcomes and acting upon them is essential, with summary information presented to top management and more detailed information disseminated throughout the organization as appropriate.

This comprehensive approach ensures that the AMS operates effectively within the scope of the organization's assets, fulfils its objectives, and adapts to changes that may impact asset performance or the organization's ability to achieve its goals. See Figure 9.

Audit

Audits assess both the effective implementation of processes and the extent to which these processes achieve intended outcomes, such as realizing value from assets that enhance the organization's overall performance. This information equips top management with the necessary insights to evaluate the effectiveness of the Asset Management System and to identify opportunities for improvement.

While audits are expected to address the entire scope of the Asset Management System, it is not obligatory for each audit to delve into every aspect of the AMS. Segmentation of audits is permissible as long as the

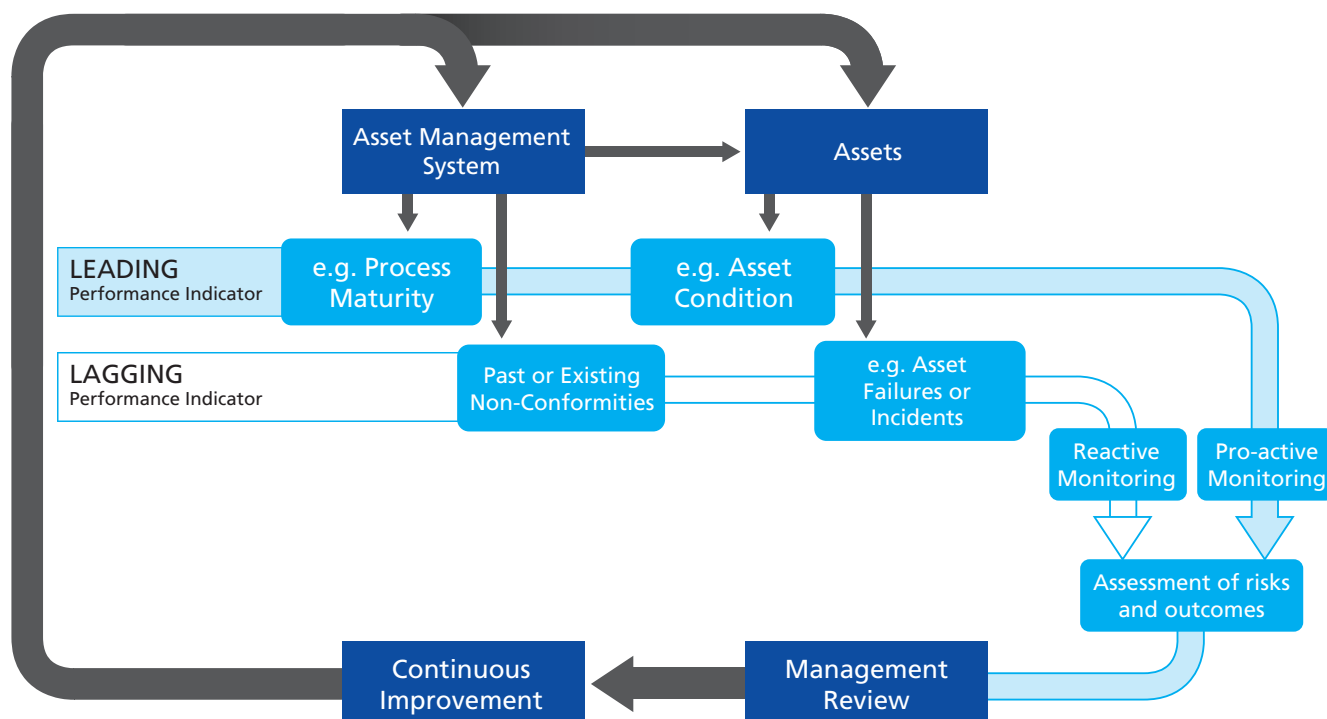


Figure 9: Assessing the Performance of the Assets and the Asset Management System

overall audit programme ensures comprehensive coverage of all organizational units, functions, activities, management system elements, and the overall scope of the asset management system within the designated auditing period.

Audits may be carried out by personnel from within the organization or by external individuals chosen by the organization sometimes with certified capabilities to perform these audits. Remote auditing can be considered where feasible. The results of audits should feed into Management Review for improvement of the AMS.

Further information on good audit practice can be found in ISO 19011:2018 and for an AMS the requirements of ISO55001.

Management Review

Management Review is a periodic review by an organization's top management to ensure its AMS continues to be suitable, adequate and effective. It would consider a number of inputs, including:

- internal and external changes which impact on the organization's asset management activities;
- asset and asset management performance; and
- changes in the profiles of asset management related risks and opportunities.

The review can result in changes or improvements being made to the AMS. The visibility of top management undertaking the review is a key part of demonstrating their commitment to asset management and its continual improvement.

Management Reviews serve as opportunities for the organization to evaluate the suitability of its asset management policy and objectives for fulfilling its purpose. It enables the organization to establish new or updated asset management policies and objectives for continual improvement and to drive ongoing improvement, aligned with future needs. Additionally, Management Reviews should assess the long-term viability of the assets essential for achieving organizational objectives. It is important for the organization to communicate the outcomes of Management Reviews to relevant stakeholders. It is the link between audits and the performance evaluation of the AMS.

Many organizations have adopted an assurance model known as the 'Three Lines of Defence'⁴⁴.

In this model:

- the first line of defence is operational management, which is responsible for maintaining effective internal controls and executing risk and control processes on a day-to-day basis.
- the second line of defence comprises various risk management and compliance functions to help build and/or monitor the first line of defence controls. For example, functions that monitor compliance with applicable laws and regulations. These are management functions that have a degree of independence from the first line of defence, and ensure that processes are properly designed and operating as intended.
- the third line of defence is Audit. This is independent of line management, to provide assurance to the governing body and senior management on the effectiveness of governance, risk management and internal controls. This covers all parts of the organization and their activities and includes the manner in which the first and second lines of defence achieve risk management and control objectives. It will include activities relevant to the organization's asset management capability. An Internal Audit function in an organization would normally report into an independent audit committee.

In addition to this independent Internal Audit function, audit activities are also usually undertaken within different parts of an organization, as an activity within the 'second line of defence'. Organizations would typically have Health & Safety, Environmental, Quality and technical auditors who evaluate the level of compliance with technical standards, legislation and regulatory requirements. These audits would cover work done by the organization's own staff and outsourced to suppliers.

Determining Asset Management Assurance and Audit also utilizes the activities with the Monitoring (see Section 7.10.1), and Incident Management and Response (see Section 7.7.6)

7.3.5. Technical Standards and Legislation

All asset management organizations are required to comply with relevant laws. The law is enacted

44. 'The Three Lines of Defense in Effective Risk Management and Control', Institute of Internal Auditors Position Paper, January 2013. <https://na.theiia.org/training/templates/Pages/The-Three-Lines-of-Defense-in-Effective-Risk-Management-and-Control.aspx>

through legislation and may be supported by regulations that describe what is required. These laws may be international or national and normally represent a considered view that considers many factors and stakeholders. Regulations may, of course, relate to some specific industry or assets and can be initiated by many factors including, for example, corrective action from inquiries and political initiatives.

The regulations may in turn be supported by standards that may include criteria for compliance – such as permitted levels and tolerance for a noxious chemical. These form the basis for testing conformance with regulations and provide more specific detail and application.

Below this level are codes of practice that provide further recommendations, which can again be supported by standards that define criteria. Codes of practice are often for an industry – such as rail or highways. Although these are not mandatory in as far as they are not directly linked to regulatory compliance, in practice these will often be used by a court of law to test if an organization is following recognized good practice. If an organization is found not to be complying with a recognized code of practice without very good justification, in the event of an incident, they may be prosecuted.

See Figure 10.

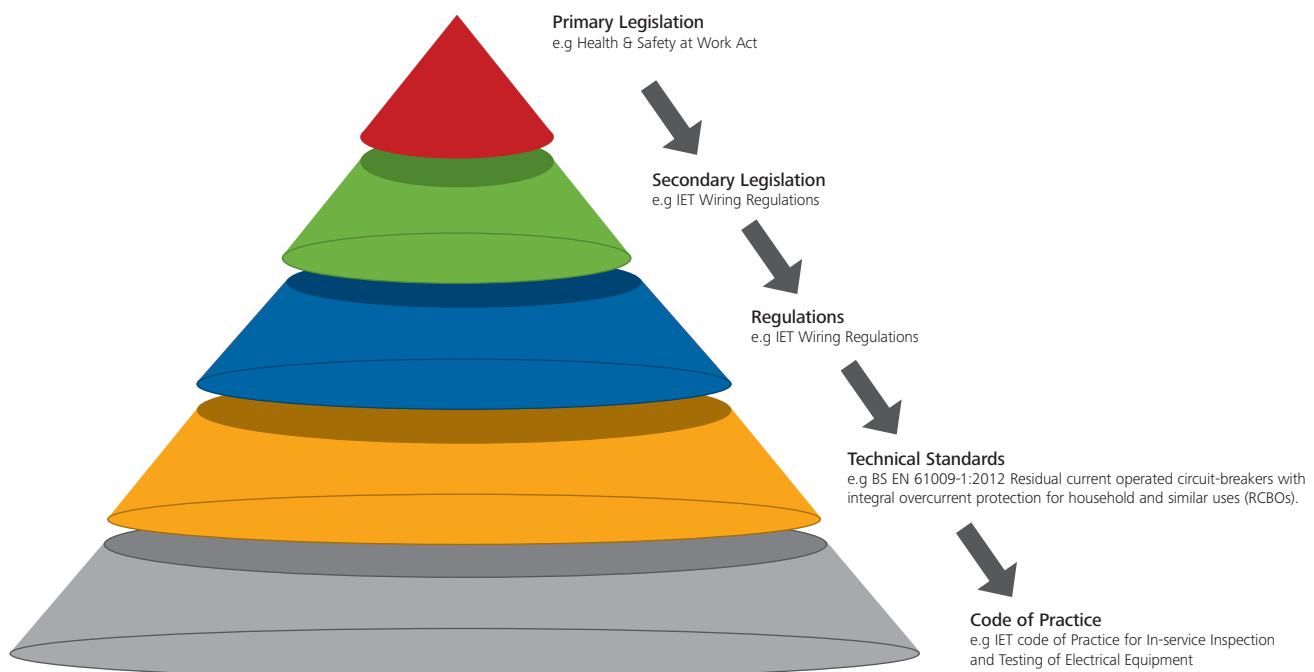


Figure 10: Hierarchy of Legislation, Regulations and Technical Standards

Below the international, national and industry regulations, standards and codes of practice come standards that are more specific again – down to the standards and specifications that are put in place by an organization to ensure that not only legislation, but their own asset management policy and requirements are achieved by application of the relevant standards.

Technical Standards and Legislation must be considered when developing the SAMP and plans and in the delivery of life cycle activities.

Organizations must have processes to identify the relevant technical standards and legislation and incorporate the requirements into their own policies and processes. In order to demonstrate compliance with the requirements, it is good practice for this to be audited by individuals who are independent of the associated processes, and the results reported to an independent compliance committee within the organization (see Asset Management Assurance and Audit 7.3.4).

See SSG Technical Standards and Legislation for further information on this subject.

7.4. Organization & People

Organization & People

- Organizational Arrangements
- Organizational Culture
- Competence Management
- Organizational Change Management

7.4.1. Organizational Arrangements

Organizational arrangements refers to the way in which people within an organization are organized by way of structure, responsibilities, and lines of communication. It is inextricably linked with organizational culture.

Managers and executives that are new to asset management often ask *'Where should we place asset management in our organization?'*

There is no one correct arrangement that would be applicable for every type of organization. However, where asset management roles and responsibilities sit in an organizational chart gives a clear indication of how seriously it is taken within the organization, and will have a big influence on how people perceive it. For example, in a traditional, hierarchical organization, if there is no one near the top with responsibility for asset management, it is unlikely that the asset management agenda will be taken seriously across the organization. This would make it very challenging for asset management practices to be driven across an organization's functions and departments or into the supply chain.

The ability of an organization to achieve its asset management objectives requires effective asset management with Asset Management Leadership (7.3.1) acknowledging and understanding how each role within an organization contributes to successful outcomes. The arrangement of organizations is a crucial concern, because:

- the way people are organized affects how well they work together;
- it is a key enabler of 'line of sight' (alignment);
- it affects the effectiveness of communications, information flows and feedback in all directions with internal and external staff, and stakeholders; and
- it can have a major influence on the development of organizational culture.

Every organization needs to decide what type of structure best suits its needs. The structure of an organization will be influenced by a number of factors, such as:

- size;
- industry sector, and products or services;
- diversity – single site /single country / large multinational;
- ownership structure – private, / government / listed company;
- maturity – a new start-up / an established business;
- cultural background; and
- the appropriate span of control for its services, products and processes.

Asset management requires people from different functions and disciplines to work more closely than many are used to. As asset management is concerned with the integration of different functions and disciplines, roles and responsibilities need to be allocated at a senior level to make this possible. Maintaining a rigid hierarchy of roles and responsibilities is unlikely to foster multidisciplinary problem-solving of the kind that is required for asset management.

Senior management must ensure that the organizational arrangements and culture are both conducive to what it is trying to achieve. The 'right' organizational arrangements are ones that best suit the organization's requirements and enable it to meet its goals quickest and most efficiently. In considering the organizational arrangements, there are three main aspects to consider:

- internal work units e.g. teams, departments, international divisions;
- external work units, e.g. suppliers, contractors, outsourced work; and
- reporting and management lines e.g. committee structures, responsibility hierarchies.

Organizational Culture (7.4.2) identifies a number of leading practice principles to apply when deciding on the appropriate organization structure and culture for asset management activities.

The most appropriate structure for an organization is also likely to change over time. What is needed to introduce asset management thinking and practices to the organization may be very different from what is needed as capabilities mature.

Further information and guidance on organizational arrangements can be found in the published SSG Organizational Structure and Culture, which includes a framework to support senior managers when determining what sort of structure best suits their organization:

- Understanding the purpose of the organization;
- Understanding the need for change;
- Identifying the necessary structural changes;
- Managing the structural changes; and
- Sustaining benefits of change.

7.4.2. Organizational Culture

The culture of an organization significantly influences its performance in various aspects, including asset management. Proactive management of culture is essential for organizations aiming to leverage asset management effectively. Each organization must determine the culture conducive to its success, considering factors such as long-term planning, openness to innovation, and risk tolerance.

Organizational culture in the context of asset management encompasses how individuals think and behave in pursuit of asset management objectives. Organizations lacking clear vision, mission, and values often foster reactive asset management cultures. Establishing rules and processes supportive of asset management objectives is crucial.

The organizational culture serves as an indicator of asset management maturity and is influenced by leadership styles, demographics, processes, and other factors. Performance management systems play a vital role in reinforcing desired behaviours.

An organizational culture should evolve, embracing diversity, equity, inclusion, and a lifelong learning culture. Transitioning from a siloed to a unified culture facilitates collaboration necessary for successful asset management implementation and meeting evolving demands.

While there are various types of cultures, alignment with organizational objectives is crucial. A culture of stewardship and collaboration positively impacts objective achievement.

Creating a culture supportive of asset management begins with top management establishing a clear

vision aligned with asset management objectives and organizational goals. The organizational structure interacts closely with culture, influencing integration between functions crucial for effective asset management.

Principles guiding the establishment of an appropriate culture for asset management include:

- Clarity of organizational purpose;
- Visible support from top management;
- Consistency across the whole organization ;
- Ensuring collaboration and teamwork;
- Defined roles and responsibilities;
- Intended communication channels;
- Effective decision-making processes including accountability.

Sustaining cultural change necessitates consistent behaviours, particularly from management, continuous communication, and reinforcement. Further information and guidance on organizational culture can be found in the published SSG Organizational Structure and Culture.

7.4.3. Competence Management

Competence is defined⁴⁵ as the ability to apply knowledge and skills to achieve intended results. Competence does not guarantee good performance, but it does enable it. Competence tends to deteriorate if not practised, and even highly competent people can struggle to perform well in a dysfunctional team or organization. Some activities occur infrequently which makes it difficult to maintain the competence of those who perform them. These factors make the management of competence an important topic.

Competence management is more than just identifying competency requirements. It involves managing the ability of individuals in asset management roles to ensure they perform their work activities effectively and as required.

Organizations should adopt an appropriate structured approach to managing competence and behaviour that covers both the development of individual competence and the development of organizational competence. This requires organizations to have processes in place to assess competence, maintain records of competence, have plans to develop

45. ISO 55000:2024

competences through training and development, and adding competent staff through recruitment and selection.

Being clear about competence requirements at all levels and ensuring these are used to select, develop and review people and define roles and responsibilities and the relationships between them supports the structure and culture of the organization.

The IAM Competences Framework is increasingly used by organizations to define their specific competence requirements and build competence management systems around them. (See Section 8 IAM Resources)

Guidance is also provided in ISO 55012:2024 Asset management – guidance on people involvement and competence.

7.4.4. Organizational Change Management

Improving asset management practices and increasing organizational asset management maturity will often require change that will impact people within an organization.

Organizational change management is a structured approach for managing the people side of change, and it can be used to support individuals through changes to asset management processes, technology, organizational arrangements, and culture.

Change begins with understanding why. It is important for individuals to understand the reason for the change and have an awareness of the nature of the change. They need to understand what is in it for them to have a desire to change. As the change is implemented, they will need to gain knowledge of the new processes and technologies, which may require training and coaching. This will give them the ability to implement and sustain the change through demonstrated capabilities in the form of behaviour or performance.

Key components of change management include:

Planning, governance and leadership. Have a clear vision of the need for change, define the outcomes and benefits of the change, and develop clear objectives to be achieved by the change. Establish

a governance structure with appropriate roles and responsibilities to manage the implementation of the change. Leadership commitment is really important both at the top and across the organization, to guide organizational behaviour and lead by example.

Stakeholder engagement plan. Identify the stakeholders who will be impacted by the change and assess the level of impact and their level of readiness for the change. Based on this assessment, develop a stakeholder engagement plan to manage the impact and encourage their participation and commitment.

Communications. Employ open and consultative communication approaches to create awareness and understanding of the change throughout the organization. Develop a communication plan that describes the type of communications to be used (e.g. briefings, newsletters, website, email blast), the audience for the communications, frequency of communications, and key messages to be communicated.

Training. Develop a training plan for the new tools and processes that will be implemented as part of the change so that stakeholders can develop the required skills and competencies, and help embed and sustain the change.

Resistance management, reinforcement and sustainment. As the change is implemented it is important to implement strategies to overcome resistance and reinforce the change. This can include implementing “quick wins” that provide early benefits and demonstrate achievement of the change objectives. Sustaining the change requires leadership commitment, effective communication, and continuing reinforcement.

An organizational change management plan is typically developed to plan and implement the change, documenting the approach to the key components of change. There are several change management methodologies that can be used to develop the change management approach including the ADKAR model and Kotter’s 8-step change model⁴⁶.

See also Management of Change (7.10.3) and Configuration Management (7.8.5)

46. <https://www.kotterinc.com/methodology/8-steps/> <https://www.prosci.com/methodology/adkar>

7.5. Strategy & Planning

Strategy & Planning

- Demand Analysis
- Sustainable Development
- Asset Management Strategy and Objectives
- Planning
- Shutdown & Outage Strategy & Planning
- Contingency Planning & Resilience Analysis
- Resource Strategy and Management
- Supply Chain Management
- Life Cycle Value Realization
- Asset Costing and Valuation

7.5.1. Demand Analysis

Demand Analysis is an essential tool to determine future stakeholder needs and how these might change over time. This can identify gaps in the capability of an organization's assets or systems to deliver these needs. Changes in customer behaviour, technology, policies, suppliers, environment, and asset condition are some of the factors which need to be assessed, as part of developing an organization's SAMP. Outputs from Demand Analysis inform risk management, capital, and operational planning, to ensure required demands and service levels can be met.

When developing asset management objectives and strategy in the SAMP, it is important to consider historical trends and lessons learned to inform future decision-making. Current and forecast demand informs the outputs required from the assets, asset systems, asset portfolios, and asset management as a whole. This requires that structured and timely demand analysis be undertaken, including processes, governance and communication, informing the SAMP and asset management plans.

See SSG on Demand Analysis for more information.

In conducting a demand analysis there are many elements to consider. Typically, these include:

Inputs

- Historical demand and the influence of business and environmental conditions on existing outcomes, including major failures in service level.

- Drivers - existing, new and emerging demand changes, e.g., population growth.
- Stakeholder needs and affordability.
- Current and predicted asset condition, life and capability to meet future demand scenarios.
- Developments and trends in new technology e.g., Artificial Intelligence
- The changes in price over time (e.g. market prices or resulting from regulatory price controls), interaction with other related services and market competition
- Changes in supply chain capability
- Environmental, regulatory, social, political, and legislation changes, current and future.

Outputs

- Life cycle cost analysis
- Risk management
- Resource and supply chain impacts
- Asset life extension, rationalization, repurposing, refurbishment and disposal
- Solutions that do not require physical assets
- Resource planning
- Innovation strategy and projects
- Climate and environmental impact assessment
- Influencing social and political outcomes

Quantitative tools can be used for forecasting demand and required levels of service.

Understanding future demand and stakeholder needs is likely to have a degree of uncertainty – in particular, the longer ahead the analysis considers. A range of scenarios should be considered with demand projections, including assumptions and probabilities, made for each scenario to provide a range of possible future requirements. The most likely scenario can then be used, within the context of a range of less probable outcomes.

7.5.2. Sustainable Development

The United Nations define Sustainable Development⁴⁷ as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Sustainable development incorporates the environmental, social, and economic aspects of activities (sometimes referred to as the triple bottom line approach) encouraging a holistic approach to decision-making which looks beyond short-term

47. World Commission on Environment and Development, (1987):

impacts and consequences by developing sustainable solutions, plans and activities.

An organization's assets determine much of its economic, social, and environmental impacts over multiple timeframes. Environmental protection and social improvements are important quality-of-life factors that can affect the long-term value proposition of the organization. Setting clear sustainability objectives and criteria enables decision-making through the asset life cycle. Decisions can be consistently evaluated and tracked for effectiveness. Examples include incorporating the use of new technology and innovation, efficiency improvements by asset reduction, redeployment or repurposing, life extension and recycling.

Asset management has an important and enduring role to play in sustainable development through:

- The effective management of the assets in a nation's infrastructure, manufacturing, and service base, which are key enablers for economic well-being and many societal structures;
- The potential impact on the environment of assets and asset management activities and the approach to whole life evaluation of risks, costs, and performance of assets.
- Development of asset management related sustainability metrics and Key Performance Indicators (KPIs)
- Increasing stakeholder confidence and awareness of asset value and its management for the common good.
- Acknowledgement and communication of leading practices

Asset management processes need to support the organizational sustainability framework, including:

- Resource management, diversity, consumption, renewal, and replenishment
- Organizational Culture (see 7.4.2)
- Knowledge Management (see 7.8.2), skills, and training
- Resilience and risk management, e.g. extreme weather events
- Societal engagement and promoting cohesion
- Climate change considerations, reduction of carbon emissions, use of water resources and energy efficiency
- Financial
- Acknowledgement of local knowledge and heritage (e.g. indigenous)

A sustainable development review supports a long-term, holistic approach to an organization's asset management and is a key input to the other subjects in Strategy & Planning (7.5) and Asset Management Decision-Making (see 7.6).

Further information can be found in the guidance document BS 8900-1:2013, Managing Sustainable Development of Organizations. Guide.

7.5.3. Asset Management Strategy and Objectives

The Strategic Asset Management Plan (SAMP) specifies the organization's long-term and life cycle approach to managing the assets to deliver the organizational objectives. It details the asset management strategy, asset management objectives, the levels of service and performance needed to satisfy objectives, the resources and capabilities needed to deliver sustainable outcomes, and the information needed to enable the development of the asset management plans (See Planning 7.5.4).

An asset management strategy and the associated asset management objectives are considered the second stage of an organization's 'line of sight' (alignment). They translate the Asset Management Policy (7.3.2) principles into guidance for making asset management decisions. They do so by converting the organizational objectives into asset management objectives and by describing the organization's long-term strategy for implementing the Asset Management Policy to achieve these objectives. The SAMP also identifies the capabilities needed to deliver sustainable outcomes, the information needed to enable asset management plan development and the role of the asset management system in supporting the achievement of the objectives.

The asset management objectives help an organization achieve the desired outcomes from its asset management activities. They should be framed in a long-term context and be forward-looking. The objectives should consider the needs of the assets, asset portfolios, asset systems and asset management as a whole, as well as address needed asset management capabilities. The objectives should consider stakeholder, economic, environmental, and social outcomes as these will drive the establishment of levels of service and asset performance, as well as provide feedback on gaps in asset management decision-making. Finally, they should be Specific,

Measurable, Achievable, Realistic and Time-bound (SMART), and established at all relevant levels and functions within the organization.

The SAMP should describe the strategic context guiding the strategy, the current and future service levels and capabilities needed to achieve the objectives, and the basis for prioritization and decision-making for asset management planning and life cycle delivery. It should also describe how the organization will develop and improve its asset management capabilities and the asset management system (i.e., its processes, information, systems, people, tools, resources, etc.).

The SAMP may include a number of functional strategies to address specific activities (e.g., capital projects, operations, maintenance) and asset classes. These functional strategies are typically an output from the Asset Management Decision-Making (see 7.6).

The development of an asset management strategy typically considers the following:

- Consistency with the Asset Management Policy, the organizational strategic plan and other organizational policies and strategies;
- Risk tolerability criteria and prioritization of activities according to risk and criticality;
- The life cycle of the assets and the interdependencies between the life cycle stages;
- The framework, including decision-making criteria, for developing asset management plan(s);
- The requirements and expectations of stakeholders;
- The functional, performance and condition requirements for the assets;
- Uncertainty due to potential future changes and sustainability requirements; and
- Management feedback to improve the organization's asset management capability and to ensure that it is still fit for purpose.

The SAMP must be communicated to relevant internal and external parties.

The cascade of asset management objectives throughout an organization has a significant impact on maintaining alignment across the organization. To counter the tendency to create organizational silos, it can be advantageous for people to have performance objectives that are complementary to

and encourage collaboration with other departments. The SSG on Asset Management Policy, Strategy and Plans and SSG on Strategic Planning provides additional guidance and examples for developing an Asset Management Strategy. Further information can be found in Developing and Maintaining a Strategic Asset Management Plan.

7.5.4. Planning

Asset management planning follows on from strategic planning and is the process of developing detailed asset management plans from the SAMP (asset management strategy and asset management objectives. See Asset Management Strategy and Objectives (7.5.3) for more information.

Asset management plans specify the activities that an organization intends to undertake to deliver its asset management objectives, along with the resources required, timescales and costs for completion, and responsibilities for their delivery. The scope of the plans encompasses:

- all activities to achieve the asset management objectives
- the levels of service and levels of production
- risk assessment
- asset-specific strategies over the asset life cycle, taking into account the risk assessment, to achieve the asset management objectives, including the levels of service

The asset management plans detail:

- the responsibilities for leading and delivery of each activity;
- the resources needed to deliver each activity, including financial, human (numbers and specialist skills / knowledge) and equipment;
- the timescales to complete activities, including access and outage requirements;
- when the expected outputs, or benefits, will be achieved; and the threats / risks to delivery, and mitigations required from the risk assessment.

The asset management plans also detail how to plan the activities, including:

- how activities within the plans are to be justified and prioritized, including the decision-making criteria to be considered and the weighting (importance or criticality) of each factor
- who is responsible for each element of the asset management decision-making process;
- the processes to determine the optimum

combination of activities necessary to deliver an objective, by applying appropriate asset management decision-making techniques;

- how the plans will be approved, monitored, reviewed and updated.

Successful delivery of the asset management plans relies on integration with:

- asset management plans from the other portfolios
- other organizational plans in both the development and delivery phases, e.g. Finance, Health & Safety, Human Resources, Legal and Procurement

The SSG on Asset Management Policy, Strategy and Plans and SSG on Strategic Planning provide additional guidance and examples for developing Asset Management Plans.

7.5.5. Shutdown & Outage Strategy & Planning

The terms shutdown, outage and turnaround are used interchangeably across many industry sectors, but all involve taking assets out of service to execute work that could not be performed whilst the assets are operating.

Shutdown, turnaround and outage strategy refers to the organization's work management processes for identification, planning, scheduling, and control of work related to shutdowns, turnarounds and/or outages.

Whilst shutdowns and outages may be required to ensure that asset performance can be maintained at acceptable levels, they can disrupt output or reduce service levels and are undesirable from a production viewpoint. However, avoiding shutdowns indefinitely will lead to asset and system failures and unreliable production.

While the typical impacts of a shutdown may be undesirable, unplanned outages can have more critical implications for customers and impact brand perception. Further, outages can have wider impacts on market availability and price to the customer because there have not been planned mitigations to lost production or service. In some industries, due to redundancy or additional capacity designed into asset systems, assets can be taken out of service without completely shutting down the production process or service to customers, minimizing impacts to the customer.

Shutdowns and outages can be expensive to coordinate and execute, requiring large numbers of skilled (and possibly scarce) labour to be set to work within a tight time window and often within limited physical space. A shutdown strategy explores the options available to plan, schedule and complete the work activities efficiently and safely within the available shutdown windows. In addition, effective material requirements planning is essential to support timely completion of asset maintenance, refurbishment, or replacement activities. This includes evaluating the impact on levels of production or service, the efficiency of undertaking fewer, but longer shutdowns/turnarounds (with a large impact on production) compared to more, shorter shutdowns/turnarounds (with less impact on production, but increased delivery costs).

Effective project management practices focusing on scope, time, budget, risk and stakeholder management while minimizing the impact on the ongoing operations are key to successful shutdown and outage activities. The scope of each shutdown / turnaround, and the work packages to be completed within it, should be determined using robust, auditable processes. Large shutdowns / turnarounds, such as those involving asset systems, usually require the collaboration of many parties, including operations, maintenance, engineering, projects, production planning, contractors, and service providers.

The application of asset planning (including operations & maintenance) decision-making identifies the optimum intervals to execute maintenance tasks and time windows within which to upgrade or replace ageing assets. This information, along with other project work, is used to create schedules or scopes of work to be undertaken during shutdowns / turnarounds. It is normal for some activities to be moved from their individual optimal timing to fit within the available shutdown / turnaround windows in order to achieve the lowest total business impact for the overall program. Due to the number of possible permutations, decision support systems that leverage asset condition and maintenance history data can be important in identifying the timing and scope for shutdown and outages. Similarly, project management and work order management systems can be very effective for planning, controlling, and completing activities as well as returning production and services online.

The return to service following a shutdown is a higher risk period due to the potential for early life failure of new assets or errors in the execution of complex sequences for re-commissioning and return to service of existing assets. These potential risks can be mitigated and managed through agreed and documented processes for commissioning and return to service.

Further details are provided in SSG on Shutdowns and Outage Strategy and Management

7.5.6. Contingency Planning & Resilience Analysis

A resilient organization is one that can withstand and recover rapidly from adversities, and this quality enables the organization to thrive under disruptions. There are two dimensions of resilience:

- the resilience of asset systems, which concerns with the ability of the system of assets to resist shocks and recover its ability to provide the intended service, and
- organizational resilience, which concerns the ability of the organization to be aware of the threats that can impact its value chain, and act effectively to manage risk and expedite recovery.

Contingency Planning and Resilience Analysis are essential capabilities for both dimensions, and they enable the organization to identify credible threats and risks (natural or manmade), understand the extent of impacts, and plan for maintaining or recovering to an acceptable level of service within an acceptable time under disruptive events, incidents or disasters.

Specifically, these capabilities help an organization assess and plan for adversities within a broader resilience framework illustrated in Figure 11, where considerations of resilience are embedded into risk management, asset maintenance, investment planning, as well as response and recovery. These capabilities are closely tied to Risk Management (7.9), the response to failures and incidents, addressed within Incident Management & Response (7.7.6) as well as the broader decision-making context concerning subjects such as Life Cycle Value Realization (7.5.9) and Sustainable Development (7.5.2).

Resilience of an asset or asset system is often specified at the creation/acquisition stage of the asset life cycle, using Systems Engineering (7.7.2)

and Integrated Reliability (7.7.3). However, the environment within which an organization and its assets operate may well change over time. Similarly, the business context may also change over time, requiring agility and adaptability from the organizational leadership to make timely changes that will allow the organization to continue to thrive.

A resilience analysis establishes an understanding of the impacts of adversities, how well, and how long it takes for an organization to recover from adversity using metrics that reflect the system's ability to deliver an intended level of service or the organizational objectives. This typically begins with understanding the minimum requirements to ensure the organization or asset can operate and an assessment of all potential threats and opportunities that may impact the operation of the organization. These threats may include natural occurrences, particularly those that are infrequent but highly impactful (such as extreme weather, earthquakes, and pandemics) and accidental or deliberate events.

Once a basic understanding of risk is achieved, a detailed assessment that evaluates the level of resilience of the system under the key scenarios should be completed to understand the extent and duration of the impacts of each scenario on the level of service or to the organizational objectives. This provides the basis for mitigating risk (implementing mitigation or building capacity to respond more rapidly) and developing contingency or business continuity plans, which need to be regularly reviewed and tested.

This approach to resilience planning is illustrated in Figure 11 and typically contains the following steps:

- Complete / Review existing risk assessments to identify potential gaps in the coverage of relevant threat vectors, particularly high-impact-low-probability events.
- Complete a resilience assessment to establish the level of impact to service levels of the relevant threats. Adopt a target recovery objective, defined by the time required to recover to a minimum acceptable level of service.
- Conduct an assessment of the current level of organizational resilience and ability to deal with and recover from shocks, and whether the leadership and culture can react with agility to emergencies and changing business circumstances.

- Select strategies to protect, and recover the activities delivered by the assets, and obtain buy in from leadership. This can be a mixed strategy that includes investing in risk mitigation (maintenance and capital planning) and instating measures for expediting recovery (contingency planning).
- Develop and implement mitigation. Introduce measures to increase response capacity and speed as part of the contingency plan.
- Regularly test / exercise, maintain and review the mitigations and plans to ensure that the responses remain fit for purpose and feed outcomes into the continual review process.

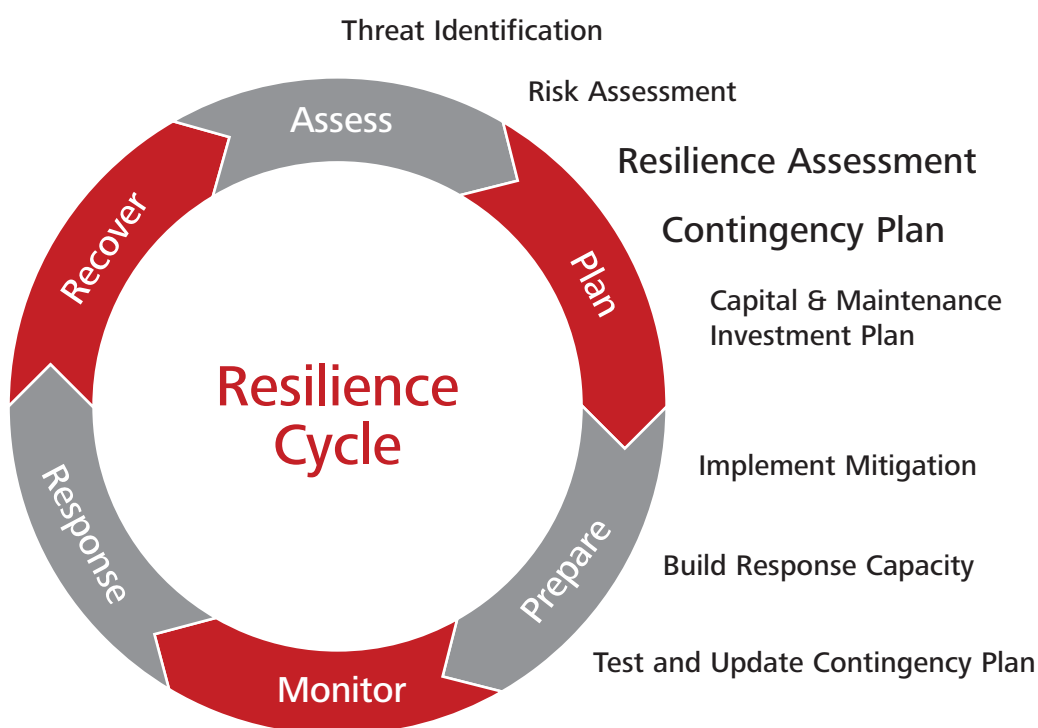


Figure 11: Resilience Cycle

More information on contingency planning can be found in ISO 22301:2012, Societal security – Business continuity management systems - Requirements.

See SSG on Contingency Planning & Resilience Analysis for more information.

7.5.7. Resource Strategy and Management

The development of a resourcing strategy is closely integrated with the processes for Asset Management Strategy and Objectives (7.5.3) and Planning (7.5.4). It typically includes analysis, for the relevant planning horizon, to determine the best ways to establish and / or procure the resources required to deliver the activities defined in the asset management plans. The resources considered include the people, plant and equipment, specialist tools and materials, services required for meeting the asset management

objectives and for implementing the activities specified in the asset management plans.

The resourcing strategy details the strategy for sourcing the required resources which can include recruitment, partnering, outsourcing or procurement. As such, it should consider the full supply chain including appraisal / selection of contractors, outsourcing-insourcing strategies, inventory, and claims management.

Development of the strategy requires analysis and planning of the optimal way to deliver the asset management life cycle activities. This includes the creation, management, maintenance, and enforcement of contractors and suppliers in a fair, equitable, and legal manner throughout the life of the assets. It includes the full supply chain and

should align with corporate policies and standards. The resourcing strategy should also be aligned with the SAMP and consider customer demand, availability of skills, level of competition in the supply chain, and the long-term sustainability of the strategy.

The appropriate mix of internal and external resources can be influenced or constrained by external factors (such as supply chain capability and / or capacity), working practices and political or labour union considerations. Organizations often identify the core resource capabilities to be developed or retained in-house and the non-core resource capabilities that may be more appropriate to buy-in or outsource. Outsourcing analysis should include an assessment of the costs and risks of the quantities, quality and timing of the resources to be procured, in addition to storage, logistics and supplier management implications. Organizations should consider the value of being an informed customer with the capability to specify, manage and monitor outsourced services.

The resourcing strategy will directly influence the general strategy supporting the procurement of services established through Supply Chain Management (7.5.8). The resourcing strategy will also be influenced by factors including the need for fairness, equity, compliance with legal requirements and corporate standards, changes in business requirements, adoption of new asset and asset management technologies, and workforce demographics. The resourcing strategy should be developed in conjunction with the organization's human resources strategy to ensure that there is suitable provision for the recruitment and / or development of the required human resources. Developing the required workforce skills is addressed through Competence Management (7.4.4).

For many organizations, production or service availability can be impacted by the failure of critical assets. In this case, an important risk mitigation is the determination and management of an appropriate spares strategy. Factors to consider for spare holdings include the consequence of failure, procurement lead times, obsolescence and shelf life, and costs for managing, storing, and maintaining spares. Alternatives such as the use of modular and standardized spares to cover a variety of assets, as well as spares sharing for expensive, infrequently used spares, should be considered in terms of the

total cost of ownership. There are well-established tools and techniques (e.g. using queueing theory) that can be used for optimizing spares that consider the cost of acquiring, holding, and maintaining spares versus the risk of spares not being available when needed.

Efficient and effective delivery of the asset management plans requires material scheduling to be matched with the relevant activities in Life Cycle Delivery (7.7) and adequately controlled, particularly where lead times are long or uncertain. The availability of shutdowns within which to perform needed work will affect the profile of resources an organization requires to deliver its asset management plans. An organization needs to closely coordinate the development of its resourcing strategy with its Shutdown & Outage Strategy & Planning (7.5.5).

The resourcing strategy should be communicated to all relevant functions within the organization, including Human Resources, Procurement, Operations as well as reviewed periodically in light of market conditions and updated to ensure it remains relevant and aligned with the Asset Management Policy, SAMP, and asset management plans.

Resource management implements and controls the requirements of the resourcing strategy by allocating adequate resources to enable the asset management plans to be implemented efficiently and safely. It delivers activities through an aligned and integrated resource management process that allocates human resources to work in a systematic way, which ensures and justifies the effectiveness and efficiency of those resources. Project and work management tools and techniques should be used to support the efficient planning and scheduling of resources.

Resource management considers and evaluates work priorities, risks, and flexibility in work plans to ensure sufficient allocation of people and plant resources to deliver planned activities. Consistent processes are applied to ensure that outsourced resources meet internal and external specifications and requirements. Furthermore, it ensures that inventory and stock are delivered according to specific requirements within agreed timescales and that all equipment and tools are maintained and calibrated at appropriate frequencies that are consistent with the delivery of activities and objectives.

Managing the resources includes:

- Financial budgeting and management for resources
- Pricing strategies for resource procurement and use
- Identification and procurement of critical spares, equipment, and materials
- Logistics and warehousing requirements and options analysis
- Use of diversity, equity, and inclusion principles in supplier assessment
- Supplier performance review, audit, and control procedure

Effective resource management needs close integration with Shutdown & Outage Strategy & Management (7.5.5), Supply Chain Management (7.5.8) and Competence Management (7.4.4).

7.5.8. Supply Chain Management

There are many reasons why an organization may engage with its supply chain to support its asset management objectives; these range from simple short-term skills shortages to strategic partnerships with aligned values and objectives over a long period, e.g., PFI (Private Finance Initiative) contracts awarded for up to 25 years. It does not matter where in this spectrum an organization is in terms of its outsourcing requirements, it is essential that the correct supply chain partner and the correct contract is established.

Organizations with more mature asset management cultures fully align their procurement and supply chain management with their asset management objectives and SAMP and the resourcing strategy developed from it.

The most mature organizations take time to gain a clear understanding of how supplier performance contributes to the value realized from assets and maintain a focus on continual improvement. They also take time to understand exactly what their own requirements are and develop clear and unambiguous bid models against which potential partners can define their response.

An organization's bid model will take outputs from their resourcing strategy, including the criticality of the work required relative to their asset management objectives, their volumes of work, management overheads, and the availability of competent staff.

Inputs to the development of the bid model may:

- Identify and set objectives for their suppliers, and consider how best to deploy contracted staff and integrate them into their own workforce;
- Specify procurement requirements and service level agreements and assess the criticality of individual supplier relationships to the asset management objectives, SAMP and plans;
- Engage in effective supplier selection activities, developing clear criteria and processes for negotiating with and choosing suppliers, and designing effective contracts that fit their Asset Management Policy;
- Consider how best to incentivize suppliers and build sustainable relationships with their suppliers that ensure their capabilities meet service level needs;
- Use appropriate performance indicators to monitor and manage supplier contracts that minimize the introduction of risk into the business;
- Monitor their suppliers' commercial circumstances and ownership to ensure that relationships continue to be viable;
- Decide how best to make the transition from one supplier management approach to another, and
- Consider the attributes they seek from suppliers in terms of their approach to collaborative working.

Designing contracts that deliver these requirements is vital to aligning supplier expectations, obligations and rights with the SAMP. It is important for an organization to carefully consider the types of contracts, supplier relationships, contract durations and supplier liabilities that would be most appropriate for the different services it requires to generate enduring value.

The contracts developed by more mature organizations tend to be more output-based based i.e. the organization defines its requirements for asset performance such as levels of reliability and allows the contract partner to define how it will achieve them, rather than specifying the exact maintenance requirements. Management of the contract also tends to be through the achievement of shared objectives and sharing of benefits rather than the application of punitive penalties. This approach is often characterized by closer and relatively open working relationships with suppliers.

Further information may be found in SSG on Procurement & Supply Chain Management.

7.5.9. Life Cycle Value Realization

Life Cycle Value Realization is core to asset management. However, a clear understanding is required of what value represents (value of what, to whom, and how demonstrated). A whole life cycle approach is also required. Asset lifespans may be extremely varied and assets may be part of complex systems, whose total 'life cycle' might be indefinite. The realization of value may be difficult to measure or demonstrate and often requires patience since there can be significant time delays between actions and their resulting impacts.

Value is the net effect of considering all the benefits achieved (performance in delivering objectives and meeting stakeholder needs and expectations), minus all the disbenefits incurred (e.g. costs, risks and unintended consequences), over a timeframe that includes all such positive and negative impacts.

The types of benefit and their recognition in terms of value, need to be defined by each organization according to their context and the degree of importance attributed to different stakeholder needs and expectations. This is typically captured in a Value Framework (see Asset Management Decision-Making 7.6.1). This is a structured set of 'business drivers' that represent the types and significance of impacts resulting from delivery of the organization's objectives. They often include Health and Safety, Financial, Environmental, Customer Satisfaction, Reputation, Social Impact, Regulatory Compliance and other motives or direct/indirect effects. Such impacts may be assessed qualitatively or quantitatively, but quantification (and, where possible, monetization) improves consistency, transparency and the ability to handle combinations or trade-offs within asset management decision-making.

The consideration of 'disbenefits' involves understanding the costs and risks of all the activities associated with asset life cycles, which can include (but are not limited to) acquire/create, operate, maintain, refurbish, replace, repurpose, retire and dispose. It also needs to take account of the resources, overheads, risks and processes that are needed to support such life cycle activities, such as facilities, data and information systems, planning, supply chain and management systems. These are aggregated into a Total Cost of Ownership (TCO) or Life Cycle Cost (LCC), combining Capex and Opex with the risks, overheads and even the 'lost opportunity costs' associated with performance limitations or downtime.

The life cycle activities and their costs are best understood and managed at the level of individual assets. However the benefit contributions from those assets are generally only evident through the performance of the higher level systems in which the assets reside. While an individual asset may be 'critical' to, or even a 'weak link' in, such systems, it is difficult to recognize value delivery from the asset's individual contribution. So value realization includes assembling the costs, risks and life cycle characteristics at one level (assets) and relating these to other value attributes (such as customer satisfaction, safety, revenue, environmental performance) measurable at the systems or even whole organization level. This makes Value Optimisation (VO) a multi-level process, requiring systems thinking as well as attention to detail at the component assets and their life cycle activities.

This is illustrated in Figure 12 which is a modified version of Figure 2



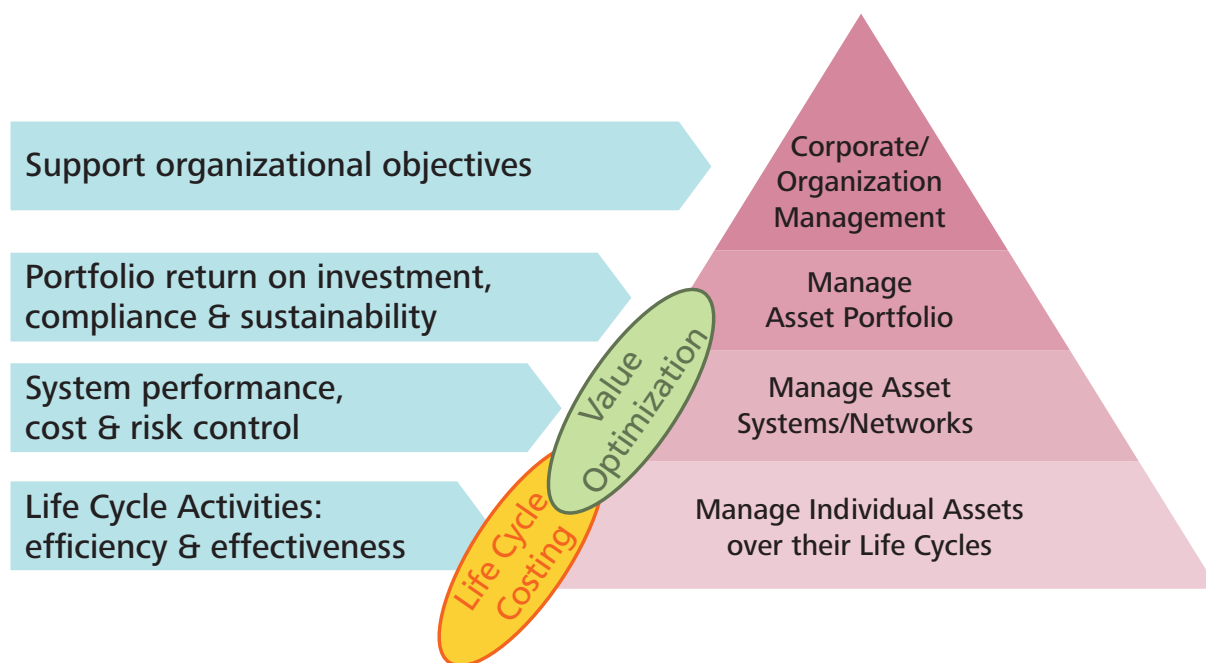


Figure 12: Life Cycle Value Realization Across the Hierarchy of Assets

LCC & VO are both particularly required for capital investment decision-making, since the proposed investments (whether at the individual asset level or whole system level) need to be evaluated for their potential value outcomes. Optimization involves finding the best value combination of the costs, risks, benefits etc, taking account of the time delays that may be incurred between expenditures and benefits resulting. The effect of such time delays is handled through the financial processes of discounting, using a Net Present Value (NPV) to represent future costs, risks or benefits in today's equivalent impact.

LCC & VO can deliver very considerable performance, financial, sustainability and risk reduction benefits. It enhances asset management decision-making and improves cross-disciplinary governance and stakeholder confidence. The principles of Life Cycle Value Realization are applicable to any organization, irrespective of asset management maturity or context. LCC & VO are likely to be particularly beneficial, however, in:

- Managing very critical assets, systems, risks or opportunities that may justify substantial expenditure; or
- Highly complex situations that involve many interacting and interdependent factors, or for which there is great uncertainty in assumptions and potential consequences.

Further details on the application of these techniques and the benefits that can be realized are contained in the SSG Life Cycle Value Realisation.

7.5.10. Asset Costing and Valuation

This is concerned with how an organization manages the financial information relating to its assets and asset management activities. This includes ensuring the quality and timeliness of financial information is appropriate for the financial reporting framework of the organization.

Each organization is typically governed by a set of accounting codes and practices according to the jurisdiction in which they operate. Like many standards, accounting codes are harmonizing across countries and irrespective of the codes applied, there are common elements from an asset management perspective outlined as follows:

- Asset valuations - the method of valuation used by the organization, its appropriateness, and the accuracy with which the valuations have been developed, including schedules & rates. It also includes the methods used to update this information and the alignment of asset valuations with the financial balance sheet of the organization;
- Depreciation - the method used to establish the residual or remaining lives of the individual assets

and if necessary, their components and the accuracy of the depreciation calculations;

- Operational costs - the method used by the organization to assess the cost of operations of individual facilities and assets and the breakdown of these operational costs in terms of labour, energy, chemicals and plant & equipment;
- Maintenance costs - the method used by the organization to assess maintenance costs (planned, predictive and unplanned) including the breakdown of these costs into labour, materials, plant and equipment;
- Renewal costs - the method used by the organization to assess renewal costs in terms of the unit costs of individual renewal activities including the breakdown of these costs into labour, materials, plant and equipment;
- Renewal liabilities - the processes used to identify future capital expenditure renewal liabilities, including any backlog in maintenance; and
- Social, environmental, safety, and reputational costs – the method used by the organization to quantify social, environmental, safety and reputational costs in monetary terms.

Organizations that are demonstrating good practice in asset costing and valuation would typically be able to demonstrate the ability to:

- recognize and adopt appropriate valuation practices that may be driven by local regulatory or legislative regimes;
- value assets at all levels of the hierarchical asset register structure and update this valuation cost-effectively in both value, unit rates and effective residual lives;
- understand the operational costs of individual assets and / facilities in terms of the above break up, together with special costs for smaller assets or equipment that may consume high power costs;
- identify the maintenance and renewal costs from the asset management information system or elsewhere for all levels of the hierarchy down to the chosen item;
- identify the organization's future renewal program, and the associated residual business risk exposure and assign suitable scenarios within the business' identified risk assessments; and
- include social, environmental, safety and reputational costs and risks in asset management decision-making.

In addition to the information laid down in local Generally Accepted Accounting Principles (GAAP) and the International Financial Reporting Standards (IFRS), relevant information regarding the financial, technical and operational information relating to asset management activities should be made available to the relevant stakeholders. This is particularly important in the case of asset-intensive companies, where assets constitute a substantial portion of the total balance sheet value and annual expenditure. The comprehensibility, relevance, reliability and comparability of the financial statements will be improved by adding information on financial, technical and operational aspects of physical assets in the Annual Report. Organizations need to consider how to combine the requirements of ISO55001 with the requirements from other sources such as the applicable financial reporting framework (e.g. local GAAP, IFRS), legal and regulatory requirements, international applicable frameworks on internal control, risk management and / or corporate governance requirements.

See SSG on Asset Costing and Valuation for more information.



7.6. Asset Management Decision-making

Asset Management Decision-making

• Decision-making

7.6.1. Decision-making

Good decision-making lies at the very heart of successful asset management. Optimal decisions are those which identify and select the best value option, taking account of all the costs, risks, benefits and timeframes involved. They also involve the handling of conflicting interests, trade-offs and uncertainties. So approaches to asset management decision-making require care and effort, in the processes that are adopted, the data and information systems that may help and in the development of understanding, skills and collaboration across the whole organization.

Proportionality

Asset management decisions vary greatly in complexity, impact and urgency. So the methods for decision-making, and effort that is worthwhile, need to be proportionate. It is inappropriate to apply the same level of sophistication to all decisions. Simple, low impact decisions can and should be made using informed common sense, perhaps supported with pre-determined rules and guidelines. Higher impact decisions, and/or those with multiple influences, inter-dependencies or stakeholder interests, justify more systematic, rigorous and auditable decision-making processes. The most urgent decisions may require 'fast track' processes and an acceptance of higher risk of error.

The rules for using different decision-making processes and criteria need to be clear and understood by everybody. The more complex and critical the issue or options available, the more rigorous and transparent/auditable we need to be in making that decision.

People in Decision-making

Decisions in asset management are, almost always, multi-disciplinary. This means that multiple stakeholders are likely to be affected and that multiple information sources are needed in order to determine the best value option. Decision-making processes, therefore, involve cross-disciplinary teamwork, extensive consultation and consensus-building. Human biases, conflicting interests and personality are all, inevitably, involved in how decisions get made. So methods to recognize and address these factors, and harness the positive benefits of different viewpoints, sourced from knowledge and experience, form an important part of establishing good practices in decision-making.

Decision-making Framework

The quality and consistency of asset management decision-making can be difficult to establish and to maintain. So a Decision-making Framework (DMF) is often needed to document decision-making responsibilities and authorities, required processes, competencies, tools and decision criteria or approval thresholds. See Figure 13. The minimum requirements for such a DMF are included in the ISO55001:2024 standard for asset management systems.

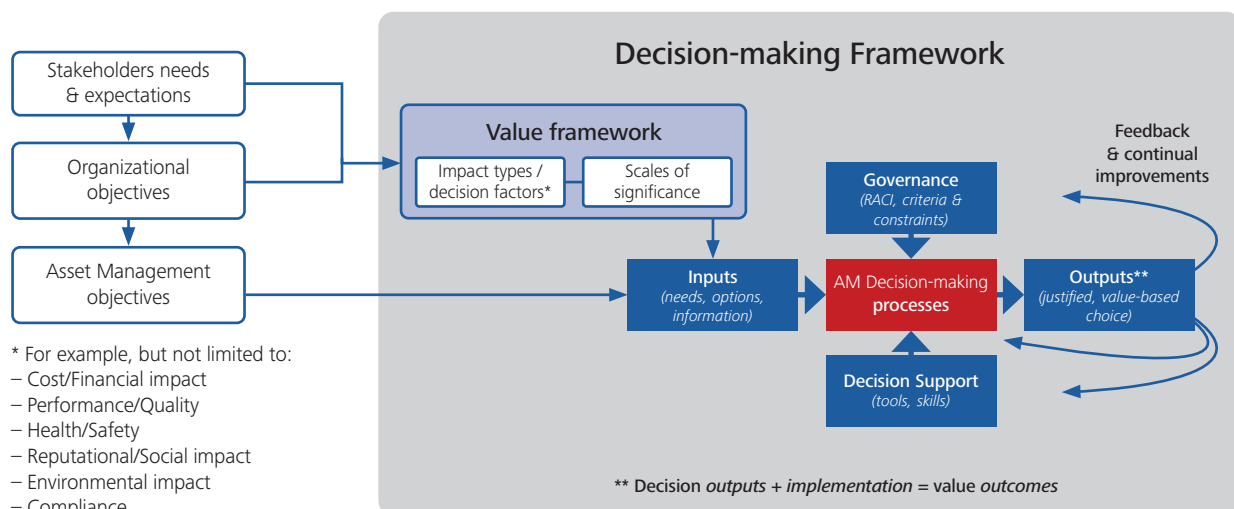


Figure 13: Example of primary elements of a decision-making framework for asset management

A Value Framework

An organization must ‘start with its ends in mind’ (i.e. desired outcomes). These determine what is therefore important, recognizing the needs and expectations of stakeholders, as represented in the organization’s objectives and, in support of these, the asset management objectives. What is important needs to be the basis for decision-making and prioritization.

These differing perspectives can be complex, especially when internal staff and external stakeholders have competing interests. A statement of values can help by outlining an organization’s core principles and guiding the culture. It acts like a moral compass for decision-making and helps everyone understand what is expected. Such values are not the full story, however, and a more systematic consideration of needs, expectations and what is therefore important should be addressed, resulting in a Value Framework.

The first stage is to ensure that stakeholder needs and expectations (Stakeholder Management 7.2.2) are understood and documented, along with the organization’s objectives and, contributory asset management objectives:

- 1 Conduct an extensive stakeholder engagement exercise to understand the requirements (needs & expectations) of all stakeholders.
- 2 Review organizational goals, objectives and any specific asset management objectives.
- 3 Develop groupings of impact types that the organization can use to recognize and demonstrate the degree of satisfaction of the stakeholder expectations and delivery of objectives (for example, financial performance, health and safety impact, environmental impact, reputation, customer satisfaction, social value).
- 4 For each of these impacts, develop scales of significance, with example ranges of impact and scores or indicators of their importance (value driver). For example, high, medium and low impacts need to be expressed in recognizable symptoms of their degree of impact, and give a numerical significance (ideally monetized, or at least able to be combined with other impacts).
- 5 These scales of significance should then be used as consistent references when determining criticalities, risks, urgencies and in decision-making (where trade-offs and combined impacts will be encountered).

Figure 14 gives an example of developing some outcomes-based value drivers.

Organizational Objective	Value Drivers/ Enablers
(Desired outcomes aligned to Stakeholder Requirements)	
Increased Production Efficiency by at least 5%	<ul style="list-style-type: none"> • System Downtime • Asset reliability • Unit production costs

Figure 14: Example of developing an outcomes-based value framework

The Value Framework and decision-making criteria need to be adaptive of changing conditions. Periodic reviews are needed to adjust for changes in context, both externally and internally. For example, new emerging risks or opportunities, new regulations, climate change, demographics, service demand, competition, supply chain dependencies, technology change/obsolescence and ageing/deterioration of assets and systems.

Decisions require options and information upon which to make a choice. The options in asset management, and the availability of relevant information, vary widely across different stages in the asset life cycle. Capital investment decisions, design, construction and commissioning choices are made without the benefit of direct operational and performance evidence, using forecasts and assumptions about future functional demand, risks, reliability, sustainability and other decision factors. Operational and maintenance decisions during an asset’s life need to optimize a trade-off between short term performance and costs against longer term consequences in future capability, condition, further costs and sustainability. End-of-life decision-making has the benefit of existing asset knowledge but needs to evaluate re-investments (and their uncertainties) against life extension, risk mitigation and other options. Information systems and decision-making processes therefore need to be suitable for these different contexts (as well as the different decision-makers).

Decision processes should include (to levels of detail proportionate to the decisions) the following considerations:

- 1 Identify, prioritize and define the problem to be solved or the opportunity to be evaluated
- 2 Collect relevant information to enable understanding of the problem/opportunity
- 3 Identify viable options (including timing options). When considering options to build a new asset, the option as to whether there are other solutions that do not involve creating new assets should be considered.
- 4 Identify stakeholders in the decision (often only possible once options are identified)
- 5 Determine, for each option, the financial and non-financial benefits and dis-benefits in line with the Value Framework and governance (decision factors, criteria, required processes etc).
- 6 Use the relevant decision-making processes to combine the benefits and dis-benefits in a determination of value for each available option. This will often include resolving trade-offs between competing impacts and timings.
- 7 Choose the best value option
- 8 Obtain acceptance/consensus from stakeholders
- 9 Validate and authorize the decision

Turning decision results into value outcomes:

- 10 Implement the decision
- 11 Review decision outcomes for continual improvement opportunities and actions

Asset management decisions can be significantly improved through the introduction of general and role-specific training in the concepts and practices for problem identification and definition, optioneering, value-based decision-making, handling of risk and uncertainty, business case justifications and stakeholder assurance/consensus-building.

Similarly, the quality and consistency of decisions can be greatly enhanced, and the availability of suitable decision support tools (DST). The necessary training and tools differ significantly across the process steps listed above and the decision types that are encountered. What is needed to identify problems and opportunities in the first place differs greatly from the techniques that are useful to understand the nature of different problems,

or the selection of candidate solutions, or their evaluation and optimization (either individually or in combination). So a range of awareness, training and supportive tools is often needed, with clarity and guidance about what is needed or applicable in which circumstances. Some of the context-specific characteristics are covered in the following sections.

Optimization

The term optimizing is often used in relation to asset management decision-making. It describes the process of establishing the best value for money. This can range from a subjective, qualitative judgement to more sophisticated techniques that can demonstrate that the best value option is being obtained, within any constraints and with a specific level of confidence.

The handling of trade-offs to find an optimal combination is a frequent requirement of decision-making. Figure 15 illustrates the optimization concept, using a trade-off between costs of a (preventive) maintenance activity and the risk of asset failure. In real life there are more variables often involved, and the scales and shapes of the curves will differ significantly. The key point is the recognition that the decision-making criterion (in this case the 'minimum Total Business Impact') represent the sum of all costs, risks and other consequences for different decision choices (maintenance intervals in this case). The optimum lies where this combination of costs and risks is lowest – and NOT where the component lines cross each other (this is where the costs would equal the risks, the 'balance' point). Optimization does not seek the best 'balance' between costs and risks: it seeks the best value combination of all positive benefits (performance, sustainability etc) and negative disbenefits (costs, risks etc).



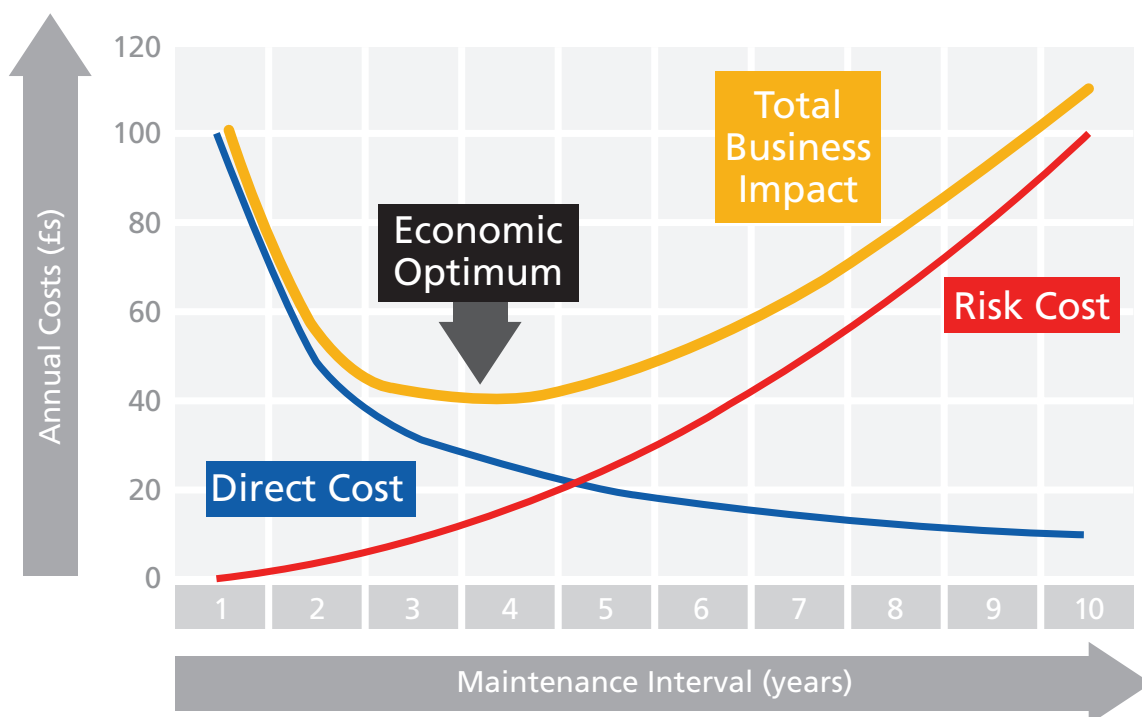


Figure 15: Example of optimizing (interval of planned maintenance)

Capital Investment Decision-making

Capital Investment Decision-making comprises the processes of evaluating and analyzing options for the creation of new assets, increasing the capability of existing assets, refurbishment, replacement or decommissioning of assets at the end of their useful or economic life. In some cases, repurposing or disposal may be appropriate for rationalization of the asset portfolio (e.g. replace a number of small facilities with a larger one).

Capital investments adds equity or 'balance sheet' value to an organization – they increase the worth of the asset portfolio, and the timing and targeting of such investments can have a significant impact on an organization's success. Capital investments can increase downstream operations, maintenance and renewals costs, particularly when creating new assets, or introducing new types of asset to an existing portfolio. So the decision-making comes under additional scrutiny, both at the individual project level and at the optimization of the combined portfolio or programme of investments.

An organization may have mandatory investments to comply with legal or regulatory conditions. Other investments are considered discretionary and are subject to value-based justification.

The business case for discretionary expenditure has to take into account how the organization funds such investments and the range of alternative investment requirements or opportunities available. Capital investments are also usually made with long horizons of implications (asset life cycle or sustainability consequences). So they have to address the time value of money (discounting) and follow strict accounting practices, financial rules and internal criteria used by the organization.

Cost-Benefit Analysis (CBA) calculations must consider the required period of the asset's function and include all Capex and Opex current and forecast expenditures and benefits. Options analysis (or business case evaluation) provides guidance on capital investment decision-making and employs a cost-benefit approach leveraging discounted cash flows. A range of criteria may be used to evaluate whether an investment is worthwhile or represents the best value in comparison to alternative uses of the money.

The most commonly used decision-making criteria for capital investments are:

Life Cycle Costing (LCC), or Total Cost of Ownership (TCO). These consider only the costs

(and risks) of a proposed investment. So they are useful only in comparison of options that would yield the same benefits over the same horizon. However they do force the correct consideration of the total, life cycle, cost rather than just the initial capital investment. They are discussed further in Life Cycle Value Realization (see 7.5.9).

Payback Period - the time taken for future benefits to recover the initial investment costs. This is just the breakeven point, and does not recognize the size or full horizon of subsequent net benefits (i.e. total value of the investment).

Net Present Value (NPV) – the value in today's money of all immediate and future cashflows (costs and benefits). A positive figure represents the degree to which the total benefits outweigh the total costs. Monetized risks and other performance impacts, including intangibles, can also be included in the NPV calculation.

Internal Rate of Return (IRR) – is a comparator useful for showing how an investment competes with alternative options. It is the rate of discounting needed to 'dilute' future benefits down to the 'breakeven point' i.e. $NPV=0$. So an IRR of 15% represents an investment that is more attractive (bigger net benefits) than one with an IRR of 5%

Development of the SAMP generates potential long-term investment requirements. At this early stage, they may be outline proposals with limited detail, on the understanding that the detailed design will follow. The initial planning stages usually create unconstrained scenarios to consider against the organization's constraints (including funding, resources, supplier capacity, and shutdown availability).

Once an investment proposal is in the strategic plan, it is normal to develop more detailed proposals and evaluate alternatives. This requires a more detailed cost-benefit analysis, supported by relevant information, including planned and unplanned maintenance and operating costs for the asset life cycle.

Capital investments to replace, refurbish or decommission ageing assets present a particular challenge, particularly in the optimal timing of

different intervention options. Deterioration may be evident (declining performance, increasing operating and maintenance costs, reducing reliability) or only inferred/predicted from symptoms of condition or ageing. The original design life or technical/'useful' life assumptions rarely represent the optimal economic life, i.e. the point at which a value-based decision would justify renewal or other investment. The development of a strategy to deal with ageing assets (and obsolescence management) can help an organization to make the correct capital re-investment decisions and optimal timings. Given the complexity and significance of these cases, quantitative modelling, with decision support tools, is often worthwhile to evaluate options with uncertain patterns of degradation, risks, costs and consequences in order to find and justify the optimal investment decision and timing.

At the portfolio level, asset investment decisions also need to consider new technology opportunities, obsolescence risks, stranded assets (through changes in functional demand) and repurposing opportunities. Changes in demand/demographics, legislation or organizational goals can all impact the priorities and investment decisions, and need to be reflected both in the Value Framework and in the individual decisions that need to be made. The drive for carbon net zero is an example, driving this risk in some sectors and geographies.

Operations & Maintenance Decision-making

The goal of maintenance is to prevent or mitigate the deterioration of the performance of assets in service and manage the risk of failures. It is good asset management practice to develop a maintenance strategy to ensure a predictable and acceptable level of performance through the useful life of the asset. This includes inspections, testing and monitoring, and preventive maintenance regimes (time-based, condition-based, usage- / duty-based and risk-based).

Normally, maintenance activities are funded from operational expenditure (OPEX) rather than CAPEX, but some larger overhauls may be recognised as capital investment in some regulatory contexts. Most operational and maintenance decisions do not consider the time value of money as they are funded from the current year's budget and are usually of a recurring nature. If they have long cycles or benefits periods, however, or have impacts on future expenditure (such as deferment of future investment

needs), then such downstream benefits or future expenditures may need to be discounted to present day values.

In some industries, assets and asset systems have their maintenance regimes determined at the time of asset design or creation, using reliability engineering techniques (Integrated Reliability 7.7.3), such as Failure Modes, Effects and Criticality Analysis (FMECA), Reliability Centred Maintenance (RCM) and Risk-Based Maintenance or Inspection (RBM/RBI).

Original Equipment Manufacturers (OEM) and suppliers often propose maintenance and inspection tasks to be carried out at recommended intervals. These recommendations are often generic, with little or no account taken of the operating environment, usage, criticality or consequences of failure. Such maintenance regimes can be overly risk averse, and so there may be opportunities to reduce the tasks or frequencies with little or no impact on asset condition or performance. Changing these maintenance regimes within warranty periods, however, can affect the validity of the warranty, so this should be considered before the regime is changed. The converse may also apply, but it is more common to find OEMs underestimate the operating and maintenance costs when selling their assets. In both the over- and under-maintenance recommendations, maintenance decision-making (and the capital investment decisions prior to them) should recognize that vendors often rely greatly on the revenues from the after-sales support phase.

Decisions related to maintenance must consider the cost of planned interventions, the risk and cost of failures and other impacts. The modelling of maintenance for decision-making requires predictions of performance and deterioration patterns, including risk profiles that consider whether failure probabilities are random or change with time or asset usage. For significant assets and planned tasks, it is impractical to evaluate and optimize the options using a spreadsheet, and more sophisticated decision support tools should be considered. For lower-value decisions, structured rule-based methods, such as FMECA, RCM & RBI can be used to challenge/adapt manufacturer's recommendations and well-established industry standards. It is often practical and worthwhile to use templates, team-based studies, expert guidance and standards for supporting such maintenance decisions.

The decision-making efforts should also be targeted and proportionate: a systematic multi-disciplined review of failure modes and predictive, preventive, corrective and other options is very costly and takes a lot of time, so should be focussed on the most critical assets and systems.

The advent of embedded instrumentation, machine learning, new condition monitoring technologies and advanced prognostics is changing the landscape of maintenance significantly. This means that operations and maintenance decision-making needs to be agile. Practices that have not been reviewed for several years are likely to be sub-optimal now. Similarly, the options to mitigate risk by alternative means (such as insurance, operator training or changes to asset loading/function) should be considered in addition to the various technical interventions that are possible.

Individual operations and maintenance decisions also need to be considered for blending and bundling opportunities. Blending involves decisions about different inspections and maintenance tasks for the same asset, seeking the optimal mix of small-and-frequent activities with less frequent but larger work scopes. Bundling opportunities include the optimal use and intervals for shutdowns and outages, allowing the downtime impact to be shared for multiple activities (but at individual timings that may be suboptimal).

In addition to all the options for operations and maintenance, decisions need to be made about spares, materials and contingency plans. Corresponding cost/risk trade-offs need to be evaluated: in the case of critical spares, considering the costs of acquisition and storage, including the lost opportunity cost of capital tied up, and the risks represented by unavailability at the time of need (taking account of lead times and operational consequences etc). Spares and materials decisions can be very significant in obsolescence management, rationalizing, and stranding of assets.

See SSG Capital Investment, Operations and Maintenance Decision-Making for more information.

7.7. Life Cycle Delivery

Life Cycle Delivery

- Asset Creation and Acquisition
- Systems Engineering
- Integrated Reliability
- Asset Operations
- Maintenance Delivery
- Incident Management & Response
- Asset Repurposing & Disposal

7.7.1. Asset Creation and Acquisition

Having determined through the development of its SAMP and asset management plans that additional or different assets are required to achieve an asset management objective for stakeholders, the organization then must select a method to acquire these assets. The plans and processes must be capable of delivering asset services within the timeframe aligned with the demand, the organizational risk appetite and the organization's capabilities.

Asset Creation and Acquisition describes policies and processes for the planning, acquisition, installation, commissioning, and handover into operations. At the time of Asset Creation and Acquisition it is important to consider asset renewal, replacement, upgrading, repurposing, decommissioning and retirement of assets. This can have impact on Asset Creation and Acquisition policies and processes. It also includes elements of approval and release of funding, arrangements for hand-over to operations, process status reporting and the monitoring and capture of actual costs and benefits analysis.

It is critical to understand all system integration and interfaces from a technical and non-technical point of view and how any organizational requirements have been confirmed.

The asset owner should understand the asset's whole life costs, financial management of the asset, future maintenance requirements ensuring maintainability, operability and reliability requirements and possibly future upgrades or obsolescence concerns of major systems and how this would be achieved.

The development of requirements, analysis, design, and development of the strategies for verification and validation (that these requirements are actually delivered) are part of Systems Engineering (7.7.2).

Assets may be created or acquired in several ways. Decision-making (7.6) includes an outline of the typical stages of decision-making in the investment planning processes to create or replace assets. Assets can be acquired from other organizations. This includes purchase of assets that are already operational or accepting the hand-over of assets constructed by others, with or without improvement plans. This can either be as the owner or contracted to manage the assets for a defined period⁴⁸.

Asset Information and IT tools are often used throughout the creation and acquisition activities:

- New Asset Information - the process of creating assets is key to defining their life cycles and the information required. It is common to plan and enhance asset information and data within this phase for both financial and non-financial asset register requirements. Sometimes, new information systems and aligned asset-data structures are required and built, e.g., either the newly created assets are digital assets, or they are physical assets to be operated and configured at scale, integrating information technology with operational technology (IT/OT).
- Support for Decision-making and Planning - Asset information supports the decision-making and planning processes, e.g. lessons learned and reliability data from existing assets performance, demand analysis modelling.
- Project / Programme Planning - Organizations often use IT tools throughout this activity to produce estimates, develop and monitor the project schedule and plan, capturing costs including manpower, plant and materials.

Further details can be found within Information Management (7.8), SSG Asset Information, Strategy, Standards & Data Management and ISO55013 Guidance on the management of data assets.

Project and Programme Delivery

The creation phase is often managed as a project, or programmes of work consisting of multiple

48. ISO 55001:2024 Asset management system – Requirements "Acquisition can be either purchase, lease or design, build, installation or commissioning or other asset based capability provisioning, such as public-private-partnership or build-own-operate." Clause 8.1 Note 2

projects. Each project has its own set of deliverables and project success criteria (such as time, cost and quality) aligned with the asset management plans. Where multiple projects or resources are managed within a programme, various techniques are available to maximize the opportunity to deliver the overall programmes efficiently as possible.

Project management is a recognized discipline with different certifiable approaches to control activities to ensure delivery and governance. The waterfall method of project delivery consists of a series of sequential tasks (this is the most traditional), whereas the Agile delivery method breaks the project into smaller tasks and are arranged in multiple sprints and cycles. In all of these methodologies, projects are managed through a project cycle divided into discrete phases, separated by governance gateways that approve or halt progress to the next phase. One simple example is:

- Concept phase – establishment of a project team with a project sponsor and representatives that can consider whole life aspects of the assets. Where part of an organization has overall responsibility for asset management, this often performs the role of the project sponsor. The project team confirms deliverables / benefits and success criteria.
- Definition phase – exploration of one or more options and selection of the one that will best meet the project deliverables within the constraints of the project success criteria. Investment appraisal models are generally used to support the decision-making process where there is more than one option (see Decision-making 7.6).
- Implementation phase – procurement and delivery of the solution to time, cost and quality targets.
- Handover and closeout phase – hand over of the asset to the end user. Generally this is the operator / maintainer. The sponsor determines whether the expected benefits have been realized and the project team reviews how the project was delivered and identifies lessons to be learned.

When the assets are digital, if the organization's asset management policies determine that the assets are continuously replaced at end-of-life, then the project management of the implementation and handover must be continuous. Project Management frameworks may then need to include elements of Agile as well as waterfall delivery. Example assets

that fall into these categories are: disposable medical devices; utility smart meters; ancillary power and battery technologies that iterate software continuously according to grid services trials.

As part of asset creation, there is a growing trend to plan assets, their operation and maintenance and their renewal with a sustainable lens. This has been driven by changes to legislation and organizational policy and by efforts to reduce the total cost of ownership.

Practically, within the asset creation and acquisition phase of the life cycle, this trend has led to:

- tighter stakeholder relationships
- a focus on component and material reusability
- changes to asset ownership structure, changes to service and warranty contract durations and matching more closely the stakeholders' long-term requirements and the asset lifetimes.

For example, a manufacturer and retailer of rail equipment may change to become a more vertical circular services organization by retaining ownership and servicing responsibility throughout the equipment's lifetime and leasing it to an operating customer. This manufacturer will then design the rail equipment with long-lasting components / reusable materials since the recovery of value can happen over a longer period of ownership.



7.7.2. Systems Engineering

Systems Engineering focuses on how to design and maintain complex systems over their life cycles.

Systems range from the simple to the hugely complex, built from many smaller sub-systems.

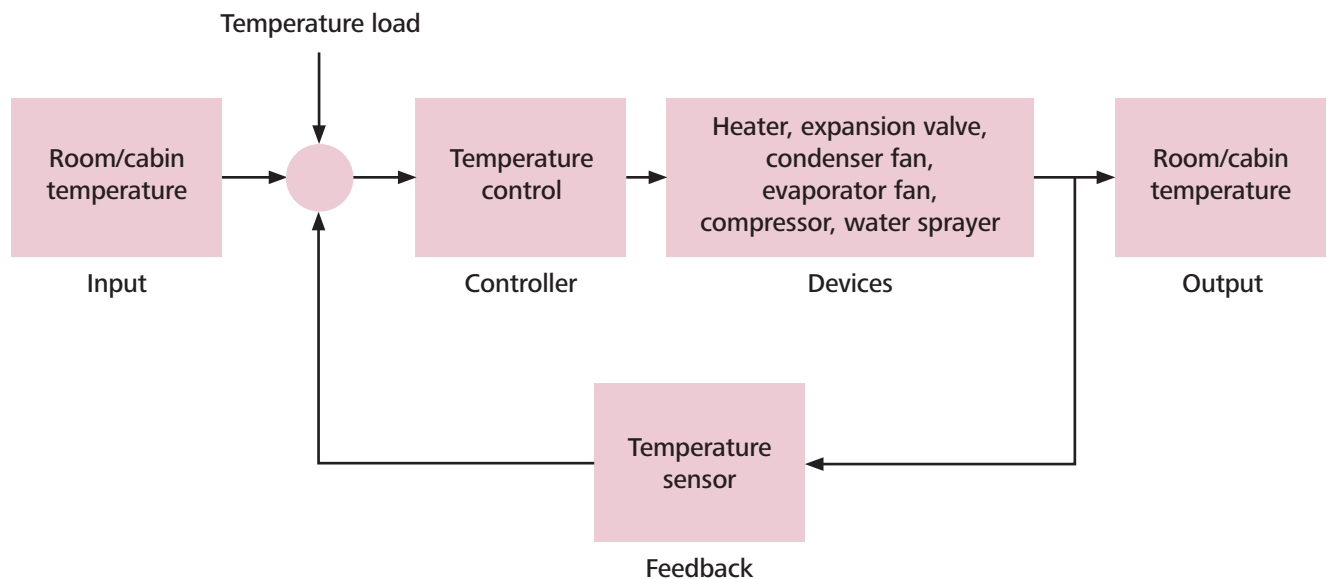


Figure 16: Example of a Simple System for Controlling Room Temperature

A simple system for controlling room temperature is shown in Figure 16. This simple system incorporates many different disciplines:

- Thermodynamics for temperature flow
- Electrical for the control circuits and sensors
- Mechanical for the fans, pumps, compressors

Systems Engineering is therefore an interdisciplinary field that seeks to establish policies and managerial and technical processes for the requirements analysis, design and evaluation and operation and maintenance of asset systems and their sub-components.

Systems Engineering focuses on the ability of the system to successfully deliver its required function and seeks to do this by identifying Reliability, Availability, Maintainability and Safety (RAMS) requirements for the system as well as for its constituent components.

The management of interfaces between systems, whether to new assets, existing assets, or systems, but especially when there is a human interaction, is an essential element of Systems Engineering. Interface parameters must be clearly specified and managed to avoid poor performance.

Systems Engineering also includes the development of functional and technical specifications, safety approval of equipment, installation processes and acceptance processes including the review, verification and validation of the assets delivered against the RAMS requirements.

Figure 17 shows a typical Systems Engineering approach, the V diagram. On the left side of the V, requirements are established and cascaded through the design process. On the right side of the V, components are integrated and validated into an overall system to meet these requirements.



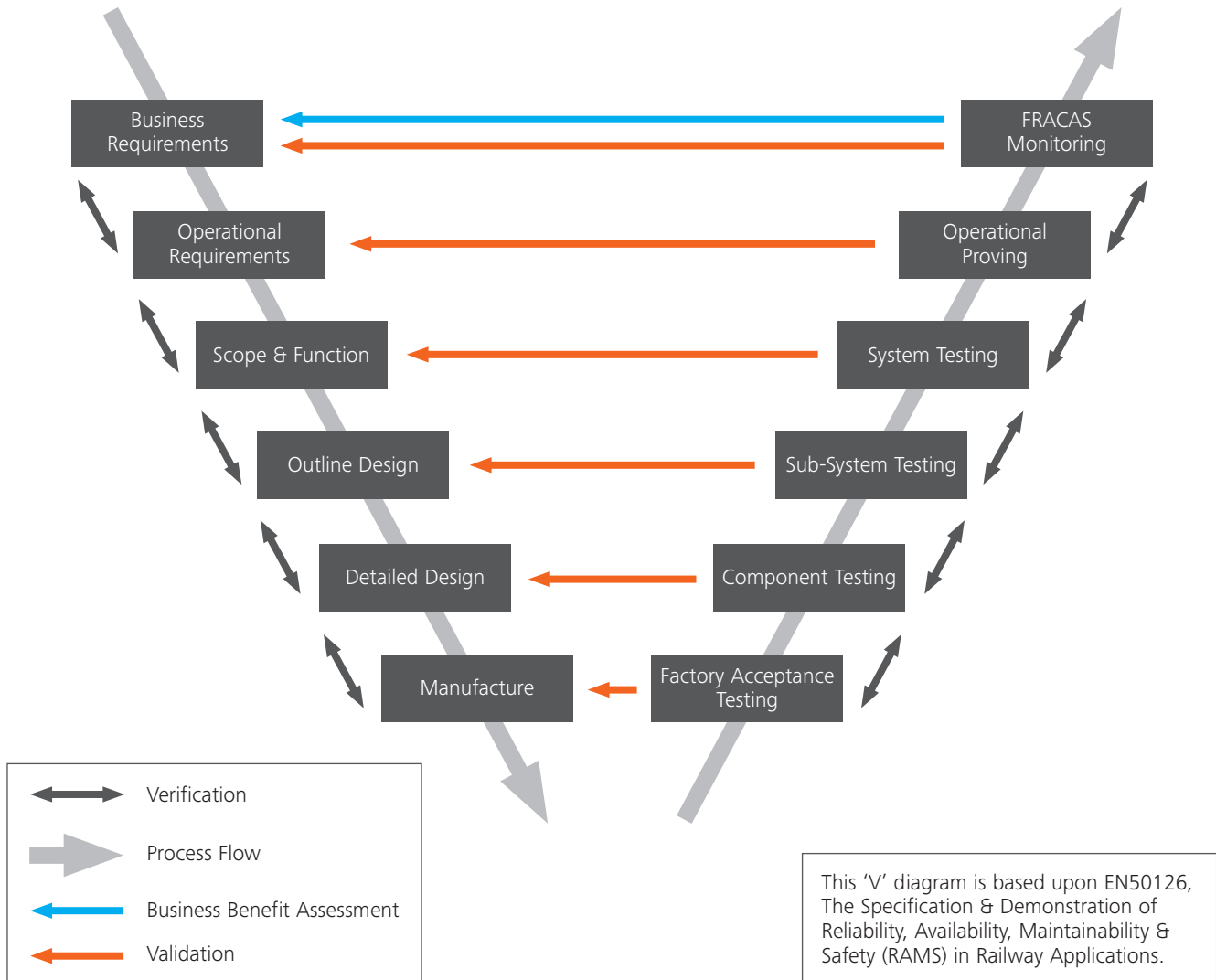


Figure 17: Systems Engineering V Diagram

A good practice approach to Systems Engineering can be found in ISO 15288, Systems and Software Engineering, System Life Cycle Processes.

Maintenance of the system should be concerned with guaranteeing its ongoing functionality. It is therefore advisable that the operational standards and parameters established during acceptance testing are the standards maintenance returns the system to i.e. the maintenance supports perpetual commissioning.

See SSG on Systems Engineering for further information.

7.7.3. Integrated Reliability

Reliability engineering is the systematic application of engineering principles and techniques, throughout

a product life cycle, to ensure that a system or asset has the ability to perform a required function, under given conditions, for a given time interval. Integrated Reliability is a holistic and systematic approach to specify, analyze, deliver, monitor, and improve the reliability of an asset or a system, leveraging a collection of policies, principles, processes, systems, and tools.

Reliability principles, and techniques should be applied, ideally at the conceptual stage, or as early as possible in the lifecycle, to influence design decisions that will minimize downtime. Identifying reliability problems, and opportunities to mitigate potential failure modes, as early as possible in the life cycle will influence design outcomes with minimal disruption or financial impact, compared to trying to manage

reliability problems once the asset or system is in service.

Reliability is generally taken to mean operation with a specified probability of failure under stated operating conditions. This specified probability of failure is both at the asset level and at the system level. Even if no individual part of the system fails, but the system as a whole does not do what was intended, then there is still a loss of system reliability. Conversely, system reliability can be mitigated through redundancy of assets meaning asset failures do not necessarily result in system reliability issues.

Although reliability is best managed as early as possible in the lifecycle, it requires consideration throughout the lifecycle. Existing assets or systems may not be performing to the required level of reliability to meet targets set out in the asset management objectives, and for these assets it will be necessary to develop reliability growth plans to see how monitoring, changes to maintenance or asset upgrades could be used to deliver the required level of reliability.

Typical techniques and activities undertaken as part of Integrated Reliability include:

- Calculating the allowable system failures for each system component or overall system
- Reliability modelling by evaluating the reliability potential of alternative designs
- Assessing the reliability of a system developing a model that represents the time-to-failure of the entire system based on its components.
- Conducting a Failure Modes, Effects and Criticality Analysis (FMECA) or Reliability Centred Maintenance (RCM) study
- Understanding system design specifications e.g., operating context
- Identifying and developing strategic programs to manage the consequences of failures based on failure modes, operating context, criticality, risk, and maintenance task effectiveness.
- Root cause analysis to determine all factors, causes and proposed corrective and preventive actions to mitigate future occurrences.
- Collecting, analyzing, and interpreting failure data to support monitoring and understanding of asset/system failure modes.
- Providing input to operations and maintenance decision-making to determine the appropriate maintenance or inspection regime.

- Spares analysis for criticality, availability, and redundancy and to optimize stock holdings.
- Operational performance reporting to identify potential actions to improve asset reliability and health.
- Formulating and running tests on components, subsystems, and the system itself.
- Investigating user complaints and field failures.
- Identifying, tracking and monitoring asset technical or process changes to improve reliability using a management of change (MOC) (see Management of Change 7.10.3) process.
- Defining and implementing standard operating procedures.
- Systematic approaches to optimize the effectiveness of asset maintenance strategies.
- Feedback to designers with information on how to improve the life of a system and its ease of operation and maintenance.

See SSG on Reliability Engineering for more information.

7.7.4. Asset Operations

Asset Operations comprises the policies, processes, and procedures used to operate assets, asset systems and portfolios of assets, and achieve asset management objectives. It provides a framework for communicating instructions and for provision of training on how to operate the assets within their design, maintenance, operational, reliability, safety, environmental and legal parameters.

Asset Operations may include the development and management of an asset operations strategy, to define the approach and resources required to manage and implement operations, and a plan to deliver the strategy and ensure that the assets or assets systems:

- meet their functional requirements.
- are operated to deliver the required service level, and within the operating parameters (as specified / designed) for the asset.
- meet all statutory and technical requirements for health, safety and environment, security, and reliability.
- achieve and sustain defined levels of physical, functional, and financial performance.
- provide a basis, data, and evidence for continuous improvement.

In developing an asset operations strategy, it is important to consider the risks associated with

inappropriate operation of the assets including:

- asset loss or systems failure, including consequential financial loss.
- reduced asset life.
- breach of statutory obligations.
- creating an unhealthy or unsafe environment and consequential liabilities.
- risk of harm to the environment.
- inefficient operational performance, resulting in higher operating costs; and
- adverse customer and/or stakeholder perception.

A contributory factor to these risks is operational error. Systems can be designed and configured to reduce the potential for such errors through:

- greater automation of system control.
- better equipment and assets.
- in-built protection in equipment; and
- inherent fail-safe designs.

These approaches are developed using Systems Engineering (7.7.2) and Integrated Reliability (7.7.3) as part of asset management decision-making. Human factors and ergonomic studies are often incorporated into the design stage of assets and asset systems, to improve the ease of and discipline in asset operation which will further reduce the potential for operational error.

See SSG on Maintenance Delivery and Asset Operations for further information.

7.7.5. Maintenance Delivery

Maintenance of assets is an integral function and value contributor to asset management. The goal of maintenance is to ensure an asset continues to provide its intended function by preventing or mitigating the deterioration of the performance of assets in service and managing the risk of failures. This ensures that assets continue to meet their service and performance requirements - including safety, environmental and output performance. The selection of the appropriate maintenance and inspection regimes is necessary to achieve this combined with proficient execution to achieve asset management objectives.

Maintenance delivery encompasses the management of maintenance work activities for assets throughout their intended life cycle. This incorporates the effective and efficient management of the processes and resources to deliver the chosen regime and

management activities of identification, planning, scheduling, execution and analysis. This requires cross-functional coordination and integration of activities across Operations, Engineering, Finance, Human Resources, Information Technology and specialist support functions.

Maintenance strategies may change as an asset ages or the operational context / criticality changes, or new assets are introduced.

Asset data and information record keeping is an essential input for the periodic review and necessary updates of asset maintenance strategies throughout its remaining life. Maintenance delivery can generate large volumes of data and information, such as the results from measurements and monitoring, condition reports and records of activities completed. This data and information needs to be well managed through the asset information process. For many organizations, the volume and complexity of planning, scheduling and delivery and coordination necessitates the use of an Enterprise Asset Management System (EAMS).

Asset Maintenance activities can generally be divided into three categories:

Inspection, testing & monitoring – activities to confirm the safety and integrity of assets and to provide information for determining maintenance and renewal needs. This encompasses periodic visual inspections, sophisticated diagnostic testing and remote condition monitoring systems that enable predictive maintenance to be undertaken.

Preventive maintenance - planned activities to prevent or reduce the impact of faults, failures or excessive deterioration. Preventive maintenance is based on risk and criticality and is related to the maintenance regime being applied to an asset (time-based, condition-based, usage/ duty-based and risk-based).

Corrective maintenance - activities performed to repair defects, damage or address a shortfall in performance to restore the asset to a defined standard and keep it operational. Understanding the root cause of corrective maintenance is important to feed into maintenance requirements.

The planning, coordination, and scheduling of maintenance activities, the competent labour resources to deliver them, and other essential supporting resources can be a major undertaking. In particular, shutdowns, turnarounds, and outages can have a strategic impact on an organization's ability to realize value. These activities require close coordination and communication with key internal and external stakeholders.

Developing maintenance delivery plans is an output of asset management planning. These plans are built considering:

- maintenance specifications and standards
- asset inventorial information
- condition and performance information

Tools and techniques are often deployed to determine the most appropriate bundling and scheduling of maintenance tasks for efficient delivery.

More information can be found in SSG on Maintenance Delivery and Asset Operations and GFMAM Maintenance Framework.

7.7.6. Incident Management & Response

Incident Management and Response encompasses responding to failures and incidents of an organization's assets or its asset management system in a systematic manner. The process includes incident detection and identification, fault analysis, use of standard responses, temporary and permanent repair procedures, site access and hand-back, reporting and updating of asset information systems.

Failures and incidents can have a wide range of consequences for an organization and its stakeholders. The response arrangements an organization employs to handle failures and incidents should be commensurate with the consequences of the failures and include mechanisms to escalate control of the response to the appropriate level of management.

Following the detection or identification of a failure or incident, the initial response is geared towards mitigating the consequences and evaluating whether the production or service can be safely restored. It is common to have resources on a 24/7 rota to provide the initial response.

A recognized process for Incident Management and Response is FRACAS (Failure Reporting, Analysis and

Corrective Action System), this typically encompasses:

- **Failure Reporting** – Major unplanned events (e.g. fires) normally have specific planned responses and would normally be addressed through contingency planning (see Contingency Planning & Resilience Analysis 7.5.6). Regular faults such as asset failures are normally captured through the normal work capture systems (e.g. EAMS – Enterprise Asset Management System). Incident management and response includes the capture of all relevant information for investigation of failures and incidents to ascertain their root causes.
- **Analysis** – There should be a formal Root Cause Analysis (RCA) process that ensure the appropriate analysis techniques are applied. For example, simple techniques such as 5 Why or Fishbone analysis are suitable for many failures, but more complex failures may need specialist techniques or equipment such as high speed photography or metallurgic analysis. The process must also ensure the correct people are involved, including the use of external experts if required.
- **Corrective Actions** – Corrective actions should not only include the actions necessary to resolve the fault or incident but also the actions to monitor their ongoing success. This monitoring may be for a predetermined period. Once the organization is satisfied that the actions taken have resolved the incident, there should be a formal closeout and results communicated to the relevant parties. Reviewing the response to faults and incidents can provide learning to improve processes and practices.

An organization's ability to respond to and the time within which it can restore service following a failure or incident will be dependent on the availability of competent labour, specialist tools and equipment necessary to effect temporary or permanent repairs and spares (which can range from sub-components to complete assets).

7.7.7. Asset Repurposing & Disposal (including Renewal)

Assets can have long lives, well beyond normal business cycles. There is almost always a point where they are removed from service, decommissioned and either repurposed, reused (materials or components)

or disposed of. Where that service is still required, the asset may be renewed or upgraded.

An example of historical assets repurposed by new organizations is the Thames Tunnel, built by Marc and Isambard Kingdom Brunel between 1825-1843 as a horse tunnel, which was converted to a rail tunnel in 1869 and further upgraded in 2007-2010 to become part of the London Overground. One of the construction shafts is now a station, while the original pedestrian entrance shaft is now a museum and education centre. However, for some assets disposal is the only option like the Fukushima Daiichi Genshiryoku Hatsudensho number 1 nuclear power plant.

The costs of decommissioning and disposal can be significant for some sectors, and methods can attract significant stakeholder attention - especially if it is perceived that there is potential for adverse environmental impacts.

Asset Repurposing or Disposal includes the integration with other asset management activities. Re-use, reclamation, recycling and reduction of waste and carbon footprint encourages organizations to include repurposing and recycling as key considerations in asset decommissioning activities as part of life cycle management. The financial and risk management implications of asset repurposing or sale or disposal are significant inputs to asset management decision-making.

For further information see SSG on Decommissioning and Disposal, SSG on Life Cycle Value Realisation and SSG on Capital Investment, Operations and Maintenance Decision-Making.

Some of the options that may exist for Repurposing and Disposal are:

- Sale of assets with residual value and a market;
- Component cannibalization within the organization;
- Deployment as a training aid;
- Redeployment or reuse by another organization;
- Recycling by a third party;
- Scrap;
- Donation.

The SAMP and asset management plans should have considered end of life management and the need for asset renewals, repurposing and decommissioning

as part of the asset lifecycle planning. The driver for renewals, repurposing and decommissioning could be economic due to increased unplanned failures for example but could also be for other reasons such as environmental and legislative changes. The approach to renewal, repurposing and disposal will very much depend on the maturity of the asset management in the organization, the asset class, and alignment to the other aspects of life cycle activities. For example, high-value, low-volume assets (e.g., water treatment plants) would typically experience reuse / repurposing, whereas low-value, high-volume run-to-failure-and-replace assets (e.g., smart meters) will be managed by like-for-like replacements and material recycling / recovery or disposal.

The end of life is a key point of Value Realization. Learning from end of life decisions should feed into the lessons learned for new asset life cycles, both challenging assumptions on lifetime and end of life options when replacing assets. For some large public assets where large losses have occurred at disposal, this point of value has triggered shifts in infrastructure policy to protect future national liability, (e.g. demilitarization, dismantling and disposal of military assets).

Options that prevent waste and result in no residual contamination are generally preferred, followed by reuse / repurposing and finally recovery and then disposal. See Figure 18. Rising material costs and legislation often incentivize organizations to take this approach, and organizations often require materials and supply chain circularity audits, environmental impact analysis, and land rehabilitation plans to better understand the options available.



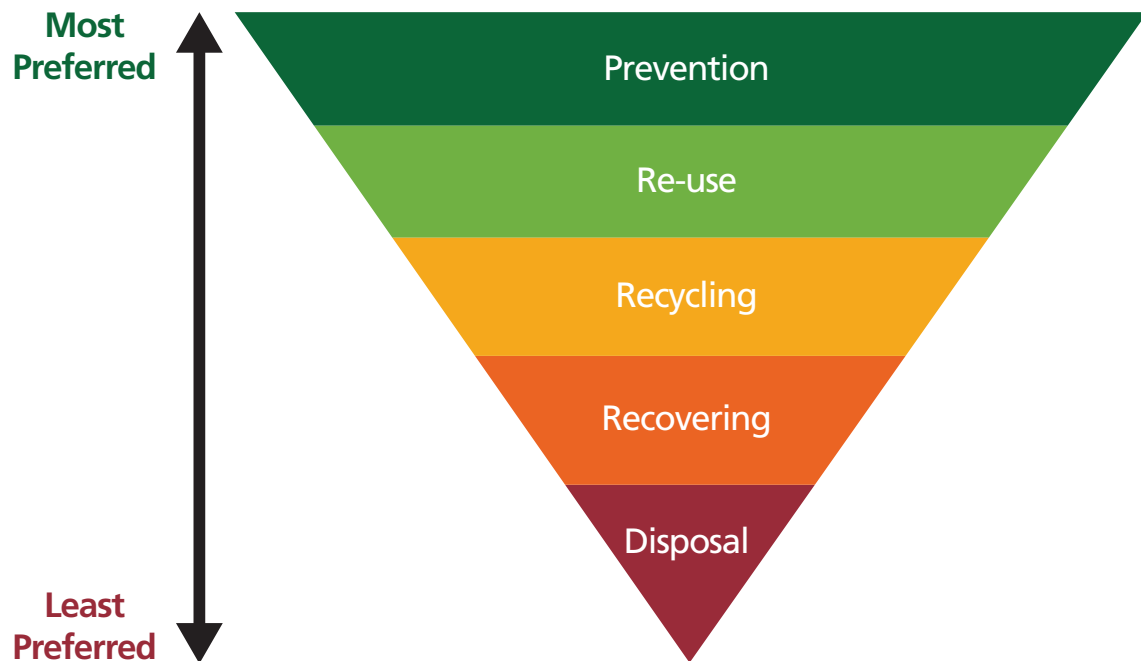


Figure 18: Waste Hierarchy

Reuse and repurposing assets can lead to ownership transferring between organizations, often requiring both parties to perform analysis and due-diligence. In other industries, such as military and nuclear, a specialist owner is appointed to take ownership of the end-of-life assets. Increasingly asset as a service or servitization options are becoming available where manufacturers lease assets or sell an output (Section 6.7.1). The sector, legislation, the residual value of the asset materials and viable business models have a significant impact on the options available.

Although the assets may no longer be in use, part of the Repurposing or Disposal must factor in the data archive and transfer. The assets' historical data must be archived and handed over to the new custodians of the assets / components and if necessary third parties (e.g. national regulating bodies), ensuring compliance, safety and any mandatory processes are completed. Increasingly, particular digital systems are mandated for this purpose. Three examples of data transfer are:

- Decommissioned nuclear plant operators must handover detailed registers (and sometimes digital twins) of asset usage and radioactive contamination to decontamination authorities.
- Component and material wastes are legally required to be handled with a "duty-of-care" documents held between the disposer, the carrier and the treatment facility and European

Waste Regulators and Tax Authorities require these documents to be retained for years after the disposal.

- UK smart meters originally supplied by an owner but then removed by another company must have an "Industry data (DCC) flow" triggered on decommissioning to ensure return and proper financial and non-financial processes take place.

ISO 55013 "Asset management - Guidance on the management of data assets" details more on the topic of data as part of disposal.



7.8. Information Management

Life Cycle Delivery

- Asset Management Data and Information Strategy
- Knowledge Management
- Asset Management Data and Information Standards
- Asset Management Data and Information Management
- Asset Management Data and Information Systems
- Configuration Management

Many asset management activities rely on effective decision-making which in turn relies on data and documented information. The asset data and information used by an organization to inform decision-making, see Asset Management Decision-making (Section 7.6.1), requires effective management to ensure usefulness to the organization within the required timescales.

Suitable accountability and management of this asset data is required to ensure and maintain usefulness. Although typically associated with a physical asset, asset data and information can be associated with any asset management function, and this should be considered within an organization's asset management information strategy.

Asset data and information can be created, acquired, or generated at all stages of the asset life cycle. Asset data supporting asset management activities is generally required for at least as long as the asset itself exists.

Therefore, it is important for an organization to consider the information it needs to support the achievement of its organizational objectives clearly defining the asset information required for those involved in managing, operating and maintaining its assets.

The configuration or nature of the asset can constrain or prevent data acquisition activities and also make it difficult to check or improve incorrect or missing asset data. Asset interventions occur at a discrete period. Therefore, subsequent checking or improvement of asset data arising from these interventions may result in additional data sources.

Decision-making may be based on asset data and information regarding the asset's location, condition, criticality, probability, and consequence of failure, specifications and costs, constraints such as resource availability, and other priorities, such as compliance with regulatory requirements. Given this there may be many stakeholders within an organization reliant on available data and information of appropriate quality and trustworthiness.

The collective term Asset Management Information refers to data and information within an organization, both of which should be considered as assets in their own right.

The terms data and information within industry guidance are commonly referenced together or interchangeably. Within the domain of asset management data and information should be managed with equal importance.

The SSG on Asset Information, Strategy, Standards & Data Management provides further information to support section 7.8.

7.8.1. Asset Management Data and Information Strategy

Good asset management information enables better decisions to be made. See Asset Management Decision-Making (Section 7.6.1). The decision may be based on data and information regarding the asset's criticality, location, condition, probability and consequence of failure, work specifications and costs, constraints such as resource availability and competence, and other priorities, such as compliance with regulatory requirements or financial reporting.

An Asset Management Information Strategy should align with an organization's Strategic Asset Management Plan (SAMP) and define how an organization intends to acquire, maintain, analyze, utilize, combine, improve, archive and delete asset information to sustain levels of data quality required to support asset management functions and providing improved services.

The Asset Management Information Strategy should set out asset information management objectives and consider the life cycle costs of the provision of asset information and the value the information adds to the organization in terms of improved decision-making

and supporting the day-to-day delivery of asset management activities. Governance, responsibilities and capabilities should also be assessed and defined within an organization's asset information strategy. An organization's Asset Management Information Strategy can be presented as a stand-alone item or incorporated within the overarching Strategic Asset Management Plan (SAMP).

An Asset Management Information Strategy should consider:

- The organization's Strategic Asset Management Plan (SAMP);
- Alignment with the organization's services and how it supports or improves these;
- Asset management decisions and the information required to support these;
- The relationship with the organization's processes for asset management including ownership, roles and responsibilities;
- The proposed approach to defining information requirements taking into account the costs of providing asset information and the value of the information;
- Definition of data dictionaries, structures, taxonomy, classifications and codification;
- Information flows, system interfaces and the overall logical data model;
- Data management and governance arrangements;
- The costs, benefits and timescales for delivery of improvements to asset information management;
- The main outcomes and functionality required from Asset Management Data and Information Systems (7.8.5);
- The core Asset Management Information Systems required;
- A description of how different Asset Management Information Systems (both existing and proposed) will integrate;
- A strategy for migrating both data and users from existing systems to new systems
- The management of structured and unstructured content;
- The strategy for continuous system improvement, including automation;
- The technology and software to be used to deliver the Asset Management Information Strategy;
- Consideration and implementation of security requirements; and
- Requirements to disclose financial and non-financial information.

The Asset Management Information Strategy should contain objectives relating to the proposed improvements in asset data and information that are Specific, Measurable, Achievable, Realistic and Time bound (SMART).

Internal and external stakeholder consultation should be undertaken via stakeholder engagement (see Section 7.7.2 Stakeholder Management) to ensure that the Asset Management Information Strategy captures their information and access requirements in an efficient and maintainable way. The Asset Management Information Strategy must be signed off by responsible and accountable stakeholders within the organization.

Knowledge within an organization is derived from the combination of experience, values, information in context and insight and can be reliant on key individuals to recall specific events or to know where to access data or information. The quality of this understanding will affect the consistency and quality of decision-making. For example, forecasts of future asset performance require good knowledge and not just good data. A key challenge for organizations is to ensure that such personal knowledge and insights are secured and made more widely available for future decision-making and to counteract the potential loss of knowledge when individuals are absent or leave an organization or when control of an asset passes from one organization to another. Organizations should consider knowledge within their information management strategy, e.g., BIM (Building Information Modelling) is increasingly being used to prevent loss of knowledge (and information) at key stages in the life cycle of an asset.

Digital techniques to capture and store tacit knowledge introduce systematic ways to capture personal knowledge within corporate systems; as an example, lessons learned is one standard approach. See Knowledge Management (Section 7.8.2) for more information.

7.8.2. Knowledge Management

The aim of knowledge management in asset management is to create a repository of shared explicit knowledge about assets and their management. This shared knowledge enables informed, evidence-based, and timely decisions, leading to improvements in efficiency throughout the life cycle of equipment and processes.

Knowledge management should be treated as a process that fosters a culture of collaboration and sharing within an organization. The transfer of knowledge among leaders, teams, and other internal and external stakeholders should be encouraged. This reduces dependence on key individuals and mitigates risks associated with the loss of knowledge.

Leadership plays a crucial role in promoting the importance of knowledge management. It is interconnected with various organizational capabilities such as culture, competency management, and change management. Organizational culture should support and encourage knowledge sharing, creating an environment conducive to learning and collaboration.

Knowledge management in asset management involves a dynamic process that includes identifying, capturing, organizing, and retaining knowledge. It entails transforming tacit knowledge (knowledge held by individuals) into explicit knowledge (knowledge that is documented and shared):

Identify. It is important to identify and map critical knowledge related to assets and their management systems.

Capture. Determine which individuals possess this knowledge and encourage them to externalize or share it, making it explicit through records or documentation.

Organize. Establish regular practices for reviewing and updating knowledge to keep it relevant. As assets and technologies evolve, and organizational structures change, ensure that knowledge management practices adapt accordingly. Assess the effectiveness of knowledge management in asset management through relevant indicators. These indicators should demonstrate how retained knowledge is being used in decision-making processes to mitigate associated risks over time.

Retain. Once critical knowledge is retained, utilize it to stimulate learning and innovation within an organization. Encourage the conversion of individual explicit knowledge into shared explicit knowledge. This ensures that knowledge remains dynamic and relevant as assets, technologies, people, and structures evolve. Succession planning should support retention of knowledge.

7.8.3. Asset Data and Information Standards

Organizations involved in the management of assets rely on asset data, information and asset knowledge as key enablers for activities in the subject groups for Strategy & Planning (7.5) and Life Cycle Delivery (7.7). as well as managing and demonstrating compliance with regulations and statutory requirements.

Asset Management Information Standards are required to ensure that asset information is collected, classified, categorized and maintained to agreed quality levels and timescales. Standards for the measurement process also define the units and purpose for the data, for example, the codification and definition adopted for condition assessments.

Asset Management Information Standards typically include:

- Classification of assets to an agreed hierarchy to allow an overall asset inventory to be created and managed, including the definition of asset relationships and dependencies;
- Definition of the required attributes that should be gathered and managed for each asset type and what these attributes represent;
- Common approaches to the definition and allocation of the criticality of an asset and asset systems to support asset management decision-making;
- Common approaches to the assessment and recording of the condition of an asset in order to support activities within Strategy & Planning (7.5);
- Common methods for categorizing asset defects and failures for use in planning remedial actions to improve service and reliability;
- Defined approaches to the assessment and recording of the performance or serviceability of an asset to support long- and short-term planning activities;
- Agreed methods for assessing and recording the utilization of an asset to help determine overall asset lives and requirements for intervention activities;
- Data and information quality requirements;
- Agreed methods for assessing and recording sustainability characteristics of assets, to meet an organization's sustainability objectives; and
- Common methods to assess future Asset Management Information System integrations.

Asset Management Information Standards should also define the quality standard appropriate for

the different types of information, considering the criticality of the assets and the criticality of the decisions made using the asset management information.

Existing international and national standards, as well as industry good practice guidance, are available relating to data and information management principles, including BIM, Digital Twins, and Artificial Intelligence, and these should be reviewed to support the development of an organization's Asset Management Information Standards.

7.8.4. Asset Management Data and Information Management

Data and Information should be managed within an Asset Management System to achieve both asset management and organizational objectives.

The management process should consider:

- **legal requirements:** the legal requirements for holding, managing, and transferring asset data;
- **data dictionaries:** data specifications and requirements from the organization's management system to enable consistent definition of attributes, units of measurement, criticality, quality, and source for the different types of asset data;
- **data frequency:** the frequency for updating data; while some asset data may remain static across all life cycle stages others can be updated at pre-defined intervals of time, frequency can also align to legal or regulatory requirements.
- **data volume:** the volume of data can determine which tools and storage environments are most appropriate to be used, including BIM and Digital Twin which can require large storage repositories.
- **data security:** including access, loss of confidentiality, improper use, or improper modification, alterations, and deletions;
- **data availability:** ensuring the availability of data is defined and accessible by the asset management team when required; including BIM, telemetry data, as applicable;
- **data responsibility:** clear allocation of roles and responsibilities related to the management of asset data.
- **data quality:** definition of required data quality,

Where it is not possible for an organization to achieve these data requirements, it is important that

direction and guidance is provided as appropriate. As an example, poor data quality, in some instances, is unavoidable. Where this scenario occurs this should be identified, and users informed how much the data can be relied upon to enable informed decision-making.

Data quality requirements⁴⁹ for asset data closely relate to asset data requirements. Quality requirements are determined and managed alongside the data requirements to ensure an adequate balance of cost, risk and performance. Data quality can be assessed using a confidence scale similar to that of the condition scale of the underlying asset. Data quality dimensions can be used to apply data quality measurements. These may include, but are not limited to:

- **Accuracy** – the data is a true reflection of the entity it represents;
- **Completeness** – a measurement indicating how complete a set of data is for each asset data record;
- **Consistency** – data is consistent in its definition, rules, format and value;
- **Validity** – all data held complies with data storage rules;
- **Timeliness** – data reflects the current state of an asset and complies with organizational standards for data update timescales;
- **Uniqueness** – all keys should be unique with no duplication of data. All assets should be recorded once only.

Changes to assets, digital technologies, processes, and organizational configurations may directly or indirectly impact data and information and associated management processes and should be controlled through the organization's change management processes. Organizations should undertake periodic reviews of their data and information to ensure it is suitable and the agreed quality is maintained in alignment with defined improvement plans.

The procurement or collection of data and information has an associated financial cost. A commercially led benefit analysis and risk review, including statutory and regulatory requirements, should be undertaken to prioritize activities by accountable and responsible individuals.

49. ISO 8000 series provide guidance on assessing and managing data quality.

Data and information associated directly with assets may include:

- Data that is either dynamic or static;
- Records of the existence of an asset, collectively known as an asset inventory or asset register;
- Attributes of these assets. An attribute is a quality or feature as a characteristic or inherent part of an asset e.g. make, model, serial number, age, rated capacity;
- Attributes of the asset systems, e.g. capability, sustainability, criticality
- Location, spatial information, dependencies, and connectivity information – especially in Geographical Information Systems (GIS);
- Logical groupings e.g. systems, equipment types, zones;
- Access requirements e.g. permits, right of way requests, safety related information;
- Historical records of past events and work carried out on the asset - either during short, medium, or long term planned activities or as the consequence of unplanned tasks (e.g. breakdown repairs);
- Documents, BIM, design models and drawings, and photographs of the asset;
- Asset types: an understanding of the types of asset within the asset management system and how they are represented in data is critical, for example: point assets, linear assets, area/polygon assets, volume assets, system level assets;
- Meta-data: This is data that describes data including its structures, data types, business rules, data locations and data qualities;
- Intervention data: This is data that records the history of work done on the asset;
- Work bank – activities associated with asset such as maintenance, renewal, enhancements and failures;
- Unstructured data – user manuals, drawings, photographs; and
- Financial data – cost across the whole life cycle of the asset (e.g. procure, operate, maintain, replace, dispose)

7.8.5. Asset Management Data and Information Systems

Asset Management Information Systems are the set of tools and systems that an organization uses to collect, store, maintain, process and analyze its asset data and information. Although asset management information systems can be paper-based, typically, digital software applications and systems are used to effectively manage assets over their life cycle.

Asset Management Information Systems can range from paper-based to fully integrated Enterprise Asset Management (EAM) systems. Organizations should consider the strategy and needs of all functions, data and information flows, including statutory and regulatory requirements, when implementing, adopting, and improving Asset Management Information Systems.

Typical Asset Management Information Systems include:

- An asset register to detail the assets of interest to an organization;
- A Geographical Information System (GIS) and / or topological systems to record the location and spatial details of assets;
- Work management systems to plan and record work activities related to an asset;
- Logistics systems to manage the storage, issuing and use of materials and spares;
- Shutdown / outage management systems to plan access to assets for work activities, including permits;
- Demand management systems to forecast how demand on assets will change over time;
- Decision support tools such as investment modelling systems to support strategic planning activities;
- Processes for migration from external to internal systems, and vice-versa;
- Process, telemetry and SCADA systems to record how well assets have performed and are meeting their service requirements;
- Common data environments, to collect, manage and disseminate model data and documents between multi-disciplinary teams to provide a collaborative working environment;
- Condition monitoring systems to monitor key condition indicators of assets, such as temperature and vibration, to help predict possible future failures;
- Mobile working devices to collect data and information from, and disseminate it to, front-line operations and maintenance staff;
- Resource management including training and competency records, see Resource Strategy and Management (Section 7.5.7);
- Financial management to manage commercial aspects, such as reporting, see Asset Costing and Valuation (7.5.10);
- Sustainability information to record progress towards an organization's sustainability objectives.

- Benefits analysis to support continuous improvement.

Across an asset's life cycle, different functions of an organization will have specific associated asset data and information requirements, including presentations in differing formats. It is therefore important to have a robust reporting system as part of the asset information system.

There is often no clear dividing line between Asset Management Information Systems and other enterprise/organization systems. Information in Asset Management Information systems may be used for wider organizational purposes and information in enterprise/organization systems may support asset management objectives. For example, training and competency records in enterprise human resource systems may support decisions about who has the competency to respond to defects with specific types of assets. It is important for organizations to understand the interfaces between these systems, which system is the primary repository, and the management and maintenance responsibilities.

7.8.6. Configuration Management

Configuration management identifies, records and manages the functional and physical attributes of assets (Section 7.8.3), software and related documentation including the links between the components of a system. It provides a process for systematic control of changes to the identified attributes of items for the purpose of maintaining integrity and traceability throughout the life cycle.

Configuration management is integral to Asset Creation and Acquisition (Section 7.7.1) and closely aligned with the principles and requirements of Systems Engineering (Section 7.7.2). It is a significant

part of the wider Management of Change process (Section 7.10.3).

Configuration management typically comprises the following 5 elements:

- **Configuration management and planning** - establishing documented controls and mechanisms for configuration management, and the production of configuration management plans.
- **Configuration identification** – identification of an item (a hardware and/or software/data product) and its defining attributes. These are recorded and base-lined then subject to formal configuration change control to manage changes to the defining attributes of the item.
- **Configuration control** - processing and approval to manage changes to an item's defining attributes and to re-baseline them as necessary.
- **Configuration status accounting** - process of recording and reporting on items, their defining attributes, associated configuration baselines and changes to these attributes through time.
- **Configuration verification & audits** – functional and physical audits to ensure that defined functional and performance attributes of items have been implemented / achieved and items are installed in accordance with the requirements of its approved supporting documentation.

Further information on configuration management can be found in:

- ISO 10007:2017 Quality management — Guidelines for configuration management
- EIA-649-C 2019 National Consensus Standard for Configuration Management

Please see SSG on Configuration Management for more detailed information.

7.9. Risk Management

Risk Management

• Risk

7.9.1. Risk

Risk, and risk management, forms a very important part of good asset management. Understanding what might happen, and doing the right things, at the right time, to affect the likelihood and/or consequences of such potential events, are essential practices within asset management planning and decision-making.

In ISO 31000:2018 risk is defined as “the effect of uncertainty upon objectives”. In theory, therefore, risk management should deal with uncertainties of both positive (opportunity) and negative (threat or hazard) events. In practice, most organizations use the term principally to address the undesirable events, such as failures, vulnerabilities or constraints. In this context, a risk is identified as the undesirable circumstance and scaled in significance by the combination of likelihood (probability or frequency) and consequences. For example, a potential failure of an asset to perform its required function, a vulnerability to error in the performance of a task, or a possible disruption in deliveries for important parts. In each case, the seriousness of the risk is represented by combining the event’s probability and consequence(s).

High, Medium and Low (or similar terms) are commonly used to distinguish different levels of consequence, but are difficult to combine in consistent ways to recognise multiple consequences, and different levels of likelihood. Quantification enables better and more rigorous risk management. Typically, this involves the organization choosing ranges of different consequences, and scoring (or monetizing) their significance. This also forms a core part of a “Value Framework”, used to document the organization’s definition of what is important, and providing scales of their achievement (See Asset Management Decision-making 7.6).

The term ‘criticality’ is often used as an indication of the importance of an asset, or an activity,

to the delivery of an organization’s objectives. Such importance also, therefore, represents the consequences of (unplanned) unavailability of that asset or activity (e.g. the impact of failure). Scales of event consequences used for risk management should take account of, and be aligned to, such functional importance. Risk extends the criticality to take account also of the failure probability (or frequency).

As risks are inherently uncertain (and difficult to measure), they need to be managed in a systematic, transparent and proportionate way. ISO 31000:2018 and ISO/IEC 31010:2019 provides useful guidance on the processes involved in such risk management. They include the identification, assessment, prioritization and treatment of risks to control and monitor the probability and/or the consequences.

Having identified and assessed the risks, the treatments available to address the risk are often grouped into the so-called 4Ts:

- **Transfer** a risk to another party. Some risks can be transferred to a second or third party by mutual agreement e.g. a contractor or insurance.
- **Terminate** the activity that generates the risk.
- **Treat** a risk by reducing the likelihood and / or consequences
- **Tolerate** a risk (if tolerable and no other option is viable or worthwhile).

Risk treatments range from the preventive (reducing or eliminating the probability of the event) to the mitigation of consequences (such as contingency plans and options to prevent escalation of consequences). These can be envisaged in the “Bow-tie” model⁵⁰, identifying and addressing the component causes of the issue, and/or controlling the potential effects and consequences.

In the treatment of particularly high risks, a combination of treatments may be needed and justified, since any single control may be imperfect. Risks that comprise very low probabilities of extremely high (“catastrophic”) consequences usually need special attention, with such methods as Event Tree Analysis (ETA) and Fault Tree Analysis (FTA).

Risk framework, risk matrix and risk register

Scales of likelihood and different types of

50. <https://www.gov.uk/government/news/bowtie-a-visual-tool-to-keep-an-overview-of-risk-management-practices>

consequence are often organized into a matrix, enabling a demarcation of risk zones such as 'intolerable', 'negligible' and 'ALARP'. ALARP is named after the goal - to reduce the risk to "As Low As Reasonably Practicable". The ALARP area represents risks in which a trade-off is considered between the cost of controls and the degree of risk reduction they will achieve. This is achieved when any further risk reduction would be "disproportionately"

expensive. This framework would be approved by top management and guides the identification, assessment, and monitoring of risks at a level appropriate to their significance.

See Figure 19 Illustration: typical (say 5x5) risk matrix, showing red/intolerable, yellow/ALARP and green/negligible regions.

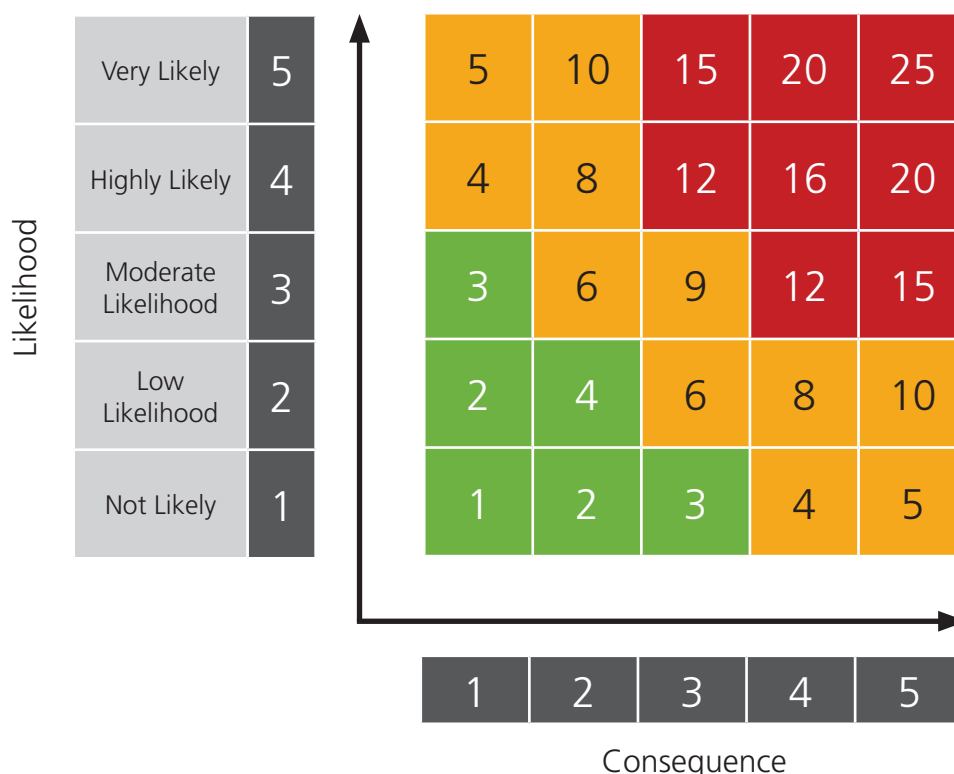


Figure 19: Risk Matrix (5 x 5 example)

A risk register is a valuable aid to maintain consistency of the risk management processes. It provides a common location for recording risks, scoring or quantifying them, prioritizing their attention and tracking the evaluation of the issue, selection of controls, implementation of those controls and the residual risk assumptions. It also provides a basis for overall risk status reporting, with coherence between asset-related risks, process/activity-related risks and enterprise-level risks.

Risk appetite and risk tolerance

An organization's approach to risk management is represented in its risk appetite and risk tolerance. These will vary depending on an organization's sector, culture, and objectives.

- Risk appetite is the amount and type of risk that an organization is willing to pursue or retain.
- Risk tolerance is the readiness of an organization or stakeholder to bear the risk after risk treatment. Any risk, whose combination of likelihood and consequence is 'intolerable' (i.e. the red zone in a risk matrix), MUST be controlled, at least enough to drop below the tolerance limit.

There are different domains of risk management in most organizations, sometimes causing confusion but needing to be aligned and integrated to avoid conflicts and confusion. Enterprise risk management tends to deal with broad risk categories at a 'total impact' level, such as Environmental, Health and Safety, Customer Satisfaction, Reputational, Financial,

Cybersecurity and Technical (which includes higher impact asset failures). Asset-related risk management focuses more specifically on the assets and systems of assets (what can fail, how, why and with what effect). Whereas process-related risks are associated with activities, tasks or business processes (such as project risks, or vulnerabilities in the management system).

Risk management within asset management

Risk management needs to be integrated with (and in some cases, embedded within) many asset management activities. To ensure consistency and sustained effectiveness, this requires clear rules or policies, processes and responsibilities, plus active planning, training, tools and communications.

Examples of important elements include:

- A risk management policy, setting out the core principles, 'must do' practices and risk acceptance/tolerance criteria. A risk management policy sets out an organization's approach to risk management and is integral to its internal control and governance arrangements.
- Risk management processes and training, with understanding of risk controls and mitigation options.

- Quantified risk incorporated into strategy, planning and decision-making processes, including justification of investments, budgeting and resource prioritization.
- Understanding how risks change with time. The 'level' of risk is needed to prioritize attention to issues, but the rate of change of risk (increasing likelihood and/or escalating consequences of events) needs to be considered in decisions about the optimal timing for interventions (e.g. preventive action) or other risk controls (e.g. contingency planning).
- Alignment of criteria and scoring/scaling methods for strategic, tactical and operational risks, criticality definitions and the Value Framework used in decision-making and performance reporting.
- Alignment of risk management practices for asset-related risks, process/activity-related and enterprise risks.
- Review and audit processes, with performance measures that recognize risk and uncertainty.

See SSG on Risk Assessment and Management for further information.



7.10. Review & Continual Improvement

Review & Continual Improvement

- Monitoring
- Continuous Improvement
- Management of Change

7.10.1. Monitoring

Effective asset management provides assurance for the achievement of organizational objectives and realization of organizational sustainability through value realization and preservation from the investment, use, maintenance, and disposal of assets.

It is important that measures and associated targets align with the organization's asset management strategy and objectives (SAMP) and provide feedback on and understanding of asset performance. This feedback is a key input to asset management decision-making processes.

The SAMP defines the desired functional performance, level of service and condition of assets and monitoring activities should be aligned with these. The monitoring process would typically be data-driven analysis that enables decision-makers to make informed choices about asset utilization, investment, and optimization. By having a clear understanding of the value realized by assets, organizations can fine-tune their strategies, leading to improved asset performance and overall effectiveness.

Monitoring value realization can be performed on an asset or a portfolio of assets, with the latter providing a more systemic view when considering the organizational outcomes and impacts.

A robust monitoring framework includes asset performance and health indicators that can be aligned back to the Asset Management objectives. Other key performance measures targeting specific stakeholders should be included to demonstrate conformity with the intent of the Asset Management System. The metrics used to monitor value realization must be able to show the value realized at each relevant stage of the life cycle and clearly demonstrate the results achieved to enable assessment against the asset management and organizational objectives. Adjustments can then

be made as part of the ongoing value realization process.

The term 'asset health' is used in relation to measures that monitor the current or predicted condition or capability of an asset to perform its desired function, by considering potential modes of failure. Clear criteria are required to understand when there is a deviation from the level of performance required for an asset so that the need for appropriate remedial action can be evaluated. It is common for asset systems to have specific performance criteria. In order to understand and manage their performance and support strategic and tactical decisions, it is usually necessary to monitor the performance of the component assets as well as the overall asset system.

To manage the current and future performance of assets, a range of performance measures can be required, including lagging measures to monitor past performance (e.g., for incidents, failures, and defects) and leading measures to predict future performance (e.g., to avoid incidents and failures).

Condition monitoring is a form of proactive, predictive monitoring for physical assets. This can range in sophistication from periodic visual inspection to on-line continuous monitoring. Condition values can be used to plot the actual deterioration curve for the asset. It is important to review the cost-effectiveness of monitoring. It is also essential that monitoring programs involve both operations and maintenance personnel, as many failure modes can be detected by operators.

Monitoring can generate large quantities of data, which will impact an organization's information systems. See Asset Management Data and Information Systems (Section 7.8.5).

Figure 9 (see 7.3.4 Asset Management Assurance and Audit) illustrates the principles of these different types of measures or indicators, and how they also contribute to continual improvement. The diagram applies to the monitoring of both assets and the elements of the asset management system (AMS).

Asset Management System Monitoring

As well as monitoring the performance of its assets, an organization should monitor the performance of the Asset Management System that supports

and manages them. The overall purpose of this monitoring is to enable the organization to evaluate the extent to which it is delivering its asset management objectives (from the SAMP), asset value realization and the effectiveness of the management system. Specific key performance measures and dashboards targeting specific stakeholders should be developed to demonstrate conformity with the intent of the Asset Management System.

Financial and non-financial performance measures are required at various levels of granularity to give insight on the current and potential future performance of the Asset Management System. The measures and their analysis and evaluation should be designed to identify whether the policies and processes of the Asset Management System are being followed and whether the outcomes of the processes are in line with expectations.

At the highest level, summary information is presented to top management, with increasing levels of detail provided through the organization appropriate to the decisions and issues that are being managed. Good practice requires clear accountabilities for both the reporting of measures and acting on them.

Outcomes from the Asset Management System monitoring identify changes in the organization's risk profile or actions. (Section 7.3.4)

7.10.2. Continuous Improvement

Continuous Improvement is an ongoing process of analyzing the performance of both the assets and the Asset Management System, identifying opportunities, and making incremental changes to increase value. It both emphasizes and demonstrates that improvement programs must start with careful planning, must result in effective action, and must move on again to careful planning in a continuous cycle. Among the most widely used tools for continuous improvement is a four-step quality model—the plan-do-check-act (PDCA) cycle, also known as Deming Cycle or Shewhart Cycle:

Plan: Identify an opportunity and plan for change.

Do: Implement the change on a small scale.

Check: Use data to analyze the results of the change and determine whether it made a difference.

Act: If the change was successful, implement it on a wider scale and continuously assess your results. If the change did not work, begin the cycle again.

As can be seen from Figure 20, continuous improvement affects all areas of the value realization cycle and all areas of asset management.

Continuous improvement is a cornerstone of effective asset management. By constantly striving to improve,

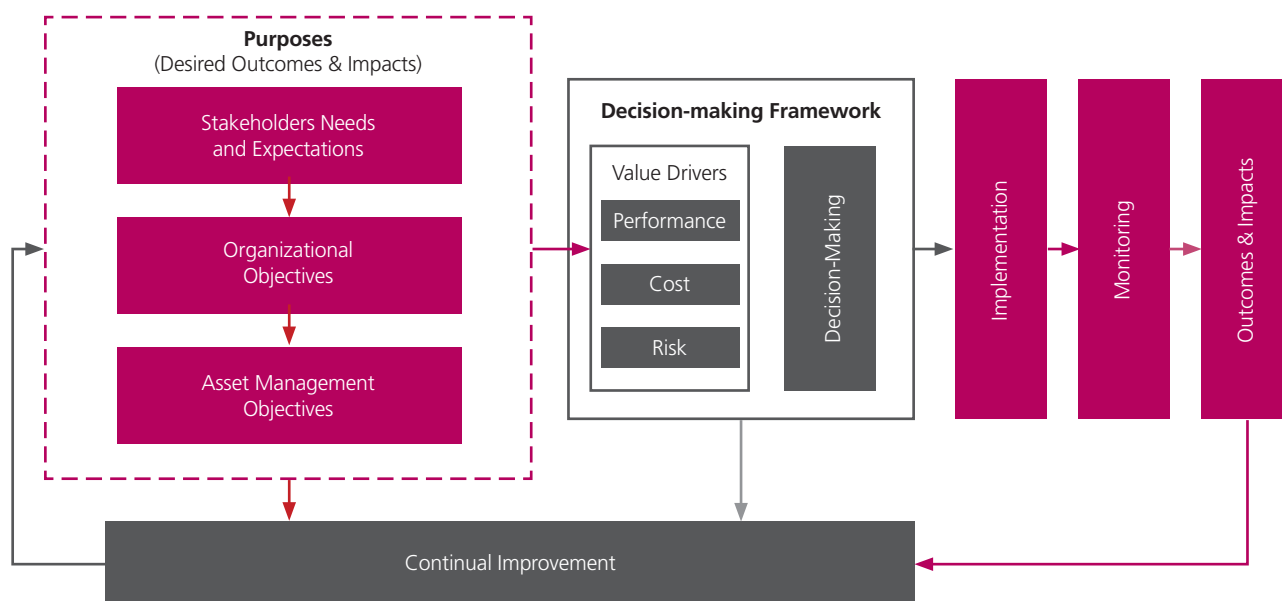


Figure 20: Value Realization Cycle

organizations can maximize the value they derive from their assets, optimize the balance between performance, cost, risk, and achieve long-term success through the realization of desired outcomes. Continuous improvement is crucial in asset management for several reasons:

- **Optimizes Asset Performance:** Over time, assets degrade and impact an organization through the realization of undesired outcomes. Continuous improvement allows an organization to identify areas for improvement in maintenance, operation, and utilization. This can extend the lifespan of assets, reduce downtime, and optimize their overall performance.
- **Reduces Whole Life Cycle Costs:** By proactively addressing potential problems and inefficiencies, an organization can avoid costly repairs and replacements down the road and lessons learned from operations can better inform asset design and selection. Continuous improvement helps to identify opportunities to optimize resource allocation and reduce costs in all life cycle stages.
- **Improves Risk Management:** Many asset failures are preventable. A continuous improvement mindset allows an organization to identify and mitigate risks associated with assets before they escalate into major problems and to adapt processes where necessary. This proactive approach can improve safety and reduce the likelihood of accidents and disruptions.
- **Adapts to Change:** The operating environment for assets can change rapidly due to technological advancements, regulations, evolving business needs, and environmental factors. Continuous improvement allows an organization to adapt its asset management strategies to these changes, ensuring that assets remain fit for purpose and contribute to meeting objectives.
- **Enhances Decision-making:** By collecting and analyzing data on asset performance, an organization can make data-driven decisions about investments including maintenance, upgrades, and replacements. This data-driven approach leads to more informed and effective asset management approaches which can continuously evolve.
- **Boosts Innovation:** A continuous improvement culture encourages employees to think creatively and identify new ways to improve asset management practices. This can lead to innovative solutions that enhance efficiency, sustainability, and overall value creation.
- **Maintains Competitive Advantage:** In today's competitive landscape, organizations that effectively implement their asset management strategies have a significant edge. Continuous improvement ensures that asset management practices remain aligned, efficient and effective, allowing an organization to deliver superior performance compared to competitors.

7.10.3. Management of Change

Management of Change addresses the need to manage a range of permanent and temporary changes within an organization related to asset management. This could involve adapting to new legislation, integrating novel technologies, or handling the loss of staff with critical asset knowledge.

Changes may influence organizational objectives or risk tolerance. An organization must anticipate both predictable and unpredictable changes. A robust Management of Change process is required to address the impact of such changes.

Risk assessment and management (Section 7.9) should identify, evaluate, and prioritize risks associated with changes, and plan mitigations. It is vital to consider the effect of changes on asset or asset system criticality, as the importance of an asset to business operations can change over time.

Changes affecting assets or asset management activities significantly involve organizational personnel. Success in implementing change depends heavily on the clarity of documentation and communication strategies directed at those involved or impacted by the change. The management approach should match the significance of the change and the potential impacts, sometimes necessitating a dedicated change management plan.

The airline industry had to manage a significant change in asset utilization as a direct result of the Covid-19 pandemic. This introduced significant

travel restrictions and a resulting dramatic drop in passenger demand. Airline companies had to quickly adapt their operations to a reality where a large part of their fleet was grounded.

The decline in air travel required a systematic approach to grounding aircraft fleets, maintaining them while not in use, and reallocating resources. This required a re-evaluation of asset management strategies and maintenance schedules.

The airline companies had to meticulously plan and manage the grounding of aircraft, ensuring they were stored in a way that would prevent corrosion or damage and keep them in a state of readiness for when air travel demand returned. They also needed to work closely with regulators, financial institutions, and insurance companies, given the high value and regulated nature of their assets. This response to Covid-19 required a dynamic approach to asset management, incorporating strategic, operational, and financial considerations.



7.11. Value & Outcomes

Value & Outcome

- Outcomes and Impacts

Value Realization is the process of achieving the expected or desired outcomes from an organization's assets. Outputs are well understood but 'outcomes' include the impacts – and ask the question 'for whom?'

Asset management is all about getting the most out of assets to achieve its desired outcomes. It focuses on the value assets bring to the organization and everyone involved, including stakeholders. Recognition, measurement and reporting of value needs to take account of multiple impacts and consequences – over different timeframes. One of the hardest challenges is to manage successfully the trade-off between short-term cash gain compared to long-term liabilities, or 'free' resources such as nature.

While money is important, value is a broader concept. Value can include many things: how much things cost, potential risks, how well things work, safety, income from assets, environmental impact, reputation, quality, sustainability, and following/ complying with regulations. An important concept is the 6 Capitals which are embedded in Integrated Reporting⁵¹.

The 6 Capitals recognize such things as valuable in six categories: financial, manufactured, intellectual, human, social and relationship, and natural⁵². This value can be positive or negative, financial or non-financial and affects how decisions are made, how resources are utilized and how progress is monitored. An outcomes-based value framework should be developed that defines an organization's objectives and what stakeholders need and expect.

7.11.1. Outcomes & Impacts

Outcomes are the organization's results / outputs, combined with their impacts and consequences. These will be perceived differently by stakeholders according to their expectations and situations.

Outcomes can be positive or negative, financial or non-financial, and are ultimately about the realization of value. Some consequences are extremely long-term and so Outcomes need to recognize multiple timescales.

Outcomes (and outputs) are significant in assessing an organization's asset management capabilities (and AMS). They help determine to what extent asset management contributed to the achievement of organizational objectives.

Outcomes-based value frameworks (see Section 7.6.1 Decision-making) help define the key actions, barriers and capabilities that would help an organization realize better its desired outcomes. Regular monitoring and improvement actions help prevent the realization of undesired outcomes.

An organization should 'start with the end in mind' when developing objectives and establishing capabilities.

The 'ends' in this context are the desired outputs and impacts it intends to generate. Ultimately it is what the organization is trying to achieve through its asset management system. Outcomes to assess overall performance should be quantifiable, measurable, achievable and time bound. Where impacts may take a long time to manifest or become evident, 'leading' indicators may be needed to indicate likely future outcomes.

The impacts of some asset management decisions will take a long time to be realized. So, a benefits realization framework should track the outcomes over time. Accountability for outcomes should be clearly defined in the benefits realization framework. It is important that the organization's monitoring activities are aligned with the organizations' value framework (Section 7.10.1). These should trigger responses to any deviations, directly improving achievement of organizational objectives. A better understanding will enable adjustment of the Asset Management System if required.

Outcome and impact reviews should also contribute to the continual improvement of assets and asset management (Section 7.10.2).

51. Integrated Reporting is becoming mandatory in auditing and Annual Reports of corporations globally. Asset Management is a useful means of integrating non-financial data with financial. It is also useful because it already uses holistic approaches, i.e. Integrated Thinking.

52. <https://integratedreporting.ifrs.org/what-the-tool-for-better-reporting/get-to-grips-with-the-six-capitals/>

Key Outcome and Impact areas of review would typically include but not be limited to the following:

- Review of an organization's operating context which includes internal and external factors that affect its ability to achieve the intended performance of its Asset Management System
- Review of Stakeholders (internal & external) and their requirements
- Review organizational objectives remain aligned to stakeholder requirements and asset management objectives remain aligned to organizational objectives

- People do asset management and have a huge influence on an organization's outcomes and impacts therefore a review of knowledge, skills and competencies to deliver the desired outcomes for the organization including roles and responsibilities assigned for realizing outcomes
- Review of leadership, culture and behaviours ensuring the right leadership, culture and behaviours are present to facilitate the realization of desired outcomes and impacts.

Figure 20 (see 7.10.2 Continuous Improvement) shows these interrelationships.



8 IAM Resources

8.1. Introduction

The IAM has produced, and continues to develop, resources to support both individuals and organizations in their asset management journeys. Some of the main IAM resources items are shown below.

A number of these resources utilize the IAM 6-box Model (the “conceptual model” in many references). They often refer to the “39 Subjects” (the asset management subjects that comprise the asset management discipline in the previous version of the Landscape). They also reference other external documents produced by international bodies such as the ISO55000 suite of documents and the GFMAM documents.

The IAM conceptual model has evolved to become the “10-box Model”, as described in Section 5. The IAM has reviewed the impact of these changes on our resources; and has prioritized a programme of work to review and revise each of them. As this work progresses, the outdated material and references will gradually disappear.

With the new 10-box Model comprising 10 Capabilities, and the revised Landscape Version 3, we have updated our mapping of the latest asset management subjects mapped to these Capabilities (see Appendix A and Figure 5 (Section 5.3)).

8.2. The Big Picture

This is a highly visual tool designed to start conversations about asset management within an organization, and with customers, suppliers and wider stakeholders. It comprises a set of materials, including a short video that explains the structure and key points of Asset Management. The intention is not to provide a model or template for how to do asset management, but to capture what it feels like, depicting the cultural as well as the technical barriers. A number of Big Picture images illustrate this version of the Anatomy.

<https://theiam.org/knowledge/Big-Picture>

8.3. The Pathway to Excellence: Asset Management Maturity Scale and Guidance

This introduces the subject of asset management maturity and how it can be defined, scaled and recognized. It contains a generic maturity scale, ranging from ‘Innocence’ to ‘Excellence’, with the attributes and symptoms that could be expected. The guidance addresses the context-dependence nature of assessing asset management maturity and provides insights for recognizing what asset management excellence might represent to an organization within a particular context.

www.theIAM.org/Maturity



8.4. SAM+ Tool

The Self Assessment Methodology ‘Plus’ has been designed to help organizations assess their capabilities against the requirements of PAS55 or ISO55001 or the subjects which comprise the asset management discipline. www.thelAM.org/SAM

8.4.1. Endorsed Assessors

To get most value from the assessment and certification process, it is advisable to use assessors that are recognized through a formal scheme, such as those managed by National Accreditation Bodies, or the IAM’s Endorsed Assessor Scheme.

Such assessors will be able to demonstrate that their individual auditors have knowledge and understanding of asset management as well as the management system standard. This can be achieved by testing compliance with the Global Forum’s Auditor Assessor Specification for ISO55001, currently through examination to the IAM’s ‘Certificate in Asset Management’.

8.5. IAM Competences Framework

Asset management spans a wide range of disciplines. The precise mix of competences that people and organizations need depends on their objectives, the context and circumstances they are operating in. The Competences Framework: supports organizations with planning and developing the asset management capability they need to meet current and future needs; helps individuals plan their training and professional development and creates a firm base for designing training. www.thelAM.org/CF

8.6. Implementing and Improving a Management System for Asset Management

This guide provides guidance for organizations that wish to put in place or improve an existing management system for asset management. It also provides practical guidance on how to go about embedding a management system – from the initial assessment of ‘where you are now’ through to developing and implementing practical solutions. The guidance is intended to complement the ISO55000 suite of documents.

8.7. Developing and Maintaining a Strategic Asset Management Plan

This publication provides practical advice for the development of a Strategic Asset Management Plan (SAMP). It explains the process of strategic planning and how this applies to:

- assets and their optimal, whole life cycle management
- improvements in the asset management capabilities of an organization

The guidance is intended to complement the ISO55000 suite of documents, providing insight into the role and suitable content for a Strategic Asset Management Plan (SAMP), and how it should be developed.

8.8. Subject Specific Guidance documents (SSGs)

These documents are designed to expand and enrich the content of the subjects that comprise the asset management discipline subjects summarized in this Anatomy document.

The SSGs identify what should be considered when creating, maintaining and improving an asset management system in relation to that subject. Where appropriate SSGs also provide case study examples. www.thelAM.org/SSG





9 Further Reading

9.1. Standards and Publicly Available Specifications

- BSI PAS 55:2008, Asset Management - Part 1: Specification for the optimized management of physical assets
- ISO 55000:2024, Asset management - Overview, principles and terminology
- ISO 55001:2024, Asset management - Management systems – Requirements
- ISO 55002:2018, Asset management - Management systems – Guidelines for the application of ISO 55001
- ISO Guide 73:2009, Risk management – Vocabulary

9.2. Global Forum

All documents can be found at www.gfmam.org/publications

- The Asset Management Landscape, Third Edition
- GFMAM Competency Specification for an ISO55001 Asset Management System Assessor, Second Edition
- Asset Management Maturity – A Position Statement, Second Edition

9.3. Other Publications

The IAM has a list of “Recommended Books”, which are not necessarily in accordance with the IAM’s considered views but are, nonetheless potentially useful and of interest to people who already understand Asset Management. Some of them offer provocative views.

In order to keep this list up-to-date, it is maintained on our website.

See <https://theiam.org/knowledge-library/recommended-books/>

You are encouraged to visit the websites and material published by other members of the Global Forum. The IAM believes that Asset Management will develop and improve its profile because of all our efforts.

9.4. References

- ISO55001: 2024 Asset management - Asset management system – Requirements
- ISO55012: 2024 Asset management – guidance on people involvement and competence
- ISO 55013 Asset management - Guidance on the management of data assets
- ISO 31000:2018 Risk management — Guidelines
- ISO/IEC 31010:2019 Risk management — Risk assessment techniques
- ISO 8000 series Data quality
- ISO 19011:2018 Guidelines for auditing management systems
- ISO 22301:2012, Societal security – Business continuity management systems - Requirements
- ISO 15288, Systems and Software Engineering, System Life Cycle Processes
- BS 8900-1:2013, Managing Sustainable Development of Organizations. Guide.
- ISO 10007:2017 Quality management — Guidelines for configuration management
- EIA-649-C 2019 National Consensus Standard for Configuration Management
- Implementing and Improving a Management System for Asset Management
- Developing and Maintaining a Strategic Asset Management Plan
- SSG Asset Management Policy, Strategy and Plans
- SSG Demand Analysis
- SSG Strategic Planning
- SSG Capital Investment, Operations and Maintenance Decision-Making
- SSG Life Cycle Value Realisation
- SSG Shutdown and Outages Strategy and Management

- SSG Technical Standards and Legislation
- SSG Systems Engineering
- SSG Configuration Management
- SSG Maintenance Delivery and Asset Operations
- SSG Reliability Engineering
- SSG Decommissioning and Disposal
- SSG Asset Information, Strategy, Standards & Data Management
- SSG Procurement & Supply Chain Management
- SSG Organizational Structure and Culture
- SSG Risk Assessment & Management
- SSG Contingency Planning & Resilience Analysis
- SSG Asset Costing & Valuation
- SSG Stakeholder Management
- GFMAM Asset Management Landscape, Third edition
- GFMAM Auditor Assessor Specification for an ISO 55001 Asset Management System Auditor/Assessor, Second Edition
- GFMAM Maintenance Framework, Second edition

‘The Three Lines of Defense in Effective Risk Management and Control’, The Institute of Internal Auditors Position Paper, January 2013. (<https://na.theiia.org/training/templates/Pages/The-Three-Lines-of-Defense-in-Effective-Risk-Management-and-Control.aspx>)

10 Glossary

This Glossary does not include all terms used within the Anatomy. Some terms are explained in the body of the text.

ISO 55000 contains definitions for some terms relating to asset management. For convenience, a number of these are included in this Glossary, as the definitions and their associated notes aid understanding (where more clarification is provided than within the Anatomy).

asset	Item, thing or entity that has potential or actual value to an organization. Notes: (1) <i>Assets can be physical or non-physical.</i> (2) <i>A grouping of assets referred to as an asset system can also be considered as an asset.</i>	ISO 55000:2024
asset life	period from asset ideation to asset end-of-life Notes: (1) <i>"Useful life" is the period over which an asset is capable of fulfilling a purpose to an entity.</i> (2) <i>Asset life can differ from the period the organization holds responsibility for the asset.</i> (3) <i>End-of-life is when the asset can no longer cause any residual obligations.</i>	ISO 55000:2024
asset management	Coordinated activity of an organization to realize value from assets. Notes: (1) <i>Realization of value normally involves a balancing of costs, risks, opportunities and performance benefits.</i> (2) <i>Activity can also refer to the application of the elements of the asset management system.</i> (3) <i>The term "activity" has a broad meaning and can include, for example, the approach, the planning, the plans and their implementation.</i>	ISO 55000:2024
asset management plan	Documented information that specifies the activities, resources, costs and timescales required for an individual asset, or a grouping of assets, to achieve the organization's asset management objectives. Notes: (1) <i>The grouping of assets may be by asset type, asset class, asset system or asset portfolio.</i> (2) <i>An asset management plan is derived from the strategic asset management plan.</i> (3) <i>An asset management plan may be contained in, or may be a subsidiary plan of, the strategic asset management plan.</i>	ISO 55000:2024
asset management system	Management system for asset management	ISO 55000:2024
asset management strategy <i>(also refer to definition for the SAMP)</i>	long-term optimized approach to management of the assets, derived from, and consistent with, the organizational strategic plan and the asset management policy Notes: (1) <i>The asset management strategy converts the objectives of the organizational strategic plan and the asset management policy into a high-level, long-term action plan for the assets and/or asset system(s), the asset portfolios and/or the asset management system.</i> (2) <i>The high-level, long-term action plans for the assets and the asset management objectives are normally the outputs of the asset management strategy. These elements together form the basis for developing more specific and detailed asset management plan(s).</i>	PAS 55-1:2008

asset portfolio	Assets that are within the scope of the asset management system. Notes: (1) A portfolio is typically established and assigned for managerial control purposes.	ISO 55000:2024
asset system	Set of assets that interact or are interrelated.	ISO 55000:2024
asset type	grouping of assets having common characteristics that distinguish those assets as a group or class	ISO 55000:2024
capability	measure of capacity and the ability of an entity (system or organization) to achieve its objectives Notes: (1) Asset management capabilities include processes, resources, competences and technologies to enable the effective and efficient development and delivery of asset management plans and asset life activities, and their continual improvement.	ISO 55000:2024
competence	ability to apply knowledge and skills to achieve intended results	ISO 55000:2024
critical asset	asset having potential to significantly impact on the achievement of the organization's objectives Notes: (1) Assets can be safety-critical, environment-critical or performance-critical and can relate to legal, regulatory or statutory requirements. (2) Critical assets can refer to those assets necessary to provide services to critical customers. (3) Asset systems can be distinguished as being critical in a similar manner to individual assets.	ISO 55000:2024
effectiveness	extent to which planned activities are realized and planned results are achieved	ISO 55000:2024
guiding mind	An expression used to describe the consistent and considered decision-making and objective setting to achieve best value from assets (explicitly not the same as the owner). See Sections 6.7 and 3.1	
incident	unplanned event or occurrence	ISO 55000:2024
level of service	parameters, or combination of parameters, which reflect social, political, environmental and economic outcomes that the organization delivers Note: (1) The parameters may include safety, customer satisfaction, quality, quantity, capacity, reliability, responsiveness, environmental acceptability, cost and availability.	ISO 55000:2024
line of sight	expression used to describe the desirable alignment through an organization, for example that all activities contribute demonstrably to the chosen objectives – see Section 3.4.3	
management system	set of interrelated or interacting elements of an organization to establish policies and objectives as well as processes to achieve those objectives Notes: (1) A management system can address a single discipline or several disciplines. (2) The management system elements include, among others, the organization's structure, roles and responsibilities, planning and operation. (3) This constitutes one of the common terms and core definitions for ISO management system standards given in Annex SL of the Consolidated ISO Supplement to the ISO/IEC Directives, Part 1. It has been modified by the addition of "among others" in Note 2 to entry.	ISO 55000:2024

monitoring	<p>determining the status of a system, a process or an activity</p> <p>Notes:</p> <p>(1) <i>To determine the status, there can be a need to check, supervise or critically observe.</i></p> <p>(2) <i>For the purposes of asset management, monitoring can also refer to determining the status of an asset. This is typically referred to as “condition monitoring” or “performance monitoring”.</i></p> <p>(3) <i>This constitutes one of the common terms and core definitions for ISO management system standards given in Annex SL of the Consolidated ISO Supplement to the ISO/IEC Directives, Part 1. It has been modified by the addition of Note 2 to entry.</i></p>	ISO 55000:2024
objective	<p>Result to be achieved.</p> <p>Notes:</p> <p>(1) <i>An objective can be strategic, tactical or operational.</i></p> <p>(2) <i>Objectives can relate to different disciplines (such as financial, health and safety, and environment). They can be, for example, organization-wide or specific to a project, product or process).</i></p> <p>(3) <i>An objective can be expressed in other ways, eg as an intended result, as a purpose, as an operational criterion, as an asset management objective or by the use of other words with similar meaning (e.g. aim, goal, or target).</i></p> <p>(4) <i>In the context of an asset management system, asset management objectives are set by the organization, consistent with the asset management policy, to achieve specific results.</i></p>	ISO 55000:2024
organizational plan	<p>documented information that specifies the plans to achieve the organizational objectives</p>	ISO 55000:2024
organizational objective	<p>overarching objective that sets the context and direction for an organization's activities</p> <p>Note:</p> <p>(1) <i>Organizational objectives are established through the strategic level planning activities of the organization.</i></p>	ISO 55000:2024
performance	<p>measurable result</p> <p>Notes:</p> <p>(1) <i>Performance can relate either to quantitative or qualitative findings.</i></p> <p>(2) <i>Performance can relate to managing activities, processes, products, services, systems or organizations.</i></p> <p>(3) <i>For the purposes of asset management, performance can relate to assets in their ability to fulfil requirements or objectives.</i></p> <p>(4) <i>This constitutes one of the common terms and core definitions for ISO management system standards given in Annex SL of the Consolidated ISO Supplement to the ISO/IEC Directives, Part 1. It has been modified by the addition of Note 3 to entry.</i></p>	ISO 55000:2024
policy	<p>intentions and direction of an organization as formally expressed by its top management</p>	ISO 55000:2024
risk	<p>Effect of uncertainty on objectives.</p> <p>Notes:</p> <p>(1) <i>An effect is a deviation from the expected – positive or negative.</i></p> <p>(2) <i>Uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of, an event, its consequence, or likelihood.</i></p> <p>(3) <i>Risk is often characterized by reference to potential events (as defined in ISO Guide 73) and consequences (as defined in ISO Guide 73), or a combination of these.</i></p> <p>(4) <i>Risk is often expressed in terms of a combination of the consequences of an event (including changes in circumstances) and the associated likelihood (ISO Guide 73) of occurrence.</i></p> <p>(5) <i>This constitutes one of the common terms and core definitions for ISO management system standards given in Annex SL of the Consolidated ISO Supplement to the ISO/IEC Directives, Part 1. The definition has been modified to add “on objectives” to be consistent with ISO 31000.</i></p>	ISO 55000:2024

single source of truth	Expression describing the aim for information and data, which has a tendency to be siloed and conflicting or wrong or out-of-date – this harms decision-making and optimizing value from assets	
stakeholder	interested party person or organization that can affect, be affected by, or perceive itself to be affected by a decision or activity	ISO 55000:2024
strategic asset management plan (SAMP) <i>(also refer to definition for asset management strategy)</i>	documented information that contains and aligns asset management policy, objectives, strategies and approaches for developing and managing the asset portfolio and the asset management system Notes: <i>(1) A SAMP is derived from, may be contained in, or may be a subsidiary plan of the organizational plan.</i>	ISO 55000:2024
sustainability	state of the global system, including environmental, social and economic aspects, in which the needs of the present are met without compromising the ability of future generations to meet their own needs Notes: <i>(1) The environmental, social and economic aspects interact, are interdependent and are often referred to as the three dimensions of sustainability.</i> <i>(2) Sustainability is the objective of sustainable development.</i> <i>(3) In asset management sustainability of assets or asset systems refer to their ability to meet present objectives without compromising their ability to meet future objectives.</i>	ISO 55000:2024
sustainable	Achieving or retaining an optimum compromise between performance, costs and risks over the Life Cycle, whilst avoiding adverse long-term impacts to the organization from short-term decisions.	PAS 55-1:2008
value chain	<i>"a set of activities that an organization carries out to create value for its customers"</i>	Porter, Michael E., <i>"Competitive Advantage: Creating and Sustaining Superior Performance"</i> . 1985

Appendix A

Mapping of Asset Management Subjects Arranged in the 10 IAM Capabilities Against ISO 55001:2024

Asset Management Subjects	Do Subjects Map?	ISO 55001:2024
Subjects Listed in order of the 10-box Model		
Purpose & Context		
Organizational Purpose and Context		Section 4
Stakeholder Management		Section 4
Leadership & Governance		
Asset Management Leadership		Section 5
Asset Management Policy		Section 5
Asset Management System		Section 4
Asset Management Assurance and Audit	N	
Technical Standards and Legislation	N	
Organization & People		
Organizational Arrangements		Section 5
Organizational Culture	N	
Competence Management		Section 7
Organizational Change Management		Section 6
Strategy & Planning		
Demand Analysis	N	
Sustainable Development	N	
Asset Management Strategy and Objectives		Section 6
Asset Management Planning		Section 6
Shutdown & Outage Strategy & Planning	N	
Contingency Planning & Resilience Analysis	N	
Resource Strategy and Management		Section 7
Supply Chain Management	N	
Life Cycle Value Realization	N	
Asset Costing and Valuation	N	
Asset Management Decision-making		
Decision-making		Section 4

Life Cycle Delivery		
Asset Creation and Acquisition	N	
Systems Engineering	N	
Integrated Reliability	N	
Asset Operations		Section 8
Maintenance Delivery	N	
Incident Management & Response	N	
Asset Repurposing & Disposal	N	
Information Management		
Asset Management Data and Information Strategy	N	
Knowledge Management		Section 7
Asset Data and Information Standards	N	
Asset Management Data and Information Management		Section 7
Asset Management Data and Information Systems	N	
Configuration Management	N	
Risk Management		
Risk		Section 6
Review & Continual Improvement		
Monitoring		Section 9
Continuous Improvement		Section 10
Management of Change		Section 8
Value & Outcomes		
Outcomes & Impacts	N	

The Institute of Asset Management

The IAM is both a Professional Association and a Learned Society: we are dedicated to extending and developing the discipline and knowledge base as well as encouraging, enabling and recognizing personal knowledge, capability and high standards of practice.

The Purpose of the Institute is:

“We promote and develop the asset management discipline and profession to positively impact the world’s biggest challenges, now and into the future”.

The following key priorities are defined as ‘enduring’ and they will not be varied except during formal strategic reviews, whereas the Objectives, Goals, Budget and Work Plans for each year are developed annually:

- 1) Collect / Collate / Disseminate existing knowledge and good practice
- 2) Generate and extend knowledge and good practices
- 3) Influence public policy and stakeholder expectations
- 4) Promote capability and excellence in asset owning organizations or their suppliers and structured schemes for recognizing these achievements
- 5) Promote knowledge and competence of individuals and structured schemes for recognizing these achievements
- 6) Deliver Member publications, engagement and networking opportunities and other valuable Member Services
- 7) Raise profile and respect for IAM and the profession
- 8) Collaborate with and support other bodies having similar objectives
- 9) Develop and maintain an appropriate and sustainable organization

In pursuing these aims we will be led by our key behaviours: include and collaborate, seek convergence of the discipline, celebrate good practice wherever it is found, inspire the adoption of asset management. www.theIAM.org/Strategy

One of the IAM’s key activities is to promote engagement and interaction of its members so

that they learn from events, publications, training and discussion as well as formal professional development. Members can direct their own learning as suits their needs and to that end, the IAM is creating appropriate resources to support them.

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