ASSET MANAGEMENT IN HIGH PERFORMANCE ORGANIZATIONS

A Roadmap to High Performance: ISO 55000 and a Management Systems Approach to Asset Management

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Asset Management is About More than Managing Assets

What does it mean to be a high performance organization when it comes to asset management? And what is an asset, anyway? The definition of the term "asset" can be very broad. Indeed, an asset can be considered any resource needed by and available to an organization to accomplish its work. However, physical assets such as real estate, infrastructure, building systems, fleets, specialized equipment and other personal property are what drive most asset management programs.

As for what it means to be a high performance organization, here are six characteristics that all such organizations have in common:

1. Well organized to accomplish their business[1]; i.e., roles are clearly understood, responsibilities are aligned with accountability, appropriate communications and coordination takes place across all management "silos" and between all levels of the organization.
2. Aware of risks and opportunities in their business environment and in everything they do.
3. Performance oriented, i.e., they understand how to measure success in the business they're in and have good systems to do so, business goals are clearly communicated from top management to operational activities, and performance against those goals is clearly communicated from operational levels to top management.
4. Well informed; i.e., have good information about the environment they operate in and on all the important aspects of their business activities.
5. Adequately resourced; businesses that are less than ideally financed and staffed must be good at optimizing their uses of limited resources.
6. Exceptionally good at the business they're in.

[1] Note: we use the term "business" to include the activities involved in accomplishing the organization's mission, whether or not they are for-profit business activities.

There is no shortage of information, opinion or guidance on how to build a high performance organization, yet high performance organizations remain the exception rather than the rule, and even rarer is the organization that routinely succeeds in all areas. Why is this true? Although the characteristics of high performance organizations are based on common sense principles, it's difficult for organizations to consistently live those principles on a day-to-day basis. Furthermore, high performance organizations tend to grow with their successes, and growth brings changes to activities and relationships that may not always be consistent with those principles. Sustaining a high performance organization requires consistent leadership and attention to how these characteristics are exhibited in every facet of the organization, including asset management.

Fortunately, there's a roadmap for becoming a high performance organization and remaining one: the international management systems standard called **ISO 55000: Asset Management**. It's based on a systems engineering approach to management standards begun by the International Organization for Standardization (ISO) in the late 1980s. ISO defined a management system as "the way in which an organization manages the inter-related parts of its business in order to achieve its objectives."[2] Organizations with effective asset management systems are, by definition, high performance organizations.

The ISO 9000 quality management systems standard was first published in 1987 and has been revised and updated every few years since. ISO 9000 introduced the world to the "management systems standard" and today more than two dozen ISO management systems standards[3] have become widely adopted around the world.

Many ISO management systems standards use a uniform structure to define common terminology and identify requirements for what organizations need to do to achieve their

[2] What is a Management System? (www.iso.org/management-system-standards.html)
[3] ISO Management Systems Standards List; (www.iso.org/management-system-standards-list.html)

goals. ISO 55000 Asset Management addresses what organizations need to do to achieve all their goals; more specifically, what they need to do to make sure they use their resources properly to achieve those goals. This standard supersedes and expands upon the now retired PAS 55 Asset Management standard considered by some one of the most popular standards of all time[4]. PAS 55 focused narrowly on physical assets, but ISO 55000 reflects the full range of asset types – both tangible and intangible – making it the perfect roadmap for high performance organizations in any line of business.

The body of this paper discusses the evolution of ISO 55000 and explores some useful ways to understand and apply the basic concepts in the standard. It discusses who's using the standard currently and the benefits they've realized. If you want to "cut to the chase," before taking the time to read the entire paper, jump ahead to the section on "Conclusions and Next Steps" starting on page 42.

The authors of this paper hope these ideas will spur you to begin to develop your own roadmap for implementing asset management based on these global best practices. If you get asset management right, you get it all right.

Most of all, just get started. ISO 55000 Asset Management provides a strategic roadmap for becoming a high performance organization, and guides leaders in assessing the maturity of their asset management systems and sustaining their high performance organizations. Whether you start big, or start small, ISO 55000 will guide your way.

Jack Kelly and Michael Hardy

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[4] ISO 55001 Asset Management supersedes PAS 55 (www.bsigroup.com/en-GB/Asset-Management)

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Why This Paper

The International Organization for Standardization (ISO) defines an asset as "something that has potential or actual value to an organization." This sweeping definition of an asset is the basis for the asset management standard known as ISO 55000 first published in 2014. This is much broader than the traditional definition, which defined assets solely in physical terms, such as, "property, plant, and equipment." However, ISO acknowledges that, while this International Standard is intended to be used for managing physical assets, it can also be applied to other asset types[5].

For more information about the history of asset management practices, see "Appendix A: The Origins of Asset Management"

Most people, who manage physical assets or who manage organizations that rely on physical assets, have experienced significant disruptions caused by the failure to effectively manage or maintain those assets. These asset-related problems may be financial in nature, such as a growing backlog of deferred maintenance, or they may be problems affecting reliability or service level. Major disasters, such as a train derailment, bridge collapse or pipeline rupture tend to capture the headlines, but even minor asset failures can have a big impact on an organization's ability to serve its stakeholders and meet its objectives. Given all the issues competing for management attention, it shouldn't surprise anyone that senior executives typically don't pay much attention to their organization's assets until something goes very wrong.

[5] [ISO 55000 sec. 1, Note 1]

The initial reaction when these disasters or inconveniences occur is to wonder whether there might have been some way to prevent the failure from happening. Commissions are formed and investigations are done to explore ways to address the underlying issues that cause these problems and prevent future occurrences. Thankfully, there is a solution already in practice that can prevent most asset-related failures: It's called asset management. This paper is an introduction to the internationally recognized standard for best practices in asset management.

Who Should Read this Paper

This paper is primarily intended for people who work in private and public-sector organizations that rely on physical assets to accomplish their missions. ISO 55000 stipulates that top management must provide leadership if asset management is to be successful[6], so it follows that the ideal target audience for this paper is a C-level executive, government agency director or other senior decision maker with overall responsibility for organizational performance. In practice, however, asset management execution will rest with department managers and business unit directors who control or oversee some part of the organization's assets. Additionally, budget directors, capital planners, risk managers, controllers and other performance managers will benefit from understanding the management systems approach described here.

We also believe that this paper has value for people whose organizations manage assets such as financial instruments, human resources, brand reputation and intellectual property. The principles of ISO 55000 and management systems approach to asset management apply equally well to these non-physical asset types.

Others who will benefit from this paper include regulators of utilities, bond holders and other lenders, business investors, and government grant-making agencies that play the role of investors.

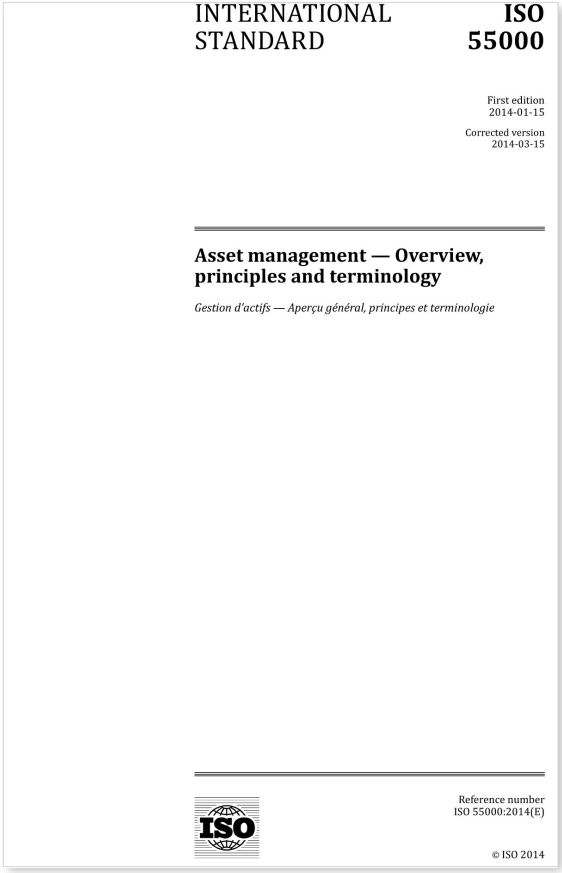
[6] [ISO 55000 sec.2.5.3.3]

The Evolution of ISO 55000: A Management Systems Standard

The early 1980s in the UK saw serious challenges in the British gas and oil extraction industry due to an oversupply of those fuels on the world market. The first of these challenges was how to reduce production costs for British companies during a downturn in oil and natural gas prices. The engineers working with the gas and oil extraction companies introduced new asset management concepts that dramatically reduced production costs, while simultaneously extending the useful life of the associated equipment. The late 1980s saw one of the worst oil rig accidents in history. This prompted the engineers to revisit the risk management processes in place at that time and try to identify why they had failed. The process of privatizing British Rail from 1994 to 1997 and resulting performance problems prompted the transport engineering community to develop the Public Performance Measure (PPM), a measure of the punctuality and reliability of passenger trains in Britain. This measure gave the Office of Rail Regulation a tool with which to hold the private sector rail operators accountable for the performance of a formerly public service.

In the early 1990s, a small team of engineers from oil and gas extraction companies got together informally to develop new asset management guidelines to integrate risk considerations more thoroughly into the management cultures of their companies. This informal group expanded later to include the engineers from transport who had developed the PPM and wanted to generalize this approach to hold providers of other outsourced asset management functions accountable for their performance.

During this general timeframe, the International Organization for Standardization (ISO) had begun to develop a new approach to management standards. This approach incorporated systems engineering concepts that had been pioneered in the US, and defined a management system as a collection of elements representing different aspects of an organization's structure, policies, and practices. Some of these elements supported common management activities, e.g., the management of safety programs, quality programs, maintenance programs, environmental programs, etc. Other elements supported other activities of the organization, e.g., finance, legal, risk management, strategic planning, IT, etc. Most of these specialized management activities had their own sets of guidelines and standards[7]. Under the systems engineering approach, all the elements of an organization's management system needed to be recognized and coordinated with one another for the overall system to function effectively. It was clear that sustained top management support would be required to achieve this coordination. The management systems approach required the top management of organizations to do just that.


INTERNATIONAL STANDARD

ISO 55000

First edition
2014-01-15

Corrected version
2014-03-15

Asset management — Overview, principles and terminology

Gestion d'actifs — Aperçu général, principes et terminologie

Reference number
ISO 55000:2014(E)

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ISO used an early version of this approach in 1987 when it published ISO 9000, the management systems standard for quality management. It refined the approach in the update to this standard in 1994 and in the 1996 publication of ISO 14000, the environmental management systems standard. Further improvements in the management systems approach to standards were made in the 2000 update to ISO 9000.

[7] See Appendix A: The Origins of Asset Management

The following year, ISO published a separate guide for the development of future management systems standards. It was called ISO Guide 72:2001 *Guidelines for the justification and development of management systems standards*. One of the main purposes of these new guidelines was to standardize, as much as possible, the structure and language of all management systems standards. It was believed that this standardization would make it easier for organizations to integrate the different management systems standards being developed by ISO into their core business practices.

In 2004 the organizations that employed the engineers who had been meeting informally for several years formed the Institute for Asset Management (IAM). These engineers were certainly familiar with the approach to management systems standards that the International Organization for Standardization (ISO) had begun to adopt with ISO 9000 and ISO 14000. They decided to use the general characteristics of that approach to develop a new asset management guideline. Later that year, the newly formed IAM was successful in getting the British Standards Institution (BSI) to publish its proposed document as Publicly Available Specification 55:2004, "Optimal Management of Physical Infrastructure Assets." It's more commonly known simply as PAS 55.

PAS 55 was written for any organization where physical infrastructure assets were important to achieving its goals. It was published as two documents:

PAS 55-1: Specifications for the optimized management of physical infrastructure assets

PAS 55-2: Guidelines for the application of PAS 55-1

PAS 55-1 provided a general description of asset management, the characteristics of an asset management system, and a standard set of terms and definitions for use in discussing asset management. It also provided specific, but comprehensive, requirements for an asset management system. The specificity of these requirements made it easy to assess an organization's compliance with them and to determine the maturity level of its asset management system. Failure to meet a requirement was considered a "deficiency."

In 2005, the British Office of Gas & Electricity Marketing (Ofgem), the regulatory authority for the network of gas and electric utility companies in the UK, announced a significant change in its approach to assuring compliance with its regulations. It published its intention to allow its regulated companies to provide a certification of PAS 55 compliance in lieu of Ofgem conducting its own Asset Risk Management (ARM) survey. It stated its plan to publish the certification status of each network company in April 2007 to provide those companies sufficient time for implementation of the new requirements. In 2007, as promised, Ofgem published the PAS 55 certification status of its network companies along with the planned certification dates for those companies not yet certified. The published list clearly showed that many UK utilities had begun to use PAS 55 certification to demonstrate their asset management competence.

In 2008, the IAM led a significant revision to PAS 55 to comply with the BSI policy for updating its specifications. Although the 2004 version of PAS 55 had been purchased mainly by companies in the UK, there had been a growing international awareness of this document in other European countries, as well as in the Commonwealth countries (Canada, Australia, and New Zealand) and China. During the revision of PAS 55, over 1300 comments and suggestions were received from 49 organizations in 10 countries as well as many multinational organizations, representing 15 industry sectors. Electricity and gas distribution was the largest industry sector that contributed comments followed closely by the engineering/consultancy sector.

The transport, regulatory/public, power generation, and water sectors were also major commenters. The new document was issued by the BSI as PAS 55:2008, "Optimal Management of Physical Assets."

For convenience, all subsequent references to PAS 55 in this paper will be to the 2008 version. Because of the broad nature of the input to this revision from different industry sectors around the world, many considered it to be a de facto international standard, even though it had not yet been reviewed with the rigor or breadth of input of an ISO standard.

As was the case in 2004, the 2008 version was also published as two documents:

PAS 55-1: Specifications for the optimized management of physical assets

PAS 55-2: Guidelines for the application of PAS 55-1

Section 3 of PAS 55-1 provided terms and definitions that created a common language for the asset management system framework. For example, it defined the term "asset management system" as consisting of the following sub-elements: the "organization's asset management policy, asset management strategy, asset management objectives, asset management plan(s), and the activities, processes and organizational structures necessary for their development, implementation and continual improvement." It then defined each of these sub-elements as well as other terms necessary to understand the relationships between the elements and to define some elements in greater detail.

Section 4 of PAS 55-1 provided 28 objective high-level requirements (and multiple sub-requirements) for what organizations needed to do to establish and maintain a disciplined approach to asset management. The requirements were organized according to the main elements of an asset management system, the first of which dealt directly with assets, e.g., asset management policy, asset management strategy,

asset management objectives, and asset management plans. These were followed by elements that supported asset management, e.g., organizational structure and commitment, management of outsourced activities, training, communications, documentation, and information management. There was a major section that presented the requirements for identifying and managing risks, including risks introduced by changes to asset management policies. The last three groups of requirements dealt with implementing asset management plans, assessing the performance of the asset management system and making the necessary improvements, and requiring top management to review the organization's asset management system periodically to ensure its continuing adequacy.

PAS 55 represented a radical departure from earlier asset management guidelines in several important ways:

1. It was directed at entire organizations, not at the various specialized functions that supported asset management within organizations. These specialized functions and specific industries and sectors were the audiences for most previous "asset management" guidelines and manuals.
2. It wasn't directed at any specific industry or sector, public or private sector entity, asset type, or geographic area. PAS 55 was applicable to all sizes of organizations, from large multi-national companies to small businesses; national infrastructures; all sizes and levels of public sector organizations from entire governments at the national, state, and local levels to agencies of all sizes within those governments.
3. It was based on a management systems approach to asset management. In other words, it considered the characteristics of an organization's structure, policies, and practices as elements in a management system that needed to work together in a coordinated manner to accomplish the organization's goals.
4. Although PAS 55 focused mainly on the management of physical assets and asset systems, it recognized the relationship between physical assets and other asset categories, e.g., human assets, information assets, financial assets, and intangible assets.

5. The requirements in PAS 55-1 were comprehensive and addressed the organizational, policy and procedural elements of an organization's asset management system that were deemed important by experts to achieve the organization's goals. The requirements specified what organizations must do to integrate or coordinate those elements with one another for the organization to be successful but didn't specify how the organization should fulfill each requirement. It should be noted that all successful organizations will have satisfied many, if not most, of these requirements at some points in time. However, most organizations find it challenging to address all these requirements all the time.
6. The specificity of the requirements made it relatively easy to determine whether an organization was complying with them, although judgment was still required to determine the degree of compliance.
7. The compliance process could easily identify areas where an organization was weak in complying with the requirements so it could take corrective actions.
8. PAS 55 didn't expect organizations to achieve "perfect" results when they first began to establish their asset management systems. One of the foundational principles in PAS 55 was continuous improvement. An organization's asset management system must include metrics for how well the organization is achieving its organizational goals as well as metrics on how well the assets are performing in support of those goals. If the organization isn't achieving the results it desires, it can take corrective actions to do so, including improving the metrics, if needed.
9. The management systems framework for asset management established by PAS 55 helped organizations implement a structured, disciplined and sustainable approach to asset management that suited their own situations, e.g., business types, resources, risk profiles, regulatory environment, etc.

After the revision of PAS 55 in 2008, the IAM worked closely with the British Standards Institution (BSI) to explore the best way to produce a formal International Standard, through the International Organization for Standardization (ISO). The aim was to increase the degree of international and cross-sector participation in the development of asset management good practice and its application in many more parts of the world. In late July 2009, BSI submitted a proposal to form a "Project Committee" to develop an International Standard, seeking input from experts, industries and other learned societies from around the world.

ISO Project Committee 251 (ISO/PC251) was established by the ISO Technical Management Board in August 2010 and held its first plenary meeting in Melbourne, Australia from 28th February to 4th March 2011. The last meeting of the Project Committee took place in Calgary, Canada from 29th April to 3rd May 2013. By this point in time, teams from 31 countries had participated in the development of the new standard.

In 2006, during the period when PAS 55 was being revised, the BSI and ISO were evolving their ideas about the common structure and language of management systems standards first addressed in ISO Guide 72:2001. Early that year, the BSI published PAS 99:2006 "Specification of common management system requirements as a framework for integration." Before the year was out, a draft ISO Guide 83 “High level structure and identical text for management systems standards and common core management system terms and definitions” was circulated for review by one of the ISO technical committees. The final ISO Guide 83 was published in 2011 and was almost immediately superseded by Annex SL, published by ISO in 2012 as part of the Consolidated ISO Supplement.

In 2014, the International Organization for Standardization (ISO) published a new international standard for a “management system for asset management,” i.e., an asset management system: ISO 55000. This was the first management systems standard based on Annex SL. Within the next year, ISO 9000 and ISO 14000 had been revised to comply with Annex SL. PAS 55 was withdrawn by the BSI and is no longer in effect.

The Rise of a New International Standard: ISO 55000

ISO 55000 is a series of three documents that define and describe the management systems approach for asset management.

- ISO 55000: Asset management – Overview, principles and terminology
- ISO 55001: Asset management – Management systems – Requirements
- ISO 55002: Asset management – Management systems – Guidelines for the application of ISO 55000

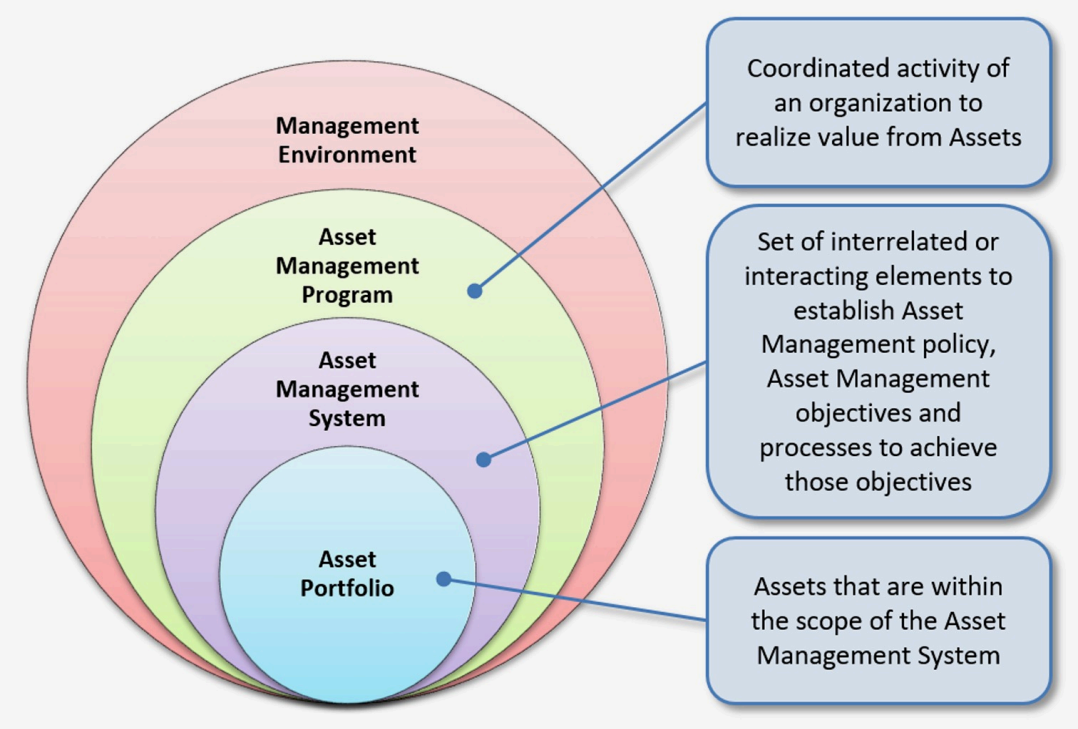
Taken together, this suite of documents is usually referred to as ISO 55000 and that's the way we'll refer to them together going forward.

The initial draft of the new international asset management standard that the BSI proposed to the ISO in 2009 was identical to PAS 55 as far as the terms and definitions and requirements were concerned. It had most likely been prepared by the IAM from PAS 55. By the time the final version of ISO 55000 was published in 2014, however, it looked very different. This was the result of several factors:

- Bringing in comments and new ideas from many groups from around the world through the rigorous ISO comment process including comments and approaches from a large number of industries.
- Aligning the final version to comply with the standard ISO format for management systems standards set out in Annex SL.
- The 2009 publication of the ISO 31000 Risk Management standards meant that the final version of ISO 55000 didn't need to incorporate detailed Risk Management requirements that had been included in PAS 55-1.

Compare and Contrast: PAS 55-1 and ISO 55000.

1. Both documents continue the management systems approach to asset management and are aimed at organizations of any size and type, not to specialized types of assets or asset management support functions.
2. The introductory sections of PAS 55-1 and ISO 55000 both provide an excellent overview of asset management, its benefits, and the importance of integrating the asset management system with other management systems. However, ISO 55000 goes into greater detail about the nature of the different systems elements and their relationships with one another.



KEY RELATIONSHIPS IN ASSET MANAGEMENT TERMINOLOGY

3. The global community of asset management professionals who developed ISO 55000 have, as they say, been there and done that. The standard provides a common understanding of how to define an asset, what asset management is, why asset management is essential in high performance organizations, and how asset management fits into the larger management environment of the organization.

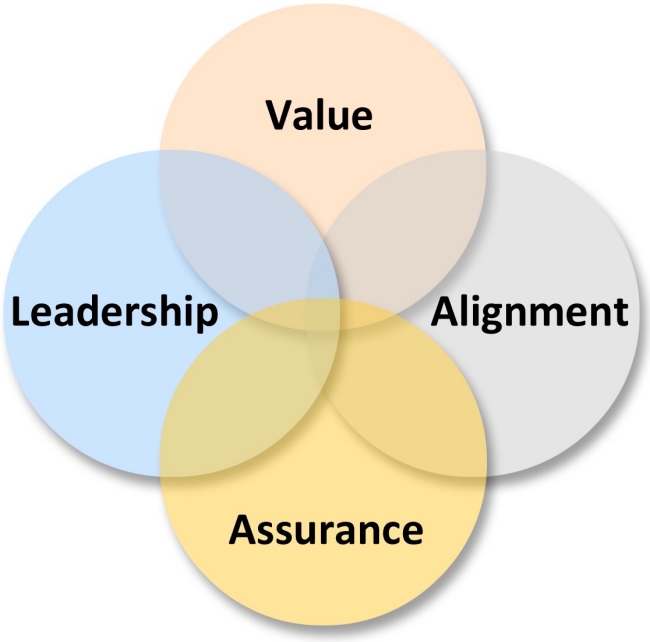
ISO 55000 emphasizes a number of very strategic principles upon which asset management, as a core operation, is built, namely:

a. **Value** - Assets exist to provide value to stakeholders - Asset management does not focus on the asset itself, but on the value that the asset can provide to stakeholders and customers.

b. **Alignment** - Asset management translates operational requirements into technical and financial decisions, plans and activities for assets.

c. **Assurance** - Asset management provides assurance that the organization's assets will provide the value for which they were acquired.

d. **Leadership** - Leadership and workplace culture are determinative in the realization of asset value.



STRATEGIC PRINCIPLES OF ISO 55000

These principles need to be implemented in a management system that puts the principles into practice. ISO 55000 helps by identifying and relating a set of key requirements that, when implemented in an asset management system, improve operational outcomes and mission success.

4. Many of the terms and conditions in ISO 55000 are the same or very similar to the terms in PAS 55-1, but there are some important differences:

   a. The definition of assets was broadened from physical assets, specifically "plant, property, buildings, vehicles and other items that have a distinct value to the organization" in PAS 55-1 to "something that has potential or actual value to an organization" in ISO 55000. This is an important and fundamental change, but it will take time for this change to be understood and embraced outside of organizations that manage physical assets.

b. ISO 55000 simplified many of the definitions in PAS 55-1, but also added some important definitions, e.g., the definition of a "management system" and a "strategic asset management plan (SAMP)," two of the most important concepts in the standard.

5. Many of the requirements in ISO 55000 are very similar to the requirements in PAS 55-1, but there are also some important differences:

   a. Most of the requirements in ISO 55000 are much less prescriptive than the corresponding requirements in PAS 55-1 and leave the specifics for meeting the requirements up to the organization to determine. This is part of a trend across all ISO management systems standards, as show below:

9.1 Monitoring, measurement, analysis and evaluation

The organization shall determine:

What needs to be monitored and measured;

The methods for monitoring, measurement, analysis and evaluation, as applicable, to ensure valid results;

When the monitoring and measuring shall be performed;

When the results from monitoring and measurement shall be analyzed and evaluated.

   b. Because risk management requirements had already been published in a separate international standard (ISO 31000), ISO 55000 didn't contain detailed requirements for risk management. However, it did require that top management ensure that the organization's approach to managing risks for asset management is aligned with its overall approach to managing risks.

c. ISO 55000 also required organizations to consider the opportunities associated with various courses of action in addition to the risks. This was an important new perspective for asset management because it focused organizations on the positive effects of good asset management decisions.

d. ISO 55000 replaced a lengthy set of detailed requirements in PAS 55-1 for developing an asset management strategy with four simple requirements related to the establishment and maintenance of a strategic asset management plan (SAMP). The SAMP was defined in ISO 55000 as "documented information that specifies how organizational objectives are to be converted to asset management objectives, the approach to developing asset management plans, and the role of the asset management system in supporting achievement of asset management objectives." This is one of the most powerful concepts in the standard because it brings the essential aspects of the asset management system together in one place.

e. ISO 55000 brought several specific requirements together for top management to demonstrate leadership and support for the asset management systems and included a separate requirement for the organization to provide the resources to establish, implement, maintain, and continually improve the asset management system. This explicit requirement for top management to provide adequate resources wasn't included in PAS 55-1.

f. ISO 55000 simplified and expanded the requirements for developing asset management plans.

g. ISO 55000 also strengthened the requirements related to outsourcing, competence, documentation, and information management.

6. As highly regarded as it was by many organizations around the world, PAS 55 could never have achieved the same level of international acceptance as an ISO standard.

In order to comply with the standard ISO format for management systems standards set out in Annex SL, the requirements in ISO 55000 are organized under following major headings:

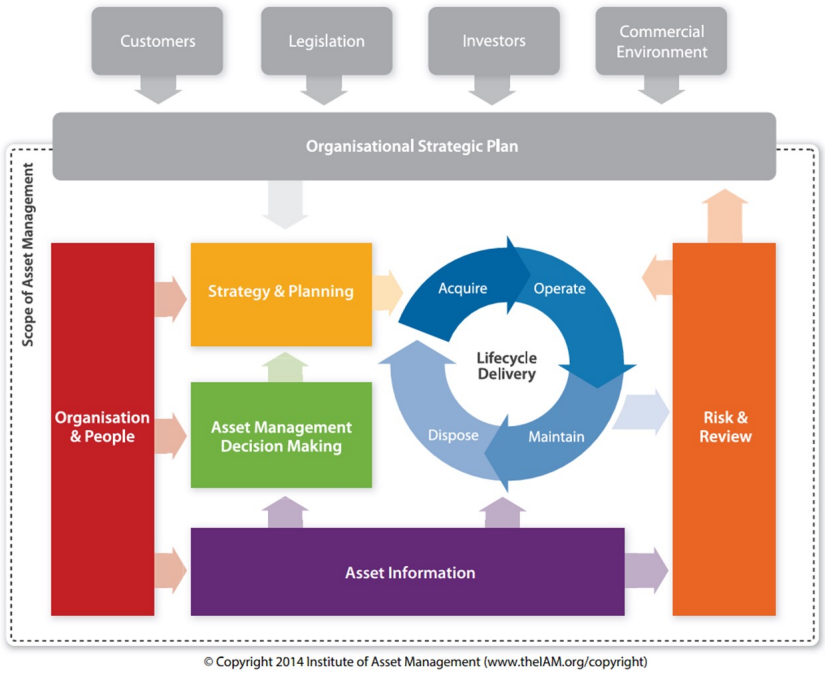
- Context of the organization
- Leadership
- Planning
- Support
- Operation
- Performance evaluation
- Improvement

The actual language under these headings has also been standardized across the different ISO management systems standards as much as possible. The intent of this standardization of structure and language is to encourage organizations to adopt multiple management systems standards by reducing the implementation burdens on organizations that do so. It is also believed that a standardized approach will make it easier for organizations to integrate the different management systems standards into their own business practices.

Another View: The IAM Conceptual Model

The Institute for Asset Management (IAM) developed a conceptual model for considering asset management that provides an additional way to understand the scope of asset management and the elements required for successful execution of an asset management system.

The IAM Conceptual Model shows the importance of asset information and risk in asset management and adds emphasis and clarity to guidance provided in ISO 55000 section 7.5 (Information Requirements), and Section 6 (Planning). Financial information, technical data and other detail about assets must be consistent and traceable to meet relevant legal, regulatory and stakeholder requirements in the context of organizational objectives[8]. Risks associated with assets must be accounted for in the asset management plan, adaptable to how risks may change over time, and be included in the organization's strategic risk management approach and contingency planning[9]. The reader may find it useful to review ISO 31000 which provides extensive guidance on all aspects of risk management.



The graphic elements representing Organization & People, Risk & Review, and Asset Information create visually a container within which the other elements function. We find it particularly useful to think about these three elements as part of the "management environment" that any high performance organization needs to have regardless of what it does or where it wants to focus its attention.

[8] [ISO 55001 sec 7.5.e pg 6]
[9] [ISO 55001 sec 6.2.2.k pg 5 – and elsewhere]

- The organization needs to retain qualified people, be organized effectively, and have the right policies and practices to achieve its objectives.
- Before doing anything else, the organization needs to understand its risks and opportunities, and engage in ongoing monitoring and review to manage them.
- To make good decisions, the organization must have sufficient, accurate and timely information about itself, its environment and its stakeholders, and there must be sufficient, reliable resources available to get its job done, i.e., its assets.

The graphic elements representing Strategy & Planning, Asset Management Decision Making and Lifecycle Delivery form the operations group for an asset management system. This group focuses on acquiring, operating, maintaining, and retiring the assets needed to accomplish the organization's mission.

- The organization needs to have a way of translating its mission goals into the resources, i.e., assets, needed to achieve those goals. In the language of ISO 55000, this is called a Strategic Asset Management Plan (SAMP).
- Once the strategic alignment of mission goals and assets has been established in the SAMP, the organization must make a variety of decisions such as what to acquire and what to retire, what to maintain and how often, how much and what kinds of workforce training are needed, how to finance capital needs, and how to prioritize the many competing demands.
- The organization must execute those decisions effectively at every stage of the asset lifecycle.

Grouping these six elements in this way helps us understand that the "management environment" of any management system will be remarkably like what is described here regardless of the type of "operations group" it is meant to support. This understanding may help organizations replicate their management systems approach across other activities relevant to the management of facilities, environment, quality, energy, occupational health and safety, information technology, logistics and more.

IAM Conceptual Model in Depth

Although the IAM didn't identify any of the elements as more important that the others, we believe there is a natural hierarchy that represents the order in which an organization might address them. Organizations that have already embraced a management systems approach to asset management and have a good sense of where they are on the maturity scale should first engage the elements for which their gaps with the standard are most pronounced. Organizations that have their risks under control might want to engage their areas of strength and pursue opportunities.

The following summaries of the ISO 55000 requirements within each of the six IAM systems elements are necessarily short and don't mention all the requirements that some might consider more important. The goal is to give readers a sense of how comprehensive the requirements in ISO 55000 are and how helpful they can be in addressing any asset management issues their organizations might have.

1. Organization & People

   If all the requirements in the standard were grouped according to the IAM systems elements, the largest number of them would fall under this element. One of the most common ideas that people have when they first think about this element is that it's all about getting top-level management support for asset management and enough qualified people to carry out the asset management policies. These requirements are certainly included in this element, but also many more. ISO 55000 also requires the organization to determine the scope of its asset management system; in other words, which assets will be included in its system. This is a very big deal. It means that an organization can focus its ISO 55000-based asset management discipline on only those assets it feels need the extra attention at the time, not on all its assets at once.

Pacific Gas & Electric (PG&E) has both a gas distribution business and an electricity distribution business. Because its serious safety problems had only appeared in its gas distribution business, it chose to certify only that business as ISO 55000 compliant. PG&E's electricity distribution business remains uncertified. ISO 55000 also requires an organization to identify all the stakeholders that are relevant for the assets included in its asset management system and to consider their requirements and expectations in the asset management planning process.

The standard requires top management to ensure that the asset management system is compatible with the organizational objectives. The standard also requires organizations to determine and provide the resources needed to establish, implement, maintain, and continually improve their asset management systems. There are also requirements for documentation, collaboration and continual improvement. In fact, the standard requires documentation of policies and activities throughout the asset management system.

2. Risk & Review

As stated in the section "The Evolution of ISO 55000", one of the IAM's imperatives in developing its initial asset management systems guidance was to assure that an organization's awareness and consideration of risk was imbedded in its culture and processes. Even though the subject of risk management is so vast that it warrants its own international standard (ISO 31000), organizations must address asset risk in the context of their asset management systems. That means asset risk exposure should be understood and measured in a manner deemed appropriate, whether the risk is known to exist currently or is related to emerging threats or general uncertainty. ISO 55000 also requires organizations to consider opportunities as well as risks when planning for all aspects of the asset management system.

Understanding asset risk provides organizations with the opportunity to make smarter investments that build resilience and adaptation into critical asset-centric functions including master planning; human, natural and cultural resource management; strategic mergers and acquisitions; design and construction standards; utility systems and public infrastructure; continuity of operations and emergency management, to name a few. Risk and uncertainty increase with poor planning, but good planning can help the organization realize new opportunities.

No organization has the resources to sustain every asset to a level of peak performance for all time. They must consider risk in determining investment priorities since not all assets are equally important to the mission, nor are all risks related to assets the same. To establish an actionable prioritization framework, organizations incorporate the risk factors for each asset, or asset class, into the asset information profile. The profile describes what information needs to be monitored and measured, and the methods for doing so, and includes metrics on the performance of assets and on the achievement of organizational mission goals that are impacted by asset performance.

Organizations are also required to conduct periodic management reviews and internal audits to determine whether the asset management system is performing as expected and delivering value. This process of continuous improvement is a hallmark of the management systems approach.

3. Asset Information

ISO 55000 requires an organization to "determine its information requirements to support its assets, asset management, asset management system, and the achievement of its organizational objectives." This includes information on organizational roles and responsibilities for asset management, processes for managing its information, characteristics of identified information, requirements for aligning financial and non-financial information, and many other very broad information requirements including documentation requirements. The standard gives organizations great flexibility in how they address the technical aspects of their information requirements and systems, but is comprehensive in what they need to consider.

Asset information forms the core technical component of any asset management system. Decisions, strategies, plans and delivery are only as good as the information upon which they rely. Establishing your "Data DNA" provides a foundation for asset information that considers the many factors that make your organization unique. We explore this further in the section "Asset Information & Data DNA" later in this paper.

4. Strategy & Planning

If asset managers ruled the world and had no limitations on resources, all assets would be maintained at peak functionality and replaced at the optimal times, but that clearly isn't possible in the real world. One of the major advances in the practice of asset management was the recognition that assets exist, not just to perform functions, but because they help an organization accomplish its objectives. This concept was first expressed in PAS 55 and continues in ISO 55000. Since most organizations' resources are limited, choices must be made on how those resources can be applied to assets in a way that optimizes the organization's mission performance. Effective capital asset investment strategies are aligned with an organizations goals and consider all relevant business drivers during the decision-making process.

ISO 55000 requires organizations to develop a Strategic Asset Management Plan (SAMP) as the first step in making the link between organizational goals and the assets needed to achieve them. The SAMP must identify the organization's asset management objectives, make sure that they're aligned with the organization's objectives (including mission objectives, corporate values, levels of service and other objectives as appropriate), and document how they will be addressed by the asset management system. ISO 55000 also requires the organization to integrate its asset management planning activities with other organizational planning activities, including planning for financial, human resource, and other support functions. Consideration of risk and opportunity is incorporated throughout these requirements.

5. Decision Making

ISO 55000 has only one requirement for this element – when planning how to achieve its asset management objectives, the organization shall determine and document the criteria for asset management decision-making. Decision Making is an area for which ISO did not see a need for additional, more prescriptive requirements in 55000. There are myriad technical standards that support operational decision making for most asset types; ISO 55000 takes an executive's view of asset management.

One hallmark of a high performance organization - and one of the most difficult to achieve - is the successful evolution of decision making from an exclusively tactical, operational processes to a comprehensive organizational view of asset management built on the core principles of ISO 55000.

6. Lifecycle Delivery

ISO 55000 requires organizations to plan, implement and control the processes needed to implement their asset management plans. There are also requirements to monitor and address risks associated with these processes and to take corrective actions when nonconformities or incidents occur.

Who's Using ISO 55000

There are two ways to determine who's using ISO 55000. The first is to identify organizations that have been officially certified as compliant with ISO 55000. The second is to identify organizations that have not received formal certification as compliant with the standard, but which have demonstrated that they are using the standard to guide their asset management practices.

The ISO Technical Committee 251 (ISO/TC251) is responsible for the development and maintenance of ISO 55000. TC251 maintains a website[10] which provides a list of certified ISO 55000 compliant organizations it has compiled from publicly available information. Because ISO doesn't maintain an official central registry of ISO 55000 certified organizations, TC251 doesn't claim that their list is encyclopedic. The authors of this paper performed independent research to source information about ISO 55000 certified organizations and were able to confirm many of the organizations on the TC251 list as well as identify a few that were not.

While there are scores of stories that could be told about organizations embracing ISO 55000 and certifying their adoption of the standard, the authors of this paper have chosen to share the following examples. These organizations represent a broad range of organization type, regional focus and industry sectors.

[10] The link can be found at https://committee.iso.org/sites/tc251/social-links/resources/known-certified-organizations.html

The Babcock International Group and Scottish Water

Babcock International is UK-based multinational corporation, which specializes in support services for managing complex assets and infrastructure in safety- and mission-critical environments. Scottish Water is a public corporation that provides water and sewerage services across Scotland. It is accountable to the public through the Scottish Government. An article written just after the publication of ISO 55000 in 2014 reported that they were the first two companies certified compliant with ISO 55000 by BSI.

Sodexo

An international food service and "quality of life" company headquartered in France. In 2016, the company received accreditation for compliance with ISO 55000 for its global asset management framework and for the application of the framework at two sites in the UK. In September 2017, the company was awarded ISO 55000 certification for its facilities management services at the International School of Beijing.

AbbVie

A global biopharmaceutical company with a significant presence in Ireland, reported in June 2017 that its plant in Ballytivnan had become one of the first Irish businesses to receive an ISO 55000 certification for its asset management capabilities.

Sydney Trains

The rail mass transit system serving the Sydney metropolitan area, reported in July 2017 that it was the first public sector organization in Australia to be certified as ISO 55000 compliant.

Origin Energy

Most public utilities in Australia and New Zealand are required to be certified as ISO 55000 compliant and the Treasury Departments in those countries require local government agencies to have Strategic Asset Management Plans that comply with ISO 55000 to justify their capital budget requests. Budget decisions are based on the maturity of the agencies' asset management programs. Requests from mature agencies receive relatively little additional scrutiny from their respective Treasury Departments, but immature agencies receive very close scrutiny and are less likely to have their requests fully funded.

Pacific Gas & Electric Corporation

The first US company to have one of its business units, PG&E gas distribution, certified compliant with ISO 55000.

University Health System

UHS in San Antonio, TX is the first healthcare system globally to be certified compliant with ISO 55000.

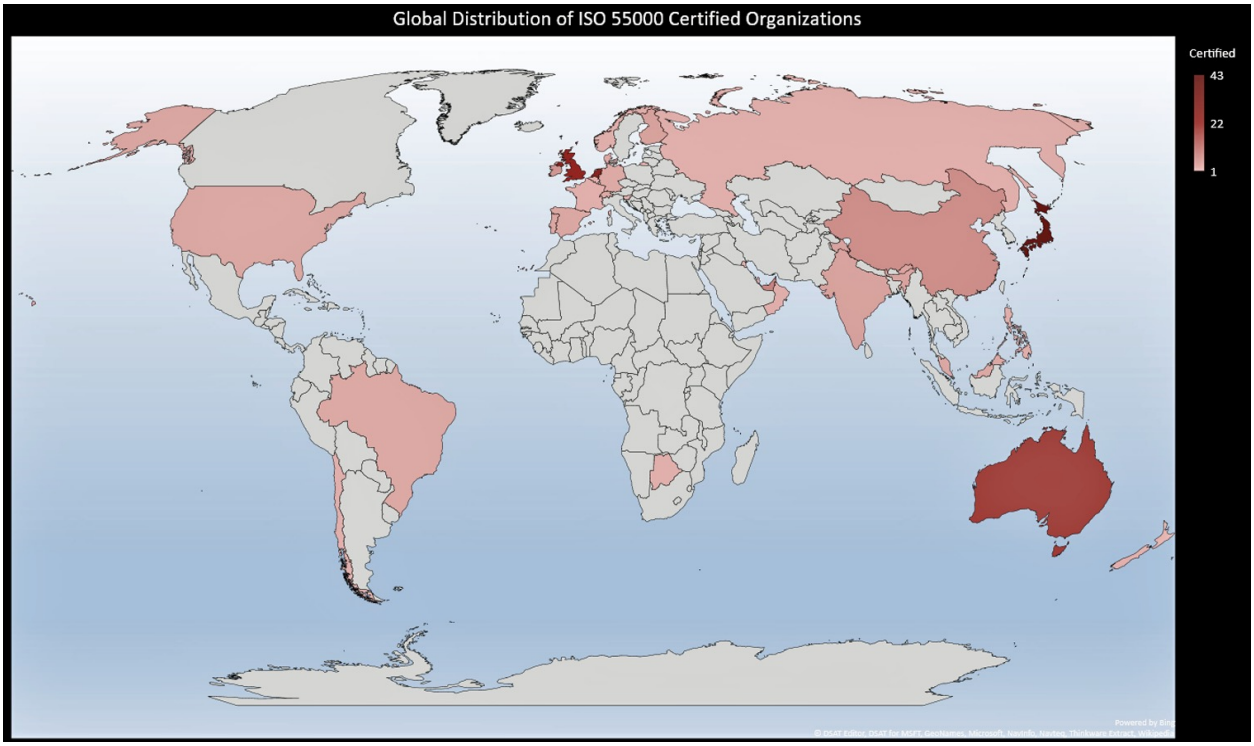
Philips Healthcare

This division based in Franklin, TN has been certified compliant with ISO 555000 for the management of its biomedical equipment assets.

Research into ISO 55000 adoption and/or certification also turned up a few other examples from across the world that aren't on the TC251 list, including a large oil refinery in Saudi Arabia, several South American power distribution companies, EDF Nuclear (UK), London Gatwick Airport (UK), and Western Power Distribution (Australia).

ISO 55000 Certification by the Numbers

The TC251 list is very revealing. As of April 2018, this list included 168 certified organizations from 31 countries operating in 16 sectors. Although Japan is the country with the highest number of certified organizations (43), the continent of Asia comes in second to Europe in this regard with 60 organizations in seven countries as compared to 72 organizations in 14 European countries. Within Europe, the Netherlands and UK have far and away the largest numbers of certified organizations, with 27 and 23, respectively. Australia has the fourth highest number of certified organizations (19).



The distribution of certified organizations across sectors and continents is also revealing. The Water & Wastewater sector leads with 41 certified organizations concentrated mostly in Asia and Europe. Coming in second with 36 organizations is the Electrical sector concentrated mostly in Europe.

The most striking thing about these statistics is the relatively poor showing by the Americas, for which the TC251 list has 5 certified organizations, only 2 of which are in the US. Although the authors of this paper have identified at least 1 additional certified organization in the US, we are clearly behind much of the world in adopting this standard.

Embracing the Principles of ISO 55000

Formal certification of compliance with the standard isn't the only way to measure its adoption. The key asset management concepts in ISO 55000 form the foundation of an effective asset management system and asset management success with or without formal certification. But as organizations evolve their traditional views of asset management and embrace a management systems approach, they will naturally begin with informal adoption of the standard and graduate to self-certification before considering the business case for formal certification. The business case for certification will continue to vary widely among sectors in response to specific business drivers, but we anticipate the emergence of a robust certification ecosystem of accredited Conformity Assessment Bodies (CABs) in the next few years to service a global demand for certification.

More information about the TC251 list and ISO 55000 certified organizations can be found in Appendix B.

The Asset Leadership Network (ALN) is proud to have close relationships with several of the non-certified early adopters of ISO 55000 in the US and Canada. Early adopters within the US government include the US Army Corps of Engineers, Civil Works Program; the Western Area Power Administration; the Bonneville Power Administration; the Tennessee Valley Authority; and US Coast Guard, Civil Engineering Program. The Federal Transit Administration and the Federal Highway Administration have included the planning requirements of ISO 55000 in the criteria they use for awarding grants to state and local

governments. Other early adopters include the Denver Regional Transportation District; the City of Calgary, Canada; and the Pacific Gas & Electric Company, which is certified. The ALN's annual Federal Asset Leadership Week held each Fall has showcased presentations from many of these early adopters.

There is a growing body of knowledge and commercial resources to support organizations looking to embrace ISO 55000. 4tell Solutions has adopted ISO 55000 as a framework around which to build their technology suite for high performance organizations that embrace a management systems approach to asset management. ALN is developing tools and templates to make the path to ISO 55000 adoption and certification easier to manage. ALN cooperates with a variety of asset management associations to establish best practices, and has many member organizations that promote the use of ISO 55000 and provide a variety of expert consulting and advisory services.

Benefits of Using ISO 55000

There are both internal and external benefits to good asset management. External benefits tend to be the focus of most organizations because they impact directly customers, investors, constituents and regulators. Benefits to these external stakeholders garner the most attention, so we will start there.

Most of the external benefits of good asset management are those you'd expect:

- Reductions in operating costs to become more competitive or meet budget targets;
- Improvements in safety results that reduce the likelihood and severity of accidents;
- Advances in the performance and reliability of public works and private sector manufacturing and processing facilities;
- Enhancing accountability and transparency for all stakeholders;
- Fostering stewardship and sustainability across all asset classes;
- Extending the useful life and value of facilities and equipment.

Asset Management by the Numbers

$15 → **$5**

COST TO PRODUCE A BARREL OF OIL

The oil and gas extraction companies who were the early adopters of improved asset management principles in the UK experienced dramatic reductions in their operating costs, while extending the useful life of the production equipment.

Other UK companies were reported to have achieved:

20%

REDUCTION IN CAPITAL COSTS

10%

REDUCTION IN OPERATIONAL COSTS

IMPROVED ENVIRONMENTAL COMPLIANCE (FROM WORST TO FIRST)

China Light and Power

90% reduction in system losses

20% growth in demand

40% reduction in rate charges to customers

Sodexo's facilities management clients who followed its ISO 55001 compliant asset management framework experienced these benefits from doing so:

- **220%** Operational efficiencies through improved asset management planning of
- Total cost of operation reductions of between **7%** and **12%** annually
- Increased reliability of asset infrastructure of between **10%** and **25%**.
- **40%** reduction in risk-related costs
- **20%** reduction in equipment failure rates

Saudi Aramco Shell refinery (SASREF) in Jubail, Saudi Arabia implemented an emergency maintenance and reliability program based on ISO 55000 in 2016 and realized a **13.5%** reduction in budgeted maintenance costs that year and an additional **3.2%** reduction in 2017.

A hydroelectric generation company in Brazil owned by AES Corporation, a global power company, was able to reduce forced stops in generating units by about **75%**, reduce insurance costs by **14%**, and save approximately **$2.2 million** in one year.

Other external benefits are starting to be realized, such as:

- Increased bonding and underwriting opportunities given the more stable financial results
- Increased alignment between asset management and the achievement of organizational performance goals for financial results, safety, reliability, levels of service, and other organizational objectives.
- Greater flexibility in underwriting risk with potentially lower insurance costs resulting from lower risk profiles
- Increased ability to successfully defend litigation, e.g., class actions suits resulting from safety or quality problems, by being able to demonstrate that responsible risk prevention and mitigation activities are documented in asset management plans
- Regulators having an important new tool, i.e., compliance with ISO 55000, to assure the public and their political superiors that the regulated entities will be safer and more likely to meet public performance expectations, e.g.,
    - fewer outages due to preventable maintenance problems
    - quicker recovery of services following outages
    - lower capital and operating costs resulting in lower rates or slower rate increases

These external benefits could result from improvements in asset management practices that have nothing to do with ISO 55000. What makes ISO 55000 so significant are the internal benefits it brings to the organizations that adopt it successfully. These benefits flow from four key principles in the standard:

1. Align business goals and objectives across the organization, i.e., across the "silos" and implement the "line of sight" principle that aligns the organization's strategic goals to the actions taken to manage assets. If everyone in the organization has the same understanding of what's important, they can focus and coordinate their efforts, avoid waste, and achieve results.
2. Apply transparent and consistent decision-making rules reliably and uniformly across the organization. The common terminology and requirements in ISO 55000 provide the foundation for doing this.
3. Make risk-based decisions from a position of knowledge
4. Take a long-term strategic lifecycle view

Regardless of the type of organization or the sector in which it operates, implementing these principles successfully will lead to sustainable internal benefits, including improvements in internal communications, accountability, and performance in achieving desired outcomes at lower risk and cost.

A common question is, "If my organization becomes certified as compliant with ISO 55000, does that guarantee our success?" The simple answer is "No." Compliance with ISO 55000 means is that you've implemented a successful framework for an asset management system. In other words, you have met the requirements of a good asset management system to the high level expressed in ISO 55000. However, you may not have implemented that framework in a way that will lead to success, at least initially. For example, you may have identified the wrong "key stakeholders" or left some out. You may have focused on the wrong assets when you defined the scope of your asset

management system. You may have used poor decision-making criteria in deciding which new assets to acquire or which to maintain within available resources. You may have implemented any number of the requirements poorly. The beauty of the asset management system created under ISO 55000 is that the performance metrics required by that system should reveal the results of early miscalculations and guide the organization to appropriate corrective actions. Of course, if your initial performance measures don't respond the interests of the actual key stakeholders, your organization may not survive unless it recognizes this deficiency in sufficient time to correct it. You are ultimately responsible as to whether you've implemented the asset management systems framework properly.

You are the asset management magician – ISO 55000 is your wand.

Conclusions and Next Steps

Useful guidelines about how to manage all kinds of assets are available in a variety of documents published by associations whose members work with various asset types or perform specialized asset management functions, e.g., the International Infrastructure Management Manual (IIMM) published by IPWEA, the Framework for Asset Management published by the Asset Management Council (AMC), and various ASTM standards. There are other useful asset management guidelines published by governments, also directed at specific types of assets, e.g., water supply and treatment facilities, highways, transit systems, etc. All these guidelines are intended to help asset management practitioners carry out their jobs. However, ISO 55000 is the only asset management guideline that prescribes what organizations need to do to establish competent asset management systems. It's also the only guideline recognized as the definitive international standard for a management systems approach to asset management.

ISO 55000 provides comprehensive and specific requirements for what organizations should do to implement effective asset management systems. However, it doesn't restrict organizations as to how they want to implement those requirements. This flexibility is particularly important for organizations that want to manage assets other than the physical assets that are the focus of most other asset management standards. It's also important to recognize that many of the "how to" requirements will have already been adopted by organizations based on standards and guidelines designed for their circumstances.

If your organization wants to implement asset management as envisioned by ISO 55000, we believe there's a natural sequence of actions you should take. The broad outline of this sequence follows the IAM asset management systems elements discussed earlier. How you'll want to engage these elements will depend on your organization's asset management maturity.

Human Factors

Organization & People requirements always come first. Without someone supporting the adoption of the standard, nothing else will happen. The next steps you'll take will depend on who you are and the role you play in your organization.

- If you're the head of the organization or a senior manager, or have the ear of such a person, you should pick someone on your staff in whom you have confidence and ask that he or she become familiar with the standard and give you a proposal on how to proceed.
- If you're not the head of the entire organization, but have control over the assets for a part of the organization, you can act as the head of that component and proceed as described below.
- If you're not in any kind of senior management position, but believe your organization could benefit from adopting the standard, you need to make a good argument to someone who is in such a position.
  - Sharing this White Paper with a senior manager might be a good start.
  - Spending more time learning about the standard and developing internal White Papers that make the case for asset management to senior management is another approach. This is what the Asset Management (AM) Team at the US Army Corps of Engineers (USACE), Civil Works Program did to gain top management support for incorporating ISO 55000 into its asset management program.

Once senior management is engaged in supporting the adoption of ISO 55000, there are other steps that need to be taken, all of which fall under the Organization & People element.

- The key stakeholders in the organization's asset management program need to be identified early on and engaged in the planning processes.
- A team representing the key stakeholders needs to be assigned to do the real work of putting together the organization's asset management framework. One of the first activities of this team should be to learn as much as possible about ISO 55000, PAS 55, and the more specific asset management approaches that have been published elsewhere in the world, e.g., the IIMM, the Framework for Asset Management (AMBoK), and ASTM.

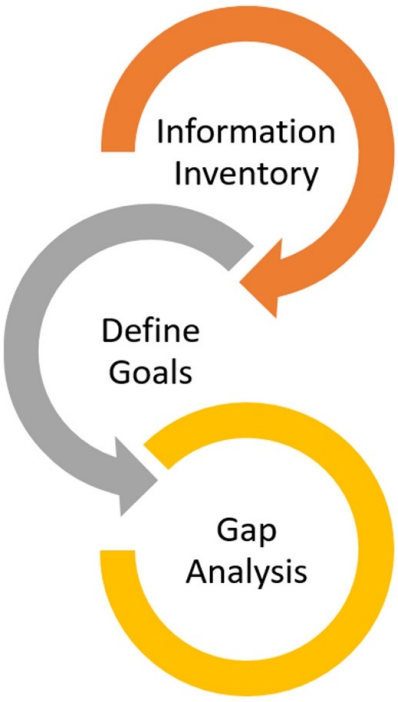
- The organization needs to decide on the scope of the asset portfolio that will be included in the asset management system. Typically, organizations will initially focus on assets that have the highest potential for savings or present the highest risks or opportunities.
- At this point, many organizations, particularly those for whom asset management is a new concept, would decide to conduct a self-assessment of their asset management practices against the requirements of the standard and base their subsequent plans on closing the most critical "gaps."
- ISO 55000 requires top management to ensure that the organization's asset management system is compatible with the organizational objectives. Organizational objectives are usually expressed in an organization's Strategic Plan. If your organization doesn't already have a Strategic Plan, this may be the first gap you'll have to address.
- Organizations that decide to implement the standard need to make sure that the key people responsible for making this happen have the necessary awareness of the standard and the skills to apply it.
- To the extent that the organization chooses to engage consultants for assistance on this path, it should be sure that those consultants are also familiar with the standard and capable of supporting the organization in its implementation.
- The same is true of software companies that support the organization's asset management program. They, too, should be familiar with the standard and capable of providing the necessary software and related consulting support to assist the organization in complying with the standard.

Manage Risk and Monitor Performance

Before developing plans for acquiring and using assets to achieve organizational goals, the organization needs to bring the **Risk & Review** requirements into play. Identifying the risks associated with the activities of the organization and the assets used to accomplish those activities must be integral to the planning process. The requirements to do this are published in ISO 31000. Understanding the criticality of assets and the risks associated with them is an important precursor to everything else the organization does. ISO 55000 requires organizations to consider opportunities for improving organizational outcomes along with risks in their planning and

implementation activities. It's also critical at this early stage in the planning process to frame the metrics needed to determine success and to assure that adequate procedures are in place to monitor and report performance against those metrics. The requirements in this element for conducting periodic management reviews and objective internal audits of the asset management system are vital to assuring the integrity of information used to support the system.

Asset Information & Data DNA



Before the planning process can begin, the **Asset Information** requirements will need to be developed and documented. Organizations need to have some understanding of their existing assets before they can make specific plans. The challenge, however, is no longer how to identify and capture necessary data, but rather how to manage the overload of data coming in from every channel, process, system and function available to the organization. So, with the volume of data no longer an issue, the question for organizations now is how to realize value and insight from information to inform decisions and develop strategies that align with mission objectives. Organizations need to define their unique "Data DNA". Every organization has a data profile that is required to support strategic decisions and is unique to its specific needs. It is imperative that organizations have complete control over the data sets that make up their profiles and that those data remain accurate and up to date. A successful data management strategy will incorporate data update requirements that flow naturally from, and add value to, normal operations for all who interact with assets.

The organization needs an inventory of those assets to be included in the asset

management system, but ISO 55000 imposes no requirement that the asset management system represent all organizational assets. Getting started with the subset of assets defined in the asset management system will deliver better results in less time and at lower cost. Perfect, complete data on all assets is an impossible standard to meet that will only bog down implementation of ISO 55000 and delay its benefits to the organization.

The organization should understand the condition of the assets in the asset management system and only as much additional information as is required to support the decision objectives of the system.

Step 1: Take an information inventory — including data sources, Key Performance Indicators (KPIs), critical benchmarks and essential management reports — to get an understanding of your data sources, management practices, system interactions and analytical products. Understanding how data flows into the organization, how it is managed internally and how those data are used will help identify both accurate, well-maintained data and data that is static, siloed, obsolete or otherwise unstructured for effective use. Tracing the origin of data often helps determine which information can provide value today and where further vetting and more robust processes will increase confidence in data integrity and reliability.

Step 2: Define organizational goals and objectives and determine how performance is measured against these goals. This can be accomplished through assessments and surveys of those responsible for establishing, managing and reporting on policies and organizational performance. This effort will establish the comprehensive set of KPIs and information required to define the organization's "Data DNA" – the minimum set of data required for strategic decision-making across the organization.

Step 3: Once the organization's unique "Data DNA" profile has been defined, a gap-analysis can be performed to compare useful, available data to needed data. This analysis will reveal opportunities for the organization to standardize operations across

resources, functions, processes and assets supporting stakeholders and constituents.

Before spending money or time to close gaps in the needed information, the organization should have at least a basic understanding of which assets pose the greatest risks and opportunities and focus its initial efforts there. The organization must also address the adequacy of asset information to identify risks and opportunities and to support the desired performance metrics. Where the asset information is not adequate for these purposes, it must be improved.

Data standardization is critical to informing performance management across asset types, locations and functional divisions. When thoughtfully developed and adopted with leadership support, an organization's Data DNA becomes an invaluable tool that enhances the policies, processes and procedures used by both internal and external resources engaged in the asset management process.

Strategic Asset Management Planning

Once the organization has determined the scope of its asset management system, identified the risk and opportunity implications of various courses of action or inaction, considered the state of available information, and determined the most appropriate ways to measure and monitor performance, it's ready to engage the **Strategy & Planning** requirements.

The strategic asset management plan (SAMP) is the document that appropriately considers risk and opportunities in linking the organization's mission objectives to the assets needed to achieve them. However, there are other, more specific asset-related plans that are also needed to guide the actual decisions that implement those plans. These might include plans for all assets in a location, e.g., a facility, or of a specific type or class, e.g., plans for motor vehicle or aircraft fleets, as well as plans for specific high value assets such as nuclear reactors.

High Performance Organizations Base Informed Decisions on Trusted Standards

The **Decision Making** requirement is engaged once the specific asset-related plans have been completed. As mentioned previously, ISO 55000 has only one requirement for this element – when planning how to achieve its asset management objectives, the organization shall determine and document the criteria for asset management decision-making.

For a listing of additional resources on this topic, see "Appendix C: Standards and Guidelines from the Global Asset Management Community"

There are already many other standards that an organization is expected to follow. Some of these are other international management systems standards, such as ISO 9000 (Quality), ISO 14000 (Environmental), ISO 50000 (Energy) and now, ISO 41000 (Facilities). There are also other international standards such as ISO 31000 (Risk), ISO 15686 (Buildings), IEC 60300 (Reliability), APPA 1000 (Total Cost of Ownership) that address a broad range of important topics too numerous to list here.

IEC 62775: Dependability Management – *Applications guide – Dependability and Financial Processes for Implementing Asset Management Systems*, discusses the importance of integrating technical and financial standards with the asset management system. It also provides a very thorough list of IEC technical standards that might be applicable to a particular asset management system. There are also standards and guidelines that impact certain computations (e.g., ROI, TCO, etc.) as well as maintenance priorities and frequencies, financing asset investments, and other calculations.

Lifecycle Operations

The decisions made in the previous element are implemented in the **Lifecycle Delivery** element. This is where assets are acquired, operated, maintained, and retired. Non-physical assets may have other lifecycle characteristics that will have to be determined by the organization. To be successful here, the organization must have sufficient numbers of well-trained persons to carry out all phases of the lifecycles across the asset portfolio in accordance with the decisions made. The work of these people and the results of that work, from the asset level up to the mission level must be monitored by the appropriate performance metrics.

Once an organization has proceeded through all these steps, it will have begun to implement an asset management system that embraces the principles of ISO 55000.

Success with ISO 55000 doesn't rest on whether an organization can manage its assets perfectly the first time through the process. In fact, continuous improvement is one of the fundamental principles in the standard. If the organization identifies a core set of key performance metrics during its ISO 55000 implementation, it will be able to monitor how well its asset management decisions are being executed as well as the extent to which they're impacting mission outcomes in the desired way. Deviations from desired outcomes will drive the evolution of key performance indicators, and measurement and monitoring methods. This will lead to improved decision support and outcomes that better align to mission objectives. This continuous improvement cycle is a critical component of an effective asset management system.

Now What?

We hope we've given you sufficient information about the benefits of the ISO 55000 management systems approach that you will want to learn more about how your organization can apply these principles to your asset management program to:

- Maximize stakeholder value from assets;
- Align asset investments with organizational objectives;
- Provide assurance that your assets deliver the value for which they were acquired;
- Create a workplace culture where top managers provide the leadership necessary to succeed.

Much of the world is ahead of the US in this regard and already reaping the proven benefits. With your support for the adoption of ISO 55000 by your organization, you can help us catch up.

If you have any questions about this paper, or want to learn more about the ISO 55000 Management Systems Standard for Asset Management, please feel free to contact the paper's authors, sponsors or contributors.

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About the Sponsors

Asset Leadership Network

The Asset Leadership Network is an organization composed of asset management industry leading organizations representing asset holders, professional and standards organizations, and solutions providers that support and help private industry, public organizations and government entities realize value from their assets through the application and practice of the ISO 55000 Asset Management set of standards and global asset management best practices. (www.assetleadership.net)

4tell Solutions

4tell™ develops Capital Asset Performance Software (CAPS) that allows organizations to effectively align their deployment of capital with business goals and mission objectives following the principles set forth in ISO 55000. The foundation is the 4tell Platform which addresses the need for owners, executives, managers, engineers, service providers, consultants, and others to be able to compile and leverage shared capital asset data on behalf of the organization. The 4tell Platform supports a variety of asset management functions including Strategic Planning, Field Inspection, Condition Assessment, Capital Programming, Budgeting and Deferred/Preventive Maintenance Planning with a focus on Open Standards and Data Interoperability. 4tell™ has developed products that drive efficiencies and enhance value from specific industry standard practices and business processes. (www.4tellsolutions.com)

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Appendix A: The Origins of Asset Management

Mankind has been managing assets since before recorded history began. Some of the earliest examples of writing from ancient civilizations in Sumer (Southern Iraq), Egypt and China were inventory and shipping records. Armies throughout the ages have managed the military assets needed to fight wars or defend their territories. Builders of monuments, temples, and other structures from ancient times to the present developed techniques and "best practices" to manage the assets they required. The advent of machine-intensive manufacturing processes during the industrial revolution created a demand for additional asset management concepts, such as preventative maintenance and "mean time to failure" estimates.

Prior to the 1990's, people didn't think about assets beyond the property that was most important to them, mainly physical assets. Manufacturing enterprises thought mostly about their factories, equipment, and, initially, their power sources. Railroads thought about their rail lines, rolling stock, and repair facilities. Mining companies and oil and gas extraction companies focused on their extraction equipment, storage facilities and transportation equipment. Utilities providing gas and electric energy services focused on their distribution networks; although some electric utilities may have also had generation equipment to think about. When telecommunication companies came on the scene, they focused on their transmission lines and equipment. Governments at all levels thought about the infrastructures that supported the public services for which they were responsible. For local governments, this initially meant water supply and wastewater disposal infrastructure, local roads and bridges, as well as educational facilities. For national and state governments, this initially meant state and national roads and bridges, but also waterways, ports, dams and levees, and other public infrastructure. All governments are concerned with their facilities and the personal property that goes with them.

Military organizations from time immemorial have recognized the need to organize, equip and train professional logisticians to manage the military's equipment and infrastructure. In the United States, this responsibility was initially assigned to the US Army's Quartermaster Corps. Established on June 16, 1775, it is the US military's oldest logistics organization. Today, each of the US military departments has its own asset management organizations to procure, construct, operate, maintain and dispose of both personal and real property. There have always been military regulations and standards that have guided the logistical support activities that support these departments.

All organizations that manage physical assets face similar problems, e.g., making sure they have the right assets to do the job; keeping the assets in good working order, at least good enough to perform as needed; and having enough competent people and money to do all that. They also face similar pressures. Private sector entities initially wanted to maximize profitability, which involved running their equipment efficiently to maximize output and hold down costs. Public sector entities focused on providing adequate levels of service. Over time, as their physical assets began wearing out, they began to realize that initial decisions to hold down costs by buying cheaper equipment and minimizing maintenance had expensive long-term cost impacts. Both private and public-sector entities began to consider the lifecycle costs of their physical assets and how acquisition, operational, maintenance, and retirement decisions affected those costs. Later on, they began to address workplace and environmental safety issues at least some of which were determined by asset-related choices. Entities that owned and managed property developed their own approaches to addressing these issues. Eventually they came together into groups to share best practices and promote common approaches.

These groups initially organized around the people who manage, operate, maintain and retire assets on a day-to-day basis. Their original focus was on training and certification for the practitioners of their respective specialties. Eventually, they evolved to include people involved in supporting activities such as planning asset acquisitions and maintenance cycles, justifying asset-related budget requests, inventorying and valuing

assets for financial reporting purposes, conducting condition assessments, writing internal organizational asset management policies, etc. As these groups evolved, several of them began preparing guidelines to share best practices with their peers.

Some of the key milestones in the evolution of modern asset management practices and guidelines that are relevant to engineers and property managers who manage assets on a daily basis include:

1950s and 60s – Systems Engineering.

The US Air Force and NASA begin to apply systems engineering concepts to solve complex organizational and process problems. Systems engineering defined complex organizations and processes as a collection, or system, of elements that could be examined individually to optimize their own performance. Equally important, however, was the power of this approach in understanding the relationships that needed to exist between various elements for the overall system to function effectively in accomplishing its purpose(s).

1964 – Integrated Logistics Support (ILS).

The publication of DODD 4100.35 "Development of integrated Logistics Support for Systems and Equipment." This directive codified the Integrated Logistics Support (ILS) philosophy that had evolved from previous guidelines developed by the individual military departments. DoD had realized that providing maintenance support for military equipment and weapons systems required the recognition and coordination of a wide range of resources and activities, not only the military equipment itself, but also the skilled personnel, materials, facilities, and funds needed to refresh and sustain it. These guidelines have evolved and been republished several times since initially issued. A more complete discussion of the ILS philosophy is beyond the scope of this paper. Suffice it to say that it brings together most of the important asset management concepts, including the importance of understanding the total costs of ownership over an asset's lifecycle and

the importance of a good maintenance program in holding those costs down. It's important to note, however, that these concepts are applied to individual weapons systems, not to the parent organizations.

1978 – Reliability Centered Maintenance (RCM)

Nolan and Heap, employees of United Airlines, publish a report to DoD on "Reliability Centered Maintenance." This report challenged the previous approach to scheduled maintenance based on fixed assumptions about failure rates based on the age of parts and equipment. Application of the RCM approach resulted in much lower maintenance costs as well as improved safety results, better-managed risks, and higher reliability.

1990s – Asset Management Guidelines for Public Infrastructure

Governments in Australia and New Zealand begin to publish asset management manuals for their local government public works infrastructure maintenance engineers. These efforts came together in 2000 with the joint publication of the International Infrastructure Management Manual (IIMM). Government interest in improving infrastructure asset management practices was a direct result of the introduction of accrual accounting practices by local governments and the use of "fair value" to reflect the value of assets on local government balance sheets. As a result of these accounting changes, local governments could see the positive impact that good asset management practices had on their P&L statements, balance sheets and bond ratings.

2000s – The Advent of Strategic Asset Management

The ASTM in the US begins to publish a series of asset and property management standards for US Federal agencies and contractors. Government agencies in the US and elsewhere also publish guidelines directed at specific infrastructure sectors. In the US, for example, the Environmental Protection Administration (EPA) published a "Reference Guide for Asset Management Tools" that was directed at drinking water and wastewater systems. The Department of Transportation has published an extensive set of guidelines

for Transportation Asset Management and also offers related training opportunities.

A common characteristic of these guidelines and standards is that they focus on practitioners who perform specific asset management functions, e.g., maintenance engineering, fleet management, etc., or who work in specific infrastructure sectors, e.g., manufacturing, telecommunications, transportation, water, etc. These practitioners eventually realized two important things.

1. Many of the management principles they had developed for their own specialties or sectors were applicable to other asset-related specialties and sectors.
2. More significant for the future, however, they realized that top management support within their organizations was essential for integrating their asset management recommendations with the other activities of the organization necessary for their recommendations to succeed.

The asset management systems standards that we have today don't focus on specialties or sectors as do the other standards and guidelines. Rather, they address how an organization from any sector should approach and coordinate the activities of its asset management practitioners with all the other activities of the organization, e.g., finance, planning, IT, human resources, etc., and do this from an enterprise-wide perspective. This is the distinction that proponents of the management systems approach to asset management have in mind when they call their approach "asset management" as opposed to the more specialized activities of asset management practitioners who are "managing assets." A good discussion of this distinction can be found in the paper "Managing Assets in the Context of Asset Management", published in May 2017 by ISO TC 251, the ISO Technical Committee for Asset Management Systems." It can be found on the Internet at: **https://committee.iso.org/sites/tc251/home/news/content-left-area/news-and-updates/new-article-managing-assets-in-t.html**.

Appendix B: A summary of the TC251 list of ISO 55000 certified organizations worldwide

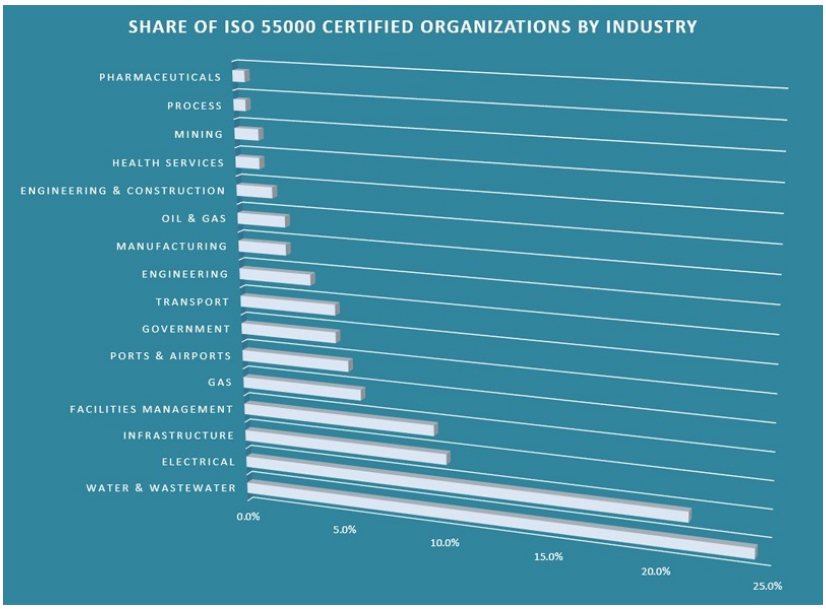
The ISO Technical Committee 251 (ISO/TC251) maintains a website[11] which provides a list of certified ISO 55000 compliant organizations it has compiled from publicly available information.

Country	Certified Organizations	Number of Sectors	Top Sector(s)
Japan	43	6	Water & Wastewater; Electrical; Infrastructure
Netherlands	27	10	Water & Wastewater; Electrical; Facilities Mgmt
UK	23	8	Water & Wastewater; Electrical; Gas
Australia	19	9	Electrical; Facilities Management; Transport
UAE	7	6	Electrical
China	6	6	various
Hong Kong	4	3	various
Ireland	4	4	Electrical
Finland	3	1	Electrical
India	3	2	Electrical
Brazil	2	1	Electrical
Denmark	2	2	Electrical
Germany	2	1	Electrical; Government
Malaysia	2	2	Electrical; Ports & Airports
Portugal	2	2	Government
Spain	2	2	Water & Wastewater; Facilities Management
Switzerland	2	2	Electrical; Ports & Airports
USA	2	2	Gas; Health Services
Belgium	1	1	Water & Wastewater

[11] The link can be found at https://committee.iso.org/sites/tc251/social-links/resources/known-certified-organizations.html

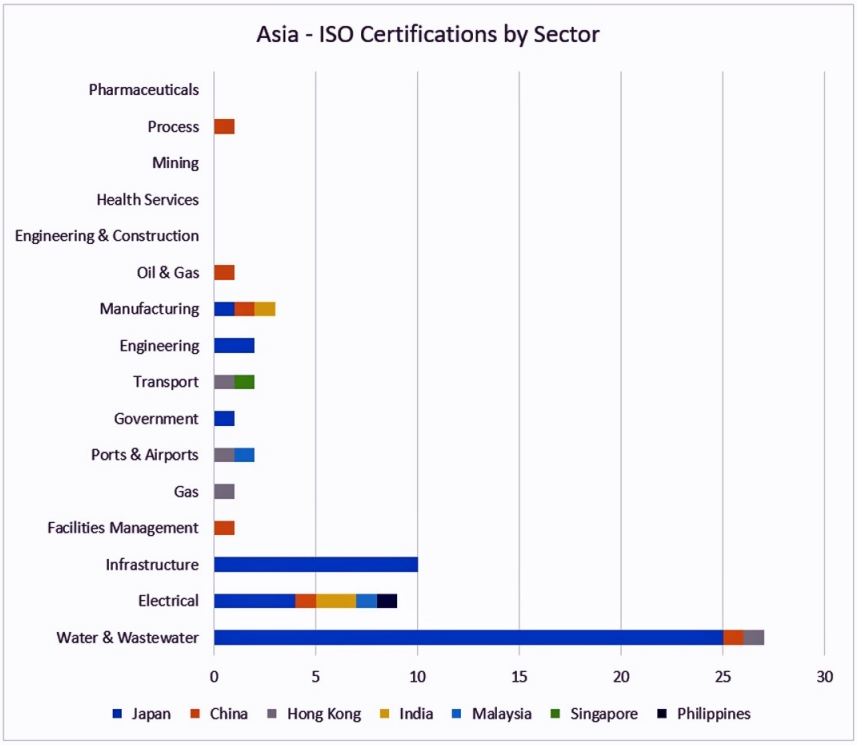
Country	Certified Organizations	Number of Sectors	Top Sector(s)
Botswana	1	1	Mining
Chile	1	1	Water & Wastewater
France	1	1	Facilities Management
Kuwait	1	1	Oil & Gas
New Zealand	1	1	Electrical
Norway	1	1	Electrical
Oman	1	1	Electrical
Philippines	1	1	Electrical
Qatar	1	1	Ports & Airports
Russia	1	1	Electrical
Singapore	1	1	Transport
Slovenia	1	1	Facilities Mgmt

The global Water & Wastewater sector represents that largest concentration of ISO 55000 certified organizations. As of April 2018, 24.4% of all certified organizations on the TC251 list operate in the Water & Wastewater sector.

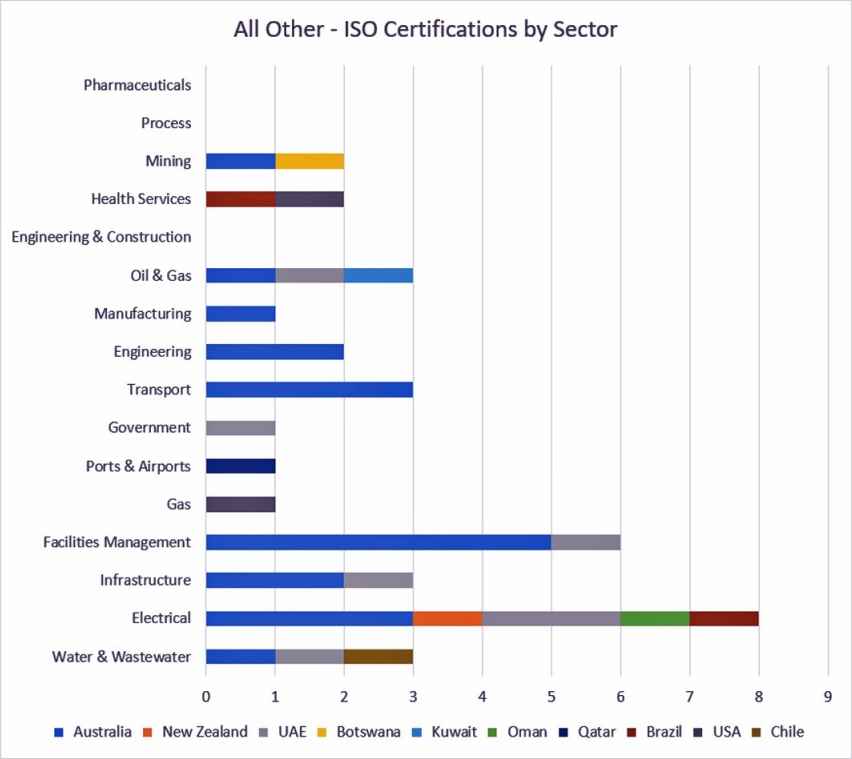


In Europe, the dominant sector is Electrical. Eight European nations plus Russia have at least one certified organization in this sector for a total of 19 in the region. Water & Wastewater is a distant second place with 11.

Asia tilts the global scale in favor of Water & Wastewater with Japan leading that sector with 25 certified organizations listed with TC251. Japan has an additional 10 certified organizations in the Infrastructure sector and leads all nations with a total of 43.



Australia leads the remaining regions with a total of 19 certified organizations distributed across 9 industry sectors. Electrical and Facilities Management are the top sectors among this group.



Appendix C: Standards and Guidelines from the Global Asset Management Community

The ISO Technical Committee 251 (ISO/TC251) maintains a website which provides a list of certified ISO 55000 compliant organizations it has compiled from publicly available information.

International Management Systems Standards published by the International Organization for Standardization (ISO):

- ISO 9000:2015 Quality management systems – Fundamentals and Vocabulary
- ISO 9001:2015 Quality management systems – Requirements
- ISO 14001:2015 Environmental management systems – Requirements with guidance for use
- ISO 14004:2016 Environmental management systems – General guidelines for implementation
- ISO 14005:2010 Environmental management systems – Guidelines for the phased implementation of an environmental management system, including the use of environmental performance evaluation.
- ISO 14006:2011 Environmental management systems – Guidelines for incorporating ecodesign
- ISO/IEC/IEEE15288:2015 Systems and software engineering – System lifecycle processes
- ISO 37101:2016 Sustainable development in communities – Management system for sustainable development – Requirements with guidance for use
- ISO 39000:2012 Road traffic safety (RTS) management systems – Requirements with guidance for use
- ISO 41001:[12] Facilities management -- Management systems -- Requirements with guidance for use
- ISO 45001:2018 - Occupational health and safety management systems – Requirements
- ISO 50001:2011 Energy management systems – Requirements with guidance for use

[12] ISO 41001 was published 23 April 2018

International Standards and Guidelines published by the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC):

- ISO 9004:2009 Managing for the sustained success of an organization – A quality management approach
- ISO 15686-1:2011 Buildings and constructed assets – Service life planning, Part 1: General principles and framework
- ISO 15686-2:2012 Buildings and constructed assets – Service life planning, Part 2: Service life prediction procedures
- ISO 15686-3:2002 Buildings and constructed assets – Service life planning, Part 3: Performance audits and reviews
- ISO 15686-4:2014 Buildings and constructed assets – Service life planning, Part 4: Service life planning using Building Information Modeling
- ISO 15686-5:2017 Buildings and constructed assets – Service life planning, Part 5: Lifecycle costing
- ISO 15686-7:2017 Buildings and constructed assets – Service life planning, Part 7: Performance evaluation for feedback of service life data from practice
- ISO 15686-8:2008 Buildings and constructed assets – Service life planning, Part 8: Reference service life and service-life estimation
- ISO/TS 15686-9:2008 Buildings and constructed assets – Service life planning, Part 9: Guidance on assessment of service life data
- ISO 15686-10:2010 Buildings and constructed assets – Service life planning, Part 10: When to assess functional performance
- ISO/TR 15686-11:2014 Buildings and constructed assets – Service life planning, Part 11: Terminology
- ISO 19011:2011 Guidelines for auditing management systems
- ISO 31000:2009 Risk management – Principles and guidelines
- ISO/IEC 31010:2009 Risk management – Risk assessment techniques
- ISO/IEC Guide 73:2002 Risk management – Vocabulary – Guidelines for use in standards

- ISO 37500 Guidance on outsourcing
- IEC 60300-1:2003 Dependability management – Dependability management systems
- IEC 62775:2016 Application guidelines – Technical and financial processes for implementing asset management

Other Useful Asset Management Standards and Guidelines

- ASTM E2132-17: Standard Practice for Inventory Verification: Electronic and Physical Inventory of Assets
- ASTM E2279-15: Standard Practice for Establishing the Guiding Principles of Property Management
- ASTM E2452-12: Standard Practice for Equipment Management Process Maturity (EMPM) Model
- ASTM E2453-13: Standard Practice for Determining the Life-Cycle Cost of Ownership of Personal Property
- ASTM E2495-13: Standard Practice for Prioritizing Asset Resources for Acquisition, Utilization, and Disposition
- ASTM E2608-08(2014): Standard Practice for Equipment Control Matrix (ECM)
- ASTM E2675-09(2014): Standard Practice for Property Management System Outcomes
- International Infrastructure Management Manual, Version 5.0 2015, published by the Institute of Public Works Engineering Australia (IPWEA)
- APPA 1000 - Total Cost of Ownership (TCO) for Facilities Management