Mechanical
Engineering Department

ISO 55001 - Diagnosis of the Organization's State

Dissertation presented to obtain a Master's degree in Mechanical Engineering

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"What E' er Thou Art, Act Well Thy Part"
Anonymous author

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To my collegues and friends for the support, encouragement and by raising the bar.

This work is dedicated to my **Father**,
that isn't more on this earth but always
taught me the value of the work:
To my **Mother**,
for the resilience that always showed;
To my **Wife**,
For the full support;
To my **Sons and Daughter**,
They give me strength to continue.

Abstract

ISO 55001 defines a set of requirements that when implemented and maintained guarantee the good performance of an organization's asset management, responding to stakeholders needs and expectations and ensuring value creation and maintenance as well as a global vision of assets in a circular economy.

Organizations where physical asset management is of major importance include all those that involves: facilities, machinery, buildings, roads and bridges, utilities, transportation industries; oil and gas extraction and processing; mining and mining processing; chemicals, manufacturing, distribution, aeronautics and defence.

However, since ISO 55001 is a new standard in the global market, because it is intrinsically difficult to implement, a diagnostic model on the state of organizations can greatly help on the implementation.

Before beginning to implement the ISO 55001 standard, it is necessary to verify whether the organization is ready to begin this task. It is usually necessary to fine-tune many aspects before starting a great task like this. But where to start? What aspects do I need to correct before starting the default implementation?

This thesis proposes a diagnostic model to evaluate the state of organizations in relation to their potential to implement the ISO 55001. The diagnosis allows to identify the aspects of the organization that are ready to receive the new standard, the critical, the fragile and the weak points of the company that must be corrected.

The diagnostic model is based on surveys, with several questions and with five possible answers. Each possibility of response has a quantification and a critical classification.

The final result is a global positioning of the company with the identification of the various aspects to be corrected in order to be possible to implement ISO 55001. A radar chart provides a global "radiography" of the company diagnosis.

The diagnostic template has been validated and the results are presented in the document.

Key Words: ISO 5500X; Circular Economy; Sustainability; Industry 4.0

Resumo

ISO 55001 define um conjunto de requisitos que, quando implementados e mantidos, garantem o bom desempenho da gestão de activos de uma organização, respondendo às necessidades e expectativas das partes interessadas e garantindo a criação e manutenção de valor assim como uma visão global dos activos numa economia circular.

As organizações para as quais a gestão de ativos físicos tem grande importância incluem todas aquelas que envolvem: instalações, máquinas, edifícios, estradas e pontes, serviços públicos, indústrias de transporte; extração e processamento de petróleo e gás; processamento de mineração e mineração; produtos químicos, fabricação, distribuição, aviação e defesa.

No entanto, como a norma ISO 55001 é um novo padrão no mercado global, por ser intrinsecamente difícil a sua implementação, um modelo de diagnóstico sobre o estado das organizações pode ajudar muito na sua implementação.

Porém, antes de começar a implementar a norma ISO 55001, é necessário avaliar se a organização está pronta para iniciar essa tarefa. Normalmente é necessário adequar muitos aspectos antes de iniciar uma grande tarefa como essa. Mas, de onde começar? Quais os aspectos são necessários para corrigir antes para iniciar a implementação padrão?

O presente artigo propõe um modelo de diagnóstico para avaliar o estado das organizações em relação ao seu potencial para implementar a norma ISO 55001. O diagnóstico permite identificar os aspectos da organização que estão prontos para receber o novo padrão, o crítico, o frágil e os fracos pontos da empresa que devem ser corrigidos.

O modelo de diagnóstico baseia-se em inquéritos, com várias questões e com cinco possibilidades de respostas. Cada possibilidade de resposta tem uma quantificação e uma classificação crítica.

O resultado final é um posicionamento global da empresa com a identificação dos vários aspectos a serem corrigidos para ser possível a implementação da norma ISO 55001. Um gráfico de radar fornece uma “radiografia” global do diagnóstico da empresa.

O modelo de diagnóstico foi validado e os resultados são apresentados no documento.

Palavras-Chave: ISO 5500X; Economia Circular; Sustentabilidade; Indústria 4.0

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Acronyms

AM – Asset Management
AMC – Asset Management Council
AMP – Asset Management Plan
AMS – Asset Management System
BP – British Petroleum
BSI – British Standards Institute
CEO – Chief Executive Officer
CPAM – Certified Practitioner in Asset Management
ERP – Enterprise Resource Planning
GFMAM – Global Forum on Maintenance and Asset Management
IAM – Institute of Asset Management
ISO – International Organization for Standardization
KPI – Key Performance Indicator
NAMS – New Zealand Asset Management Support
OFWAT – Water Services Regulation Authority
PAS – Publicly Available Specification
PC – Project Commitee
PDCA – Plan, Do, Check, Act
RACI – Responsible, Accountable, Consulted, and Informed
SAMP – Strategic Asset Management Plan
SAP – Systems Applications and Products
SPU – Seattle Public Utilities
SWOT – Strengths, Weaknesses, Opportunities and Threats
UK – United Kingdom
US – United States of America
USEPA – US Environmental Protection Agency
WPiAM – World Partners in Asset Management
WKID – Wisdom, Knowledge, Information and Data

1 Introduction

What is asset management? What are these assets? ISO 55000 defines asset management as "coordinated activity of an organization to realize value of assets".
Asset management involves balancing costs, opportunities and risks against the desired performance of assets, to achieve organizational goals. This balance may have to be considered in different periods. Asset management also enables an organization to examine the need and performance of assets and asset systems at different levels. In addition, it allows the application of analytical approaches to manage an asset at different stages of its life cycle (which can start from the conception of the asset's need until its disposal and includes the management of any post-disposal obligation). Asset management is the art and science of making the right decisions and optimizing the delivery of value. A common goal is to minimize the cost of living of assets; but there may be other critical factors, such as risk or continuity of the business, to be considered objectively in this decision making (Pais *et al*., 2018).

According to Hastings, the need for asset management as a recognized discipline arises from the complex technical nature of modern systems. Let us take an example from aeronautics field. A contrast can be drawn between, on the one hand, the Wright Brothers Flyer of 1903 (Figure 1.1), which was the first aircraft to achieve controlled flight and, on the other hand, the modern aeronautics industry (Hastings, 2014).

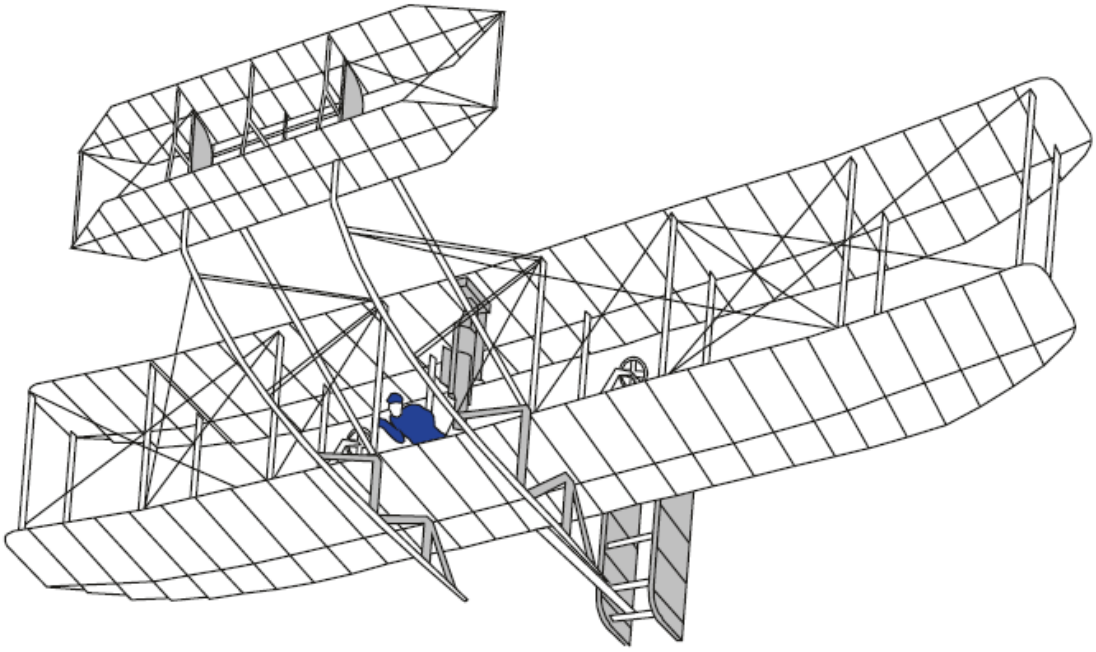


Figure 1.1 Wright Brothers Flyer 1903 (Hastings, 2014)

Initially, the Wright brothers designed, built, flew, repaired, and financed their own aircraft. They did not need asset management as a separate activity. However, aviation today involves flight operations, engineering, maintenance, finance, human resources, and a wide range of asset types on a huge scale. Figure 1.2 gives some indication of this.

It is this vast increase in complexity, across a wide range of industries, which has led to the need for asset management as a recognized discipline.

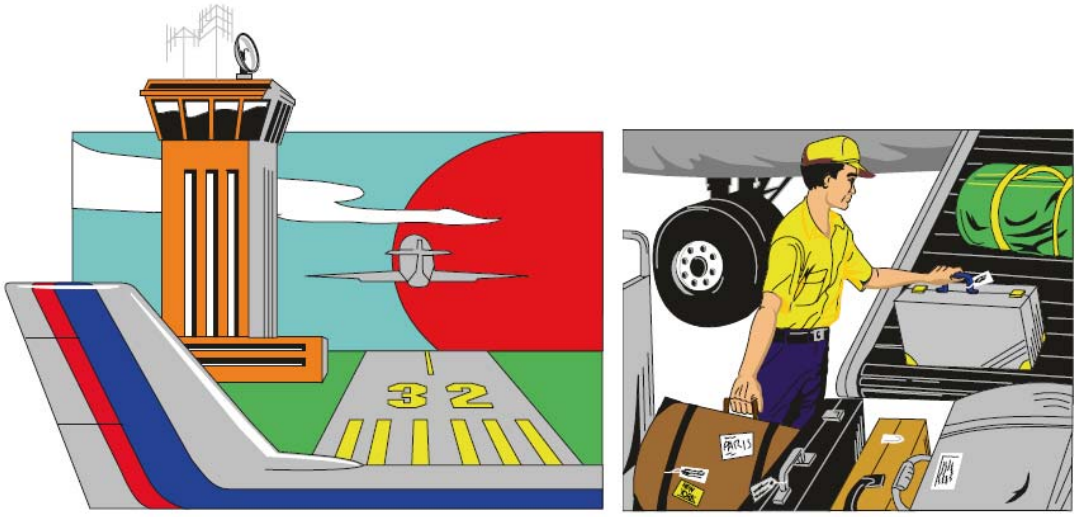


Figure 1.2 Modern aviation industry assets (Hastings, 2014)

The asset management standard ISO 55000 defines an asset as:

- *an item, thing or entity that has potential or actual value to an organization.*

This is a very general definition, which can cover any type of asset. To focus our thinking, we can recognize the following types of assets, which normally can be identified within the organizations:

- Physical Assets;
- Financial Assets;
- Human Assets;
- Information Assets;
- Intangible Assets.

Physical assets are items such as plant, machinery, buildings, roads, vehicles, railways, aircraft, pipes, wires, communications equipment, and other infrastructure. Besides physical assets, we also consider financial, human, and information assets to the extent that they support the management of physical assets. Intangible assets are nonphysical things such as goodwill and intellectual property.

Who Needs Asset Management? Organizations in which physical asset management is of particular importance, that include all those involving plant, machinery, buildings, roads and bridges, utilities such as electricity, gas and water, transport industries; oil and gas extraction and processing; mining and minerals processing; chemicals, manufacturing, distribution, aviation, and defence.

Asset management sits at a meeting point between the technical and business fields. The role of the asset manager is to bring to bear a combination of technical knowledge and business knowledge in order to effectively and efficiently meet the asset-related needs of the business as a whole. This involves several specific areas of professional activity in asset appraisal, asset acquisition, and logistic support over the asset life cycle.

The typical asset manager is likely to be an engineer, maintenance manager, or logistics specialist who has become involved with business decisions, which require both technical knowledge and a financial focus. Asset management is, however, a separate activity from technical engineering and from maintenance management. This is because the practice of engineering or of maintenance management require time, dedication, and a focus, which is different from the combination of logistic and business issues involved in asset management.

Regarding other roles in business, finance and accounting specialists are aware of fixed assets as a balance sheet entry whose technical depths are unknown.

Information technologists are skilled in establishing data management and communication systems, but the structure, content, and use of the information lie elsewhere.

Senior managers from political, legal, financial, or marketing backgrounds have business priorities and short-term imperatives and must rely on asset managers for sound asset-related advice. In addition, lobbyists for particular solutions may put forward unbalanced views of asset development options.

To the public debate may rage over the provision of facilities or issues, such as environmental impact, but this rarely involves a balanced appreciation of what is involved in planning, financing, creating, operating, and maintaining assets.

Vocalized or politicized fads and fancies can overwhelm the voice of asset management in the short term, but eventually the realities come home to roost. This work seeks to achieve a holistic view of asset management, which can help a new generation of professionals in this important field.

According to Meireles *et al*., ISO 5500X standards bring a new economic and sustainability cycle (Meireles *et al*., 2017).

The extension of the life cycle of physical assets, its adequate maintenance, reuse, renovation and recycling are strategic variables in its management.

An adequate management of physical assets as well as the optimization of their life cycle are aspects that are determinant from a global sustainability perspective.

In addition, ISO 55001 standard defines the certification requirements, considering that any Organization should emphasize on its Strategic Plan what are the sustainable principles regarding its assets as well as highlighting them in its Strategic Asset Management Plan (SAMP).

When replacing an asset, the Organizations must ensure that the energy consumption of the equipment and its environmental shall justify their replacement. For all these aspects, among many others, ISO 5500X standards can make a decisive contribution to the implementation of a new, more sustainable economy based on innovative management of the physical assets of all we depend.

According to Raposo *et al.*, the current competitive environment demands, more and more, of the companies, is a constant search in the improvement of processes in all aspects. Thus, in order to obtain a leading position, companies aim to maintain their standard above the competition (Raposo *et al*., 2017).

As a result, business development has led to significant progress in terms of quality and productivity in most industrial sectors. In the last three hundred years' humanity production has increased, services have expanded, provoking a real industrial revolution.

It is increasingly recognized that improving the quality of products and services is extremely important and necessary for the competitiveness of the organizations. For those who produce or provide a service, quality means greater customer satisfaction, specialization and market reach, increased competitiveness and profitability.

It is from this perspective that the identification of the optimum moment of substitution of an asset can be the competitiveness of organizations, through the reduction of costs that may be indexed to the maintenance policy used.

Companies are increasingly compelled to rationalize their costs, including maintenance costs, which, in the area of energy efficiency are decisive for the competitiveness of organizations. Those responsible for Maintenance are therefore also forced to become effective and previously only efficient; the volume and quality of the resources available to them to meet their objectives have become crucial.

The ISO 5500X standards set out to meet this need to manage the life of the organization's physical assets, ensuring the level of competitiveness without compromising the level of excellence of the products / services offered. The ISO 55001 standard proposes a methodology for managing the assets in accordance with the strategic objectives of the Organization, supporting decisions to acquire, replace and their disposal, aligned with practices that aim at the environmental, social and economic sustainability of equipment and the Organization itself.

1.1 ISO 55000 Family of Standards

The ISO 55000 family of standards is divided in three standards, ISO 55000, ISO 55001 and ISO 55002, they are all related with management system for asset management which is called "asset management system" throughout the tree standards. The all three standards are to be used in combination, thus the ISO 550001 specifies the requirements for an asset management system, while the other standards detail sector-specified, asset-specified or activity-specified technical requirements or give guidance on how ISO 50001 should be interpreted and applied within a specific sector or to a particular asset types.

This International Standard is primarily intended for use by:

- those considering how to improve the realization of value for their organization from their asset base;
- those involved in the establishment, implementation, maintenance and improvement of an asset management system;
- those involved in planning, design, implementation and review of asset management activities with service providers.

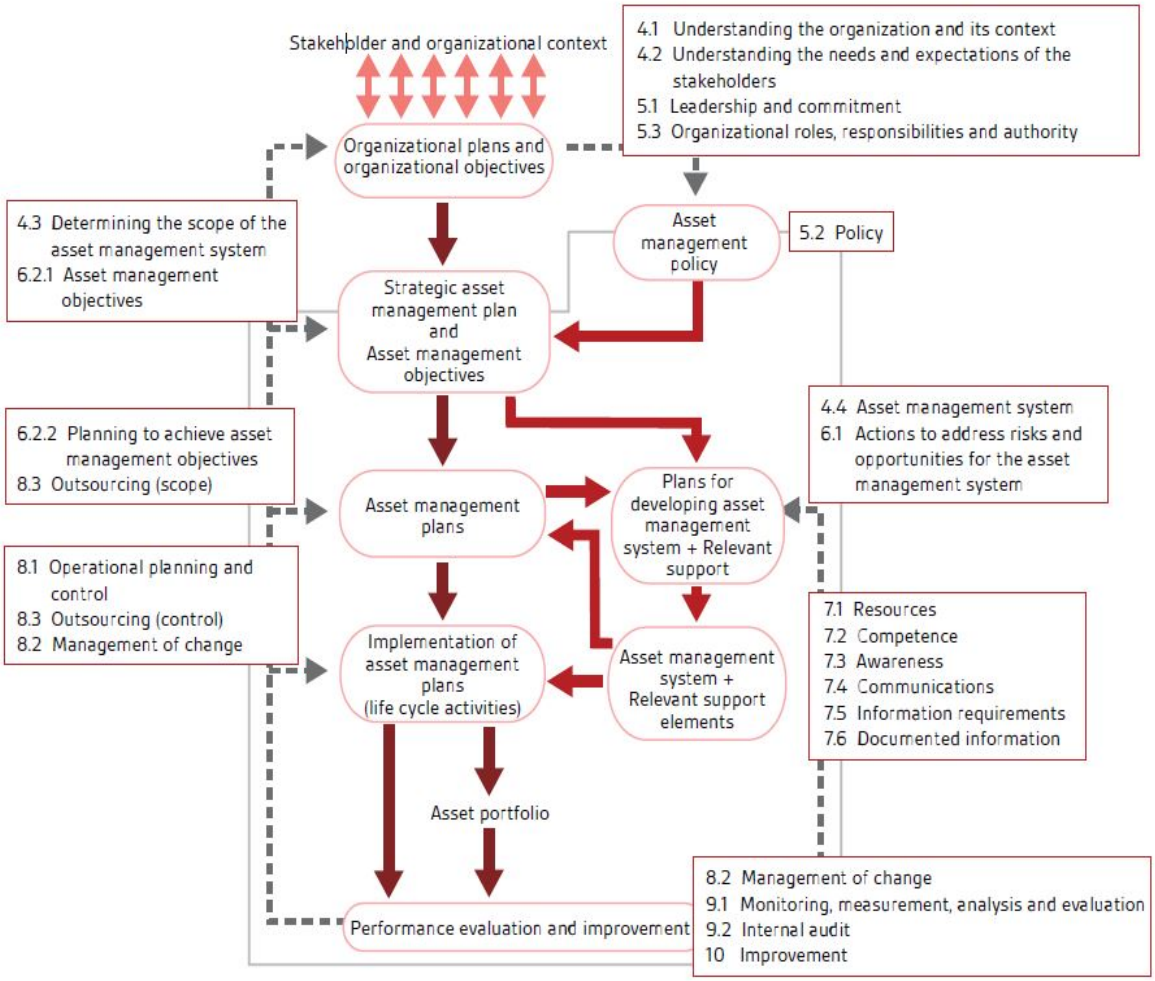


Figure 1.3 Relationship between key elements of an asset management system (Woodhouse, 2019)

The adoption of ISO 55000 family standards enables an organization to achieve its objectives through the effective and efficient management of its assets. The application of an asset management system provides assurance that those objectives can be achieved consistently and sustainably over time.

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

- data management;
- condition monitoring;
- risk management;
- quality management;
- environmental management;
- systems and software engineering;
- life cycle costing;
- dependability (availability, reliability, maintainability, maintenance support);
- configuration management;
- terotechnology;
- sustainable development;

- inspection;
- non-destructive testing;
- pressure equipment;
- financial management;
- value management;
- shock and vibration;
- acoustics;
- qualification and assessment of personnel;
- project management;
- property and property management;
- facilities management;
- equipment management;
- commissioning process;
- energy management.

An asset management system is used by the organization to direct, coordinate and control asset management activities. It can provide improved risk control and gives assurance that the asset management objectives will be achieved on a consistent basis. However, not all asset management activities can be formalized through an asset management system. For example, aspects such as leadership, culture, motivation, behaviour, which can have a significant influence on the achievement of asset management objectives, may be managed by the organization using arrangements outside the asset management system (ISO 55000, 2014). The relationship between key asset management terms is shown in Figure 1.4.

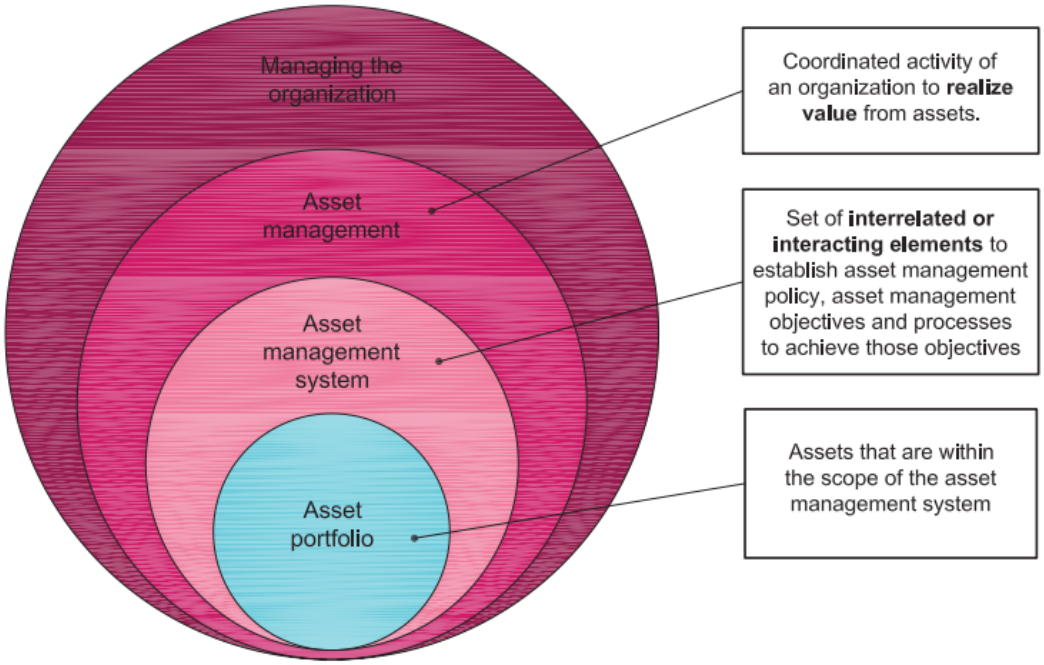


Figure 1.4 Relationships between key terms (ISO 55000, 2014)

Asset management involves no more treating each department or area as individual but the organization as one all; in this way, we see that any occurrence will affect the organization in a global way. The communication will be improved and made clear

decisions that are made in awareness of the other departments in the organization; everyone is involved and ready to give feedback on the results that were obtained through the changes that took place.

Figure 1.5 Asset Management (International Organization for Standardization, 2018)

1.2 Asset Management

Acording to Hastings, a good asset management provides the following benefits, which enable an organization to effectively and efficiently deliver business capability, and to achieve its aims in regard to profitability and service delivery (Hastings, 2014):

- a systematic approach to asset-based decisions; so, that asset requirements, acquisition, and disposal match the objectives of the business;
- an appropriate logistic support over the asset life cycle, creating improvements in asset performance;
- an effective internal processes for managing assets;
- benefits in meeting business and regulatory targets, including:
  - operational targets;
  - financial targets;
  - environmental regulations;
  - health and safety regulations;
  - insurance requirements;
  - risk management.
- a systematic framework for the training and development of staff, in understanding and managing the asset portfolio;
- ISO 55000 series of standards provides a general framework for the management of physical assets. The adoption of ISO 55000 can provide:
  - a structured view and understanding of asset management;

- effective relationships between top management, asset management, operations, and maintenance;
- improvements in asset financial returns;
- well-informed asset management decisions;
- insurance, health and safety, regulatory, and risk management benefits;
- company recognition/marketing;
- improvements in training and development.

So, to understand Asset Management better, there are some items that should be considered fundamental principles of Asset Management, as defined in the ISO 55000 standard, namely:

- Value - Assets exist to provide value to the organization and its stakeholders. An understanding of value and how your asset contributes to the value is therefore important;
- Alignment - Asset Management translates the organisational objectives into technical and financial decisions, plans and activities. Asset Management requires line of sight from organizational objectives through to tactical plans and measures;
- Leadership - Leadership and workplace culture are determinants of value realization. Asset Management requires management to take the lead and demonstrates commitment;
- Assurance - Asset Management gives assurance that assets will fulffil their required purpose. This requires the organisation to measure progress and performance with discipline and purpose, and typically includes setting up performance measures and performing periodic reviews and audits.

1.3 Objetives

This thesis has the objective to create and introduce a tool that can be used by anyone with little knowledge of this standard, where through a series of questions can be traced the organization's state to implement ISO 55000 and help though the process of implementation until to reach certification by third part. This tool will also identify and help to solve issues afterwards.

1.4 Monograph structure

The monograph as the following structure:

- The chapter 1 is given an introduction and the objectives;
- The chapter 2 deals with state of the Art;
- The chapter 3 presents how to implement ISO 55000 and the potencial of the diagnosis tool during the process;
- The chapter 4 shows the results of the diagnosis tool and it´s interpretation;
- The chapter 5 gives the conclusions and future developments.

2 State of the Art

The development of physical assets has been a hallmark of human activity from early times. Figure 2.1 shows military wagons from the city of Ur dating from 2600 B.C. Clearly the citizens of Ur were familiar with the wheel, but this means that there must also have been artisans who were familiar with the bearing, on which the wheel depends, with lubrication on which the bearing depends, and with the lathe and other woodworking and metalworking tools needed to build the wheels and the wagons. A developed system of manufacture, maintenance, and logistic support for these assets must have existed from a very early date. Despite these early beginnings, physical asset management has never been a well-understood activity within populations at large. The pattern of educational and professional specializations has generally by-passed the physical asset management field. Various technical areas, such as defence, aviation, and civil works, have evolved their own approaches to the topic, under such headings as logistics, systems engineering, public works engineering, infrastructure, and maintenance (Hastings, 2014).

Figure 2.1 Military assets - city of Ur 2600 B.C. From the “Standard of Ur” (Hastings, 2014)

According to Jones *et al*., in the United Kingdom, the oil and gas sector identified the need for an asset management approach to physical asset management in the late 1980’s. The main drivers of change were the management of safety (risk) and the achievement of financial efficiency (Jones *et al*., 2014).

In 1988, a fire at the Piper Alpha oil rig in the North Sea, linked to the subsequent Cullen Report for maintenance problems at a pump and safety valve, killed 167 workers. This accident, combined with the dramatic drop in oil prices in 1986, focused on the oil and gas industry on the need to adopt holistic asset management based on a life cycle approach. This focus on asset life cycle management has resulted in improvements in efficiency, safety and productivity in the oil and gas industry. UK water and electricity also adopted an asset management approach when they were privatized a few years later. Privatized water companies in England and Wales have also developed asset management in response to pressure regulation to minimize rate increases, while simultaneously improving the level of service provided to customers and addressing the problem of aging infrastructures. The Office of Water Services, the economic regulator of the water and wastewater industry in England and Wales, was created in 1989. The Water Services Regulation Authority (OFWAT) initially focused on improving data quality, setting service level objectives, and monitoring compliance with service levels.

The Australian Government, which identified the need to address infrastructure management early, promoted the development of asset management during the 1980’s.

The Institute of Public Works Engineering of Australia developed and issued the Australian National Asset Management Manual in 1994: introduced asset management concepts and provided guidance on their implementation. In New Zealand, the National Asset Management Steering Group was established in 1995 to develop and promote asset management practices in infrastructure. In 1996, the New Zealand Asset Management Support (NAMS) issued the New Zealand Infrastructure Asset Management Manual, which was used by municipalities and water services to develop asset management plans. The Institute of Public Works Engineering of Australia and NAMS then worked together to develop the International Infrastructure Management Manual, which was first published in the year 2000. This was built on previous manuals and case studies were included.

Asset management did not develop as fast in the United States of America compared to the UK, Australia and New Zealand, mainly due to the different structure of the industry. The USA water industry has many more organizations and a mix of municipal entities. However, some USA water utilities have implemented asset management programs in the early 2000's, such as Seattle Public Utilities (SPU) in Washington and Oregon's City of Portland Water Bureau, making them two good examples. On the wastewater side, the USA Environmental Protection Agency (USEPA) recognized the benefits of an asset management approach with the introduction of the Competencies, Management, Operations and Maintenance program in 2001. This program was one of the first initiatives to require a form of asset management planning in the USA.

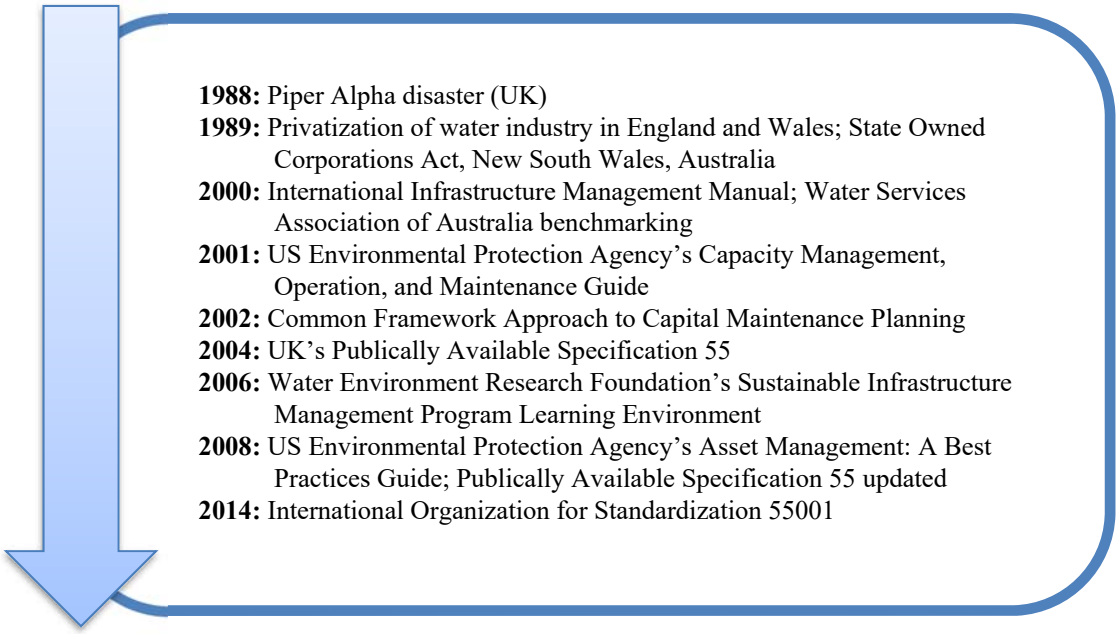


Figure 2.2 Evolution of Asset Management, adapted from "The Evolution of Asset Management in the Water Industry" (Jones *et al.*, 2014)

In 2004, the British Standards Institute (BSI), together with the Institute of Asset Management (IAM), published the Publicly Available Specification 55 (PAS 55). These specifications have been very successful, with wide use in the areas of energy, transportation, mining, process, and manufacturing industries. In 2008, 50 organizations from 15 industry sectors in 10 countries worked together to launch the latest update of PAS 55, known as PAS 55:2008. These were made up of two parts: 1. PAS 55-1:

Specification for Optimized Management of Physical Assets; 2. PAS 55-2: Guidelines for the Application of PAS 55-1. The new update provided clear definitions and a set of 28 specific requirements points to establish and verify alignment, optimization and the entire system of life management for all types of physical assets. At the end of July 2009, BSI, supported by IAM, submitted a proposal to form a "Project Committee" to develop an international standard. This ISO standard would be based on the good work already done at PAS 55 and which included knowledge of other industries and scientific societies located around the world. Thus, in January 2014, under the cover of the International Organization for Standardization (ISO), the ISO 55000 family of standards for asset management was published, (Pais *et al*., 2018).

As a standard based on continues improvement it´s used a PDCA cycle throughout all the stages of implementation and after its implementation; the PDCA cycle was originally proposed by Shewhart in 1950s in a different format. When he proposed, he had only three components in the cycle. They are: Specification – Production – Inspection. He defined in keeping in mind the Production and manufacturing processes that he worked on for improvement. It was used by various people for various purposes since then.
The famous Edward Deming often advocated for this in his speeches and books. Only in later 1950s it took a new life in the form of PDCA cycle. Deming often referred PDCA as Shewhart's cycle. But, because of the promotions done by Deming, it came to be known as Deming's cycle. Deming made a small change to it and called it PDSA, as he wanted to give more emphasis on 'Analysis' rather than just 'Inspection' or 'Checking'. (PDCA, 2019).

What does a PDCA cycle do? PDCA cycle advocated by Deming finds an important place in continual improvement. It helps a process to improve its performance on a staged and steady manner.

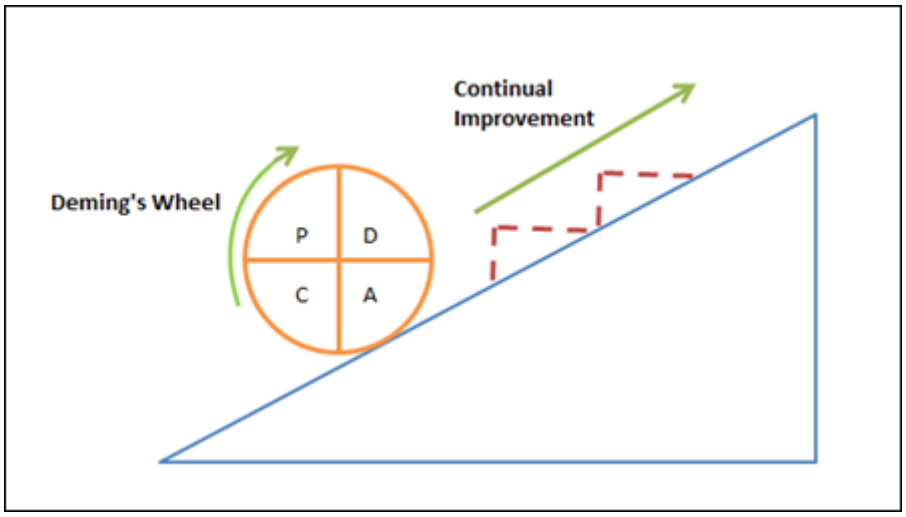


Figure 2.3 PDCA diagram (PDCA, 2019)

Some of the activities in each stage of a PDCA Cycle are:

Plan:

1. Establish the objectives and goals of the task to be improved or developed;
2. Describe the task in detail with clear specifications;
3. Develop a team that will be a part of the PDCA and set the deadlines;
4. Note down the data to be used, resources that will be needed, cost expected, risks and mitigating steps, manpower required, support needed from management;
5. Draw an implementation plan with breakdown of each task, owner, expected outcome, operating procedure or guidelines, etc.

Do:

1. As per the implementation plan, perform all the tasks;
2. Keep the stakeholders informed of the progress;
3. Adhere to the schedule and highlight any significant concerns and variations noted.

Check:

1. One the activity is performed, validate whether the outcome is as intended and planned;
2. Make a note of all variations, defects, best practices, pain areas and challenges faced;
3. Identify the root causes for the problems.

Act:

1. Correct the defects and make it comply to the specifications;
2. Identify the preventive actions for all the root causes identified;
3. Implement the preventive actions and check whether the outcome is as expected;
4. Repeat the steps Do-Check-Act until all the objectives are met to the satisfaction of the stakeholders.

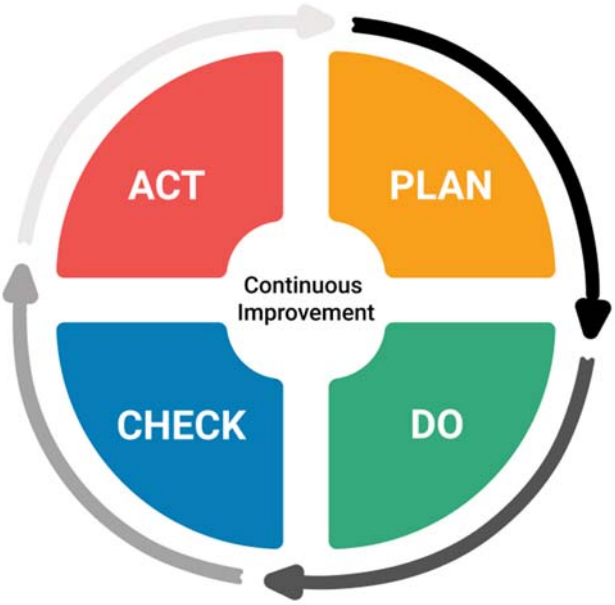


Figure 2.4 PDCA (PDCA, 2019)

Thus, the PDCA cycle will help in improving the performance of a process stage by stage in a steady and levelled manner becomes an excellent tool to use in processes where continual improvement is needed. There are other methods used just like the Hoshin Kanri Planning which is more complex and still uses a PDCA cycle in its bases.

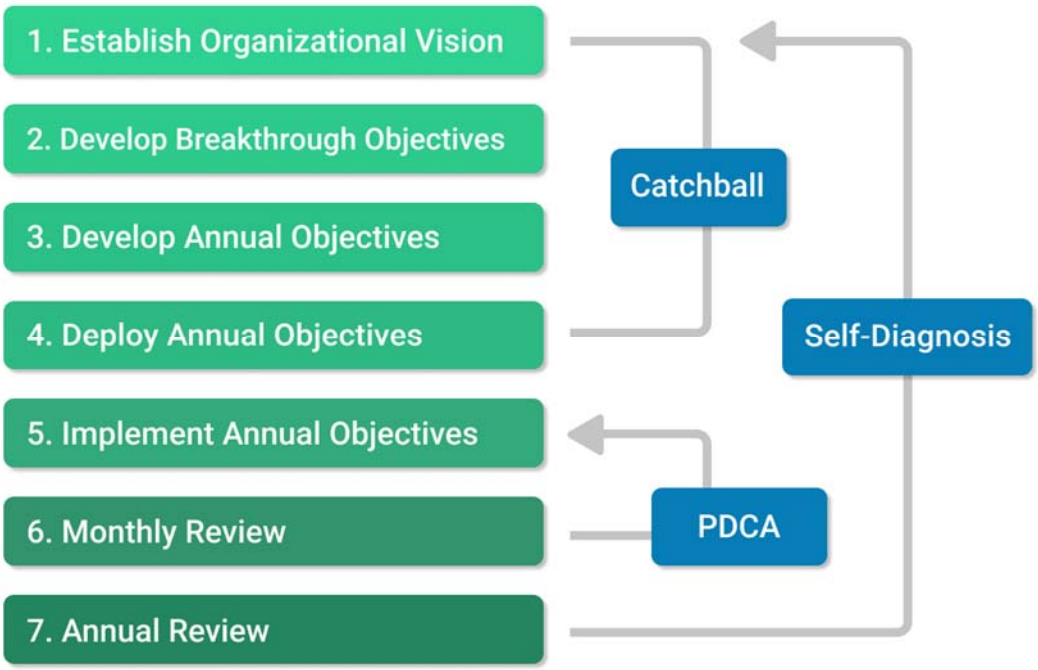


Figure 2.5 The Hoshin Kanri method (What Is Hoshin Kanri?,2019)

The use of a PDCA cycle it's always appropriated when starting a new improvement project, developing a new or improved design of a process, product or service, defining a repetitive work process planning data collection and analysis in order to verify and prioritize problems or root causes, implementing any change and working toward

continuous improvement, since asset management requires a continues improvement throughout every procedure it's an excellent tool to use and was planned to be used on asset management since its beginning.

Figure 2.6 Elements of PAS 55 (Woodhouse, 2019)

The formal documentation of good asset management practices has most recently been led by the development of PAS 55, published by BSI in conjunction with the Institute of Asset Management and 49 organizations from 15 industries in 10 countries. PAS 55 was first published in 2004 and substantially revised in 2008. It has been very widely adopted around the world, with great success as a tool for integrating and improving business practices, raising performance and assuring greater consistency and transparency. PAS 55 has now been translated into Spanish, French, Chinese, Russian and Portuguese.

The scope of PAS 55 is primarily the management of "physical" assets but is not limited to this category of asset. As is generally recognized, all asset types are highly interdependent, and the optimal management of physical assets also involves managing people, information, finances and intangible assets such as performance and activities. Indeed, it is the removal of silos and the consideration of assets in systems, along with the cross-functional optimization of their life cycles, that are core principles of good asset management.

PAS 55 was published in two parts: PAS 55-1 comprises the 28-point requirements and PAS 55-2 provides guidance for the application of PAS 55-1. The specification is structured around the familiar Plan–Do–Check–Act cycle of continual improvement, and aligns with corresponding requirements of ISO 9001, ISO 14001 and OHSAS 18001.

Given the popularity of PAS 55, and after consultation with industry and professional bodies around the world, the specification was put forward in 2009 to the International

Standards Organization as the basis for a new ISO standard for asset management. This was approved and the resulting ISO 55000 family of standards has been developed over the past years with 31 participating countries (Woodhouse, 2019).

To ensure consistency with other related management system standards and to facilitate its alignment or integration, it was considered that asset management would be best standardized as a specification, with the information on implementing asset management distilled into key requirements. The criterion for including such requirements has been that, without them, the asset management system would be regarded as deficient (BSI&IAM, 2008).

The PAS 55-1:2008, asset management is defined as systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset systems, their associated performance, risks and expenditures over their life cycles for the purpose of achieving its organizational strategic plan and organizational strategic plan that is defined as an overall long-term plan for the organization that is derived from, and embodies, its vision, mission, values, business policies, stakeholder requirements, objectives and the management of its risks. Effective implementation of asset management requires a disciplined approach which enables an organization to maximise value and deliver its strategic objectives through managing its assets over their whole life cycles. This includes determination of appropriate assets to acquire or create in the first place, how best to operate and maintain them, and the adoption of optimal renewal, decommissioning and/or disposal options.

The principal benefits of optimized life cycle asset management, in no particular order, include:

- enhanced customer satisfaction from improved performance and control of product or service delivery to the required standards;
- improved health, safety and environmental performance;
- optimized return on investment and/or growth;
- long-term planning, confidence and performance sustainability;
- the ability to demonstrate best value-for-money within a constrained funding regime;
- evidence, in the form of controlled and systematic processes, to demonstrate legal, regulatory and statutory compliance;
- improved risk management and corporate governance and a clear audit trail for theappropriateness of decisions taken and their associated risks;
- improved corporate reputation, the benefits of which may include enhanced shareholder value, improved marketability of product/service, greater staff satisfaction and more efficient and effective procurement from the supply chain;
- the ability to demonstrate that sustainable development is actively considered within the management of the assets over their life cycles.

Figure 2.7 Key principles and attributes of asset management (BSI&IAM, 2008)

The PAS 55-1:2008 is specifically intended to cover the life cycle management of the assets and, in particular, the assets that are core to an organization's purpose, such as utility networks, power stations, railway or road systems, oil and gas installations, manufacturing and process plants, buildings and airports. An asset management system is therefore vital for organizations that are dependent on the function and performance of their physical assets in the delivery of services or products, and where the success of an organization is significantly influenced by the stewardship of its assets.

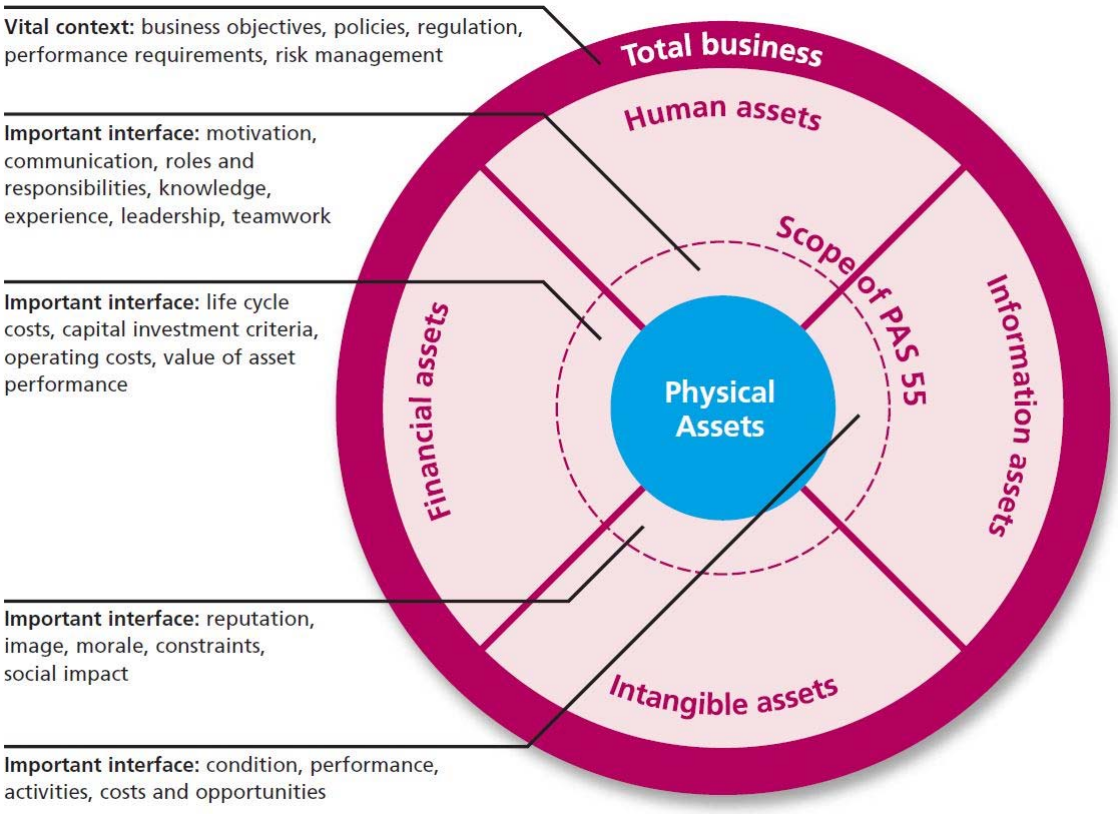


Figure 2.8 Focus and business context of this PAS in relation to the other categories of assets (BSI&IAM, 2008)

Delivering the best value for money in the management of physical assets is complex and involves careful consideration of the trade-offs between performance, cost and risk over all stages of the assets' life cycles. There are inherent conflicting factors to manage, such as short-term *versus* long-term benefits, expenditures *versus* performance levels, planned and unplanned availability, or capital costs *versus* operating expenditures. There are also different levels at which assets can be identified and managed – ranging from discrete equipment items or components to complex functional systems, networks, sites or diverse portfolios (Figure 2.6). This hierarchy brings challenges and opportunities at different levels. For example, discrete equipment items may have identifiable individual life cycles that can be optimized, whereas asset systems may have an indefinite horizon of required usage.

Sustainability considerations should, therefore, be part of optimized decision-making. A larger organization may also have a diverse portfolio of asset systems, each contributing to the overall goals of the organization, but presenting widely different investment opportunities, performance challenges and risks. An integrated asset management system is therefore essential to coordinate and optimize the diversity and complexity of assets in line with the organization's objectives, priorities and chosen risk profile.

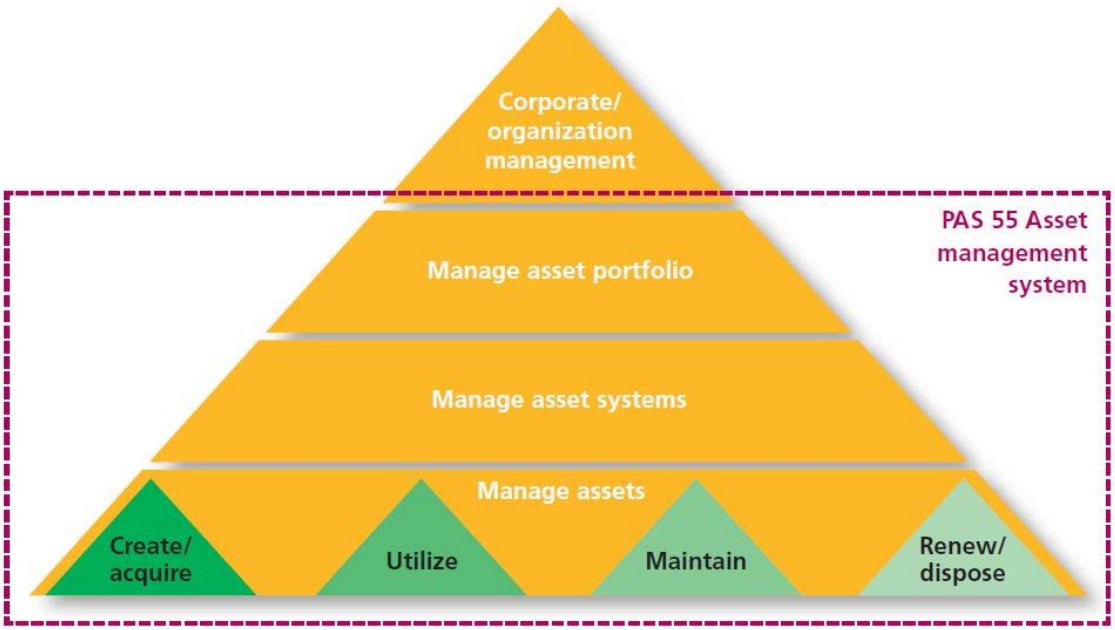


Figure 2.9 Levels of assets and their management (BSI&IAM, 2008)

In March 2005, an explosion occurred at BP's Texas City oil refinery, 15 people were killed. This was the worst industrial accident in the US for more than 10 years and led to lawsuits and inquiries. Carolyn Merritt, who chairs the US Chemical Safety Board, said in October 2006 that:

- *stringent budget cuts throughout the BP system caused a progressive deterioration of safety at the Texas City refinery* (Hastings, 2014)

The asset management is based on a collective work not in an individual even with different "languages" within the organization, most of the times decisions are made reactions for events that were unexpected and those decisions are made in isolation, cost, risk and performance should be take in consideration each time decisions need to be made and a common "language" should be used between them, many times the executive board isn't aware of the assets in the organization and every department in the organization seems to care just about himself and make decisions based on the information that they have, thus, as said before, this decisions tend to be reactive, and the departments forget that any decision doesn't concern just them but all the company and, normally, brings loss.

According to Isiadinso, BP had begun a lengthy maintenance project at their Texas city refinery, which required over 1000 contractors on site along with employees. Several trailers had been set up, close to the blow-down stack (figure 2.10), to serve as offices and meeting rooms for the contractors. In the early hours of Wednesday, March 23, 2005, workers began the start-up process of an isomerization unit by pumping highly flammable liquid into to a raffinate splitter tower, which would, normally, have approximately 2m of liquid at its base. Liquid height sensor and two alarm systems, for heights of 2m; and 3m; were installed to measure and report the height of liquid in the tower to operators and raise alarms if the liquid reached 2m and 3m respectively. However, the sensor was designed to measure heights up to 3m, and thus there was no way to tell the amount of liquid in the tower beyond that point. As workers pumped liquid into the splitter tower,

the liquid reached, and exceeded, the 3m mark, setting off the 2m alarm but not the 3m. As the liquid feed exceeded 3m, when the feed was stopped, and the height sensor reported 3m, while, in fact, the tower is believed to have reached 4m (Isiadinso, 2015).

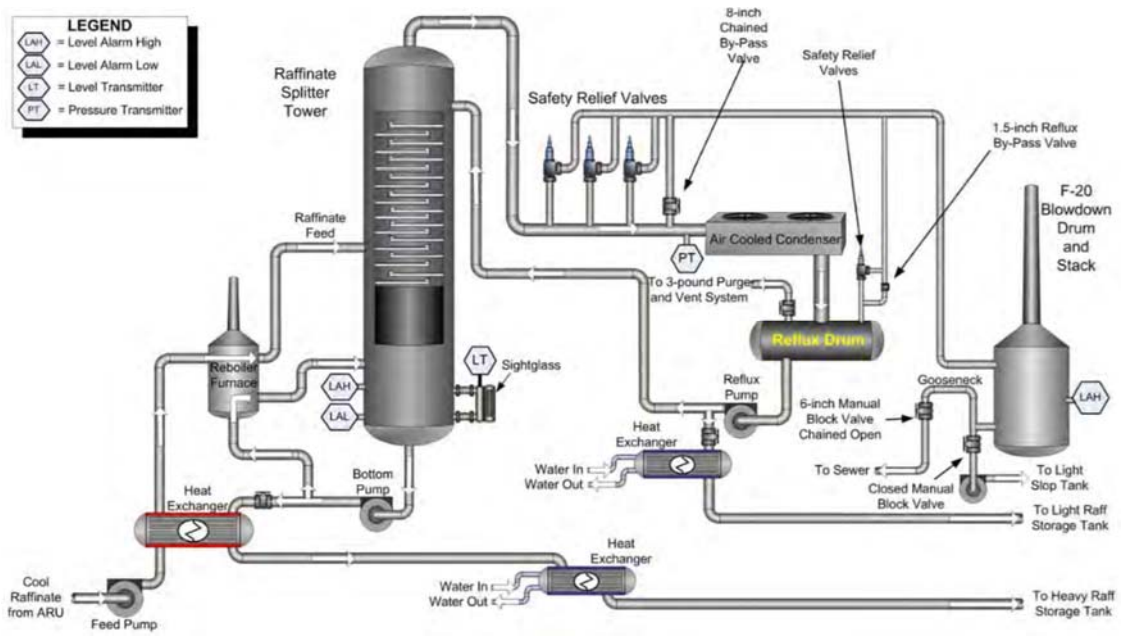


Figure 2.10 Raffinate section of Isomerization unit (Isiadinso, 2015)

Following a shift change, and very poor communication, operators recommenced the start-up process, adding more liquid to the overfull splitter tower. While liquid was being pumped in, no liquid was being pumped out, as specified in the start-up procedure, due to a level control valve being left closed. About 10 minutes later, as part of the normal process, operator lit burners in the furnace to heat up the liquid being fed to the splitter tower. With the level control valve still closed, the tower liquid level rose, and the height meter reported a height of under 3m; however, calculations show that the liquid reached 42m.

At 1 pm, the level control valve was opened, following a high-pressure alarm that caused a manual relief valve to be opened; this stabilized liquid level. However, liquid leaving the tower was at a very high temperature, and on exiting the heat exchanger (which was not designed to cool down very hot liquid), induced a temperature rise (over 150º) in liquid being fed to the tower. This caused liquid in the tower to boil and expand causing the liquid level in the tower to rise. Minutes later, the 52m, 586, 100l capacity splitter tower was completely full, and liquid flowed through an overhead pipe, down 45m, and forced open all three safety relief valves near the base of the tower; these valves redirected over 200000l of flammable liquid to the blow-down drum of significantly lower capacity. Like the tower, the blow-down drum was fitted with a liquid height sensor and an alarm, but when the drum over filled, the alarm failed to alert operators, who continued redirecting flow to the drum. Minutes later, there was an eruption of very hot highly flammable liquid, from the top of the blow-down stack, which fell to the ground creating a highly flammable vapour cloud that covered the entire refinery, especially the trailers housing the contractors. Ignition of the cloud, by backfire from an idling Diesel truck at about 1:20 pm, causing several explosions and fires, and sent shock-waves for miles in all directions.

The accident could be blamed on a wide range of failures, from mechanical to human process; however, the entire accident could be put down to human error. Starting at the very beginning with the location of the trailers. Second, employees, and maintenance workers knew how hazardous the isomerization start-up process was, but no alerted the contracts (who were in the trailers) about the start-up, as such contracts were unaware of what was happening until the eruption and explosion. Poor communication saw the situation on the ground being badly transmitted from ground operators to board staff, which lead to a one of the most obvious causes of the disaster (Isiadinso, 2015).

The lack in following procedures and communication resulted in 15 fatalities, over 150 injuries, and financial losses exceeding $1.5 billion. One small thing in a large organization brought great financial and prestige loss. The decisions made were correct to the ones that made them, but they forgot the others after and around them, clearly those decisions weren't made in a perspective of the overall system.

It has been a long road to consensus on an asset management standard. The project was launched in London in June 2010, followed by meetings of the full PC251 (Project Committee 251) at regular intervals across the world. Each of the 31 participating countries has its own mirror committees and processes to review and comment on the various drafts, resulting in thousands of hours of time going into the process. This culminated in a meeting in Calgary Canada in April 2013, where the final drafts of the standards were presented. Following this meeting – and some last-minute work – the standards were released to the world slightly ahead of schedule on 15 January 2014.

Obviously, however these standards do not represent the first attempts to codify good practice in asset management. In the sense we use it here, informal and proprietary asset management systems began to appear in the late 1990's. The discipline gained considerable impetus following a series of high-profile asset failures in out-sourced public utilities and infrastructure in the United Kingdom in the early 2000's and has spread from there. Some of the key dates are as follows:

- 2000 – First publication of the International Infrastructure Management Manual – an asset management publication targeted at local government and with a focus on appropriate asset management practices (vice systems);
- 2004 – First publication of PAS 55 – a "publically available specification" aimed at establishing appropriate asset management system (vice practices);
- Early adoption in UK rail/utilities and growth as a default standard across the world;
- 2008 – Second publication of PAS 55;
- 2011 – Second publication of the International Infrastructure Management Manual – aligned with PAS 55:2008;
- 2011 – First publication of the Asset Management Landscape – consensus of peak bodies (through Global Forum on Maintenance and Asset Management – GFMAM) on the content of the asset management discipline;
- 2012 – First publication of Asset Management – An Anatomy – practical guide to the Asset Management Landscape;
- 2013 – Second publication of Asset Management – An Anatomy;
- 2014 – First publication of ISO 55000;
- 2014 – First publication of ISO 17021-5 – a guide to auditor competency requirements for asset management assessment and auditing;

- 2014 – First publication of GFMAM Competency Specification for an ISO 55001 Asset Management System Auditor/Assessor – GFMAM consensus on the requirements for auditing against ISO 55001.

These documents have been supported by various initiatives by the peak bodies to both train and recognise asset management skills and competencies, including:

- 2009 – IAM Competency Framework and Endorsed Trainer Scheme – a coordinated set of asset management competencies with links to an associated schedule of role-based training courses and a scheme to authorise suitable organisations to deliver the training;
- 2009 – AMC Fundamentals of Asset Management course – a single day course to teach the fundamentals of the discipline;
- 2012 – IAM Certificate and Diploma – a set of "qualifications" linked to a formal assessment (examination) of knowledge and the pre-existing training scheme;
- 2012 – AMC Certification scheme (Associate, Practitioner, Senior Practitioner, Fellow) – a set of asset management competencies linked to an experience-based system of certification;
- 2014 – World Partners in Asset Management (WPiAM) Certified Asset Management Assessor scheme – a certification scheme linked to a formal assessment (examination) of knowledge against the GFMAM competency specification.

These lists are not comprehensive, but they clearly show the growing awareness of asset management and professionalization of the discipline over the last two decades. The release of ISO 55000 has accelerated the pace of change and promoted a consensus approach to the discipline, (Implementing ISO 55000, 2019).

3 Diagnosis

3.1 The Standard

There are several questions that people ask regarding ISO 55000:

- What is ISO 55000?
- Our organisation is required to comply with ISO 55001, where do we start?
- Isn't Asset Management just common sense?
- Will being certified against ISO 55001 improve our brand value?
- What are the absolute minimum requirements to get certified against ISO 55001?
- Is ISO 55000 relevant to my organisation – we already know how to look after our assets?

Although good Asset Management sound like common sense, the knowledge of what a comprehensive Asset Management system entails is not all common knowledge and some investigation or study may be required to understand the fundamentals. It is recommended that the leadership team understand the subject in order to guide the organisation down the correct path. Without this knowledge, there is a risk that the organisation over or under estimate the time, effort and resources required to achieve compliance.

This will provide an overview of the requirements but also provide some guidelines to the application of the standard.

A good place to start understanding what ISO 55000 all is about is to look at the definition of Asset Management as given in the standard overview document (ISO 55000:2014 – Asset management – Principles, overview and terminology). This document simply gives the definition of Asset Management as: "Coordinated activity of an organisation to realise value from assets".

This sounds again like common sense, but there are more to this definition than meets the eye. E.g. what is the real meaning behind "coordinated" and what is real "value"? In simple terms "Coordinated" refers to an organisation striving towards a common goal but also measuring progress along the way. "Value" can mean different things to different organisations and part of this journey is to uncover what matters to a specific organisation and how to use your assets to achieve it.

To understand Asset Management is to look at the fundamental principles of AM as defined in ISO 55000:2014 namely:

- Value - Assets exist to provide value to the organization and its stakeholders. An understanding of value and how the assets contribute to value is therefore important.
- Alignment - Asset Management translates the organizational objectives into technical and financial decisions, plans and activities. Asset Management requires line of sight from organisational objectives through to tactical plans and measures.

- Leadership - Leadership and workplace culture are determinants of value realisation. Asset Management requires management to take the lead and show commitment.
- Assurance - Asset Management gives assurance that assets will fulffil their required purpose. This requires the organisation to measure progress and performance with discipline and purpose, and typically include setting up performance measures and performing periodic reviews and audits (Starting on the Right Foot, 2019).

3.1.1 The Value of Asset Management

What is the value of Asset Management on implementing an Asset Management System?

ISO 55000 suggests the following value can be gained from applying the standard:

- Improved financial performance;
- Informed asset investment decisions;
- Managed risk;
- Improved services and outputs;
- Demonstrated social responsibility;
- Demonstrated compliance;
- Enhanced reputation;
- Improved organisational sustainability;
- Improved efficiency and effectiveness.

The above are some generic examples of the value of good Asset Management but what is the real value in the context of real organisation? (Starting on the Right Foot, 2019)

3.1.2 The Real Value of Asset Management

It seems the words "real" and "really" appears many times - the reason for that is that if you don't really understand why you are doing this, you may start down the wrong track, on the wrong foot, expecting unrealistic or irrelevant outcomes. This is not a shorth term project, it is a long-term commitment that will require resources and commitment for the long term and are bound to fail if the wrong expectations are created at the start, especially to senior leadership. There should be developed a business case to determine and document the value of asset management and should be considered the following questions:

- Which of the major risks in your organisation will be addressed through this approach? By how much will the risk be reduced?
- What benefit could I gain from implementing an Asset Management system – e.g. increasing revenue, production or productivity?
- What costs can I save by taking decisions that consider cost risk and benefit over the life cycle of an asset?

The diagram below shows some of the value drivers that could be considered:

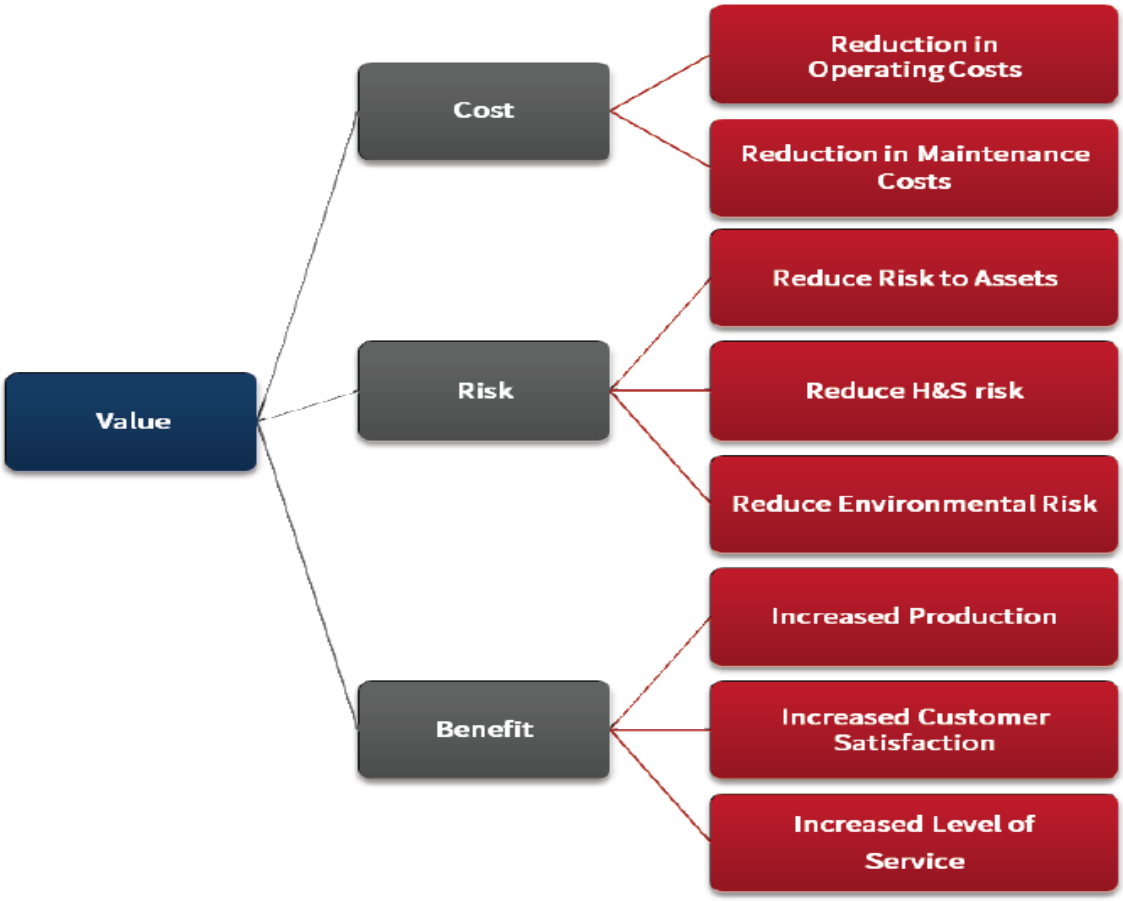


Figure 3.1 Value drivers of Asset Management (Verhoef,2018)

At this point we still not sure of the benefits to the organizations, but there should be a commitment to start an Asset management journey. Another aspect to consider is the cost and time required for implementing an ISO 55000 Asset Management system. One way to get an understanding of value, cost, time and resources is to perform an ISO 55000 readiness assessment.

Figure 3.2 ISO 55000 Readiness Assessment (ISO 55000 readiness assessment, 2019)

No matter what the current level of Asset Management maturity has in the organisation; before attempting to align the Asset Management systems and processes with good practice (as outlined in ISO 55000) it is important to understand just how big or small a task that will be. This is true regardless of whether the company is already certified to PAS 55, or are just starting out on the journey towards better Asset Management within the organisation.

While the organization could jump straight in and conduct a full Gap Assessment against the requirements of ISO 55000, just because some of the fundamental building blocks are not in place in the organisation, then this may lead to false starts and unrealistic expectations regarding the potential costs and benefits.

These basic steps should be considered before commencing on the asset management journey.

- Leadership buy in, this is surely a top down initiative, the leadership team has a good understanding what an Asset Management System is and the potential benefits. An introductory course or conference would be a good starting point.
- Get input from stakeholders on what benefits they expect to gain from Asset Management and therefore what will the drive behind the journey be.
- Get alignment internally, communicate, share and negotiate but making sure all internal stakeholders agree on what the major benefits will be and ensure that it matters to the organisation and constitutes real value.
- Determine the approach to compliance with the standard. What do application options exist?
    - Certification - certification usually applies where regulators explicitly require certification or if there is a competitive advantage in certification;
    - Compliance - aiming to comply but not certify, this may cost less but still have significant benefit;
    - Alignment - also a lower cost option than certification but with some value gained.
- There should be a clear information about funds and resources that will be required for this initiative and create a clear picture of what will be required in order to minimise surprises down the track.
- Have a roadmap for the journey, the understanding / taking stock of what you have and what you still need to develop. This can be determined through an ISO 55000 readiness assessment. The output of a readiness assessment should give a roadmap for the journey and may also uncover some benefit to the organisation.

In order to start on the right foot, the organisation needs to have a clear understanding of value and have the required buy-in and commitment right at the beginning of the journey (Starting on the Right Foot, 2019)**.**

3.2 Application of ISO 55000

While history will be the ultimate judge, there is strong potential for ISO 55000 to be adopted broadly. In fact, ISO has suggested it was likely to be its second biggest selling standard within two years of publication. This prediction didn´t come to pass, but the ISO 55000 as a series of ISO standard will move surely asset management from the historic "bottom-up" drive to a "top-down" drive. That is, instead of the technical elements of a business seeking to push asset management concepts up through their organisation to improve efficiency we will now see regulators and boardrooms drive implementation for one or a combination of the following reasons:

- Regulatory Compliance – With its status as an ISO standard, ISO 55000 will most likely become the basis on which economic regulators will assess the adequacy of pricing submissions received from the organisations that they regulate in ensuring that the represent "value for money" while also protecting the longer term integrity of the assets and satisfying public interests;
- Contribution to Due Diligence – For those not working in regulated industries, ISO 55000 is likely to serve as a benchmark for appropriate stewardship of an

organisation's assets and therefore afford some legal protection in the event of safety, environmental or financial issues. Insurers may also assess the adequacy of an organisation's Asset Management system using ISO 55000 when determining premiums, providing additional incentive;

- Marketing strategy – Some organisations may simply see some form of certification as offering an inducement to investors or providing some other commercial advantage. If the objective is merely to "tick the box" with certification rather than improve their Asset Management performance, then this may drive inappropriate behaviours;
- Competitive advantage – Some boardrooms may see the potential for organisational efficiencies and subsequent commercial advantage inherent in good asset management practices. This will most likely drive the most committed and holistic approach to implementing ISO 55000, with a focus on improving the business over certification.

Regardless of the organisational imperative, there are a range of ways that an organisation might seek to apply ISO 55000:

- Alignment – an organisation might choose simply to benchmark its current practices against ISO 55000 and adopt those elements it considers appropriate. This might be appropriate for existing, large organisations in lightly regulated industries, where the cost of changing embedded practices might exceed the benefits of moving to an ISO 55000 compliant asset management system (at least in the short term!). There is a sliding scale here, from simply benchmarking to almost full compliance and we would recommend any asset-owning organisation give at least some consideration to aligning their practices with the ISO 55000 standards;
- Compliance – an organisation may choose to develop an asset management system that is fully compliant with the requirements of ISO 55001, but not seek certification. This could potentially yield all of the benefits of a certified asset management system, but without the initial and on-going cost of certification. This might be appropriate for a medium to large start-up organisation in a lightly regulated industry. In this case, using ISO 55001 to guide the development of an asset management system will likely be both less expensive and more effective than starting with a blank sheet of paper or practices "borrowed" from similar existing organisations;
- Certification – an organisation might choose to embrace the full certification process. This will obviously incur costs in both achieving and maintaining certification and we would tend to recommend this approach only where there is a clear business case. Examples would include a mandatory regulatory requirement or a clear market/insurer incentive (What is ISO 55000?, 2019).

3.2.1 Asset Management Policy

One of the core documents required by ISO 55001, is an Asset Management Policy, two key definitions are contained in ISO 55000:2014:

- "Policy" – it is the "intentions and direction of an organisation as formally expressed by its top management" (ISO 55000:2014 Section 3.1.18);
- "Top management" – that is, in turn, defined as being "person or group of people who directs and controls an organisation at the highest level".

Primarily, the ISO 55001:2014 states (in Section 4.3) that the scope of the organisation's Asset Management system should be aligned with the Asset Management Policy - the Asset Management System is the management system to manage the organisation's assets. It is used by an organisation to plan, coordinate, control, execute, monitor and improve the activities associated with managing assets. It is not just a computerised information system, although this may form part of an organisation's Asset Management System. The Section 5.2 of ISO 55001:2014 requires that the policy is aligned with and consistent with other organisational policies and plans (including the Strategic Asset Management Plan).

Second, it is a requirement of ISO 55001:2014 (in Section 5.1) that Top Management demonstrates leadership and commitment by, amongst other things, ensuring that the Asset Management policy is established and is compatible with the organisation's overall business objectives. Top leadership involvement in the development of the Asset Management policy is clearly important.

Third, Section 5.2 of ISO 55001:2014 has some specific requirements regarding the content of the Asset Management Policy. Amongst these are that it should:

- be appropriate to the purpose of the organisation;
- provides a framework for setting Asset Management objectives;
- includes a commitment to satisfying applicable (mandatory and legal) requirements;
- includes a commitment to continual improvement of the Asset Management System.

In addition, there are a number of other requirements concerning things such as:

- a requirement for the policy to be documented, available and communicated, and,
- a requirement for the policy to be reviewed on a regular basis and updated if required.

While the requirements of ISO 55001:2014 are mandatory (at least for those seeking alignment or certification against this standard), ISO 55000:2014 (the Overview, Principles and Terminology document) and ISO 55002:2014 (the Application Guidelines document) contain a number of other items which provide guidance when developing your Asset Management Policy. These include:

- a suggestion that the principles by which the organisation intends to manage its assets are set out in the Asset Management Policy, while the approach to

implementing these principles is contained in the Strategic Asset Management Plan;
- the Asset Management Policy should be a short statement and need not be a separate document – for example, it could be contained within the Strategic Asset Management Plan.

ISO 55002:2014 also (in Section 5.2) suggest that the policy commits the organisation to applying specified principles when making decisions relating to asset management, and gives some examples of the types of commitments that could be made, such as:

- a commitment to provide the resources necessary to deliver the organisation's asset management objectives;
- a commitment to use specified decision-making processes or guidelines when making decisions about assets;
- a commitment to measuring and reporting on asset and asset management performance;
- a commitment to the achievement of long-term, sustainable outcomes.

What should the Asset Management Policy contain? First, it should be short, no more than one or two pages. Asset Management Policy should be similar in nature to the organisation's Safety Policy or Environmental Policy. Typically, those documents of one-page are posted conspicuously around the organisation. It is important to remember that the policy should provide high level guiding principles only, and the detail should be contained in other documents, most likely in your Strategic Asset Management Plan, or in other related policies, plans and procedures.

Second, the policy should be useful in providing guidance regarding asset management and asset-related decisions. The Asset Management Policy should indicate high level principles that should be applied when deciding. The exact principles contained in the policy depend, at least to some extent, on the organisation's industry, its overall strategy, and the environmental context within which the organisation operates. Nevertheless, there are likely to be many common elements that will apply to most, if not all, organisations.

Third, there are some mandatory elements that should be in any Asset Management policy. These are:

- a commitment to comply with all relevant legislative, regulatory and legal requirements, and
- a commitment to continual improvement of the Asset Management System.

How should Asset Management Policy be developed? At least as important as what the Asset Management Policy contains is how it is developed. As mentioned earlier, Top Management needs to demonstrate their commitment to the effective management of assets within their organisation, and one of the key ways that they do this is through the Asset Management Policy. It makes sense, therefore, that they are involved in developing and agreeing to the policy, and that this policy is subsequently signed by Top Management, or a member of the Top Management team. In this sense, the Asset Management Policy should be considered as being similar to the Safety Policy or Environmental Policy that exists in most organisations. So, it is recommended that the

Top Management team, in an interactive workshop or workshops, develop the Asset Management Policy, if possible.

It is also important that the structure and length of your Asset Management Policy is consistent with other policies (such as Safety Policy and Environmental Policy) that the organisation may have. Making a consistent message regarding the importance of all of these policies and ensure that the length and level of detail contained in your Asset Management Policy is consistent with these other policies.

After Asset Management Policy is developed, it is vital that it is communicated for the entire organisation, and that it forms the basis on which Asset Management decision making is founded. So, the visibly around your organisation it is essential, should be considered places like, meeting room walls, notice boards, intranet and reception areas. The Asset Management Policy meaning must be made know to everyone in the organization, this could be via team briefs, a short video presentation as part of a regular communication meeting or many other ways and included in the process for new employees. The organization members need to understand what the implications of this Asset Management Policy is for them, and the decisions that they make that have an impact on your assets (How to write a Good Asset Management Policy, 2019).

3.2.2 Strategic Asset Management Plan

According to ISO 55000, the Strategic Asset Management Plan (SAMP) is a documented information that specifies how organisational objectives are to be converted into asset management objectives, the approach for developing asset management plans, and the role of the asset management system in supporting achievement of the asset management objectives. This definition clearly shows that its role is to capture asset management objectives that link the organisational objectives to lower level plans. The SAMP therefore has a pivotal role in the asset management document hierarchy as illustrated in Figure 3.3.

Figure 3.3 Asset Management document hierarchy (Developing a Strategic Asset Management Plan, 2019)

In this role, the content of the SAMP must be driven by the larger asset management planning process. The ISO 55001 compliant planning process is illustrated in Figure 3.4.

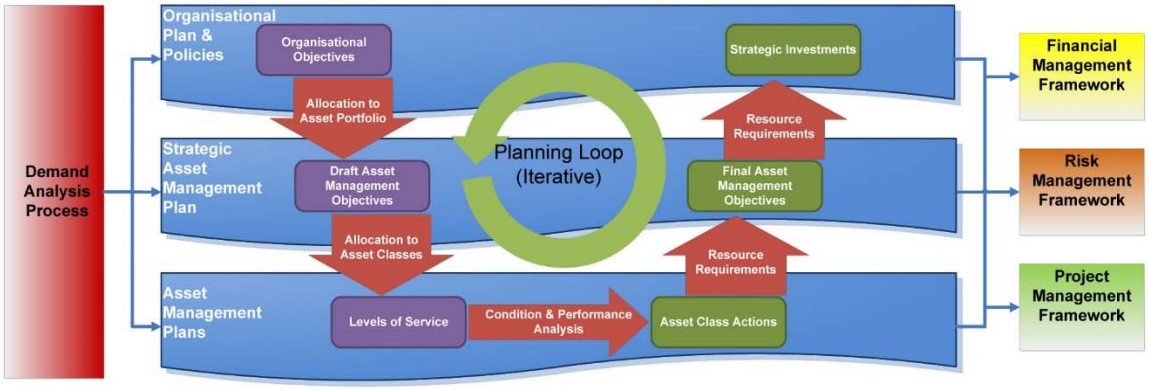


Figure 3.4 Asset Management Planning Process (Developing a Strategic Asset Management Plan, 2019)

The Figure 3.4 shows how the iterative planning process will generate asset management objectives that are aligned with the organisational objectives, informed by demand information (i.e. stakeholder wants and needs) and consistent with the condition, performance and capability of both the asset portfolio and the asset management system. What is an asset management objective? These are the "results to be achieved" or the aims/goals/targets for asset management. They address both the assets and the tools for managing them (i.e. the asset management system) and examples might include:

- achieve 94% availability in the process plant;
- expand capacity to 2.4 million units per annum, or,
- introduce a new Enterprise Resource Planning (ERP) system to support expansion to multi-site operations.

As seen from the examples, these objectives reflect the outcomes that asset management should produce rather than the methods for achieving them. They therefore need to be supported with appropriate high-level actions that will deliver them. As with any actions, good strategic initiatives will be adequately resourced with clear timelines, measures of success and accountabilities. These high-level initiatives may, however, be delivered either as a project in their own right or by allocating appropriate levels of service and detailed objectives to subordinate plans, as illustrated in Figure 3.4. Possible initiatives matched to the objectives above might be:

- apply lean maintenance to the process plant to increase availability by 10% by the end of the year;
- commission Train 3 by the end of 3rd quarter;
- implement Systems Applications and Products (SAP) across the business by the end of the year.

When combined with the Asset Management Objectives, the strategic initiatives provide the required direction for lower level planning. These are, however, the deliverables from

the planning process and the SAMP is merely the method for documenting these. The quality of the planning process will determine whether the Asset Management Objectives and strategic initiatives are appropriate, achievable and accomplished. The quality of the SAMP will determine whether these objectives and initiatives can be communicated to the people who need to use them. Consequently, the SAMP will be "good" if it is a successful communication tool that delivers the right information to the right people at the right time. Let's look at each of these individually.

Having the "right information" obviously relates to appropriate, achievable asset management objectives and is mostly dependent on carving out an appropriate role for asset management planning within the organisation's strategic planning hierarchy. This can be a challenge since most organisations have been undertaking strategic planning for a long time but only recently tried to introduce formal asset management planning. Consequently, we often see organisations where the organisational plan covers the key asset investments and implementing the SAMP is merely a "nice to have", to be attempted if resources allow.

While the "right people" will clearly vary with organisational structure, the customers for the SAMP usually aren't in the asset management area, since these people already know what is happening in the area. The most common customers are:

- Executives - who need to understand what the assets (and the asset management system) are going to deliver, sign off on the associated resources and track progress;
- Technical Managers - who need to write the detailed asset management plans for their specific assets;
- Other Managers (Administration; Finance; Human Resources; Research and Development; Procurement and Project) - who need to understand the asset management system and to deliver to support it.

Delivering the information at the "right time" is more about the method of delivery, since the SAMP is always waiting. The key is to ensure that the document is presented in a way that lets the "right people" get the information they need, which implies a short, readable document that clearly lays out the Asset Management Objectives and strategic initiatives with enough background to understand why they are important and appropriate.

The ISO 55000 does not actually require very much of the SAMP at all. In fact, it only specifically requires inclusion of the asset management objectives and documentation of the role of the asset management system in delivering the Asset Management Objectives. There are a few implied requirements such as clause 4.3, which requires the scope of the asset management system to be aligned with the SAMP and therefore implies that the SAMP must provide a basis for this, and clause 6.2.2, which similarly implies the SAMP must provide a basis for establishing the subordinate asset management plans required to achieve the asset management objectives. Overall, however, there is little guidance on the content of a SAMP within ISO 55001.

ISO 55002 provides guidance on implementing ISO 55001 and makes the following recommendations regarding the structure and content of the SAMP:

- the SAMP should document the approach to implement the principles laid out in the asset management policy;

- the SAMP should document both the framework for achieving the asset management objectives and their relationship to the organisational objectives;
- the asset management documentation (including the SAMP) should be scaled to match the organisational size/complexity (from a single document combining the organisational plan, SAMP and subordinate plans to separate documents with additional layers of plans below the SAMP);
- the SAMP should include a statement of stakeholder needs;
- the SAMP should include a statement of scope for the asset management system;
- the SAMP could include the asset management policy if desired.

There are also a few other items that are required by ISO 55001 as documented information and are therefore candidates for inclusion in the SAMP:

- the method and criteria for decision making and prioritising;
- the processes and methods for managing assets over their life cycles;
- the actions to be taken, including resources, responsibilities, timeframes and evaluation methods;
- the planning time horizons and review periods;
- the implications of the plans;
- the actions to address risks and opportunities.

Because the guidence from the standard is limited around the SAMP requirements. The ISO standards leave a great deal of latitude regarding the content and structure of this document. In fact, doesn't even need to be called as SAMP, it can be called an asset management strategy or whatever else the organization decide (Developing a Strategic Asset Management Plan, 2019)**.**

3.2.3 Asset Management Plan

According ISO 55000 the Asset Management Plan is a documented information that specifies how organisational objectives are to be converted into asset management objectives, the approach for developing asset management plans, and the role of the asset management system in supporting achievement of the asset management objectives. This definition clearly shows that its role is to capture asset management objectives that link the organisational objectives to lower level plans. The Strategic Asset Management Plan (SAMP) therefore has a pivotal role in the asset management document hierarchy as illustrated in Figure 3.5.

The ISO 55000 says that Asset Management Plan (AMP) it´s a documented information that specifies the activities, resources and timescales required for an individual asset, or a grouping of assets, to achieve the organisation's asset management objectives. This definition really captures the intent of the Asset Management Plan, which is to write down the things that need to be done to deliver the asset management objectives. As these objectives are derived from the organisational objectives, it also emphasis the hierarchical nature of the core asset management documents as in Figure 3.5.

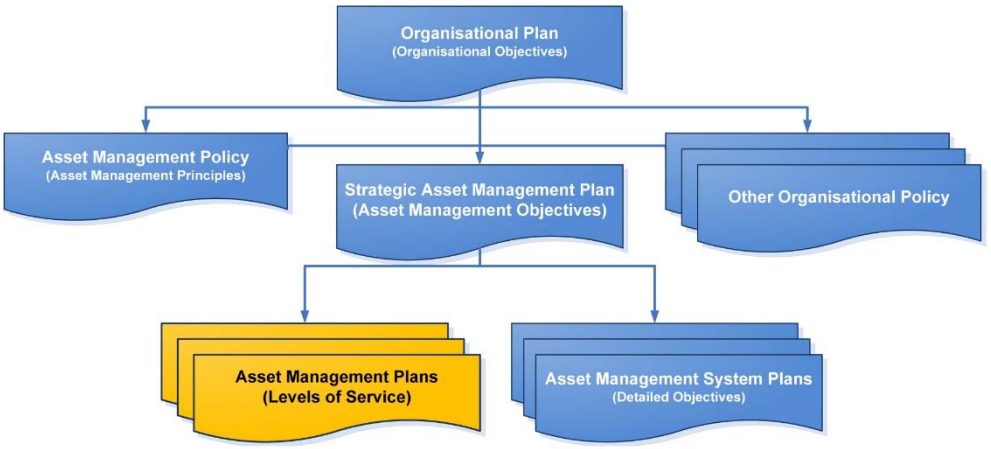


Figure 3.5 Asset Management document hierarchy (What Does a Good Asset Management Plan Look Like?, 2019)

There can be multiple plans in this diagram, but we should note that this is not a requirement of the definition, nor is it a requirement of ISO 55001:2014, which simply states:

- *The organization shall establish, document and maintain asset management plan(s) to achieve the asset management objectives. These asset management plan(s) shall be aligned with the asset management policy and the SAMP.*

The standard does require documentation of decision criteria, processes and methods for managing assets, but very carefully does not require these to be part of an Asset Management Plan, even in the guidance in ISO 55002:2014. The guidance does, however, emphasise the need for an iterative planning process that will allow the organisation to balance its objectives with its available resources.

Asset Management Plans need to capture the lower level outcome of a comprehensive Asset Management planning process that is integrated with other organisational planning activities ISO 55001 compliant planning process is illustrated in Figure 3.4.

The iterative planning process will generate Asset Management Objectives that are aligned with the organisational objectives, informed by demand information (i.e. stakeholder wants and needs) and consistent with the condition, performance and capability of both the asset portfolio and the Asset Management system. These Asset Management Objectives must be further broken down into detailed objectives applicable to specific assets or asset classes, that are commonly knowned as "levels of service". Detailed information on the current condition and performance of the assets can then be used to identify gaps and establish actions to close them. These then roll up into coordinated projects across multiple asset classes and eventually into strategic programs across the organisation. In every stage, the resources required are compared with the resources available and the iteration is undertaken to balance these. The final outputs will be delivered and tracked through other organisational frameworks such as budgeting, risk management and project management.

Should be clear that Asset Management Plans are about communication. The planning process establishes what needs to be done to deliver the organisation's objectives and the job of the plans is to communicate these requirements. In order to achieve it, the plans communicate from the asset managers (who conducted the planning) to:

- Internal staff (who need to complete the actions);
- Management (who need to provide the resources);
- Other Asset Managers (who need to know what performance to expect from this asset class);
- Other specialists (such as Human Resources or Learning and Development, who need to know what is expected of them).

The success of an Asset Management Plan should therefore be judged on its performance in these key roles and this allows us to define recommended content for a "good" Asset Management Plan as well as a recommended structure for an organisation's suite of plans.

In order to deliver on its role as a communication tool, an Asset Management Plan must clearly be read and understood. To this end, it is recommended a focus on the following three points with regards to the content of an asset management plan:

1) Keep it *short* - everybody is busy and long plans simply don't get read. Short plans are also much easier to maintain;
2) Make it *visual* - tables and graphs can convey significantly more information than the equivalent space in words. They also break up the document, making it easier to read;
3) Use *references* - by referencing other plans and data sources, the information is available for those that need it without cluttering up the plan for those who don't. It also avoids issues with discrepancies between the different data sources that could lead to incorrect decisions and allows for each document/reference to be reviewed and updated on a timescale appropriate to its content.

The following format can be useful in this regard:

- *Asset Class information* - a description of the scope of the particular plan, including the criticality and value of the assets and any interdependencies with other assets for the delivery of that value. For example, customer facing assets such as trains are often dependent on a large number of other Asset Classes (track, stations, signals, and so on). Changes in these other assets can have a significant impact on delivery of value if not well considered.
- *Owners and Stakeholders* - a list of roles and responsibilities relevant to the Asset Class(es) covered by the plan. This supports interaction between these stakeholders and appropriate distribution of the plan.
- *Current and Desired Levels of Service* - the Asset Management Objectives specific to the content of the plan. These typically consist of a level of service statement supported by one or more performance measures with appropriate targets; for example, "Best in class reliability", supported by a Mean Time Between Failure measure with a target of 1000 hours. Historic performance against the target and anticipated future changes in the target should be shown as these are indicators of gaps to be closed. This content is ideal for presentation in tables or graphs.
- *Life Limiting Factors* - a description of the key factors expected to drive the equipment out of service – e.g. fatigue, cost, obsolescence or demand changes. This content recognises that asset lives from acquisition are merely estimates

used to justify the expenditure and that the true disposal point requires more careful tracking.

- *Health, Safety and Environment* - a description of any issues in these areas affecting the management of the asset. For example, this area might record a known change in legislation requiring the existing fleet to be retired before a specified date.
- *Life Cycle Strategies* - this section describes the approach to each phase of the asset's life cycle and any known issues. It would typically reference detailed content such as the maintenance program, basis of design documentation, statement of operating intent or similar information. It would, however, identify issues with these documents, such as a recent change in operations that is outside the original strategy.
- *Budget* - a summary of the detailed budget showing the required and allocated resources for management of this asset, divided into segments appropriate to the organisation (e.g. sustaining capital, expansion capital and so on).
- *Risks* - a summary of the key asset management risks (not the entire risk register – though this might be referenced) that currently affect the asset.
- *Actions* - the list of prioritised and resourced actions to address the gaps. Examples of actions might include:
    - acquisition of additional assets to meet increasing demand or to replace old assets;
    - disposal of old assets to meet declining demand or control risks associated with failure;
    - application of Reliability Centred Maintenance techniques to reduce maintenance costs or to improve reliability;
    - modification of assets to expand their functionality or increase reliability;
    - an Operator Driven Reliability program to reduce failures associated with operator error or misuse.

The structure "tells the story" of the asset, with the final actions building from the issues identified in each section. There should not be more than 6-8 pages of content per asset class, bearing in mind that the audience for the document is not the technical experts in the asset, but they already know what is required.

There is no "right way" to structure your asset management plans. The simplest case is for discipline-led organisations. In that case the organisation has a strong central technical group broken into "disciplines" with clearly defined responsibilities for specific areas of the asset portfolio (for example, many organisations recognise structural, mechanical and electrical disciplines). In this case, it is generally sensible for each discipline to maintain one or more Asset Management Plans, each covering a specific Asset Class. Risks associated with this approach include a prioritisation of technical requirements over business objectives, including inadequate interfaces between the disciplines and poor overall prioritisation of activities. These can be addressed by a strong SAMP process to force cross-functional collaboration.

Another option can be a single Asset Management Plan covering the entire asset portfolio. This minimises the effort required in the preparation and maintenance of the plan and is therefore suited to organisations with simple asset portfolios or minimal Asset Management resources. The risk is, naturally, that the single plan does not provide enough

resolution to identify key asset management issues lurking in the detailed performance information for the assets.

Our final option is a zone-led approach. Here, the organisation is divided into operational regions or zones that are largely independent. If there is limited central technical support, then each zone manager must run their own Asset Management Plan(s), even where they operate similar assets. In this case, the risk is generally around inconsistent approaches to the same Asset Class, resulting in sub-optimal performance. This can be offset by establishing exchange forums to ensure differences in practice are discussed and best practice is shared across the organisation.

There can be diferent structures for the Asset Management Plan. For example, you may operate a zone structure, but allocate specific Asset Classes to each zone manager to conduct planning (What Does a Good Asset Management Plan Look Like?, 2019).

3.2.4 Asset Management Strategies and Plans

The figure 3.4 shows the organisational objectives as given, but many of the corporate business plans or other organisational level strategy documents we see are not that explicit. This is a critical first step, since it ensures that all of the remainder of the planning proceeds from a single set of requirements. To get it right, the organisation needs to spend some time understanding what it does and the environment it is doing it in. The relevant factors vary greatly with industry, but include external factors such as economic, social and environmental conditions and internal factors such as governance and culture. There are many ways to do this, but the Strengths, Weaknesses, Opportunities and Threats (SWOT) approach is a good way to start.

The analysis at the organisational level doesn't end there. An understanding of context leads to identification of the stakeholders, whose needs will be key to understanding the organisation's value proposition and setting appropriate objectives. A particular failing that we have seen is to skip some of the stakeholders, resulting in an incomplete definition of value. Most people recognise their customers and owners as stakeholders, but forget about their regulators, contractors and internal employees, all of whom have a critical role in establishing value. In practice, you should have a proactive relationship with all of your key stakeholders and a deep understanding of their needs and objectives and how they interact with your own.

In the Figure 3.4, these two activities (understanding context and engaging stakeholders) are part of the "demand analysis" process shown on the right and is the key to success in the planning process.

At the Strategic Asset Management Plan level, the demand analysis process is about understanding how the asset base works to deliver the organisational objectives (e.g. which systems are the most critical from each of cost, risk and performance perspectives) as well as the appropriate level of asset management maturity to manage cost, risk and performance. The various asset management objectives will fall out of this process and will reveal further stakeholders that must be engaged; for example, manufacturers and prime contractors when you wish to expand your assets and perhaps employees and unions when your market is contracting. Again, we've seen a number of organisations that don't recognise the importance of these stakeholders and therefore don't engage them early enough or deeply enough. A greater problem at this level, however, is the generation of "shelfware" – documents that meet the ISO 55000 requirements, but that are not really accepted or adopted by the organisation and therefore spend all of their time sitting on

the shelf rather than adding real value to the organisation. When we see them, they are usually out of date and any success is "despite" rather than "because of" the documents.

There are a number of reasons that organisations generate shelfware as follows:

- Bolt-on documentation - Almost every organisation already has some form of corporate strategic plan, and many already have a range of subordinate plans for divisions, branches or other groups. These usually already include asset management tasks and objectives and staff are using them. When specific documentation to support the asset management system is "bolted on" to this framework, it becomes an unnecessary additional burden and there is a tendency to produce the required document and then shelve it and get back to business as usual.
- Compliance without consideration - We often see organisations that have rushed into the implementation of ISO 55001 without spending enough time thinking about the appropriate structure for them. Their Strategic Asset Management Plans are compliant with the requirements of the relevant standard but are not fit for purpose given the structure and nature of the organisation. For example, one organisation produced a very technical strategy document and then passed it to a group of regional managers that did not have the background to understand or apply it.
- Excessive length - Many organisations make the document too long and then find that their people don't have the time to read and understand it or the organisation as a whole doesn't have time to maintain it.
- Lack of engagement - If the Strategic Asset Management Plan is the product of a small asset management elite within a larger organisation, the staff that should be using it to guide their activities can lack the sense of ownership they need to encourage compliance. On other occasions, they are simply unaware that the document exists at all.
- These issues are not new – similar problems emerge with any change to an organisation's key planning documents. Consequently, we have a good idea of what will work to solve them: design the asset management planning process. Some good steps are:
    - Plan first, write later - The planning process itself needs to be at the heart of the activity. Design a process that gets the right people in the room with the right information to genuinely understand the organisation's objectives and translate these into Asset Management Objectives. This will usually occur through a workshop or series of workshops; the following tips can be used to get the best out of these:
        - distribute useful pre-reading (the organisation's strategic plan, audit reports, KPI records, and so on) to attendees with a clear expectation they will be reviewed;
        - formally assign responsibilities for additional preparation (e.g. operations manager to have the production plan on hand, maintenance manager to have the statutory maintenance requirements);
        - consider using an external facilitator to provide an impartial mediator and secretariat for the process;
        - formally minute the workshops/strategy sessions.

- Reuse existing documentation - Have a critical look at the organisation's current planning documents. Do they work? If so, it is far better to incorporate an asset management section into them rather than to create a new document. Remember, ISO 55000 cares about the achievement of the intent of the requirements rather than the specific documents used.
- Define the audience. Regardless of the specific documents in use, you need to have a very good idea of who the reader is for each document. This will allow the structure, content and length to be match to them and create a document that they are much more likely to use. For example, executives need to get to the heart of the matter very quickly and with a focus on the linkage to the organisation's objectives and the resources required to achieve them. Lower levels need more technical detail so they can execute their specific responsibilities.
- Keep it simple, sunshine - Work out how to match the content to the audience. For example:
    - Executive summary for the senior executive, so they can understand the key activities and the resources required;
    - Short body summarising the process followed and outcomes reached;
    - Appendices with details for those who need them, minutes of the workshops, project plans for the strategic initiatives, stakeholder analyses and so on;
    - Diagrams throughout, a picture really is worth a thousand words;
    - The outcome of this process should be a relatively short document – a body of less than ten pages, that forms part of an integrated suite of strategic-level planning documents and sets the asset management objectives that will be delivered by the detailed asset management planning to follow.

Our planning process clearly shows how the asset management objectives flow down to the asset classes, usually in the form of a Level of Service table or similar. It also shows further "demand analysis" activity. In this case, the activity is to obtain a detailed understanding of the context in which the specific asset class is operating. A few of the relevant considerations include how hard it is working, the extent and quality of maintenance activities and the support environment. New stakeholders will again emerge, particularly maintenance contractors and specific equipment manufacturers or vendors, who must be engaged to understand the environment and appropriate actions that need to be taken. For example, a key question for electronics is usually "How long until these are obsolete?" and the relevant vendors are usually well positioned to help organisations with this.

Shelfware is again a common problem we see with Asset Management Plans, but our article "What does a good asset management plan look like?" addresses this issue with a good discussion of both content and structure, including options for different types of organisational structures. Consequently, we'll only touch on the highlights here:

- each Asset Management Plan should be short and visual, which can be achieved by using references to access other plans (e.g. the maintenance plan) or data sources (e.g. risk registers and full budgets) for those who need them.

- be clear on the audience and use the Asset Management Plan to tell the "story" of the asset that lets them understand and execute their responsibilities, including:
    - Internal staff – complete their allocated actions;
    - Management – provide the resources;
    - Other Asset Managers – understand what performance to expect from this asset class;
    - Other specialists (e.g. Human Resources, Learning & Development), understand what is expected of them.

Above all, strongly resist the temptation to make the Asset Management Plan the repository for every single piece of information the organisation possesses on an asset! This is probably the number one reason for the creation of shelfware asset management plans and represents a significant lost opportunity for the organisations that succumb to it. There is no doubt that detailed information is valuable, but it needs to be kept in the right location for those who need to use it.

There is no one right structure for asset management planning documents. Building an integrated set of asset management planning documentation requires a structured process that must be designed, not bolted on to existing processes. Existing documentation that is working should be modified to meet ISO 55000 requirements, rather than supplemented with additional documents. Above all, the process must recognise that the act of planning is where the value is created. Whatever documents are used they are merely tools for communicating the planning outcomes and must therefore be designed to transmit this information. Long documents represent a failure of the design process that is captured in the sentiments of Blaise Pascal:

- *I made this letter very long because I did not have the time to make it shorter*. (Integrating & Aligning Asset Management Strategies & Plans, 2019)

3.2.5 Effective Asset Management

If you're considering how to implement ISO 55000, you are probably working for an existing organisation. That means you are grappling with the complexities of locating and arranging human resources for asset management tasks in an environment where existing personnel are already fully employed and additional resources are difficult or impossible to obtain. This segment discusses the options, including the costs, risks and benefits and should help you prepare your business case.

While neither ISO 55001:2014 nor ISO 55002:2014 provide significant guidance on how to build an appropriate lower level structure to support an asset management system, the possible models fall on a spectrum between the following two extremes:

- Fully dispersed model – everybody in the organisation is an "asset manager" with knowledge and skills matched to their specific role;
- Fully centralised model – "all" asset management activities are undertaken in a single central area, staffed with genuine experts in the discipline of asset management.

As with most spectra, there are costs, benefits and risks associated with each option. The trade-off is illustrated in the Figure 3.6.

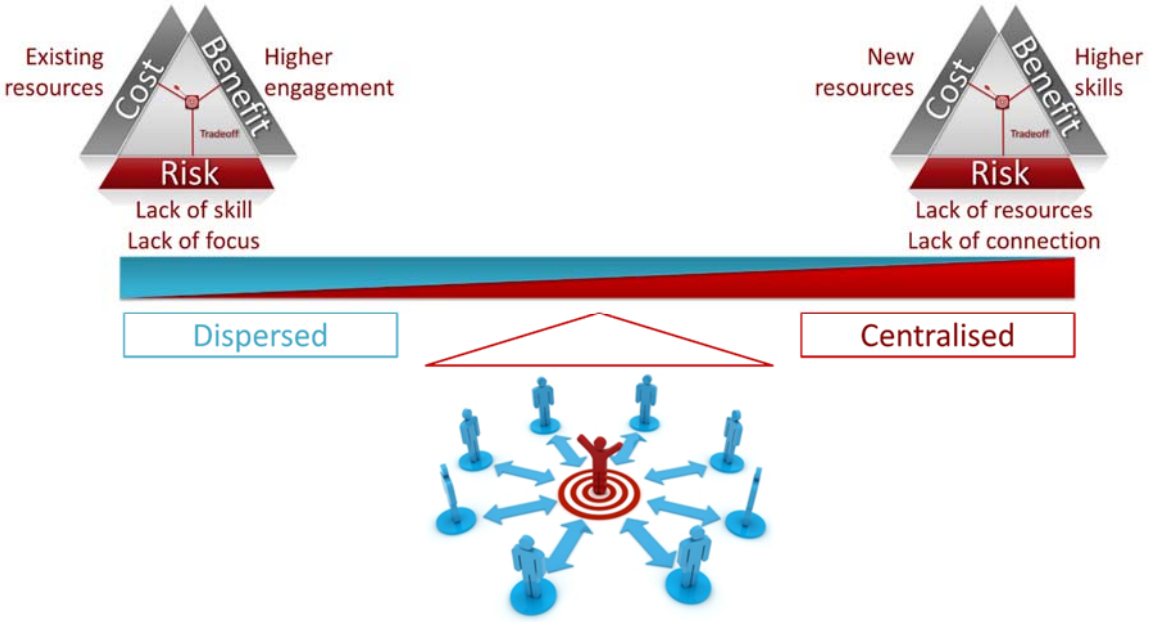


Figure 3.6 Costs, Benefits and Risks (Organising for Effective Asset Management: Leadership, 2019)

As an organisation moves towards the dispersed end, it imposes higher and higher skill requirements on personnel that are not specialists in the asset management discipline. For example, maintenance experts might be required to lead the design of an asset management plan and then integrate content from projects, operations and disposals that they don't really understand. This has the benefit of breaking down silos and forcing a "whole of organisation" approach, where everybody has an understanding of the purposes and benefits of asset management, but it creates risks around a lack of specialist asset management skills/knowledge and a lack of focus as already busy people add more tasks to their "to do" list. Ultimately, this has potential to undermine the effectiveness of the asset management system, with inconsistent, incomplete and inaccurate planning and execution of tasks.

When the organisation reverses direction and tries to centralise its asset management activities, we see the above problems go away and another set of issues appear in their place. Firstly, the organisation needs to establish new positions with dedicated asset management skill sets and finding the resources to do this can be a challenge. Next, these highly skilled asset management experts need to find a way to engage with the day to day maintenance and operating activities of the organisation without creating a silo mentality, where asset management is seen as something done "over there" with no real connection to the actual workings of the organisation. If these challenges are not navigated successfully, then the asset management department will be under-resourced and disconnected from the remainder of the organisation. It will be an ineffective overhead and the asset management system will fail.

An asset management "centre of expertise" of just a few personnel fitted naturally into this organisational model and was able to focus on building processes and templates while the disciplines applied these templates to their classes of asset. This required a moderate on-going investment to staff the centre of expertise, but with consulting resources only required to transfer new knowledge and skills into the organisation.

The exact size and structure will depend on the organisation; the following guidance are to support selection of an appropriate structure:

- there must adequate resources to prepare asset management tools, templates and processes as required;
- the resources may be any mix of consulting, specialist asset management or other staff as appropriate to the specific organisation;
- the asset's "owners" must be actively engaged with asset planning, regardless of who is nominally responsible for this process;
- every individual must possess competencies appropriate to their specific roles and responsibilities.

There is one more key ingredient, there must be what we like to call a "visible champion" amongst top management and they must have enough control over the asset management resources to drive the system forward. Of course, control over the resources is not the only requirement for this visible champion.

The requirement for a visible champion is part of the ISO 55001:2014 requirement for the organisation to assign and communicate relevant roles, responsibilities and authorities (clause 5.3). These clauses recognise the fundamental importance of high-level accountability for the asset management system if the system is to be effective.

This last criterion is particularly important and that's why its prefered the term "visible champion", which gives a sense of how the individual must act to engender success.

Given the criticality of visible top management support to success of any change initiative, the preferred approach for implementing an asset management system must be to appoint a dedicated executive-level "champion." However, that this is simply not practical for most organisations and a suitable position must be found from within the existing executive workforce. The criteria suggest allocation of asset management accountability to either the operations executive or a corporate strategy/risk executive. It should be noted, however, that such individuals may require significant support to understand their responsibilities as most asset management professionals currently come from technical backgrounds.

One more note on leadership: top level involvement is essential, but this does not mean that asset management leadership stops with the CEO. Leadership is independent of organisational position, and a Maintenance Manager, an Operations Supervisor, or even a Reliability Engineer can still shape the culture within their circle of influence and create meaningful change. There will be limits to what you can achieve at lower levels in the organisation, particularly where your people interact with those other workgroups who may not share the same cultural beliefs or perspectives.

With so many other elements of asset management, there is no one right structure for an asset management organisation. There are, however, some clear principles to follow in designing the asset management: adequate resources with appropriate competencies and engaged asset owners. These principles point towards a "centre of expertise" structure, where a small group of asset management professionals provide tools, training and advice to support the rest of the organisation to manage their assets.

The organisation also needs to identify a visible champion that will not just hold the accountability for asset management but also provides the leadership and guidance to make it happen. The ideal solution is a dedicated executive, but also acknowledge that

this will often be impossible; in such cases, it is worth looking beyond the technical side of the workforce as operations or corporate risk executives might have broader interest in the life cycle management of the assets, provided they have adequate links to technical experts to mitigate any shortcomings in their knowledge (Organising for Effective Asset Management: Leadership, 2019).

3.2.6 Key Asset Management Processes

The requirement is laid out in clause 8.1 of ISO 55001:2014:

- *The organisation shall plan, implement and control the processes needed to meet requirements…*

The clause goes on to identify, implement and monitor the processes and treat/monitor risks, but it does not dictate specific processes. ISO 55002 does not provide much additional; the Institute of Asset Management's (IAM's) created the Conceptual Asset Management Model, as can be seen in Figure 3.7.

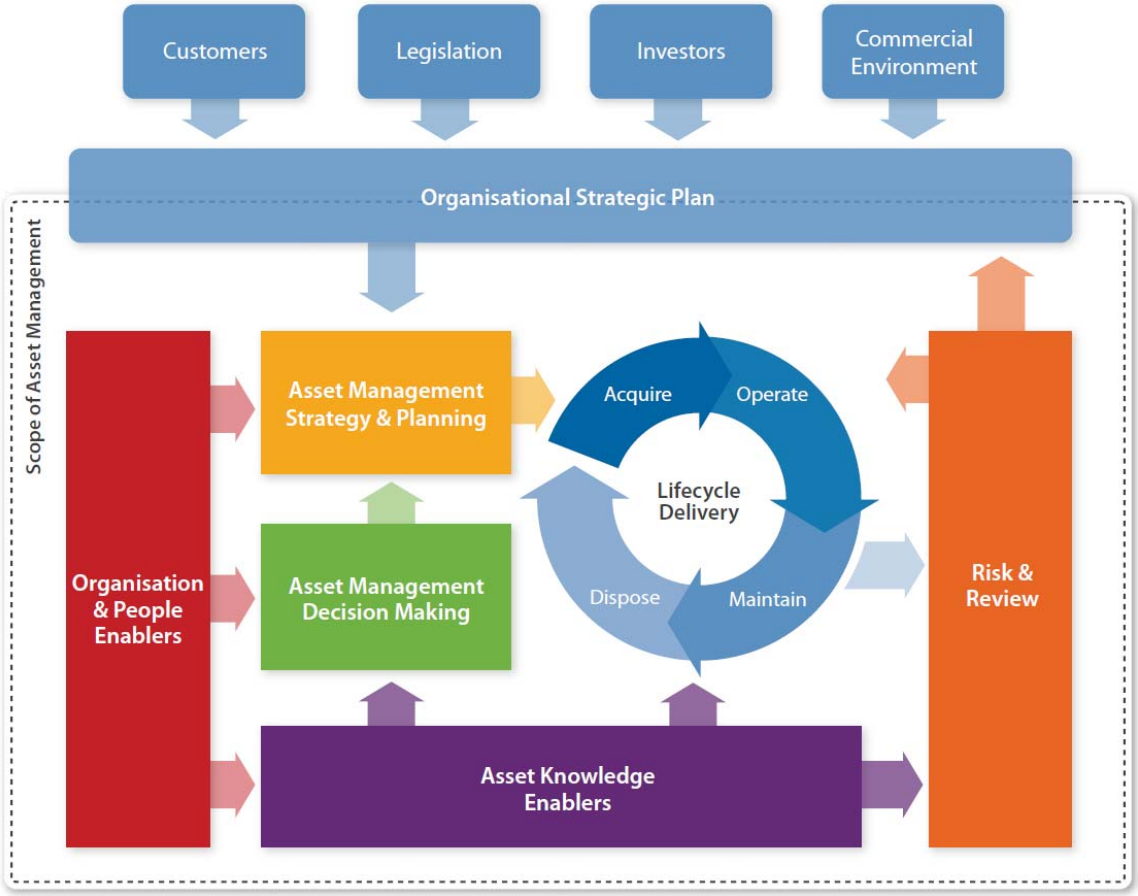


Figure 3.7 Conceptual Asset Management Model (Key Asset Management Processes, 2019)

This model shows very general process requirements, including the planning and decision-making processes we already discussed, as well as processes for life cycle delivery, asset information management, organisation and people management, risk management and performance management/review and these will apply to all organisations. Unfortunately, the details of these processes depend on the nature of the

organisation and its assets; so, there is no "one-size fits all" set of processes. For example, an organisation that builds civil assets from raw materials will need quite different acquisition processes to an organisation that buys and operates vehicles from the manufacturer. This means that the organisation is going to have to do some work to identify what processes it needs and how sophisticated they need to be. Luckily, there is a global consensus to start from the Asset Management Landscape.

The Asset Management Landscape was published by the Global Forum on Maintenance and Asset Management (GFMAM) and is currently in its second edition. It divides the discipline up into 39 subjects and 6 groups as shown in Figure 3.8.

Figure 3.8 Asset Management Landscape (Key Asset Management Processes, 2019)

The colour coding on this diagram aligns with the IAM conceptual model above, helping to get an idea of where each subject fits. There are also good references around to help understand the content of each subject, including the Institute of Asset Management's *Asset Management – An Anatomy*, the Asset Management Council's Asset Management Body of Knowledge and the Institute of Public Works Engineering Australia's *International Infrastructure Management Manual*.

After the understanding of each subject, it will be in a good position to identify the processes the organisations require. ISO 55001:2014 links these requirements to the actions identified:

- An organisation that undertakes complex procurements (e.g. construction of buildings or integration of complex systems) would require robust project management processes based on a suitable standard methodology (e.g. Project Management Body of Knowledge). Conversely, an organisation that buys assets "off the shelf" may have simple procurement processes focussed on achieving value for money and compliance with specifications/standards.
- An organisation that operates passenger vehicles (aviation, marine, rail, etc.) would require robust operational procedures to ensure the competence of its

operators and subsequent safety of its customers. Conversely, organisations that primarily own and manage roads or other fixed assets may have essentially no operational procedures since the assets are not "operated" in the usual sense.

- An organisation that employs large numbers of operators or technicians would require robust human resources processes to ensure the personnel are competent and the workforce size is appropriate. Conversely, a smaller organisation may have simple processes in this area.
- In many cases, the required processes can, even, vary within the organisation. An airline might apply strict processes to the maintenance of its aircraft but much simpler processes for the maintenance of its office facilities. These distinctions are driven by the different risk profiles of the two asset types and highlight the fundamental importance of risk in determining the processes required in an organisation. It is worth spending some time discussing this process.

Every organisation considering implementing ISO 55000 needs to have a clear process for identifying and managing risks. Typically, this process is built around *ISO 31000:2009 – Risk Management – Principles and Guidelines* and is the key to successful implement asset management. Every asset management decision, including selection of processes, needs to balance the competing factors of performance, cost and risk and processes must exist to identify and quantify risks in order to include them in this trade off.

It is important to note that there is no need, nor is it desirable, to maintain a separate risk management process to support asset management. The organisation's risk appetite and identification, analysis and treatment tools should be consistent across the organisation and every decision it makes, including non-asset decisions. This has the added benefit of reducing the amount of process documentation that must be developed and maintained, with follow on reductions in areas such as training.

ISO 55000 draws a distinction between process and procedure that is important. Under clause 7.6.1, ISO 55001 requires an organisation's asset management system to include:

- *Documented information determined by the organisation as being necessary for the effectiveness of the asset management system.*

ISO 55000 requires organisations to think about risk associated with its processes and to document only those processes where failure to do so would threaten the effectiveness of the asset management system.

With this clause in mind and a view to reduce the administrative burden associated with implementing ISO 55000, the following principles are recommended to be applied when identifying necessary procedures:

- *Don't write unnecessary documents* - as we discussed above, the requirements for documented information within ISO 55001:2014 are not as onerous as might look. This is a deliberate strategy, since many organisations excel at burying themselves in written procedures that nobody has time to read anyway.

- *Second hand can be just fine* - following on from the previous point, the first preference when you do need a document should be to modify something that already exists. This is usually quicker, reduces the total number of documents and gets better buy in. It is, however, good practice to maintain a cross-reference matrix that shows how each of the requirements in ISO 55001:2014 is met within the structure.
- *Keep it Simple, Sunshine* - always keep written procedures as short and simple as possible, swim lane flowcharts and RACI (Responsible, Accountable, Consulted, Informed) charts are a good way to show people their responsibilities without telling them how to execute those responsibilities (Key Asset Management Processes, 2019).

3.2.7 Asset Management Competence

ISO 55001 contains a requirement for organisations to ensure that they:

- understand the competences required of individuals involved in managing their assets and periodically review and update these;
- ensure that those individuals have the required competences;
- understand any competence gaps that exist, and have plans and processes in place for bridging those gaps, and,
- maintain adequate records to demonstrate that required competences are held.

These are general requirements, and do not provide much guidance regarding how to go about ensuring that these are met. The intent of this section is to help to fill that gap.

The framework shown in Figure 3.9 is useful in providing guidance regarding the competences required.

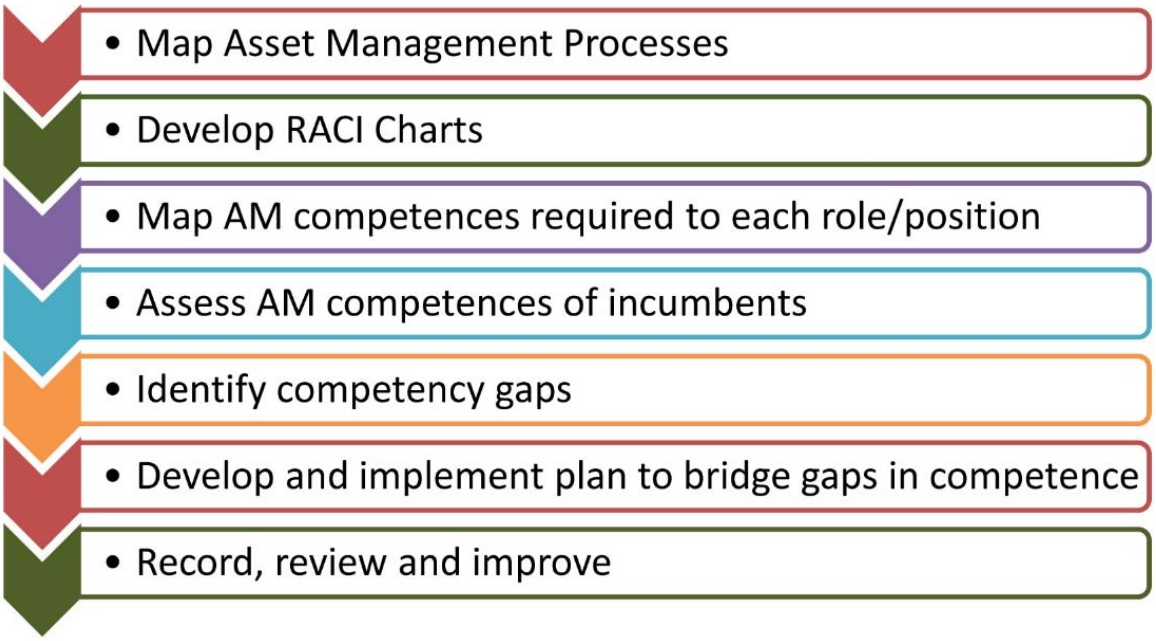


Figure 3.9 Asset Management Competences Required (Asset Management Competence, 2019)

The key steps in each of these processes should be mapped using, for exemple, the standard Business Process mapping techniques and, for each of these steps, it should be determined who is Responsible for performing the activity, who is Accountable for ensuring that it is done, who needs to be Consulted as part of the activity, and who should be Informed of the outcome. This is typically done in a Responsible, Accountable, Consulted, and Informed (RACI) chart. This allows to consolidate all of the Asset Management activities that are performed by each role or position, which then makes it easier to identify the competences required by each role in order to successfully perform that activity.

To identify the competences required for each role, there are two possible sources: the first of these is the Institute of Asset Management (IAM) Competence Framework. Initially developed to align with the requirements of PAS 55, this was updated following the release of ISO 55001:2014 to ensure that it aligned with the terminology contained within that document.

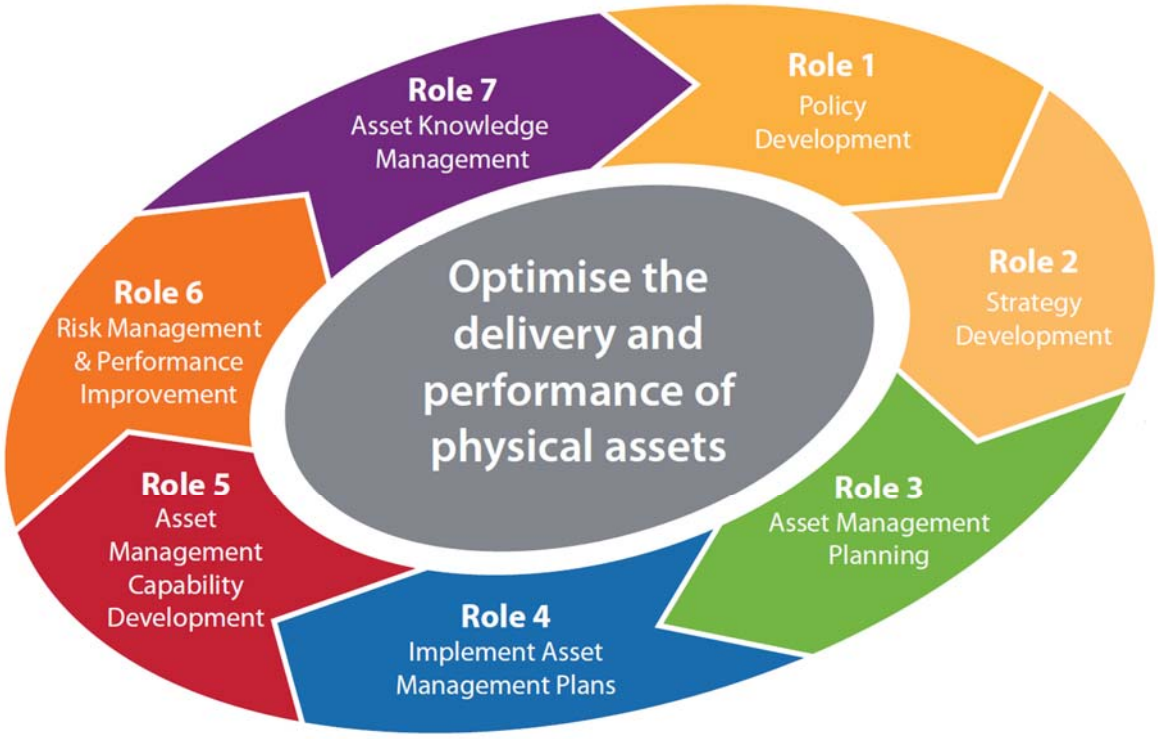


Figure 3.10 Competence Framework (Competences Framework, 2019)

The framework is based around seven key Asset Management "roles", specifically (Figure 3.10):

1) Policy development;
2) Strategy development;
3) Asset management planning;
4) Implement asset management plans;
5) Asset management capability development;
6) Risk management and performance improvement;
7) Asset knowledge management.

It then assigns one or more "competence units" to each role. There are 27 competence units in total, and these have titles such as:

- Develop the AM strategy;
- Create and acquire assets;
- Etc.

Each of these competence units are then broken down further into 153 elements of competences which provide more detailed guidance, and have titles such as:

- to develop key strategies for the overall system, asset portfolios and/or asset groups that support strategic aims and objectives;
- to develop (asset) design specifications to achieve optimum customer, business and life-cycle requirements.

The IAM framework outlines the generic knowledge and understanding requirements associated with each role forms the foundation on which the IAM's Endorsed Trainer scheme is based on. It also has been used to shape the requirements for achievement of IAM's Certificate and Diploma in Asset Management. In doing so, it provides a very useful contribution allowing you to better understand the Asset Management competences that may be required in your organisation.

A potential second source of Asset Management competences is the list of competences developed by the Asset Management Council in Australia. This lists 243 (Certification Competencies, 2019) individual competences, but as this list of competences was developed primarily to assist with their individual certification scheme (e.g. Certified Practitioner in Asset Management - CPAM) rather than to assist organisations to identify the Asset Management competences that they require, it is not quite as well classified as the IAM framework and therefore will need a bit more work to make effective use of it.

In practice, it is highly unlikely that the roles and position descriptions within an organisation map neatly to the generic roles contained within the IAM Competences Framework. To use the AM Council list of competences will also be needed to map these to the roles and positions in the organisation. To perform this activity, would be helpful that the process maps and RACI charts are used to identify the competences required, but, in the absence of these, its possible to work directly from the position descriptions for each role involved in Asset Management. This assumes, of course, that the organisation structure is clearly documented, and that the position descriptions for all asset management related roles in the organisation have been developed and are up to date.

As the IAM competence requirements are still quite generic, it will also be important to identify other elements of competence that may be specific to the industry or organisation and ensure that these are also listed. Some of these competence elements may be required in order to ensure compliance with externally imposed legislation or regulations. For example, in many industries, certain positions hold statutory roles and their incumbents are required to hold specific qualifications, have had specific experience and/or have passed specific examinations in order to comply with those statutory requirements.

In addition, it can be chosen to specify the level of competence that is required for each competence element for each role in your organisation. It may be useful to think of competence as having four levels as illustrated in Figure 3.11.

Figure 3.11 Level of Competence (Asset Management Competence, 2019)

For example, in relation to the development of Asset Management plans, for some roles, all that may be required is that they have a basic understanding of what is needed in an Asset Management Plan and what an Asset Management Plan is used for so that they can contribute meaningful information for inclusion in that plan. Other roles may need to be Competent so that they can develop the plans, while others may need to be Advanced or expect so that they can modify and improve the template used for documenting Asset Management Plans.

Developing a comprehensive view of all the competences that are required for effective Asset Management is not necessarily a simple or straightforward task. At this point, it may look like an overwhelmingly complex and time-consuming task. But it need not necessarily be the case. As with all decisions relating to Asset Management, in determining the scope and level of detail associated with mapping competences to roles you should consider:

- *Risks* - what are the risks to the business if certain roles/positions/activities are performed by people who are not competent?
- *Benefits* - what are the potential benefits to the business if certain roles/ positions/activities are performed by people who are highly competent?
- *Costs* - how long will it take and what will it cost to identify the competence requirements and assess current levels of competence for this role/position/activity.

Regardless of the level of detail, it will be used in mapping roles to competences; however, it should be able to justify why have been chosen to go to that level of detail in terms of the above three considerations.

Identifying and mapping competences is a task that many Learning and Development professionals will be familiar with, it is likely that they will take the lead in this area within your organisation. However, they will more than likely need help from suitably

skilled and qualified Asset Management professionals to ensure that all the Asset Management competences required are noted and properly documented.

All of this, however, only ensures that the understanding of the competences that should have in place in the organisation, it does not address the question of how to assess whether those competences are in place.

At this point it is worth making sure that you understand what is meant by the term "competence". Competence can be defined as being "the ability to do something successfully or efficiently". In other words, competence can only be demonstrated by doing something. Attending a course and understanding theories and concepts does not necessarily make you competent, someone is only competent when it knows how to, and can demonstrate that can apply these concepts and principles in practice. So, attending a course and passing a theoretical exam, while it may be a prerequisite on the pathway to competence, does not, of itself, mean that are competent. For example, just because someone has passed the theoretical test for your driver's license does not necessarily mean that he/she knows how to drive a car.

Competence can be considered as having the following four dimensions:

1) *Task Skills* - the capacity to perform tasks to the required standard;
2) *Task Management Skills* - the ability to plan and integrate several different tasks and achieve a work outcome;
3) *Contingency Management Skills* - the ability to respond to irregularities, breakdowns and other unanticipated occurrences; and,
4) *Job/Role Environment Skills* - the capacity to deal with the responsibilities and expectations of the work environment, including working with others.

It is important, therefore, when assessing competences, that all four of these dimensions are assessed.

In terms of the first dimension listed above, demonstrating competence requires the achievement of an agreed benchmark standard when performing the task. It is important, therefore, that this standard is documented, as least as far as this is possible. Some larger organisations have defined their own standards for the performance of specific tasks. In other cases, you may need to rely on the standards that have been established as part of a recognised training course or qualification. The IAM competence standards unfortunately do not explicitly specify the level of performance that is expected.

In order to assess the competences, it will be necessary for the organisation to collect evidence and make judgements on whether a specific competence has been achieved. The evidence could take several forms:

- *Direct, for example:*
  - Observation of workplace performance;
  - Oral questioning;
  - Demonstration of specific skills.
- *Indirect, for example:*
  - Completion of written tests or examinations;
  - Review/assessment of previous work undertaken;
  - Achievement of externally awarded qualifications/certification.
- *Supplementary, for example:*
  - References from previous employers;

- Reports from Supervisors;
- Work diary/log books;
- Examples of reports or workbooks.

In order to comply with the requirements of ISO 55001, the organisation will need to determine what and how much evidence is required to make the assessment judgement. However, in making this determination, you should consider the following four "rules" of evidence.

The evidence should be:

- *Valid*
  - It relates to the unit of competence being assessed;
  - It considers all four dimensions of competence (i.e. task skills, task management skills, contingency management skills and job/role environment skills discussed above).
- *Sufficient*
  - It provides enough evidence to be able to adequately judge competence.
- *Current*
  - Is recent enough to show that the skills and knowledge are still able to be applied.
- *Authentic*
  - It should be provable that the work proffered as evidence is the individual's own.

Once the evidence requirements have been determined, then, the next step is to develop and execute a plan for collection of the relevant evidence, including, where required, on-the-job assessment of work performance.

Once the current level of Asset Management competence has been identified, this can be compared with the competences and level of competence required of the position. Appropriate actions can be planned and taken to bridge any identified gaps. This will normally be done through standard Human Resources processes for Personal Development Planning and may incorporate a combination of attendance at training courses, delivery of one-on-one training and coaching, or other personal development activities.

Finally, for effective competence management, a competence management and recording system should be in place to ensure that workforce competences are adequate to permit the organisation to achieve its asset management objectives (and overall organisational objectives). This system should include processes for:

- ensuring that position descriptions are up-to-date, and that roles and responsibilities for each position are accurately described;
- ensuring that the competences required for each position/role are adequately described and periodically reviewed and updated;
- assessing/judging the current level of competence (with respect to their job role) of everyone involved with Asset Management;
- ensuring that the competences currently held by all individuals are accurately recorded together with any training received;

- planning and delivery of programs to bridge identified gaps in competence, including identifying or designing and planning education programmes, training courses and other development activities;
- recruitment of competent people;
- career planning for key individuals;
- succession planning for key positions/roles;
- periodically reviewing and continually improving all of the above elements (Asset Management Competence, 2019).

3.2.8 Asset Management Culture

What is culture? A simple definition is "the way we do things around here". If you want a more complex definition that means the same thing, you can define it as:

- *The values and behaviours that contribute to the unique social and psychological environment of an organization.*

In other words, an organisation's culture related primarily to behaviours (what people do) as underpinned by a set of values (unwritten, and often subconscious, beliefs or rules regarding what is considered "acceptable" and/or valued).

There are many, many books and articles written about organisational culture, and it is not our intent to discuss the general aspects of organisational culture in this thesis, but instead to discuss some key points relating to organisational culture as it applies to Asset Management and ISO 55001.

ISO 55001 makes no direct reference to organisational culture. In fact, the word "culture" is not mentioned once in ISO 55001:2014. Yet most who are involved in establishing sound Asset Management processes and systems within organisations recognise the vital role of an organisation's culture in facilitating success. So, what are the key aspects of an organisation's culture that separate those organisations that do Asset Management well, from those that do it less well? To answer this question, begin with some common models of culture and examine these for applicability to asset management.

Consider the six elements of an organisation's culture:

1) History - a shared narrative of the organisation's past, which keeps people anchored to the key values which the organisation was founded on;
2) Values - the beliefs and assumptions that provide a set of guiding principles for decision-making;
3) Heroes - those employees and managers whose status is elevated because they embody organisational values and, therefore, serve as role models for others;
4) Rites and Rituals - the ceremonies and routine events which bring people together;
5) The Cultural Network - the informal network within an organisation which works behind the scenes to communicate information, spread gossip and rumours and influence behaviours.

The Asset Management culture, then, will be the way that these elements interact to shape the management of, and indeed the way to think about, the assets. These elements therefore provide a valuable basis for informing, how can be influenced to an Asset

Management culture, but do not in themselves answer to the question with regards to what "good" looks like. To do this, it should turn to Ledet's model of Operational Improvement, illustrated in Figure 3.12.

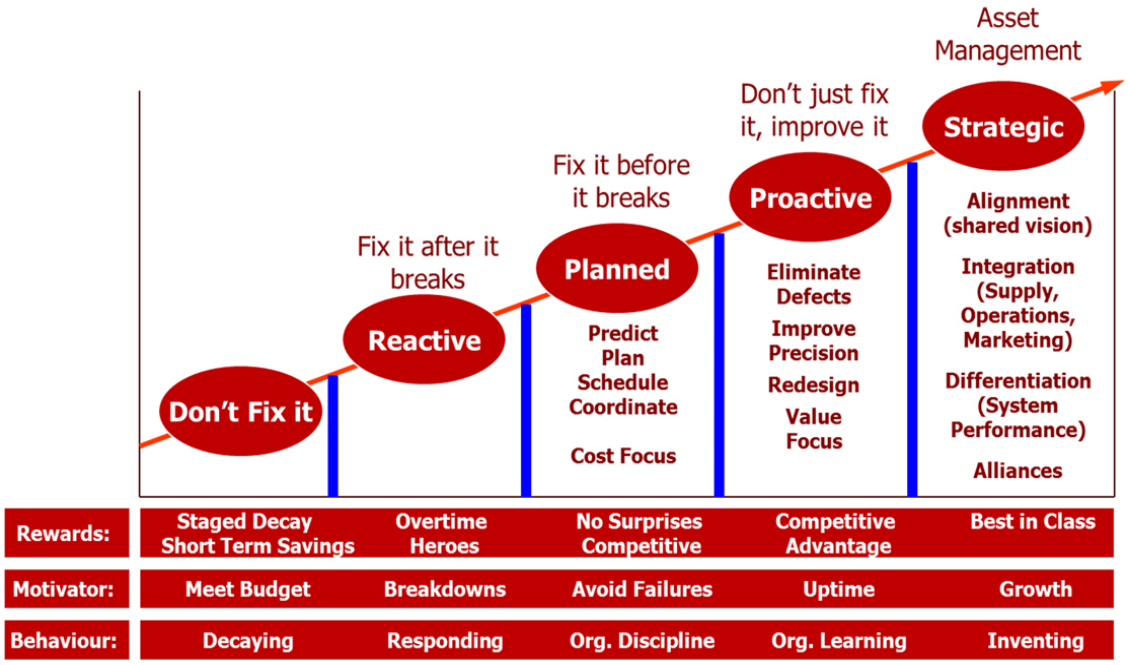


Figure 3.12 Operational Improvement (Asset Management Culture, 2019)

Note that Ledet's original terminology have been modified to describe the "Strategic" domain as "Asset Management", because it believes that several key cultural elements that exist in this domain are dominant in a best-practice "Asset Management" organisation. In fact, it is easy to see how Ledet's Alignment and Integration elements correspond to the Value and Alignment Fundamentals of Asset Management from ISO 55000:2014. Considering the Leadership and Assurance Fundamentals as well, it can define five characteristics that can differentiate a "good" Asset Management culture from less effective cultures. These are:

- Vertical Organisational Alignment;
- Horizontal Organisational Alignment;
- Organisational Discipline;
- Continuous Improvement Mentality;
- A Proactive Mindset.

Vertical organisational alignment is often otherwise known as "line of sight". In a vertically aligned organisation, all members of the organisation:

- to know and understand the organisation's mission, strategy, objectives and goals;
- to understand their role in helping to achieve those goals, and,
- to ensure that their actions are aligned with the achievement of those goals.

In excellent organisations, members of the organisation are enthused by the organisation's mission and objectives and are highly engaged and motivated to ensure that the organisation succeeds.

The Vertical Alignment based on the organisation's strategy, objectives and goals creates shared values that form a set of guiding principles for decision-making, and therefore fit within the Values element of Deal and Kennedy's model (Deal and Kennedy's Cultural Model, 2019). The achieving can be reached in this critical to the Alignment (shared vision) element of Ledet's model and the ISO 55000 Fundamental of Value. As such, Vertical Alignment is an essential characteristic of a "good" Asset Management culture.

When we refer to Horizontal Alignment, we are referring to cross-functional alignment across departments. In a horizontally aligned organisation, all organisational departments:

- are working towards the achievement of shared goals; these goals are optimised for the all organisation, rather than being optimum for one department without consideration of the impact on other departments;
- are looking for opportunities to collaborate on joint improvement initiatives that are focused on the common good.

Achieving a horizontally aligned organisation requires a high degree of understanding, on the part of members of one function, of their impact on other functions and all organisation.

This characteristic is also part of the Value element of Deal and Kennedy's model, as well as Ledet's Alignment (shared vision) element and the ISO 55000 Value Fundamental. In addition, it contributes to Ledet's Integration element and the ISO 55000 Alignment Fundamental and it is, therefore, a key characteristic for an effective Asset Management culture.

Organisations that perform Asset Management well adhere to clearly defined processes and procedures, particularly where the risks associated with non-compliance are significant. Individuals hold a high degree of personal accountability for compliance and need to operate within a culture that values and promotes understanding of the importance of compliance in ensuring that the organisation achieves its goals. This is not a culture of "grudging compliance", it is one where the compliance is genuinely valued and appreciated.

The ISO 55000 Fundamentals of Leadership and Assurance exist, in part, to drive informed compliance and the Leadership Fundamental explicitly recognises the importance of culture in achieving this. Within Ledet's model, Organisational Discipline is an essential aspect of the Planned domain and only takes an additional importance as the organisation moves toward the Strategic/Asset Management domain (Figure 3.13).

Figure 3.13 Organisational Discipline (Asset Management Culture, 2019)

Organisations that perform Asset Management well have an innovative element to their culture to enable them to identify and adapt to new opportunities and situations. One of the challenges in establishing this is that innovation is often seen as being mutually exclusive to Organisational Discipline. How can it be encouraged the compliance while at the same time encouraging innovation and improvement? The secret to achieve both is in establishing clear boundaries within which innovation can occur, and processes for ensuring that innovations don't jeopardise the achievement of organisational objectives. It is important to ensure that that the potential risks associated with each proposed innovation are fully explored and dealt with prior to embarking on an innovation project. Larger organisations may establish innovation "skunk works" as a means of achieving these goals. But in all cases, it requires those working on the innovation to have a clear and realistic understanding of the risks associated with varying from approved processes and procedures, and the potential impacts of changes on other individuals and departments within their organisation.

The complete set of Asset Management Fundamentals describe a continuous improvement process and capturing this mindset is therefore at the heart of "good" Asset Management. Equivalently, Ledet identifies continuous improvement as a key aspect of the Proactive domain, with this again carrying forward into the Strategy/Asset Management domain.

One of the key features of Asset Management excellence within an organisation is a relentless focus on being ahead of the game. Organisations that are good at asset management don't just let things happen, they make them happen. And when events do occur that are outside their control, they are already prepared for them, and have contingency plans, systems and processes in place to deal with them. This constant, proactive mindset is an essential element of the culture of high performing Asset Management organisations. It has much in common with the High Reliability Organisations studied by Weick, Sutcliffe and Obstfeld. High reliable organisations are characterised by "processes of collective mindfulness which are indicated by a preoccupation with failure, reluctance to simplify interpretations, sensitivity to

operations, commitment to resilience, and deference to expertise". This aligns with the "System Performance" focus in Ledet's model and the Assurance Fundamental of ISO 55000.

So, how can be established an Asset Management culture? Changing organisational culture is notoriously difficult and takes considerable time. There are entire books written on the topic, and space prohibits a detailed examination of this topic in this section. The following represents six practical tips that address the elements of culture in Deal and Kennedy's model and, based on our experience, works to deliver sustainable change in the five key characteristics of an effective Asset Management culture.

A shared set of values based on the organisation's goals and objectives is essential to a sound Asset Management culture. Unfortunately, most organisational and departmental visions, goals and objectives are thoroughly boring and serve neither to inspire nor to motivate those that work within them. If possible, it should be maked the vision for the organisation or department simpler, more personal and more emotional. Finding a common theme that aligns with people's personal wishes and desires and look that they will rally behind. People generally want to make a difference, and if it can tap into that desire and align it with the goals and ambitions of your organisation, then, it can be a very powerful force.

In addition, is needed to keep reminding people of the vision – why do they work here? In what way can they contribute towards the achievement of this higher cause? They can be inspired; they will require less management. They will, within the limits of their capabilities, direct energies towards the achievement of your shared goals. This will help to achieve the goal of Vertical Alignment discussed earlier in this section.

People's values cannot be changed directly but can be established routines in behaviour that gradually shape those values, which is the point of the Rites and Rituals portion of Deal and Kennedy's model. For example, if it's needed to establish a higher level of Horizontal Alignment within your organisation, creating regular meetings that encourage cross-functional communication and collaboration and therefore facilitate a "whole of business" viewpoint and focus. For example, making sure that the Production/Operations people attend regular Maintenance Planning meetings, or that key Supply representatives attend Shutdown Planning meetings. Establishing cross-functional improvement teams also helps in this area, workshopping improved Preventive Maintenance programs with maintainers, engineers and operators is often a great way to create a higher degree of collaboration and alignment. The more regular and habitual these meetings become, then the more they become ingrained as "the way we do things around here".

Formal performance measurement systems should encourage and reward the desired behaviours, but informal reward systems should as well. If Horizontal Alignment is the aim, why not ensure that Maintenance Manager performance and Production Manager performance are measured using the same KPIs? Rewarding the Maintenance Manager (and Production Manager) for ensuring that the organisation meets its Production targets, and simultaneously rewarding the Production Manager (and Maintenance Manager) for ensuring that the plant achieves its reliability targets will create a much more collaborative relationship than the traditional way of assessing performance.

But in addition to that, situations where an individual has gone above and beyond expectations, and demonstrated behaviours that you would like to see repeated in your organisation, and ensure that that performance is recognised, a pat on the back, or a mention in a meeting can be a very powerful tool for creating "Heroes" that illustrate to others the behaviours that they should aspire to display.

Following on from the previous point, story-telling can be used as a powerful tool to create an organisational mythology which demonstrates the way in which individuals have, in the past, demonstrated the behaviours that you would like others to emulate. This can tap into both the Heroes and History elements of Deal and Kennedy's model and powerfully influence culture (Figure 3.14).

Figure 3.14 Heroes (Asset Management Culture, 2019)

Clearly, a leader cannot ask others to behave in one manner, and then act in a different way. It needs to walk the walk, as well as talking the talk. Being aware that those that he is leading are watching every move, and if something done that is inconsistent with what have been asked to others to do, it will be noticed. Must set even higher standards for the leader than for expected from the others.

Finally, it needs to be sensible of, and actively manage, the Cultural Network, the rumour and gossip mill that exists within your organisation. The organization should be with positive stories that reinforce the culture that its being implemented, rather than negative stories.

The actions that have been discussed above can only be realistically, if driven from the top down. Ideally, if an organisation-wide culture change is required (and it often is, when establishing an Asset Management culture), then this should come from the CEO and his/her colleagues in the C-Suite. However, leaders at lower levels in the organisation can often help to establish the right culture within their own sphere of influence. Leadership is therefore a vital aspect of establishing a sound Asset Management Culture.

Effective culture change requires the right balance between the use of Leadership Tools (creating an inspiring vision and continually communicating it, finding and telling stories that inspire alignment with the new vision, walking the talk, etc.) and Management Tools (ensuring that roles and responsibilities are clear, establishing the right performance measures, recruiting the right people, ensuring that the organisation has the right competencies, etc.). Many people are more comfortable using the Management Tools than the Leadership Tools. However, those that swing the balance to increase their use of

Leadership Tools frequently achieve great results – these are the people that can be seen collecting the awards for outstanding performance.

The ISO 55001 makes several references to the role of top management and leadership in establishing sound asset management practices. Many of the activities expected of top management in ISO 55001 are managerial in nature (for example, ensuring that an asset management policy, Strategic Asset Management Plan, etc., are established). However, many are true leadership activities and involve words such as:

- Communicating;
- Supporting;
- Promoting.

Without these activities, a true Asset Management culture cannot be established.

As mentioned earlier, top level involvement is essential, but individuals at all organisational levels can display leadership, shape the culture within their circle of influence and create meaningful change. There will be limits to what you can achieve at lower levels in the organisation – particularly where your people interact with those from other workgroups who may not share the same cultural beliefs or perspectives (Asset Management Culture, 2019).

3.2.9 Asset Management Data

The common definition of the term "data" represents unorganised and unprocessed facts and is usually static in nature. However, to be able to make decisions using that data, it first needs to be processed and organised into "information", that, usually, has some meaning or purpose and has typically been processed with a particular aim or objective in mind (e.g. to be used to make a decision). Decisions are then made using that information by people who have "knowledge", that is the interpretation of information using human understanding based on study and experience. Data is not information, and information is not knowledge. Rather, information is derived from data, and knowledge is derived from information. Finally, the term "wisdom" could also be defined, which combines knowledge with experience and judgement, and which allows to a better understanding of knowledge, information and data is needed in order to make an effective decision. All of this can be visualised as shown in the Wisdom, Knowledge, Information and Data (WKID) pyramid shown in Figure 3.15.

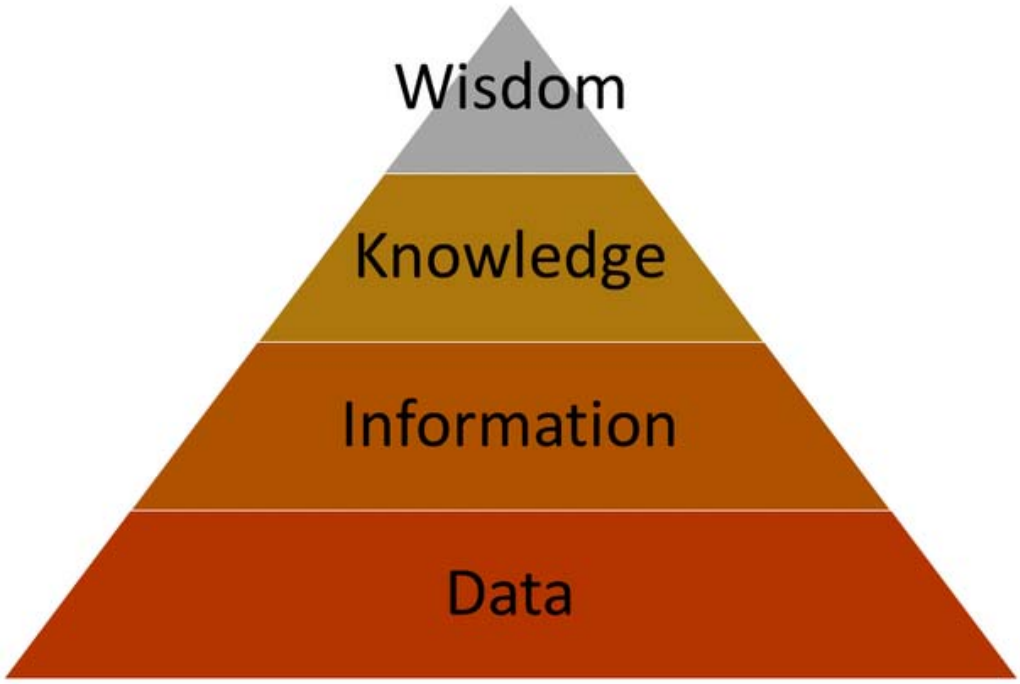


Figure 3.15 Vital elements of effective Asset Management is decision-making (Asset Management Data and Decision Making, 2019)

In the context of this section, the term "data", are generally also referring to "information" and, occasionally "knowledge", especially when this knowledge is captured in the form of documents and procedures.

The requirements contained within ISO 55001 regarding Asset Management Data are fairly general and high level. At face value, they seem deceptively simple. Essentially, ISO 55001 requires organisations to:

- Understand what their information needs are to meet the requirements of stakeholders (internal and external) regarding information and reporting (financial and non-financial). This, by definition, would include data and information required to meet any statutory or legal reporting and record-keeping obligations, including ensuring that traceability meets any legal and regulatory requirements.
- Understand what data and information are required in order to support the achievement of organisational and asset management objectives.
- In addressing the previous bullet point, to consider the impact of quality, availability and management of information on decision making.
- Determine:
    - What data is to be collected;
    - The level of quality of data collected;
    - How and when to collect the data;
    - How and when to analyse and evaluate the data collected.
- Have processes in place for the effective management of information.
- Have an effective document management system in place.

However, the devil is in the detail. When was the last time that the organisation you work for seriously considered what data it needs in order to make effective decisions? Are there

adequate specifications in place which describe the quality of data required? And if there are, to what extent are these specifications adhered to?

There is a comparatively strong case for considering data, information and knowledge within an organisation as assets in their own right. Certainly, the ISO 55000 definition of an asset as being "something of potential value to an organisation" could well apply. And the similarities do not end there. It is also possible to consider that data and information and the systems that collect and process data and information have lifecycles, just as physical assets do. It could be visualised as is shown in Figure 3.16.

Figure 3.16 The Data/Information Lifecycle (Asset Management Data and Decision Making, 2019)

Of these elements of the data lifecycle, the most important aspect is the first: Identifying the Need.

ISO 55001 clearly states that data and information needs to be collected in order to ensure that:

- stakeholders' needs for information and reporting are met, and,
- the organisation can meet its asset management and organisational objectives.

It therefore makes sense that these should be the starting points for determining what data and information you need, and for designing the systems and procedures for collecting, managing and analysing this data and information. This is, in essence, a top-down approach.

Most of the data collected will go towards making more effective asset management decisions. Accordingly, it should be considered the types of asset management decisions that will be made and the comparative importance of those decisions in the context of achievement of the organisation's Asset Management objectives.

Note that decisions can be made at many different organisational levels, including:

- Strategic Decisions - potentially those with the greatest potential business impact, but also those for which objective data is most likely to be difficult to obtain and analyse;
- Management Decisions - such as those relating to the replacement or upgrading of assets to better meet business needs;
- Operational Decisions - involved with short term control of maintenance and operational activities.

The data to support these decisions can come from both within and outside the organisation, and both sources must typically be consulted to make informed decisions. Data from within the organisation may come from corporate Information Systems, from Operational Technology systems, or from neither of these.

For all the data being considered, it is not sufficient to just identify what is needed; ISO 55001 also requires you to assess:

- The quality required of the data collected;
- How and when to collect the data;
- How and when to analyse and evaluate the data collected.

Data quality can be specified in terms of many attributes, including:

- Completeness - is all of the data to be collected, or only some of it?
- Accuracy - does the data accurately represent reality, particularly a concern when human data input is required?
- Timeliness - is the data available as and when required?
- Accessibility - is the data readily available to those using it?
- Consistency - are the same definitions and standards applied across the organisation?

When assessing and specifying organisations data requirements is potentially vast and wide-ranging. The real question in terms of ISO 55001 alignment, is what level of detail is required in order to demonstrate that the organisation has adequately considered and identified its information requirements?

A pragmatic approach should be taken, the answer lies, as is usual in all things related to Asset Management, by considering, for each decision and/or information or reporting requirement:

- The Benefits of better decision making/reporting;
- The Risks associated with poor (non-data-driven) decision making or reporting, and,
- The Costs associated with specifying, collecting, managing and analysing the data required for more effective decision-making and reporting.

To this end, it should be started by:

- Identifying your most critical assets – this is a requirement in order to align with other parts of ISO 55001 in any case, so, it should not be an additional onerous task;
- Identifying the requirements of all key stakeholders (including regulators and other external stakeholders) regarding the mandatory provision of reports or information;
- Identifying the types of decisions that you will make, which will have the greatest potential impact on the achievement of your asset management (and organisational) objectives. These decisions could include:
    - Capital Investment Decisions;
    - Decisions regarding the allocation of Operating Expenditure;
    - Technical Decisions relating to day-to-day Operations;
    - Decisions regarding the timing of major events or activities such as shutdowns or overhauls;
    - Decisions regarding the allocation of Working Capital (such as for spare parts holdings);
    - Decisions relating to whether to insource or outsource particular activities;

- Etc.

For critical assets and critical decisions, it should carefully consider what information you need to have in order to make an effective decision, and therefore what data you require in order to be able to provide that information. The needed data could take many different forms including:

- Data about the assets themselves - what they are, what they cost to acquire, where they are located etc.;
- Data about the current condition of the assets;
- Data about the current level of performance of the assets - in terms of technical performance and cost performance, operating and maintenance;
- Data relating to the activities that have been performed on the assets - operational activities, maintenance activities and modifications/upgrades/replacements;
- Data about the financial or other impacts - if the assets underperform or fail to perform at all;
- Data relating to safety - environmental or other incidents associated with the assets;
- Data relating to forecasts of future asset performance, costs and risks;
- Other data that allow adequate evaluation of alternative courses of action.

Clearly, the data that is required for more critical decisions and/or reports must be collected, evaluated and analysed with a high degree of quality and rigour. In an organisation with effective asset management decision making in place, we would expect to see that the organisation has:

- Consciously considered this issue;
- Identified the data required to support decision-making for critical decisions on critical assets;
- Identified the data required by stakeholders for reporting on critical assets, and,
- Specified the quality standards for those data elements in terms of the attributes mentioned earlier in this thesis - Completeness, Accuracy, Timeliness, Accessibility and Consistency.

Once the data requirements have been specified, then processes and systems must be put in place for collecting, processing, utilising and managing that data. The key steps in this process can be visualised in Figure 3.17.

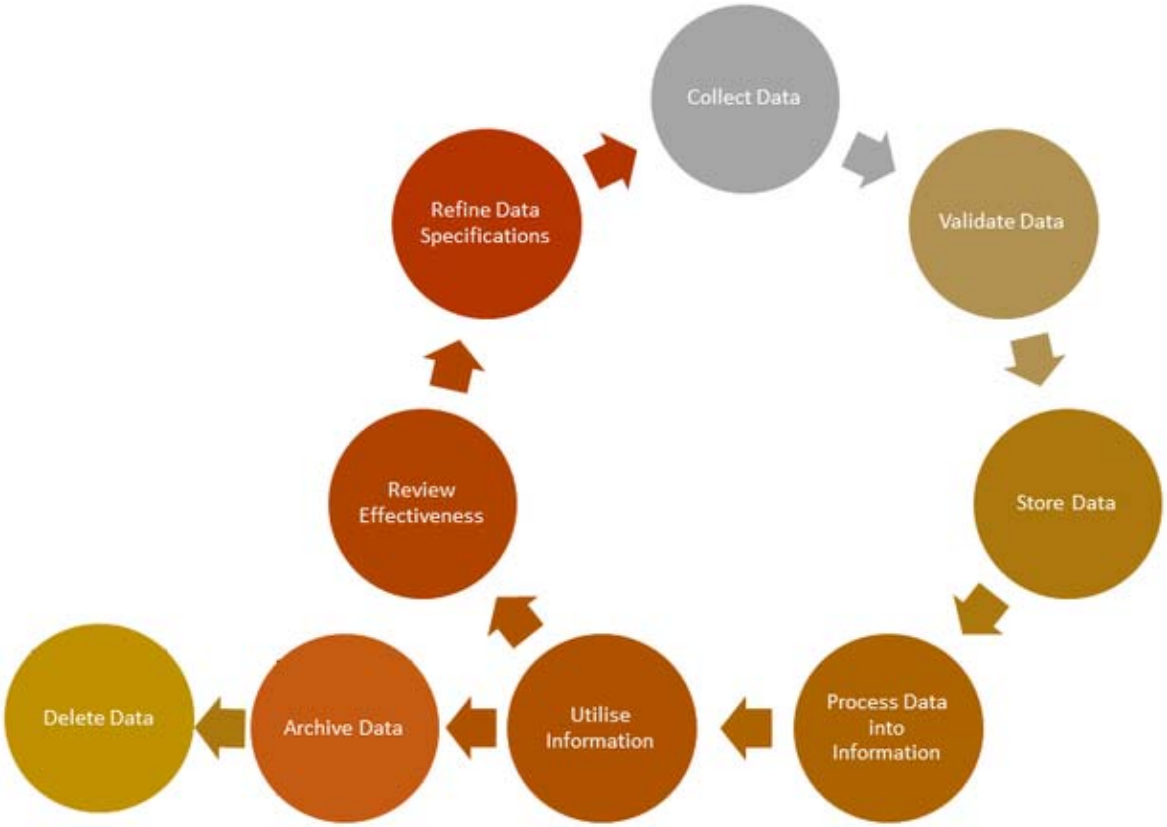


Figure 3.17 The Key Steps (Asset Management Data and Decision Making, 2019)

Some notes on each of these steps include:

- Collecting Data - some data may be collected without the need for human input; for example, asset performance or condition data may be able to be collected directly from the machine. It will be important to ensure, particularly for data that is obtained via human input, that the data collected complies with the relevant quality standards for that data. For example, when collecting data relating to new assets, it will be important to ensure that "as built" data is collected, not just "as designed" or "as approved for construction".
- Validating Data - given the issues associated with assuring the quality of data collected; frequently an additional step is required in order to ensure that the data collected does comply with the relevant quality standards, and that, if needed, adjustments are made to the collected data. For example, when collecting downtime data for key assets, if control room operators assign codes to this data to indicate the cause of the downtime, then these may need to be reviewed on a daily basis in order to ensure that the causes assigned by the control room operators accurately reflect reality.
- Storing Data - data can be stored in many ways in a large number of locations. While it is easy to focus on electronic storage within corporate information systems, data may also be stored in paper form (for example operator check sheets) and in systems outside the formal corporate systems, including Process Historian databases, as well as individual user's spreadsheets and databases. In order to maintain the integrity of critical data, care should be taken to ensure that there is only "one source of truth" for all stored data – that duplicate and potentially contradictory values for the same data item do not exist.

- Processing Data into Information - this is the sexy bit that gets all the attention and costs for all the money. Suffice it to say that data, until such time as it is processed into meaningful information, is of limited or no value. Great care should be taken, therefore, to ensure that the functionality required of information processing systems (whether they be ERP systems, Reliability Modelling software or other optimisation algorithms) is properly defined, and that rigorous testing is performed to ensure that data is accurately translated into information that is meaningful for effective decision making.
- Utilise Information - if data that has not been processed into information has no value, then this is even more true for information that is not effectively utilised. In order to effectively utilise information, business processes associated with reporting and decision-making must require the relevant information to be used. Those utilising the information must understand its meaning and importance, and decisions made must be implemented. These requirements have less to do with the quality of the information (although obviously the information must be presented in a manner that enables its effective use), and more to do with business processes, accountabilities and competence.
- Review Effectiveness and Refine Data Specifications - as part of a continuous improvement loop, organisations should periodically assess whether the information they are receiving is adequate to meet their requirements for effective decision making, and whether the results that are being achieved as a result of their decisions using this information are delivering the expected outcomes. This may lead to improvement in many elements of the data management system, including the specification of what data is to be collected, data quality specifications, information processing requirements and/or business processes and competences.
- Archive and Delete Data, there should be formal processes in place for periodically either archiving or deleting data that is no longer required. This could include processes for summarising data (for example, consolidating minute-by-minute data into daily averages) prior for archiving. The key item to consider here is the likely need is for future access to this data. In some cases, there may be legal or other statutory requirements for data retention that may need to be complied with.

One other area to consider when discussing data management is the requirement for appropriate record keeping and document management. There are a number of documents that are required by ISO 55001 to be developed and effectively controlled. These include:

- Asset Management Policy;
- Asset Management Objectives;
- Strategic Asset Management Plan;
- Asset Management Plans;
- Evidence of Asset Management Competence;
- Evidence of the results of monitoring, measurement, analysis and evaluation of Asset performance and Asset Management system performance;
- Evidence of implementation of recommendations from Asset Management audits;

- Evidence that Management Reviews of the Asset Management system have taken place.

All of the usual document management controls should apply to these documents, including effective change control, revision tracking, access controls, etc. However, in addition to the documents listed above, document management controls may need to be applied to a number of other documents that form part of the Asset Management system in order to ensure compliance and reduce overall business risks associated with non-compliance. This could include, for example, control over documented operating procedures, maintenance procedures, etc. It will be important to identify those additional documents that should be controlled and make sure that the appropriate controls are in place.

It should be taken caution relating to Asset Management Data and Information Processing. An awful lot of organisations overestimate their organisation's ability to capture and effectively utilise data and information. When it comes down to specifying and configuring information systems, it is very easy to get caught up in all of the possibilities that these technologies can provide. But, just because it could, it doesn't mean it should.

Figure 3.18 Overloading the System (Asset Management Data and Decision Making, 2019)

There is a common view that electronic data storage is cheap and getting cheaper, and that therefore we should collect as much data as we can (particularly now we are talking about the possibilities of Big Data), even if not sure how it will be used it yet. Nevertheless, the reality is that unless you apply appropriate quality standards to that data

then, all that you will end up with is a lot of unusable junk cluttering your corporate hard drives. Data storage may be cheap but assuring that data quality can be expensive in time and effort, so should be considered carefully what data is needed to store. Some engineers are inveterate hoarders, never wanting to throw anything out because "it may come in handy one day" only to find that they cannot get into their workshop/shed/warehouse because it is piled high with rusting rubbish.

Along similar lines, most commercial software packages these days have capabilities that are far in advance of what organisations currently use. The business case for using these more advanced capabilities is often seductively attractive. However, frequently we find that the organisational discipline and competences required providing the required data to the quality standard for effective use of these new capabilities is seriously lacking, and the effort required to enhance competences and implement the required level of discipline is far greater than expected. As a result, the capabilities are never fully implemented, the information systems are often filled with low quality, non-useable data, and considerable time and expense has been spent in inputting this data, a totally non-value-adding activity.

As previously mentioned, just because it could, does not mean it should. The decisions regarding data and information management are firmly grounded in a pragmatic view of how things work in the real world (Asset Management Data and Decision Making, 2019).

3.2.10 Roadmap to ISO 55001

Getting ready to start the journey will require as a minimum:

- Getting leadership buy-in;
- Getting input from stakeholders;
- Getting alignment internally on where the value lies;
- Determining your approach to compliance with the standard, which could either, be one of Certification, Compliance or Alignment;
- Identifying high-level funding and resource requirements;
- Building a roadmap for the journey.

Although the above already sounds like a journey this will be a set up to start the bulk of the work towards compliance (or alignment or certification) "on the right foot". Once it has a clear mandate to proceed, it is recommended stepping through the journey as shown below.

Figure 3.19 The Journey (Roadmap to ISO 55001 Compliance, 2019)

To gain an understanding of where the major gaps are in the asset management system, first step, usually, is to do a Readiness Assessment. This could be done internally or externally and should provide with a high-level assessment of the organisations level of maturity and whether it will be feasible to embark on the journey. The readiness assessment will typically assess the existence and level of application of the foundation documents and should give an information about where to start.

To Develop the Asset Management System, set the foundation first. The diagram below shows a logical sequence of how the building blocks of an asset management system can be established.

Figure 3.20 Logical Sequence (Roadmap to ISO 55001 Compliance, 2019)

When developing your Asset Management, the system starts by ensuring that the asset management Foundation Documents are in place, namely:

- An Asset Management Policy;
- Strategic Asset Management Plan (SAMP) and,
- Asset Management Plans (AMPs).

Processes and Procedures follow, since the foundation documents will mandate their requirement and their relative priority. These, in turn, dictate the Organisational Structure required for executing them. Specific Support Tools will be identified when processes and procedures are developed. Next training and coaching will be required to build Competence in applying the Processes Procedures and Tools. Given the competent personnel, an organisation is then able to Execute the actions from the SAMP and AMPs, whilst following the processes and procedures developed. Performance measures need to be set up to measure performance against process requirements and against the requirements from the SAMP and AMPs. The results are then Measured, and Improvement is undertaken.

The importance of establishing an "Asset Management Champion" with the right level of authority is discussed. A visible champion amongst senior leadership will be able to lead the journey and deliver results.

The Organisational Change Management ensures that all levels of the organisation are engaged and informed to ultimately change the culture of the organisation. The diagram shown in Figure 3.21 (adapted from the Kübler-Ross Grief Curve) shows that to move an organisation from blissful ignorance when ISO 55000 "sounds like a good idea" to a fully developed and adopted management system, requires a minimum of two activities to be done well.

First, there must be an engagement with the business across functional boundaries. Here, the emphasis is on providing information about what Asset Management means to the Organisation and on clearly articulating the benefits that are being pursued.

Second, after six-twelve months of developing content, the process requires a "champion" to push through and implement the changes required by the new policy, plans and procedures and make it stick. This is primarily done through visibly leading by example; showing others how it's done.

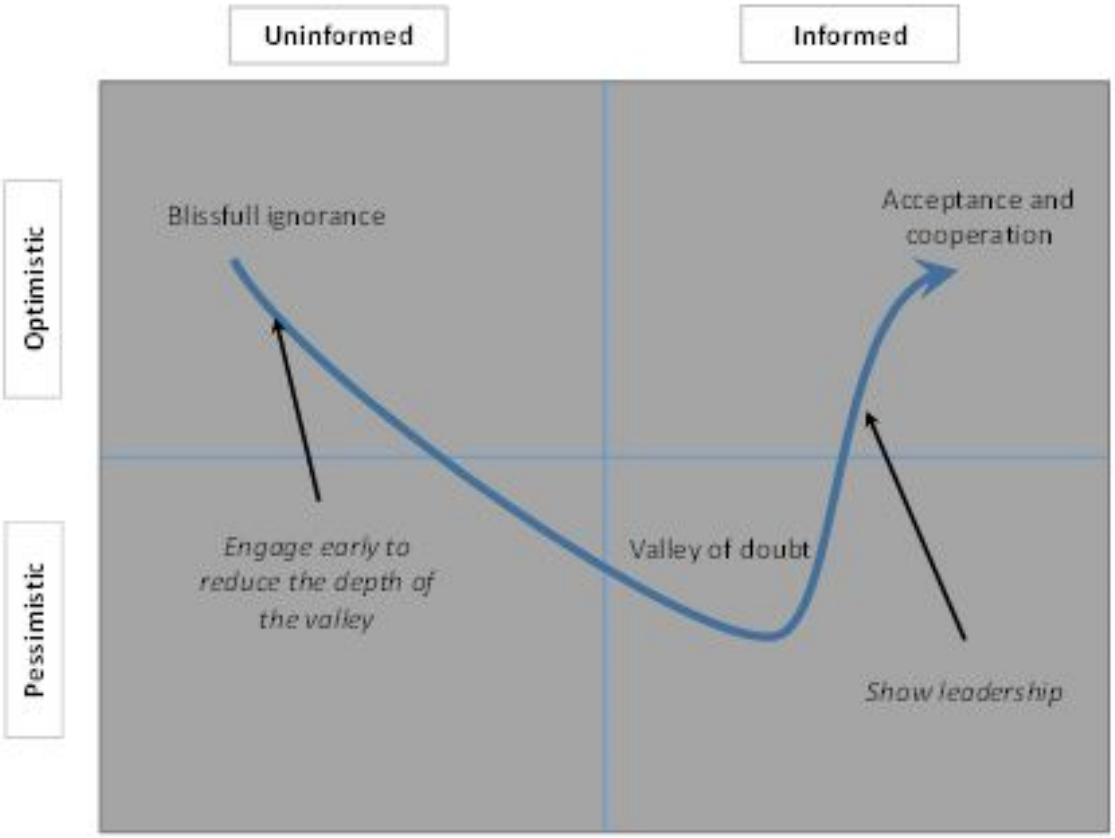


Figure 3.21 Kübler-Ross Grief Curve (Roadmap to ISO 55001 Compliance, 2019)

Throughout the journey, a level of Project Management will be required to make sure it all happens in a logical, efficient and effective order. Potentially, the first SAMP will have an objective namely to "Implement an ISO 55001 Compliant Asset Management System" with allocated resources and timelines endorsed by senior management.

Project management is a key component to deliver a comprehensive asset management system through your journey to compliance. Although leadership and change it is important, there usually is a fair amount of actual work that needs to be done. Planning and resourcing this journey could be challenging since this require extra effort from people over and above their normal duties. Active management of timelines and risks will be required to ensure the work is done. A project schedule is necessary, and regular management review will be required to ensure sustained progress.

Once the system has been developed, it may be ready for a detailed gap assessment.

Deciding exactly when to do the detailed gap assessment is a question of value. If the Asset Management System have not been started to develop, or the system is very

immature, the detailed gap assessment might not deliver much value. The detailed assessment can be done:

- Prior to the development of your Asset Management system in order to assist with developing the project plan for development and implementation;
- During the development of the Asset Management System in order to guide its progress, or,
- After your Asset Management System has been implemented and running for a few months in order to identify potential for fine-tuning or improvement or as a precursor to formal certification.

It can be decided to perform these detailed assessments at all these key milestones.

When performing a detailed gap assessment, there are a few options here:

- Internal assessment using the IAM Self-Assessment Methodology;
- External Assessment using consultants.

Ideally, you would want to use an Asset Management Assessor (Internal or External) that will be able to give you a clear indication of where the gaps lie in your asset management system. The detailed gap assessment involves a period of data and document reviews followed by interviews to back-up and confirm the documented information, and to confirm that the organisational behaviours required by the ISO 55001 standard and your documented Asset Management System are in place.

After the detailed gap assessment, attention can be focused on bridging the gaps, using, and improving your asset management system.

In this phase, the organisation would have implemented processes and systems that need to be operated, measured, audited and improved (Roadmap to ISO 55001 Compliance, 2019).

4 The Model and its Implementation

Many times, certifications come from regulator, rather as something that is needed for the organization this leads to a wall certification and leading many times to ISO 55000 certification being the end rather them the beginning. The standard just gives a framework that connects assets with organization objectives in business decision making, this should lead to collective decision making but to make decisions, they need to be well informed and many times the lack of information leads to the use of proxy data and assumptions, because many of the processes that give us information are not implemented or embedded, this can lead to the beginning, and everyone looking for faults in others, because the lack of results, the introduction of more procedures that will create more entropy in the all system; basically there needs to exist a change of culture at the risk of creating new "silos".

Anyway, having the decisions made by a group and not individuals is a great improvement, because not all changes can be made at the same time this will lead to prioritizing and may look like a bad decision for a group but it's the better to the all, till this happens optimal asset management decisions cannot be possible; so, what is an optimal asset management decision? This can be a decision that maximizes the value of assets in a long term by aligning them to the organization purposes and objectives and this can change from company to company, but there is a common ground between the organizations, they have leaders that "walk the talk" and those companies embedded those philosophies as a continues way of improvement rather them a onetime transformation and as a ongoing journey not a destination, besides everyone needs to be playing their part no matter their role or seniority, those formal policies and management systems just provide a framework for integrated decision making; but those organizations are very fluid how the information and insides go from team to team.

Clearly, good decisions rely on good information, and the way the organization treats its information demonstrates the engagement with its system, as all are aware of the improvements that need to be made, they can easily know what information they need to support the decisions, due the information importance that must be treated as an asset for the good of the entire organization and for the future generations. Perhaps, the most striking difference in an organization with a culture of asset management is how it feels like to be part of, because the organization its always learning and improving risks get more contained and incidents become by far less frequent; this creates space to think more expansibly about possibilities for greater innovation, and a longer term future and what can be learned from other industries or even for the organization very reasons for existing (The Big Picture, 2019).

Besides all explanation that was given earlier sections using the method that is being proposed, it makes easy to anyone even with a short knowledge of the standard to diagnose the state of the organization for the implementation of ISO 55001 using the correspond set of surveys, in which the evaluation of the responses indicates the position of the company in relation to the application that can be called standard. This audit method is designed to be used by members of the organization or individuals outside the organization, that can have little or no knowledge about ISO 55001. Thus, it is a simple tool and easy to apply without great human resources requirements. With this simple tool, the organization will be able to apply and ensure the improvement of the organization till the "perfection", because this same tool can be used during implementation process and

during internal audits, that can easily locate nonconformities and, finally, to verify if the corrective actions were successful; it can also locate possible problems and help to establish preventive actions. So, a continues use of this tool will help the organization on a continual improvement and making sure that each measure is suitable, adequate and affective to the asset management and asset management system.

4.1 The Surveys

The present methodology consists of 25 surveys, which are individual and can be filled either by company staff or by external consultants. For this purpose, there is a fact sheet for each requirement of the standard, which must be answered by company managers or consultants outside the company; the only requirement to answer to each survey is knowing the company procedures and be aquainted with its processes, taking into account this items if the auditor is someone outside the organization, it will need someone inside the company to follow up during the audits (Pais *et al*., 2019).

with different standard specification as the following:

- Understanding the organization and its context;
- Understanding the needs and expectations of stakeholders;
- Determining the scope of the asset management system;
- Asset management system;
- Leadership and commitment;
- Policy;
- Organizational roles, responsibilities and authorities;
- Actions to address risks and opportunities for the asset management system;
- Asset management objectives and planning to achieve them;
- Resources;
- Competences;
- Awareness;
- Communication;
- Information requirements;
- Documented information;
- Operational planning and control;
- Management of change;
- Outsourcing;
- Monitoring, measurement, analysis and evaluation;
- Internal audit;
- Management review;
- Nonconformity and corrective action;
- Preventive action;
- Continual improvement.

In Table 4.1 we can see the score that we need to be met in each stage in order to accomplish the requirements and move to next item; the maximum score is the value that is obtained if all the requirements are attained, and the minimum value represents the score needed to accomplish the stage; most of the times will be difficult to achive the highest score and in the beginning that shouldn't be expected, the same happens with the minimum score, surely the goal should not be to achieved the minimum score but an

average, always keeping in mind that this a non stop "process" and there is always room to improve and the work never stops; if it were not for, the cycle PDCA would not have meaning in each process or procedure, because as stated before there is need for a continual improvement, surely not all processes, procedures or even the organization departments will be on the same level and that isn't expected, but it's expected that each area must improve till the whole works perfectly as a "machine" where every part is an important part of the whole, and where each individual, process or department is important, no matter its position, location or situation. It should be clear to everyone in the organization the importance of each individually and as a group, and the success can only be achived with each playing its role that will make the whole go further.

Table 4.1 - The 25 stages of the diagnostic model, with their respective maximum and minimum scores (Pais *et al*., 2019).

Stage	Surveys	Maximum Score	Minimum Score
1	A. Understanding the organization and its context	3	2,4
2	B. Understanding the needs and expectations of stakeholders	4	3
3	C. Determining the scope of the asset management system	3	2
4	D. Asset management system	2	1,6
5	E. Leadership and commitment	17	13,6
6	F. Policy	12	9,6
7	G. Organizational roles, responsibilities and authorities	6	4,8
8	H. Actions to address risks and opportunities for the AMS	5	4
9	I. Asset management objectives	9	7,2
10	J. Planning to achieve asset management objectives	13	10,4
11	K. Resources	2	1,6
12	L. Competence	4	3,2
13	M. Awareness	4	3,2
14	N. Communication	4	3,2
15	O. Information requirements	12	9,6
16	P. Documented information	8	6,4
17	Q. Operational planning and control	4	3,2
18	R. Management of change	3	2,4
19	S. Outsourcing	3	2,4
20	T. Monitoring, measurement, analysis and evaluation	4	3,2
21	U. Internal audit	9	7,2
22	V. Management review	9	7,2
23	W. Nonconformity and corrective action	11	8,8
24	X. Preventive action	2	1,6
25	Y. Continual improvement	3	2,4

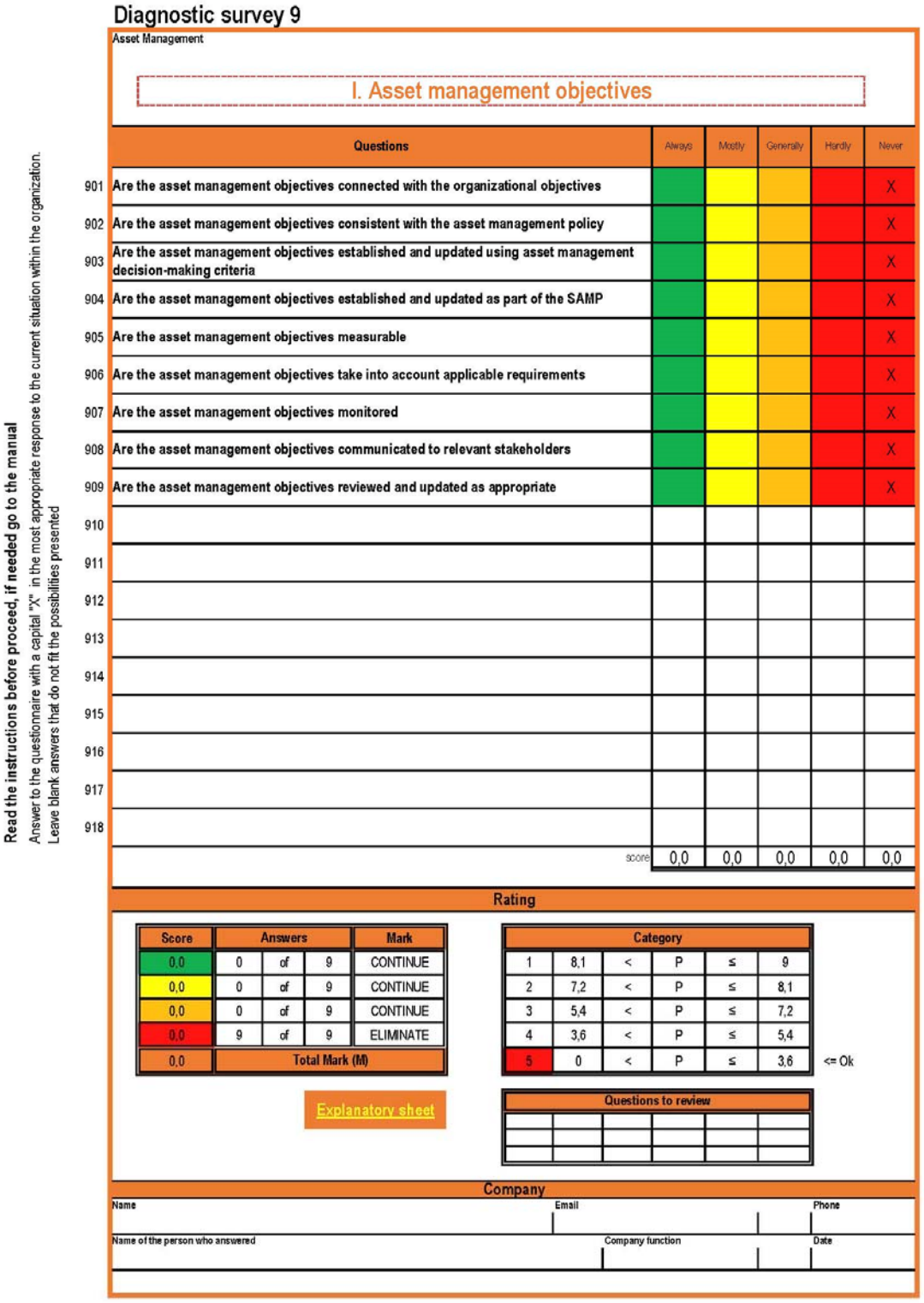
Table 4.1 presents the 25 stages that make up the several questionnaires on which the diagnostic model is based, with the respective maximum and minimum scores; the expected score should be between two and like explained before. We should not be

tempted to have the maximum score at the beginning of the whole process, because we may be inducing in ourselves and in others a false result.

For each of the items referred to, a diagnostic form, type survey, with several questions and five possibilities of response is elaborated, which are the following:

1) "Always" - always verified in the company;
2) "Mostly" - not always verified in the company;
3) "Generally" - sometimes verifies in the company;
4) "Hardly" - rarely occurs in the company;
5) "Never" - never verified in the company.

Figure 4.1 presents an example of a Diagnostic survey 9 "I - Asset management objectives".



Diagnostic survey 9

Asset Management

I. Asset management objectives

	Questions	Always	Mostly	Generally	Hardly	Never
901	Are the asset management objectives connected with the organizational objectives					X
902	Are the asset management objectives consistent with the asset management policy					X
903	Are the asset management objectives established and updated using asset management decision-making criteria					X
904	Are the asset management objectives established and updated as part of the SAMP					X
905	Are the asset management objectives measurable					X
906	Are the asset management objectives take into account applicable requirements					X
907	Are the asset management objectives monitored					X
908	Are the asset management objectives communicated to relevant stakeholders					X
909	Are the asset management objectives reviewed and updated as appropriate					X
910						
911						
912						
913						
914						
915						
916						
917						
918						
	score	0,0	0,0	0,0	0,0	0,0

Read the instructions before proceed, if needed go to the manual
Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization.
Leave blank answers that do not fit the possibilities presented

Rating

Score	Answers			Mark
0,0	0	of	9	CONTINUE
0,0	0	of	9	CONTINUE
0,0	0	of	9	CONTINUE
0,0	9	of	9	ELIMINATE
0,0	Total Mark (M)			

Category						
1	8,1	<	P	≤	9	
2	7,2	<	P	≤	8,1	
3	5,4	<	P	≤	7,2	
4	3,6	<	P	≤	5,4	
5	0	<	P	≤	3,6	<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email	Phone
Name of the person who answered	Company function	Date

Figure 4.1 Diagnostic survey (Pais *et al.*, 2019)

4.2 The Explanatory Sheets

In order to minimize doubts about the content and comprehension of the questions formulated in the diagnostic sheets, these are accompanied by an explanatory sheet (Figure 4.2).

Explanatory Sheet 23

Asset Management

W. Nonconformity and corrective action

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
2301	Nonconformity actions are taken	Nonconformity actions are ignored
2302	Nonconformities corrected	Nonconformities not corrected
2303	Consequences being taking care	Consequences of nonconformities not verified
2304	Nonconformities reviewed	Nonconformities not reviewed
2305	Causes determinated	Causes not determinated
2306	Search for similar nonconformities, or potencial	Similar nonconformities, or potencial not verified
2307	Actions needed implemented	Needed changes not implemented
2308	Corrective actions evaluated	Corrective actions not evaluated
2309	Changes made in the MAS if necessary	Necessary changes in the MAS not performed
2310	Record is kept of the nonconformity	Record of nonconformity not kept
2311	Record is kept of the corrective actions	Corrective actions record not kept
2312		
2313		
2314		
2315		
2316		
2317		
2318		

Figure 4.2 Explanatory sheet (Pais *et al.*, 2019)

The explanatory sheets are individualized by a questionnaire, and allows, question by question, to help understanding wath is needed on that section of the standard and to know which answer option to indicate. Those documents must be adapted to the different professional groups, making them easy to understand, clear making the objectives attainable; in this way, users will feel integrated throughout the process and that will lead to greater commitment and feeling of being part of the process which is central to success.

Diagnostic data sheets are identified at the top, through the number of the corresponding stage (1 to 25), by the name "Diagnostic survey", being identified by a heading designating in the corresponding stage.

There follows an intermediate zone where the grid, with the questions and columns reserved for the respective answer, is located. Each of the lines begins by indicating a number associated to each statement consisting of three or four digits. The first one(s) represent(s) the number of the inquiry sheet and the other two identify the order of the statement. It is based on this numbering that you can search for help in "Explanatory sheets". The following five possible response possibilities appear in the following columns - "Always", "Mostly", "Generally", "Hardly" and "Never" - as already mentioned. One and only one option must be answered. If it is impossible or not sure what to respond, then no option should be filled, and better understanding should be gained, so them a better option can be selected.

Finally, the lower part is reserved for determination:

- The score obtained;
- The consequent classification by categories;
- The elimination criteria achieved.

4.3 The Elimination Criteria

To each possibility of answering the several questions is assigned a degree of importance, functioning as a criterion of elimination, according to four colours (green; yellow; orange; and red) with the interpretation given in Table 4.2.

A withdrawal criterion is considered to have been achieved if the company has responded to a critically important question or exceeded the maximum number of allowable responses on matters of exceptional and inappropriate importance.

The evaluation of the questionnaires allows to determine the state of the company in the scope of the management of the physical assets of the organization.

It can be seen from the several questionnaires that the columns for "Always" or "Mostly" answers are the most desirable response possibilities and therefore the "green" colour of the elimination criterion is always attributed to them, but as it been stated before there shouldn’t be a temptation to try to falsify results or feel influenced by colors, everyone must remember that at a certain point everything will be known and at that time we can see where the fault is.

Table 4.2 Criteria of importance of the responses in the positioning of the maintenance state (Pais *et al.*, 2019)

Green	Adequate answer This answer is always desirable.
Yellow	Inadequate answer Only some answers should be of this type and the company should improve them.
Orange	Exceptional answer Few answers should be of this type, although these responses are not eliminatory, the company should improve them as soon as possible.
Red	Critical answer The company should never have this type of answer, being the first to be reviewed.

For each question answered, with a negative or central form, viz, "Generally", "Hardly" or "Never", the template automatically produces a report of fragile points (responses obtained in orange zones) or critical point reports (responses obtained in red areas).

4.3.1 The Elimination Grid

The elimination grids are no more than coloured cells in red, orange, yellow and green that are part of the questionnaire grid of each diagnostic sheet. When a critical, exceptional, inadequate or adequate response has been given, respectively, it allows to identify whether the company, in this matter, has been eliminated or not, according to the process previously described.

The process of colour assignment in the criteria of elimination results from the importance that each question contributes to the asset's management process and, consequently, its implications to the organization's reorganization.

The score (A) obtained by the company results from the formula (1):

$$A = \sum A_A + \sum A_M + \sum A_G + \sum A_H \quad (1)$$

Where,

A_A – Answer "Always"

A_M – Answer "Mostly"

A_G – Answer "Generally"

A_H – Answer "Hardly"

The score obtained gives origin to the category that the company achieves in each stage or questionnaire (Pais *et al*., 2019).

4.4 Model Implementation

According to Table 4.3, the score achieved by the company clearly demonstrates that many changes will be necessary for the application of ISO 55001.

This result was spectacle since it is a public institute where few management, quality and maintenance tools are used and where the interaction between the several areas is non-existent.

In this way, the implementation of ISO 55001 will be easier where other management tools have already been implemented and consolidated in the organization. There should be always in mind that previous processes, procedures and certifications are not to throu away and that ISO 55000 is a fresh start, ISO 55000 should be considered as a gathering of the company and the various processes and procedures remembering the interconnection whitin the organization and if anything goes wrong in a certain department or area that will affect the whole; therefore, if any documentation is already used it lets start on that, to build up to where we want to go. Applying ISO 55000 will be “the cherry on the cake”.

Table 4.3 Scoreboard reached (Pais *et al*., 2019)

Stage	Surveys	Company Score
1	A. Understanding the organization and its context	1,8
2	B. Understanding the needs and expectations of stakeholders	2,2
3	C. Determining the scope of the asset management system	1,7
4	D. Asset management system	0,0
5	E. Leadership and commitment	0,0
6	F. Policy	0,0
7	G. Organizational roles, responsibilities and authorities	0,0
8	H. Actions to address risks and opportunities for the AMS	0,0
9	I. Asset management objectives	0,0
10	J. Planning to achieve asset management objectives	0,0
11	K. Resources	0,0
12	L. Competence	0,0
13	M. Awareness	0,0
14	N. Communication	0,0
15	O. Information requirements	0,0
16	P. Documented information	0,0
17	Q. Operational planning and control	0,0
18	R. Management of change	0,0
19	S. Outsourcing	0,0
20	T. Monitoring, measurement, analysis and evaluation	0,0
21	U. Internal audit	0,0
22	V. Management review	0,0
23	W. Nonconformity and corrective action	0,0
24	X. Preventive action	0,0
25	Y. Continual improvement	0,0

Figure 4.2 illustrates the company's positioning radar map. The radar map is also called radar chart, web chart, spider chart, star chart, star plot, etc. A radar chart is a graphical

method of displaying multivariate data in the form of two-dimensional chart of three or more quantitative variables represented on axes starting from the same point. The relative position and angle of the axes is typically uninformative.

The radar chart is a chart and/or plot that consists of a sequence of equi-angular spokes, called radii, with each spoke representing one of the variables. The data length of a spoke is proportional to the magnitude of the variable for the data point relative to the maximum magnitude of the variable across all data points. A line is drawn connecting the data values for each spoke. This gives the plot a star-like appearance and the origin of one of the popular names for this plot. The star plot can be used to answer the following questions:

- Which observations are most similar, i.e., are there clusters of observations? (Radar charts are used to examine the relative values for a single data point (e.g., point 3 is larger for variables 2 and 4, smaller for variables 1, 3, 5, and 6) and to locate similar points or dissimilar points);
- Are there outliers?

Radar charts are a useful way to display multivariate observations with an arbitrary number of variables. Each star represents a single observation. Typically, radar charts are generated in a multi-plot format with many stars on each page and each star representing one observation. The star plot was first used by Georg von Mayr in 1877. Radar charts differ from glyph plots in that all variables are used to construct the plotted star figure. There is no separation into foreground and background variables. Instead, the star-shaped figures are usually arranged in a rectangular array on the page.

One application of radar charts is the control of quality improvement to display the performance metrics of any ongoing program.

They are also used in sports to chart players' strengths and weaknesses, where they are usually called spider charts.

Radar charts are primarily suited for strikingly showing outliers and commonality, or when one chart is greater in every variable than another, and primarily used for ordinal measurements – where each variable corresponds to "better" in some respect, and all variables on the same scale.

Conversely, radar charts have been criticized as poorly suited for making trade-off decisions – when one chart is greater than another on some variables, but less on others. Further, it is hard to visually compare lengths of different spokes, because radial distances are hard to judge, though concentric circles help as grid lines. Instead, one may use a simple line graph, particularly for time series (Radar Chart, 2019).

According to the needs of analisis proposed was, it clear that the radar chart was the best option to explress the results in an easy understandable way.

As we can see it can be said that the entity must improve its management culture in order to implement ISO 55001 and, at this stage, its application is completely inadequate, the organization needs to improve in basic items that already have been made clear that are essential, just like communication and documented information, but with this tool, the changes can be done and the results of those changes will be displayed.

Radar Map

Asset Management

Company: Company 1
Date: 1/jun/18

Organization Positioning

A. Understanding the organization and its context	N. Communication
B. Understanding the needs and expectations of stakeholders	O. Information requirements
C. Determining the scope of the asset management system	P. Documented information
D. Asset management system	Q. Operational planning and control
E. Leadership and commitment	R. Management of change
F. Policy	S. Outsourcing
G. Organizational roles, responsibilities and authorities	T. Monitoring, measurement, analysis and evaluation
H. Actions to address risks and opportunities for the AMS	U. Internal audit
I. Asset management objectives	V. Management review
J. Planning to achieve asset management objectives	W. Nonconformity and corrective action
K. Resources	X. Preventive action
L. Competence	Y. Continual improvement
M. Awareness	

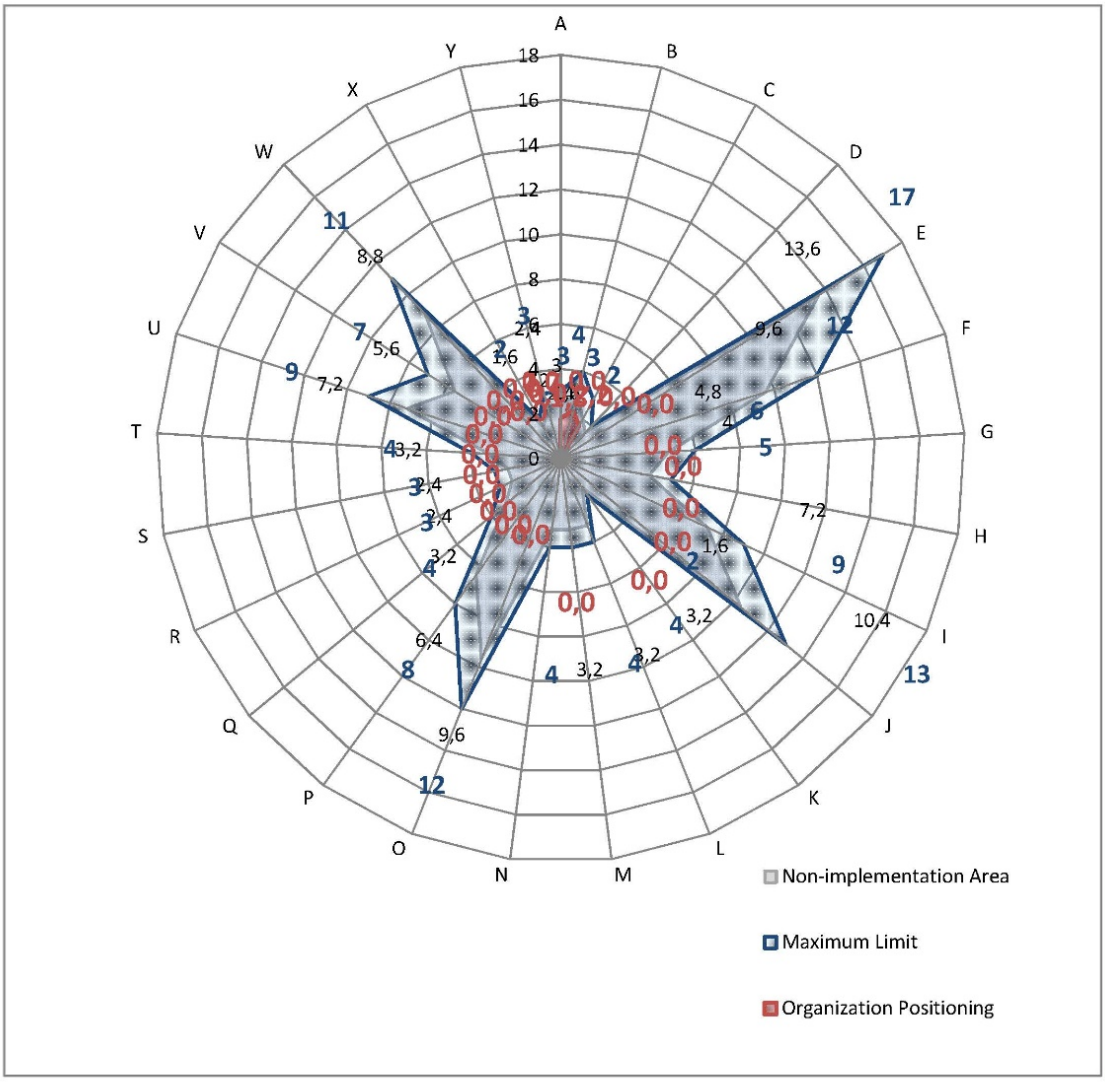


Figure 4.3 Radar Map (Pais *et al.*, 2019)

4.5 Others

Table 4.4 Scoreboard Minimum / Maximum vs Attained

Survey	Minimum Score	Maximum Score	Score Attained
A	2,4	3	1,8
B	3	4	2,2
C	2	3	1,7
D	1,6	2	0,0
E	13,6	17	0,0
F	9,6	12	0,0
G	4,8	6	0,0
H	4	5	0,0
I	7,2	9	0,0
J	10,4	13	0,0
K	1,6	2	0,0
L	3,2	4	0,0
M	3,2	4	0,0
N	3,2	4	0,0
O	9,6	12	0,0
P	6,4	8	0,0
Q	3,2	4	0,0
R	2,4	3	0,0
S	2,4	3	0,0
T	3,2	4	0,0
U	7,2	9	0,0
V	5,6	7	0,0
W	8,8	11	0,0
X	1,6	2	0,0

According Table 4.4 the minimum score was never reached; now we could take this tool and go throughout each survey and implement changes that would bring us to higher scores.

At this table, we can see that items like Leadership and commitment, Communication, Documented information and Operational planning and control obtained 0.0; those are basic requirements that greatly influence many others, those should be where to start.

Remember to keep processes and procedures simple, most of the times isn't needed to maintain terabytes of information, because information it's so easy to obtain don't fall in "love" with her, if its needed keep it, if not just discart, remember that there are costs associated with data. As we keep everything simple will be easier to understand and to apply, giving space to think and improve, remembering that improvement is the key!

As the changes are implemented according the scores attained and the use of a PDCA cycle to a continues improvement, we can, after each change, to see where we are according to the new score and introduce more changes till we are in condition to be certified, after certification the diagnosis tool, it will help us to make sure that we still in the right path and that we can introduce other improvements.

5 Conclusions and Future Developments

5.1 Conclusions

These new standards “raise the bar” for the discipline of asset management. They provide a clear and highly visible benchmark for good stewardship in a fashion that is visible to the boardroom. While certification is likely to be attractive to only a small sub-set of organisations, it is recommended that all asset-owning organisations at least should spend some time to understand the content of these standards and how well their practices align to them.

The diagnostic model developed to support the implementation of the ISO 55001 standard was easy to use and with concrete results to support organizations in identifying their strengths and weaknesses for their implementation.

The result of the diagnostic model allows an "X-ray" of the entity through a radar map, as well as several supporting reports.

The model was validated in a public institute and resulted in a diagnosis that coincides with what was predicted empirically in relation to the primary state of the management culture in which it is found.

The model, in addition to the initial diagnosis, corresponds to a tool to support the implementation of ISO 55001.

The introduction and certification organizations by ISO 55000 will be a revolution when compared with the current vision of asset management. The word “cost” will be replaced by asset’s fixed initial investment and the variable asset investment over time.

As it been said before this is a never-ending process that will need improvement throughout the organization’s life, these improvements / changes can be due to risks identified, process implemented, legislation, standard, products, equipments. We must see organizations as a living being that grows and changes throughout its life and the cause of this grow and change there must need to be a continuas adequacy for the new stage.

The relevance of assets in companies added to the influence of technologies associated with Industry 4.0, which makes assets more and more intelligent, will be the next future reality.

The next future technology to aid asset management will use the current consolidated support in an integrated and transparent way: artificial intelligence, Big Data, the Internet of Things, the Internet of People, the Cloud Computing, the Visual Reality, and the Augmented Reality, among others.

Even if certification isn’t the mark for the organization, the implementation of ISO 55000 will bring great benefits for the company and in a short time after de process begins it will be clear to the stakeholders that it was a great bet to the organization and the company will “respire” better.

5.2 Future Developments

After this work it is being clear to me that this way to manage organizations in the future and the companies must change in order to achieve this.

Probably, the major itens in asset management are, first, the people, its been made clear to me that the trained staff can take the organization to an upper level, only with employees focused the organition can have a success, they are the foundation of a successful organization; so, it is essencial to train, coach, nurture to keep them cativated, giving them achievable goals and objectives and recognizing them for the achievements and rewarding (public recognition, career progression, social benefits, increase in salary, etc.). Without those kind of policy in the company it can fall away or never reach their full potencial.

Second, will be documented information, this will be the "bible" for the organization, even with a regular change, those documents are the guide for the company without them or with a poor documentation everyone will be doing their own things, even if for them that's the best way to go, it can be said the organization must be a group and not an individual doesn't matter if that individual is a full department, it still an individual compared with full organization. So good the documentation that is prepared with contribute of all and distributed properly, it is the key to everyone be on the "same page of the music".

An organization that doesn't keep actualized information on his processes, assets, risks and events (acidents, incidents, breakdowns, etc), cannot improve; improvement is related with change, and changes needed are identified when something happens, but, if we don't have a report of the event? Remember that good decisions rely on good information, so, without information the improvement his based on what? So, make sure that the data is actualized and available.

After all continual improvement, it is an item in ISO 55000:

- *The organization shall continually improve the suitability, adequacy and effectiveness of its asset management and the asset management system"* (ISO 55001, 2014).

The Standard ISO 55000 is, and it will be a great tool to improve the life (remember that they are living biengs) of the organizations, because they will communicate better, relate better, it will solve the problems together, and this will be due to good employees and good data, which are the foundations on this standard, those will extend the companies life and her "health"

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Attachments

Stage	Surveys	Maximum Score	Minimum Score
1	A. Understanding the organization and its context	3	2.4
2	B. Understanding the needs and expectations of stakeholders	4	3
3	C. Determining the scope of the asset management system	3	2
4	D. Asset management system	2	1.6
5	E. Leadership and commitment	17	13.6
6	F. Policy	12	9.6
7	G. Organizational roles, responsibilities and authorities	6	4.8
8	H. Actions to address risks and opportunities for the AMS	5	4
9	I. Asset management objectives	9	7.2
10	J. Planning to achieve asset management objectives	13	10.4
11	K. Resources	2	1.6
12	L. Competence	4	3.2
13	M. Awareness	4	3.2
14	N. Communication	4	3.2
15	O. Information requirements	12	9.6
16	P. Documented information	8	6.4
17	Q. Operational planning and control	4	3.2
18	R. Management of change	3	2.4
19	S. Outsourcing	3	2.4
20	T. Monitoring, measurement, analysis and evaluation	4	3.2
21	U. Internal audit	9	7.2
22	V. Management review	7	5.6
23	W. Nonconformity and corrective action	11	8.8
24	X. Preventive action	2	1.6
25	Y. Continual improvement	3	2.4

Diagnostic survey 1

Asset Management

A. Understanding the organization and its context

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
101	The organization determines its external issues that are relevant to its purpose				X	
102	The organization determines its internal issues that are relevant to its purpose			X		
103	Are the Asset management objectives coherent with the organizational objectives	X				
104						
105						
106						
107						
108						
109						
110						
111						
112						
113						
114						
115						
116						
117						
118						
	score	1.0	0.0	0.5	0.3	0.0

Rating

Score	Answers			Mark
1.0	1	of	3	CONTINUE
0.0	0	of	3	CONTINUE
0.5	1	of	3	CONTINUE
0.3	1	of	3	ELIMINATE
1.8	Total Mark (M)			

Category					
1	2.7	<	P	≤	3
2	2.4	<	P	≤	2.7
3	1.8	<	P	≤	2.4
4	1.0	<	P	≤	1.8
5	0	<	P	≤	1.0

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Company 1			
Name of the person who answered	**Company function**		**Date**
			1/jun/18

Explanatory Sheet 1

Asset Management

A. Understanding the organization and its context

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
101	External issues that are relevant to the AMS are indentified such outsourcing our suppliers	External issues that are relevant to the AMS aren't identified
102	Internal issues that are relevant to the AMS are indentified such operating practices or equipment replacement	Internal issues that are relevant to the AMS aaren't identified
103	SAMP is conected with organization and there is a asset management thinking	The SAMP works alone and with no interaction with company organization
104		
105		
106		
107		
108		
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111		
112		
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118		

Diagnostic survey 2

Asset Management

B. Understanding the needs and expectations of stakeholders

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
201	Has the organization defined its stakeholders	X				
202	Has the organization defined the requirements and expectations of its stakeholders		X			
203	Has the organisation defined the criteria for asset management decision making					X
204	Are the stakeholder requirements well defined for recording financial and non-financial information			X		
205						
206						
207						
208						
209						
210						
211						
212						
213						
214						
215						
216						
217						
218						
	score	1.0	0.7	0.5	0.0	0.0

Rating

Score	Answers			Mark
1.0	1	of	4	CONTINUE
1.2	2	of	4	CONTINUE
0.0	0	of	4	CONTINUE
0.0	1	of	4	ELIMINATE
2.2	Total Mark (M)			

Category					
1	3.5	<	P	≤	4
2	3.0	<	P	≤	3.5
3	2.2	<	P	≤	3.0
4	1.2	<	P	≤	2.2
5	0	<	P	≤	1.2

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone

Name of the person who answered	Company function		Date

Explanatory Sheet 2

Asset Management

B. Understanding the needs and expectations of stakeholders

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
201	Organization defined its stakeholders	Organization stakeholders don´t are enough or don´t exist
202	Organization defined the requirements and expectations of its stakeholders	Organization requirements and expectations of its stakeholders aren't clear or don´t exist
203	Organisation defined the criteria for asset management decision making	Organisation criteria for asset management decision aren´t clear or don't exist
204	Stakeholder requirements are well defined for recording financial and non-financial information	Stakeholder requirements for recording financial and non-financial information aren't clear os don't exist
205		
206		
207		
208		
209		
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211		
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Diagnostic survey 3

Asset Management

C. Determining the scope of the asset management system

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
301	Does organization consider the external and internal issues referred to in 4.1			X		
302	Does organization consider the requirements referred to in 4.2			X		
303	Does organization consider the interaction with other management systems, if used		X			
304						
305						
306						
307						
308						
309						
310						
311						
312						
313						
314						
315						
316						
317						
318						
	score	0.0	0.7	1.0	0.0	0.0

Rating

Score	Answers			Mark
1.7	1	of	3	CONTINUE
0.0	2	of	3	CONTINUE
0.0	0	of	3	CONTINUE
0.0	0	of	3	CONTINUE
1.7	Total Mark (M)			

Category					
1	2.5	<	P	≤	3
2	2.0	<	P	≤	2.5
3	1.2	<	P	≤	2.0
4	0.6	<	P	≤	1.2
5	0	<	P	≤	0.6

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 3

Asset Management

C. Determining the scope of the asset management system

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
301	Organization consider the external and internal issues referred to in 4.1	Organization external and internal issues to establish AMS aren't completely defined or not defined
302	Organization consider the requirements referred to in 4.2	Organization requirements referred to in 4.2 aren´t completely defined or not defined
303	Organization consider the interaction with other management systems, if used	Organization don´t consider the interaction with other management systems, if used
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305		
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307		
308		
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310		
311		
312		
313		
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Diagnostic survey 4

Asset Management

D. Asset management system

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
401	Does the organization has an active asset management system					X
402	Does the organization develop a Strategic Asset Management Plan (SAMP) with documentation of the asset management system					X
403						
404						
405						
406						
407						
408						
409						
410						
411						
412						
413						
414						
415						
416						
417						
418						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	2	CONTINUE
0.0	0	of	2	CONTINUE
0.0	2	of	2	ELIMINATE
0.0	n/a	of	n/a	ELIMINATE
0.0	Total Mark (M)			

Category					
1	1.8	<	P	≤	2
2	1.6	<	P	≤	1.8
3	1.2	<	P	≤	1.6
4	0.0	<	P	≤	1.2
5	0	<	P	≤	0.0

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone

Name of the person who answered	Company function		Date

Explanatory Sheet 4

Asset Management

D. Asset management system

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
401	Organization has an active asset management system	Organization isn't active on it's AMS
402	Organization develop a Strategic Asset Management Plan (SAMP) with documentation of the asset management system	Organization as no SAMP and it's documentation
403		
404		
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Diagnostic survey 5

Asset Management

E. Leadership and commitment

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
501	There is a Strategic Asset Management Plan (SAMP)					X
502	There is an Asset Management policy well defined in SAMP					X
503	There are Asset Management objectives well defined in SAMP					X
504	There is an integration of Asset Management System (AMS) with the business plan					X
505	There are internal resources to implement the AMS					X
506	There are financial resources to implement the AMS					X
507	The organization has an Asset Management department					X
508	Does the Asset Managment departmant has it´s own budjet					X
509	The SAMP has well defined objectives and goals					X
510	The Organisation communicates about the AMS requirements and its importance					X
511	There is an internal system to assure that the AMS achieves its intended outcome(s)					X
512	There are internal audits and other cross functional evaluation					X
513	There are Key Performance Indicatores (KPI)					X
514	Are KPI reviewed periodically in a perspective of a continuous improvement					X
515	Are other relevant management roles supporting the leadership related to AMS					X
516	The Asset Management risk is aligned with organization's managing risk					X
517	Is the Asset Management risk alined with ISO 31000 series					X
518						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	17	CONTINUE
0.0	0	of	17	CONTINUE
0.0	13	of	17	ELIMINATE
0.0	4	of	4	ELIMINATE
0.0	Total Mark (M)			

Category					
1	15.3	<	P	≤	17
2	13.6	<	P	≤	15.3
3	10.2	<	P	≤	13.6
4	1.6	<	P	≤	10.2
5	0	<	P	≤	1.6

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 5

Asset Management

E. Leadership and commitment

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
501	The SAMP exist	The SAMP doesn't exist
502	Asset Management policy well defined in SAMP	Asset Management policy isn´t on SAMP
503	Asset Management objectives well defined in SAMP	Asset Management objectives aren´t on SAMP
504	Integration of Asset Management System (AMS) with the business plan	Integration of Asset Management System (AMS) with the business plan doen't exist
505	Internal resources to implement the AMS	Internal resources to implement the MAS don't exist
506	Financial resources to implement the AMS	Financial resources to implement the MAS don't exist
507	Organization has an Asset Management department	Organization don't have an Asset Management department
508	Asset Managment departmant has it´s own budjet	Asset Managment departmant doesn't have it´s own budjet
509	SAMP has well defined objectives and goals	SAMP doesn't define objectives and goals
510	Organisation communicates about the AMS requirements and its importance	Organisation doesn't communicates about the AMS requirements and its importance
511	Exist an internal system to assure that the AMS achieves its intended outcome(s)	There isn't an internal system to assure that the AMS achieves its intended outcome(s)
512	Internal audits are performed and other cross functional evaluation	Internal audits don't exist and other cross functional evaluation
513	Key Performance Indicatores (KPI)	Key Performance Indicatores (KPI) don't exist
514	KPI are reviewed periodically in a perspective of a continuous improvement	KPI aren't reviewed periodically in a perspective of a continuous improvement
515	There are other relevant management roles supporting the leadership related to AMS	Other relevant management roles supporting the leadership related to MAS doesn't exist
516	Asset Management risk is aligned with organization's managing risk	Asset Management risk isn't aligned with organization's managing risk
517	Asset Management risk alined with ISO 31000 series	Asset Management risk not alined with ISO 31000 series
518		

Diagnostic survey 6

Asset Management

F. Policy

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
601	Asset Management Policy (AMP) is according to the purpose of the organisation					X
602	There is a framework with AMP objectives					X
603	There is a commitment with minimum goals to satisfy applicable requirements					X
604	There is an objective commitment about continual improvement of the AMS					X
605	The AMP is according to SAMP					X
606	The AMP is coherent with other organizational policies					X
607	The AMP is designed according to the real organization's activity					X
608	The AMP is available in a well described document					X
609	The AMP is communicated within the organization					X
610	The AMP is available to stakeholders					X
611	The AMP is periodically reviewed and updated according to the goals defined					X
612	The AMP has a framework to accompany it systematically					X
613						
614						
615						
616						
617						
618						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	12	CONTINUE
0.0	0	of	12	CONTINUE
0.0	0	of	12	CONTINUE
0.0	12	of	12	ELIMINATE
0.0	Total Mark (M)			

Category					
1	10.8	<	P	≤	12
2	9.6	<	P	≤	10.8
3	7.2	<	P	≤	9.6
4	4.8	<	P	≤	7.2
5	0	<	P	≤	4.8

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 6

Asset Management

F. Policy

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
601	Asset Management Policy (AMP) is according to the purpose of the organisation	Asset Management Policy (AMP) isn't according to the purpose of the organisation
602	Framework with AMP objectives	Framework with AMP objectives doesn't exist
603	Commitment with minimum goals to satisfy applicable requirements	Commitment with minimum goals to satisfy applicable requirements doesn't exist
604	Objective commitment about continual improvement of the AMS	Objective commitment about continual improvement of the MAS isn't clear or doesn't exist
605	AMP is according to SAMP	AMP isn't according to SAMP
606	AMP is coherent with other organizational policies	AMP isn't coherent with other organizational policies
607	AMP is designed according to the real organization's activity	AMP isn't designed according to the real organization's activity
608	AMP is available in a well described document	AMP isn't available in a well described document
609	AMP is communicated within the organization	AMP isn't communicated within the organization
610	AMP is available to stakeholders	AMP isn't available to stakeholders
611	AMP is periodically reviewed and updated according to the goals defined	AMP isn't periodically reviewed and updated according to the goals defined
612	AMP has a framework to accompany it systematically	AMP hasn't a framework to accompany it systematically
613		
614		
615		
616		
617		
618		

Diagnostic survey 7

Asset Management

G. Organizational roles, responsibilities and authorities

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
701	The SAMP is periodically evaluated and updated					X
702	The AMS is coherent with SAMP including objective inputs					X
703	The AMS is designed according to ISO 55001					X
704	The AMS is suitable, adequate and effective					X
705	The Asset Management plan(s) and objective(s) are periodically updated					X
706	The AMS performance is periodically reported to top management					X
707						
708						
709						
710						
711						
712						
713						
714						
715						
716						
717						
718						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	6	CONTINUE
0.0	0	of	6	CONTINUE
0.0	0	of	6	CONTINUE
0.0	6	of	6	ELIMINATE
0.0	Total Mark (M)			

Category					
1	5.4	<	P	≤	6
2	4.8	<	P	≤	5.4
3	3.6	<	P	≤	4.8
4	2.4	<	P	≤	3.6
5	0	<	P	≤	2.4

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 7

Asset Management

G. Organizational roles, responsibilities and authorities

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
701	SAMP is periodically evaluated and updated	SAMP isn't periodically evaluated and updated
702	AMS is coherent with SAMP including objective inputs	AMS isn't coherent with SAMP including objective inputs
703	AMS is designed according to ISO 55001	AMS isn't designed according to ISO 55001
704	AMS is suitable, adequate and effective	AMS isn´t suitable, adequate and effective
705	Asset Management plan(s) and objective(s) are periodically updated	Asset Management plan(s) and objective(s) aren't periodically updated
706	AMS performance is periodically reported to top management	AMS performance isn´t periodically reported to top management
707		
708		
709		
710		
711		
712		
713		
714		
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718		

Diagnostic survey 8

Asset Management

H. Actions to address risks and opportunities for the AMS

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
801	Does the Asset Management System (AMS) it´s achiving the outcome intented					X
802	Are undesired effects being prevented					X
803	Is there a continous improvement policy					X
804	Are there planned actions to address the risks and opportunities including their variation along time					X
805	The AMS is flexible enough to integrate new actions and evaluate them					X
806						
807						
808						
809						
810						
811						
812						
813						
814						
815						
816						
817						
818						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	5	CONTINUE
0.0	0	of	5	CONTINUE
0.0	0	of	5	CONTINUE
0.0	5	of	5	ELIMINATE
0.0	Total Mark (M)			

Category					
1	4.5	<	P	≤	5
2	4.0	<	P	≤	4.5
3	3.0	<	P	≤	4.0
4	2.0	<	P	≤	3.0
5	0	<	P	≤	2.0

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 8

Asset Management

H. Actions to address risks and opportunities for the AMS

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
801	Asset Management System (AMS) it´s achiving the outcome intented	Asset Management System (AMS) isn't achiving the outcome intented
802	Undesired effects being prevented	Undesired effects aren't being prevented
803	Is there a continous improvement policy	There isn't a continous improvement policy
804	There are planned actions to address the risks and opportunities including their variation along time	There aren't planned actions to address the risks and opportunities including their variation along time
805	AMS is flexible enough to integrate new actions and evaluate them	AMS isn't flexible enough to integrate new actions and evaluate them
806		
807		
808		
809		
810		
811		
812		
813		
814		
815		
816		
817		
818		

Diagnostic survey 9

Asset Management

I. Asset management objectives

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
901	Are the asset management objectives connected with the organizational objectives					X
902	Are the asset management objectives consistent with the asset management policy					X
903	Are the asset management objectives established and updated using asset management decision-making criteria					X
904	Are the asset management objectives established and updated as part of the SAMP					X
905	Are the asset management objectives measurable					X
906	Are the asset management objectives take into account applicable requirements					X
907	Are the asset management objectives monitored					X
908	Are the asset management objectives communicated to relevant stakeholders					X
909	Are the asset management objectives reviewed and updated as appropriate					X
910						
911						
912						
913						
914						
915						
916						
917						
918						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	9	CONTINUE
0.0	0	of	9	CONTINUE
0.0	0	of	9	CONTINUE
0.0	9	of	9	ELIMINATE
0.0	Total Mark (M)			

Category						
1	8.1	<	P	≤	9	
2	7.2	<	P	≤	8.1	
3	5.4	<	P	≤	7.2	
4	3.6	<	P	≤	5.4	
5	0	<	P	≤	3.6	<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 9

Asset Management

I. Asset management objectives

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
901	Asset management objectives connected with the organizational objectives	Asset management objectives aren´t connected with the organizational objectives
902	Asset management objectives consistent with the asset management policy	Asset management objectives aren't consistent with the asset management policy
903	Asset management objectives established and updated using asset management decision-making criteria	Asset management objectives aren't established and updated using asset management decision-making criteria
904	Asset management objectives established and updated as part of the SAMP	Asset management objectives aren't established and updated as part of the SAMP
905	Asset management objectives measurable	Asset management objectives aren't measurable
906	Asset management objectives take into account applicable requirements	Asset management objectives don't take into account applicable requirements
907	Asset management objectives monitored	Asset management objectives aren't monitored
908	Asset management objectives communicated to relevant stakeholders	Asset management objectives aren't communicated to relevant stakeholders
909	Asset management objectives reviewed and updated as appropriate	Asset management objectives aren't reviewed and updated as appropriate
910		
911		
912		
913		
914		
915		
916		
917		
918		

Diagnostic survey 10

Asset Management

J. Planning to achieve asset management objectives

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
1001	Shall the organization determine and document the method and criteria for decision making and prioritizing of the activities and resources to achieve its AMP and AM objectives					X
1002	Shall the organization determine and document the processes and methods to be employed in managing its assets over their life cycles					X
1003	Shall the organization determine and document what will be done					X
1004	Shall the organization determine and document what resources will be required					X
1005	Shall the organization determine and document who will be responsible					X
1006	Shall the organization determine and document when it will be completed					X
1007	Shall the organization determine and document how the results will be evaluated					X
1008	Shall the organization determine and document the appropriate time horizon(s) for the asset management plan(s)					X
1009	Shall the organization determine and document the financial and non-financial implications of the asset management plan(s)					X
1010	Shall the organization determine and document the review period for the asset management plan(s)					X
1011	Shall the organization determine and document how these risks and opportunities can change with time, by establishing processes for identification and assessment of risks and opportunities					X
1012	Shall the organization determine and document how these risks and opportunities can change with time, by establishing processes for determining the significance of assets in achieving asset management objectives					X
1013	Shall the organization determine and document how these risks and opportunities can change with time, by establishing processes for implementation the appropriate treatment, and monitoring, of risks and opportunities					X
1014						
1015						
1016						
1017						
1018						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	13	CONTINUE
0.0	0	of	13	CONTINUE
0.0	0	of	13	CONTINUE
0.0	13	of	13	ELIMINATE
0.0	Total Mark (M)			

Category					
1	11.7	<	P	≤	13
2	10.4	<	P	≤	11.7
3	7.8	<	P	≤	10.4
4	5.2	<	P	≤	7.8
5	0	<	P	≤	5.2

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 10

Asset Management

J. Planning to achieve asset management objectives

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
1001	Organization determine and document the method and criteria for decision making and prioritizing of the activities and resources to achieve its AMP and AM objectives	Organization doesn't determine and document the method and criteria for decision making and prioritizing of the activities and resources to achieve its AMP and AM objectives
1002	Organization determine and document the processes and methods to be employed in managing its assets over their life cycles	Organization doesn't determine and document the processes and methods to be employed in managing its assets over their life cycles
1003	Organization determine and document what will be done	Organization doesn't determine and document what will be done
1004	Organization determine and document what resources will be required	Organization doesn't determine and document what resources will be required
1005	Organization determine and document who will be responsible	Organization doesn't determine and document who will be responsible
1006	Organization determine and document when it will be completed	Organization doesn't determine and document when it will be completed
1007	Organization determine and document how the results will be evaluated	Organization doesn't determine and document how the results will be evaluated
1008	Organization determine and document the appropriate time horizon(s) for the asset management plan(s)	Organization doesn't determine and document the appropriate time horizon(s) for the asset management plan(s)
1009	Organization determine and document the financial and non-financial implications of the asset management plan(s)	Shall the organization determine and document the financial and non-financial implications of the asset management plan(s)
1010	Organization determine and document the review period for the asset management plan(s)	Organization doesn't determine and document the review period for the asset management plan(s)
1011	Organization determine and document how these risks and opportunities can change with time, by establishing processes for identification and assessment of risks and opportunities	Organization doesn't determine and document how these risks and opportunities can change with time, by establishing processes for identification and assessment of risks and opportunities
1012	Organization determine and document how these risks and opportunities can change with time, by establishing processes for determining the significance of assets in achieving asset management objectives	Organization doesn't determine and document how these risks and opportunities can change with time, by establishing processes for determining the significance of assets in achieving asset management objectives
1013	Organization determine and document how these risks and opportunities can change with time, by establishing processes for implementation the appropriate treatment, and monitoring, of risks and opportunities	Organization doesn't determine and document how these risks and opportunities can change with time, by establishing processes for implementation the appropriate treatment, and monitoring, of risks and opportunities
1014		
1015		
1016		
1017		
1018		

Diagnostic survey 11

Asset Management

K. Resources

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
1101	The resources needed to implement MAS are known					X
1102	There is the needed resources to implement MAS					X
1103						
1104						
1105						
1106						
1107						
1108						
1109						
1110						
1111						
1112						
1113						
1114						
1115						
1116						
1117						
1118						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	2	CONTINUE
0.0	0	of	2	CONTINUE
0.0	0	of	2	CONTINUE
0.0	2	of	2	ELIMINATE
0.0	Total Mark (M)			

Category					
1	1.8	<	P	≤	2
2	1.6	<	P	≤	1.8
3	1.2	<	P	≤	1.6
4	0.8	<	P	≤	1.2
5	0	<	P	≤	0.8

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 11

Asset Management

K. Resources

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
1101	Resources needed to implement AMS are known	Resources needed to implement AMS are unknown
1102	Needed resources to implement AMS exist	Needed resources to implement AMS don't exist
1103		
1104		
1105		
1106		
1107		
1108		
1109		
1110		
1111		
1112		
1113		
1114		
1115		
1116		
1117		
1118		

Diagnostic survey 12

Asset Management

L. Competence

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
1201	Are the competences needed identified					X
1202	Do the players have appropriate education, training, or experience					X
1203	Is there formation for the players					X
1204	There is documentation proving competences					X
1205						
1206						
1207						
1208						
1209						
1210						
1211						
1212						
1213						
1214						
1215						
1216						
1217						
1218						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	4	CONTINUE
0.0	0	of	4	CONTINUE
0.0	0	of	4	CONTINUE
0.0	4	of	4	ELIMINATE
0.0	Total Mark (M)			

Category					
1	3.6	<	P	≤	4
2	3.2	<	P	≤	3.6
3	2.4	<	P	≤	3.2
4	1.6	<	P	≤	2.4
5	0	<	P	≤	1.6

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 12

Asset Management

L. Competence

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
1201	Competences needed identified	Competences needed not identified
1202	Players have appropriate education, training, or experience	Players haven't appropriate education, training, or experience
1203	Formation for the players	Formation for the players don't exist
1204	Documentation proving competences	Documentation proving competences don't exist
1205		
1206		
1207		
1208		
1209		
1210		
1211		
1212		
1213		
1214		
1215		
1216		
1217		
1218		

Diagnostic survey 13

Asset Management

M. Awareness

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
1301	Has the AMS been made knowed to everyone that as impact in the AMS objectives					X
1302	Are they aware of their importance to achive AMS objectives					X
1303	They know well their activities and the risk associated					X
1304	They know the outcome of not achiving AMS requirementes					X
1305						
1306						
1307						
1308						
1309						
1310						
1311						
1312						
1313						
1314						
1315						
1316						
1317						
1318						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	4	CONTINUE
0.0	0	of	4	CONTINUE
0.0	0	of	4	CONTINUE
0.0	4	of	4	ELIMINATE
0.0	Total Mark (M)			

Category					
1	3.6	<	P	≤	4
2	3.2	<	P	≤	3.6
3	2.4	<	P	≤	3.2
4	1.6	<	P	≤	2.4
5	0	<	P	≤	1.6

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 13

Asset Management

M. Awareness

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
1301	AMS been made knowed to everyone that as impact in the AMS objectives	Has the AMS been made knowed to everyone that as impact in the AMS objectives
1302	Everyone is aware of their importance to achive AMS objectives	No one is aware of their importance to achive AMS objectives
1303	They know well their activities and the risk associated	They know well their activities and the risk associated
1304	They know the outcome of not achiving AMS requirementes	They know the outcome of not achiving AMS requirementes
1305		
1306		
1307		
1308		
1309		
1310		
1311		
1312		
1313		
1314		
1315		
1316		
1317		
1318		

Diagnostic survey 14

Asset Management

N. Communication

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
1401	Does the organization members know what will need to be communicated					X
1402	When to communicate is defined					X
1403	With whom to communicate is defined					X
1404	How to communicate is defined					X
1405						
1406						
1407						
1408						
1409						
1410						
1411						
1412						
1413						
1414						
1415						
1416						
1417						
1418						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	4	CONTINUE
0.0	0	of	4	CONTINUE
0.0	0	of	4	CONTINUE
0.0	4	of	4	ELIMINATE
0.0	Total Mark (M)			

Category					
1	3.6	<	P	≤	4
2	3.2	<	P	≤	3.6
3	2.4	<	P	≤	3.2
4	1.6	<	P	≤	2.4
5	0	<	P	≤	1.6

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 14

Asset Management

N. Communication

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
1401	Organization members know what will need to be communicated	Organization members don't know what will need to be communicated
1402	When to communicate is defined	When to communicate not defined
1403	With whom to communicate is defined	With whom to communicate not defined
1404	How to communicate is defined	How to communicate not defined
1405		
1406		
1407		
1408		
1409		
1410		
1411		
1412		
1413		
1414		
1415		
1416		
1417		
1418		

Diagnostic survey 15

Asset Management

O. Information requirements

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
1501	Does the organization as information on the significance of the identified risks					X
1502	Are the roles and responsabilities documented					X
1503	Are the asset management processes, procedures and activities documented					X
1504	Is defined the exchange of information with its stakeholders, including service providers					X
1505	Is knowed the impact of quality, availability and management of information on organizational decision making					X
1506	Does the information has attribute requirements					X
1507	Does the information has quality requirements					X
1508	Is defined how and when information is to be collected, analysed and evaluated					X
1509	There is a specified procedure to implement and maintain processes for managing its information					X
1510	Are the financial and non-financial terminology relevant to asset management aligned					X
1511	and other relevant non-financial data					X
1512	The documentation meet its legal and regulatory requirements while considering its stakeholders requirements and organizational objectives					X
1513						
1514						
1515						
1516						
1517						
1518						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	12	CONTINUE
0.0	0	of	12	CONTINUE
0.0	0	of	12	CONTINUE
0.0	12	of	12	ELIMINATE
0.0	Total Mark (M)			

Category					
1	10.8	<	P	≤	12
2	9.6	<	P	≤	10.8
3	7.2	<	P	≤	9.6
4	4.8	<	P	≤	7.2
5	0	<	P	≤	4.8

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 15

Asset Management

O. Information requirements

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
1501	Organization has information on the significance of the identified risks	Organization hasn't information on the significance of the identified risks
1502	Roles and responsabilities documented	Roles and responsabilities not documented
1503	Asset management processes, procedures and activities documented	Asset management processes, procedures and activities not documented
1504	Defined the exchange of information with its stakeholders, including service providers	Indefined the exchange of information with its stakeholders, including service providers
1505	Knowned the impact of quality, availability and management of information on organizational decision making	Unknowed the impact of quality, availability and management of information on organizational decision making
1506	Information has attribute requirements	Information hasn't attribute requirements
1507	Information has quality requirements	Information hasn't quality requirements
1508	Defined how and when information is to be collected, analysed and evaluated	Undefined how and when information is to be collected, analysed and evaluated
1509	Specified procedure to implement and maintain processes for managing its information	Specified procedure to implement and maintain processes for managing its information not documented
1510	Financial and non-financial terminology relevant to asset management aligned	Financial and non-financial terminology relevant to asset management not aligned
1511	Documentation is consistente and able track between the financial and technical data and other relevant non-financial data	Documentation not consistente and able track between the financial and technical data and other relevant non-financial data
1512	Documentation meet its legal and regulatory requirements while considering its stakeholders requirements and organizational objectives	Documentation doesn't meet its legal and regulatory requirements while considering its stakeholders requirements and organizational objectives
1513		
1514		
1515		
1516		
1517		
1518		

Diagnostic survey 16

Asset Management

P. Documented information

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
1601	Does the AMS has documented information as required by this International Standards					X
1602	Does the AMS has documented information for applicable legal and regulatory requirements					X
1603	Are the documented information able support its assets, asset management, asset management system and the achievement of its organizational objectives					X
1604	Are the documents identification and description suitable					X
1605	Are the documents format and support apropriated					X
1606	Are the documents reviews and approvals relevent					X
1607	Are the documents available and suitable for use, where and when it is needed					X
1608	Are the documents only available for those intended					X
1609						
1610						
1611						
1612						
1613						
1614						
1615						
1616						
1617						
1618						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	8	CONTINUE
0.0	0	of	8	CONTINUE
0.0	0	of	8	CONTINUE
0.0	8	of	8	ELIMINATE
0.0	Total Mark (M)			

Category					
1	7.2	<	P	≤	8
2	6.4	<	P	≤	7.2
3	4.8	<	P	≤	6.4
4	3.2	<	P	≤	4.8
5	0	<	P	≤	3.2

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 16

Asset Management

P. Documented information

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
1601	AMS has documented information as required by this International Standards	AMS hasn't documented information as required by this International Standards
1602	AMS has documented information for applicable legal and regulatory requirements	AMS hasn't documented information for applicable legal and regulatory requirements
1603	Documented information able support its assets, asset management, asset management system and the achievement of its organizational objectives	Documented information able support its assets, asset management, asset management system and the achievement of its organizational objectives don't exists
1604	Documents identification and description suitable	Documents identification and description not clear
1605	Documents format and support apropriated	Format and support of documents not aligned with the organization
1606	Documents reviews and approvals relevent	Documents reviews and approvals relevent don't exist
1607	Documents available and suitable for use, where and when it is needed	Documents unavailable and not suitable for use, where and when it is needed
1608	Documents only available for those intended	Documents only available for all
1609		
1610		
1611		
1612		
1613		
1614		
1615		
1616		
1617		
1618		

Diagnostic survey 17

Asset Management

Q. Operational planning and control

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
1701	Is there a criteria to define the processes needed to meet requirements					X
1702	Are those processes being controlled					X
1703	Is there evidences of that processes are being controlled					X
1704	Are the risks being monitorized and treated					X
1705						
1706						
1707						
1708						
1709						
1710						
1711						
1712						
1713						
1714						
1715						
1716						
1717						
1718						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	4	CONTINUE
0.0	0	of	4	CONTINUE
0.0	0	of	4	CONTINUE
0.0	4	of	4	ELIMINATE
0.0	Total Mark (M)			

Category					
1	3.6	<	P	≤	4
2	3.2	<	P	≤	3.6
3	2.4	<	P	≤	3.2
4	1.6	<	P	≤	2.4
5	0	<	P	≤	1.6

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 17

Asset Management

Q. Operational planning and control

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
1701	Criteria to define the processes needed to meet requirements	No criteria to define the processes needed to meet requirements
1702	Processes being controlled	Processes not controlled
1703	Evidences of that processes are being controlled	No evidences of that processes are being controlled
1704	Risks being monitorized and treated	Risks not being monitorized and treated
1705		
1706		
1707		
1708		
1709		
1710		
1711		
1712		
1713		
1714		
1715		
1716		
1717		
1718		

Diagnostic survey 18

Asset Management

R. Management of change

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
1801	Are the risks being assess before any change					X
1802	Are those risks being managed					X
1803	Are the planned changes being controlled and improved the procedures					X
1804						
1805						
1806						
1807						
1808						
1809						
1810						
1811						
1812						
1813						
1814						
1815						
1816						
1817						
1818						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	3	CONTINUE
0.0	0	of	3	CONTINUE
0.0	0	of	3	CONTINUE
0.0	3	of	3	ELIMINATE
0.0	Total Mark (M)			

Category					
1	2.7	<	P	≤	3
2	2.4	<	P	≤	2.7
3	1.8	<	P	≤	2.4
4	1.2	<	P	≤	1.8
5	0	<	P	≤	1.2

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 18

Asset Management

R. Management of change

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
1801	Risks being assess before any change	Risks not mesured before any change
1802	Risks being managed	Risks aren't managed
1803	Planned changes being controlled and improved the procedures	Planned changes aren't controlled and improved the procedures
1804		
1805		
1806		
1807		
1808		
1809		
1810		
1811		
1812		
1813		
1814		
1815		
1816		
1817		
1818		

Diagnostic survey 19

Asset Management

S. Outsourcing

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
1901	Are the outsourced processes and activities being controlled and are part of AMS					X
1902	It's knowned who manages the outsourced processes and activities in the organization					X
1903	Is well defined the the information to be shared between the organization and the service provider					X
1904						
1905						
1906						
1907						
1908						
1909						
1910						
1911						
1912						
1913						
1914						
1915						
1916						
1917						
1918						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	3	CONTINUE
0.0	0	of	3	CONTINUE
0.0	0	of	3	CONTINUE
0.0	3	of	3	ELIMINATE
0.0	Total Mark (M)			

Category					
1	2.7	<	P	≤	3
2	2.4	<	P	≤	2.7
3	1.8	<	P	≤	2.4
4	1.2	<	P	≤	1.8
5	0	<	P	≤	1.2

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 19

Asset Management

S. Outsourcing

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
1901	Outsourced processes and activities being controlled and are part of AMS	Outsourced processes and activities aren't controlled and are part of AMS
1902	Knowned who manages the outsourced processes and activities in the organization	Unknowned who manages the outsourced processes and activities in the organization
1903	Well defined the the information to be shared between the organization and the service provider	Not defined the the information to be shared between the organization and the service provider
1904		
1905		
1906		
1907		
1908		
1909		
1910		
1911		
1912		
1913		
1914		
1915		
1916		
1917		
1918		

Diagnostic survey 20

Asset Management

T. Monitoring, measurement, analysis and evaluation

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
2001	Are the items that are monitored and measured enough to the MAS requirements					X
2002	Does the monitoring, measurement, analysis and evaluation ensures valid results					X
2003	It's defined when to monitorize and mesure					X
2004	It's defined when the results from monitorizing and mesurement shall be analysed and evaluated					X
2005						
2006						
2007						
2008						
2009						
2010						
2011						
2012						
2013						
2014						
2015						
2016						
2017						
2018						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	4	CONTINUE
0.0	0	of	4	CONTINUE
0.0	0	of	4	CONTINUE
0.0	4	of	4	ELIMINATE
0.0	Total Mark (M)			

Category					
1	3.6	<	P	≤	4
2	3.2	<	P	≤	3.6
3	2.4	<	P	≤	3.2
4	1.6	<	P	≤	2.4
5	0	<	P	≤	1.6

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 20

Asset Management

T. Monitoring, measurement, analysis and evaluation

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
2001	Items monitored and measured enough to the MAS requirements	Items aren't monitored and measured enough to the MAS requirements
2002	Monitoring, measurement, analysis and evaluation ensures valid results	Monitoring, measurement, analysis and evaluation doesn't ensure valid results
2003	Defined when to monitorize and mesure	Undefined when to monitorize and mesure
2004	Defined when the results from monitorizing and mesurement shall be analysed and evaluated	Undefined when the results from monitorizing and mesurement shall be analysed and evaluated
2005		
2006		
2007		
2008		
2009		
2010		
2011		
2012		
2013		
2014		
2015		
2016		
2017		
2018		

Diagnostic survey 21

Asset Management

U. Internal audit

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
2101	Are internal audits being realized					X
2102	Are the internal audits effective					X
2103	Do they have a defined periodicity					X
2104	It´s clear the requirements and reporting					X
2105	Are the audits done according the importance of the process					X
2106	Are the audits well defined within it´s purpose					X
2107	There are a audit comitee					X
2108	Are the audits results being comunicated within the organization					X
2109	There is audits evidences					X
2110						
2111						
2112						
2113						
2114						
2115						
2116						
2117						
2118						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	9	CONTINUE
0.0	0	of	9	CONTINUE
0.0	0	of	9	CONTINUE
0.0	9	of	9	ELIMINATE
0.0	Total Mark (M)			

Category					
1	8.1	<	P	≤	9
2	7.2	<	P	≤	8.1
3	5.4	<	P	≤	7.2
4	3.6	<	P	≤	5.4
5	0	<	P	≤	3.6

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 21

Asset Management

U. Internal audit

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
2101	Internal audits being realized	Internal audits aren't realized
2102	Internal audits effective	Internal audits not effective
2103	They have a defined periodicity	They don't have a defined periodicity
2104	Requirements and reporting are clear	Requirements and reporting not clear
2105	Audits done according the importance of the process	Audits done random
2106	Audits well defined within it´s purpose	Audits not defined within it´s purpose
2107	Audit comitee exists	No audit comitee
2108	Audits results being comunicated within the organization	Audits results aren't comunicated within the organization
2109	Audits evidences exists	No audits evidences
2110		
2111		
2112		
2113		
2114		
2115		
2116		
2117		
2118		

Diagnostic survey 22

Asset Management

V. Management review

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
2201	Is the AMS being reviewed with a defined periodicy					X
2202	Are the previews review actions being verified					X
2203	The internal or external relevant changes are reviewed					X
2204	There are registries of AMS performance					X
2205	Is the AMS activity as being reviewed					X
2206	There are continual improvement					X
2207	The changes in the profile of risks are reviewed					X
2208						
2209						
2210						
2211						
2212						
2213						
2214						
2215						
2216						
2217						
2218						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	7	CONTINUE
0.0	0	of	7	CONTINUE
0.0	0	of	7	CONTINUE
0.0	7	of	7	ELIMINATE
0.0	Total Mark (M)			

Category						
1	6.3	<	P	≤	7	
2	5.6	<	P	≤	6.3	
3	4.2	<	P	≤	5.6	
4	2.8	<	P	≤	4.2	
5	0	<	P	≤	2.8	<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 22

Asset Management

V. Management review

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
2201	AMS being reviewed with a defined periodicy	Is the AMS being reviewed with a defined periodicy
2202	Previews review actions being verified	Are the previews review actions being verified
2203	Internal or external relevant changes are reviewed	Internal or external relevant changes not reviewed
2204	Registries of AMS performance	Registries of AMS performance don't exist
2205	AMS activity as being reviewed	AMS activity not reviewed
2206	Continual improvement	No continual improvement
2207	Changes in the profile of risks are reviewed	Changes in the profile of risks not reviewed
2208		
2209		
2210		
2211		
2212		
2213		
2214		
2215		
2216		
2217		
2218		

Diagnostic survey 23

Asset Management

W. Nonconformity and corrective action

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
2301	When exists a nonconformity actions are taken					X
2302	Are de nonconformities corrected					X
2303	Are the consequences being taking care					X
2304	Are the nonconformities reviewed					X
2305	Are the causes determinated					X
2306	It´s determinated if there are similar nonconformities, or potencial					X
2307	Are actions needed implemented					X
2308	Are the corrective actions evaluated					X
2309	If necessary are changes made in the AMS					X
2310	A record is kept of the nonconformity					X
2311	A record is kept of the corrective actions					X
2312						
2313						
2314						
2315						
2316						
2317						
2318						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	11	CONTINUE
0.0	0	of	11	CONTINUE
0.0	0	of	11	CONTINUE
0.0	11	of	11	ELIMINATE
0.0	Total Mark (M)			

Category					
1	9.9	<	P	≤	11
2	8.8	<	P	≤	9.9
3	6.6	<	P	≤	8.8
4	4.4	<	P	≤	6.6
5	0	<	P	≤	4.4

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 23

Asset Management

W. Nonconformity and corrective action

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
2301	Nonconformity actions are taken	Nonconformity actions are ignored
2302	Nonconformities corrected	Nonconformities not corrected
2303	Consequences being taking care	Consequences of nonconformities not verified
2304	Nonconformities reviewed	Nonconformities not reviewed
2305	Causes determinated	Causes not determinated
2306	Search for similar nonconformities, or potencial	Similar nonconformities, or potencial not verified
2307	Actions needed implemented	Needed changes not implemented
2308	Corrective actions evaluated	Corrective actions not evaluated
2309	Changes made in the AMS if necessary	Necessary changes in the AMS not performed
2310	Record is kept of the nonconformity	Record of nonconformity not kept
2311	Record is kept of the corrective actions	Corrective actions record not kept
2312		
2313		
2314		
2315		
2316		
2317		
2318		

Diagnostic survey 24

Asset Management

X. Preventive action

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
2401	Are potencial failures in the AMS being identified					X
2402	Are preventive actions being taken to prevent then					X
2403						
2404						
2405						
2406						
2407						
2408						
2409						
2410						
2411						
2412						
2413						
2414						
2415						
2416						
2417						
2418						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	2	CONTINUE
0.0	0	of	2	CONTINUE
0.0	0	of	2	CONTINUE
0.0	2	of	2	ELIMINATE
0.0	Total Mark (M)			

Category					
1	1.8	<	P	≤	2
2	1.6	<	P	≤	1.8
3	1.2	<	P	≤	1.6
4	0.8	<	P	≤	1.2
5	0	<	P	≤	0.8

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 24

Asset Management

X. Preventive action

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
2401	Potencial failures in the AMS being identified	Potencial failures in the AMS aren't identified
2402	Preventive actions being taken to prevent then	Preventive actions aren't taken to prevent then
2403		
2404		
2405		
2406		
2407		
2408		
2409		
2410		
2411		
2412		
2413		
2414		
2415		
2416		
2417		
2418		

Diagnostic survey 25

Asset Management

Y. Continual improvement

Read the instructions before proceed, if needed go to the manual

Answer to the questionnaire with a capital "X" in the most appropriate response to the current situation within the organization. Leave blank answers that do not fit the possibilities presented

	Questions	Always	Mostly	Generally	Hardly	Never
2501	Is the AMS being continually improved					X
2502	It's adequated for the organition					X
2503	The intended output's are occuring					X
2504						
2505						
2506						
2507						
2508						
2509						
2510						
2511						
2512						
2513						
2514						
2515						
2516						
2517						
2518						
	score	0.0	0.0	0.0	0.0	0.0

Rating

Score	Answers			Mark
0.0	0	of	3	CONTINUE
0.0	0	of	3	CONTINUE
0.0	0	of	3	CONTINUE
0.0	3	of	3	ELIMINATE
0.0	Total Mark (M)			

Category					
1	2.7	<	P	≤	3
2	2.4	<	P	≤	2.7
3	1.8	<	P	≤	2.4
4	1.2	<	P	≤	1.8
5	0	<	P	≤	1.2

<= Ok

Explanatory sheet

Questions to review					

Company

Name	Email		Phone
Name of the person who answered	**Company function**		**Date**

Explanatory Sheet 25

Asset Management

Y. Continual improvement

Explanatory interpretation of the question

	Always or Mostly or Generally	Hardley or Never
2501	AMS being continually improved	AMS not improved
2502	AMS adequated for the organition	AMS not adequated for the organition
2503	Intended output's are occuring	Intended output's aren't occuring
2504		
2505		
2506		
2507		
2508		
2509		
2510		
2511		
2512		
2513		
2514		
2515		
2516		
2517		
2518		

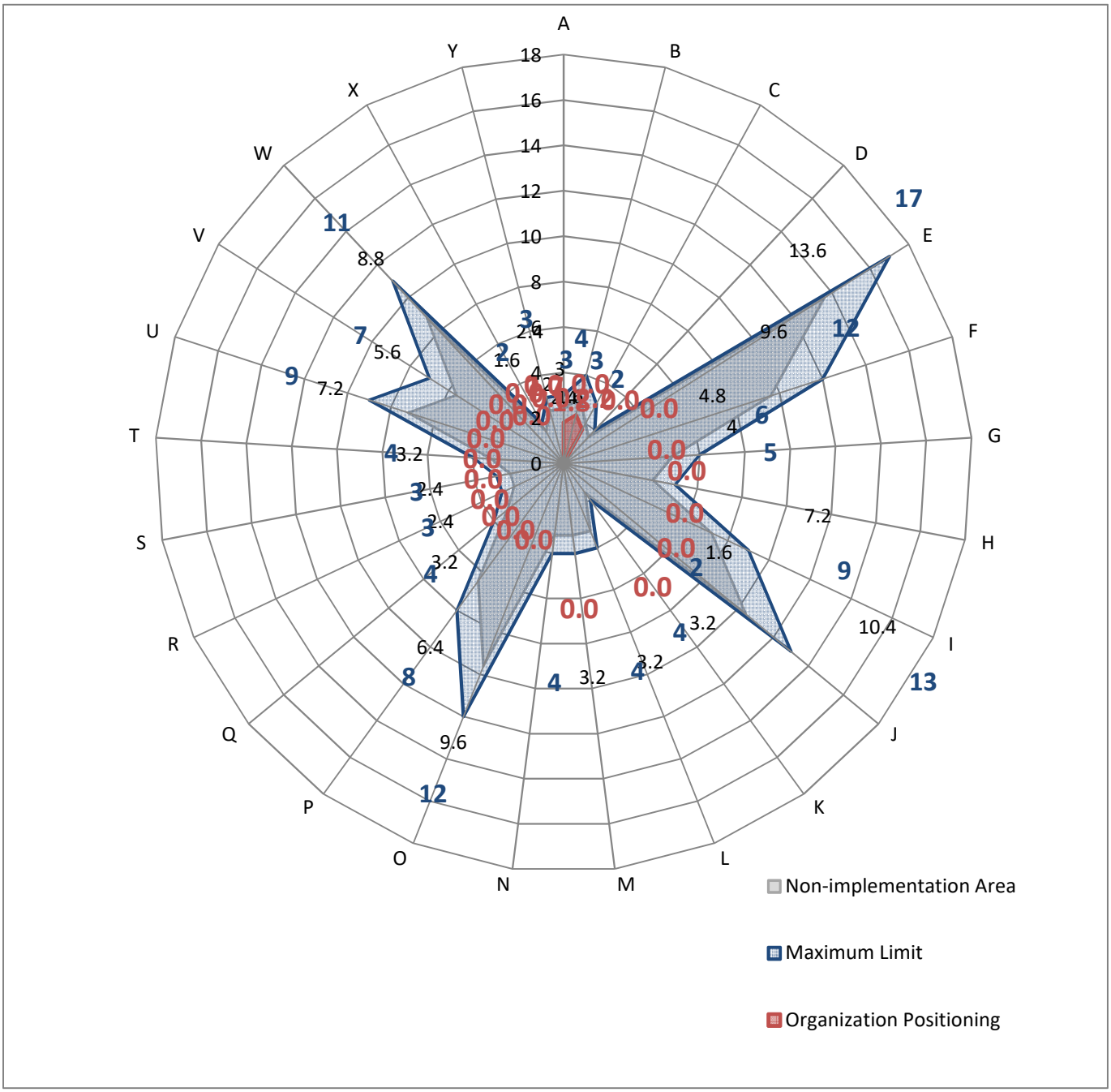
Radar Map

Asset Management

Company: Company 1
Date: 1/jun/18

Organization Positioning

A. Understanding the organization and its context	N. Communication
B. Understanding the needs and expectations of stakeholders	O. Information requirements
C. Determining the scope of the asset management system	P. Documented information
D. Asset management system	Q. Operational planning and control
E. Leadership and commitment	R. Management of change
F. Policy	S. Outsourcing
G. Organizational roles, responsibilities and authorities	T. Monitoring, measurement, analysis and evaluation
H. Actions to address risks and opportunities for the AMS	U. Internal audit
I. Asset management objectives	V. Management review
J. Planning to achieve asset management objectives	W. Nonconformity and corrective action
K. Resources	X. Preventive action
L. Competence	Y. Continual improvement
M. Awareness	



Surveys	Minimum Score	Maximum Score	Score
A	2.4	3	1.8
B	3	4	2.2
C	2	3	1.7
D	1.6	2	0.0
E	13.6	17	0.0
F	9.6	12	0.0
G	4.8	6	0.0
H	4	5	0.0
I	7.2	9	0.0
J	10.4	13	0.0
K	1.6	2	0.0
L	3.2	4	0.0
M	3.2	4	0.0
N	3.2	4	0.0
O	9.6	12	0.0
P	6.4	8	0.0
Q	3.2	4	0.0
R	2.4	3	0.0
S	2.4	3	0.0
T	3.2	4	0.0
U	7.2	9	0.0
V	5.6	7	0.0
W	8.8	11	0.0
X	1.6	2	0.0
Y	2.4	3	0.0

Stage	Surveys	Company Score
1	A. Understanding the organization and its context	1.8
2	B. Understanding the needs and expectations of stakeholders	2.2
3	C. Determining the scope of the asset management system	1.7
4	D. Asset management system	0.0
5	E. Leadership and commitment	0.0
6	F. Policy	0.0
7	G. Organizational roles, responsibilities and authorities	0.0
8	H. Actions to address risks and opportunities for the AMS	0.0
9	I. Asset management objectives	0.0
10	J. Planning to achieve asset management objectives	0.0
11	K. Resources	0.0
12	L. Competence	0.0
13	M. Awareness	0.0
14	N. Communication	0.0
15	O. Information requirements	0.0
16	P. Documented information	0.0
17	Q. Operational planning and control	0.0
18	R. Management of change	0.0
19	S. Outsourcing	0.0
20	T. Monitoring, measurement, analysis and evaluation	0.0
21	U. Internal audit	0.0
22	V. Management review	0.0
23	W. Nonconformity and corrective action	0.0
24	X. Preventive action	0.0
25	Y. Continual improvement	0.0