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# Application of the ISO 55000 Suite for a Land-Based Industrial Organization

By

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## **Abstract**

Within several industries, including the production of agricultural equipment, recent years have been a time of organizational objectives constantly being adjusted due to failing markets and economical sanctions between countries. Such failing markets tend to provoke a shift from external focus to internal focus, with increased stakeholder pressure and demands for instant structural and operational changes within organizations. But on what basis are these decisions being made? Are there any guidelines or systems helping management in conducting long-term and sustainable decisions? Together with scarce resources and ever increasing economical, social, and environmental demands from stakeholders, organizations are constantly in search of more efficient processes to better realize value from assets and satisfaction of stakeholder's expectations. In January 2014 the International Organization for Standardization (ISO) published the ISO 55000 suite. This is the very first official standard in the subject of asset management, and has reached consensus worldwide as probably the most important discipline for whole-life principles of cost, risk and sustainable performance with several impressive results to show for. According to Woodhouse (2013) "good asset management is becoming an expected normal practice in mature organizations around the world".

The aim of this thesis is to gain understanding of both the new ISO 55000 suite and the subject of 'asset management'. There will also be a mapping for current status of a land-based manufacturing organization towards the requirements of this standard. The study includes a literature study on the subject of Asset Management and the ISO 55000 suite. The study also includes a qualitative research process with the purpose to detect both positive trends and areas of improvement for this organization to align with the ISO 55000 suite. The author has conducted 14 interviews with contestants being department leaders or middle managers representing several departments and teams. This research process has resulted in a review of both positive trends and areas for further improvement.

The goal of this thesis is to detect some major strength and weaknesses - "hot points" – between this industrial organization and the requirements of the ISO 55000 suite. The importance of doing so is found in the statement: "an initial review of the organization's current processes against the requirements of ISO 55001 will determine the areas that need to be developed to support the functioning of a compliant asset management system" (ISO 55002, 2014, p.5). These hot points can further be used as a guide for this and similar organizations in where to start focusing in the future processes of leaning towards improved asset management.

This thesis has contributed to the research and understanding of Asset Management and the ISO 55000 suite within the manufacturing industry, and should help create a basis for managers in the implementation of an asset management system from the requirements found in the ISO 55000 suite. It has given insight to internal challenges and main areas of improvement for a land-based manufacturing organization with long tradition and a well-established culture.

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## List of Abbreviations

AMS	Asset Management System
BP	British Petroleum
MAST	Mature Assets Team
BSI	British Standards Institution
PAS	Publicly Available Specification
ISO	International Organization for Standardization
IAM	Institute of Asset Management
OSP	Organizational strategic plan
KGON	Kverneland Group Organizations Norway
SWOT	Strengths, weaknesses, opportunities, threats
SAMP	Strategic Asset Management Plan
LCC	Life Cost Analysis
HR	Human Resources
SMART	Specific, measurable, achievable, realistic, time-bound
ROI	Return On Investment



# Chapter 1 - Introduction

## 1.1 Background

We are living in a modern, globalized world with continually fading borders and fast access and sharing of information. The result is often access to broader markets, but with stronger competition. We see more rapid change in technology and a constant need of improved competence and continual learning. According to Frankel (2008b, p.13) “the future is less and less a reflection or extrapolation of the past”. Together with scarce resources and ever increasing economical, social, and environmental demands from stakeholders, organizations are constantly in search of more efficient and effective processes to better realize value from assets. (Maskell, 1991)(Frankel, 2008b)

Several concepts and techniques have been introduced over the last decades with the sole purpose of contributing to better performance and asset realization whereas several have been well received and implemented. Woodhouse Partnership (n.d.a) argue that a satisfactory system for management of assets is one that “maximizes value-for-money and satisfaction of stakeholders expectations. It involves the coordinated and optimized planning, asset selection, acquisition/development, utilization, care (maintenance) and ultimate disposal or renewal of the appropriate assets and asset systems.”

2014, and 2015 so far has been a time of organizational objectives constantly being adjusted due to failing markets and economical sanctions between countries. This is affecting several industries including the production of agricultural equipment. Such failing markets tend to provoke a shift from external focus to internal focus, with increased stakeholder pressure and demands for instant structural and operational changes within organizations. But on what basis are these decisions being made. Is there any guidelines or system helping management in conducting long-term and sustainable decisions?

In January 2014 the International Organization for Standardization (ISO) published the ISO 55000 suite. This became the very first official standard in the subject of asset management, and has reached consensus worldwide as probably the most important discipline for whole-life principles of cost, risk and sustainable performance with several impressive results to show for. According to Woodhouse (2013) “good asset management is becoming an expected normal practice in mature organizations around the world”.

The subject of asset management is still very young and unexplored within the manufacturing industry, and for organizations with no immediate demand for alignment, the probability of allocating time and resources will remain very low. Kverneland Group's production facility at Klepp (Norway) consists of a skilled and experienced work force, but with no overarching system on how to manage assets. Top management recognize the increased focus on asset management, and find particular interest in gaining knowledge to how the ISO 55000 suite might affect this production facility. Still, there is a limited amount of internal competence on this subject, the learning process is extensive and external analysis and guidance is very extensive and costly.

## **1.2 Aim of Thesis**

This study aims to contribute to the research of asset management within the manufacturing industry and should help create a basis for managers in the implementation of an asset management system and the requirements found in the ISO 55000 suite.

The purpose of this thesis is to map the current status of Kverneland Group's production facility at Klepp towards the requirements of the recently published ISO 55000 suite. The final results will presented as positive trends and improvement potentials.

## **1.3 Scope of Work**

The scope in this thesis includes the following:

- A start-up analysis of Kverneland Group and Kverneland Group Operations Norway (KGON) as a land-based industrial organization including challenges and opportunities.
- A comprehensive literature study to the concept of Asset Management including background and development, fundamentals and the basic ideas, context and how it can help organization better succeed on achieve their organizational objectives.
- A thorough study of the ISO 55000 suite.
- An interview process including a large number of persons inside KGON by asking questions based on the requirements of the ISO 55000 suite. Based on the results from interviews, detect both positive trends and areas of improvement for KGON to align with the ISO 55000 suite.

The goal of this thesis is to detect some major strength and weaknesses - "hot points" – between KGON and the requirements of ISO 55000 suite. These hot points can further be used as a guide for KGON on where to start focusing in a future processes of leaning towards improved asset management.

## 1.4 Methodology

The two most common research methods are qualitative and quantitative research. Qualitative methods target a small group of people and seek to understand meanings and interpretations behind statements (Blaikie, 2010). This is backed by Dörnyei (2007) when asserting that qualitative methods search for people's insight, and will obtain purposeful data. Examples of qualitative research are in-depth interviews, observations and group discussions. Quantitative methods, on the other hand find importance in objectivity. It uses a standard format to either prove or disprove a hypothesis. A major challenge of this type of research is the importance of gathering a large enough group of people (sample) to be representative for the population generalized in the study (Dörnyei, 2007). Examples of quantitative research are questionnaires, tests and laboratory experiments.

In order to gain understanding of work culture, relationships, opinions, truth, and to ensure proper engagement, this thesis use the qualitative method of research with semi-structured interviews as the tool. An interview guide was planned in advance and used as basis for the interviews (see appendix). The researcher was also given access to internal documents in order to better understand existing terms and language, and as a tool to check for internal alignment within the organization.

The interview guide is meant to cover all clauses found within the ISO 55001 (2014) standard. Note that it is not found in the scope of this thesis to compare the organization against every single requirement, but rather to roughly compare the organization towards each clause. Therefore, in the preparation of the interview guide, one to three strategic questions were conducted from the study of each clause in the standard. Based on the major set of questions, two smaller sets were created to specifically target these two groups of leadership. The questions were also personalized for each participant to better fit into their working context. The length of the interviews varied from 30 – 70 minutes depending on available time of the participants.

All the interviews were conducted as semi-structured and face-to-face interviews. This way the interview is allowed to be more flexible and loose, and it opened up for the interviewer to rephrase and/or ask follow-up questions to the interviewee to ensure correct interpretation and context of each question if needed. Dörnyei (2007) argue the strength of this structure by stating that some of the most important data often will be collected this way. The participants of the interviews are described in “5.1 Who”.

Also, the interviews were conducted in Norwegian. This because both the interviewer and all the other participants have a native language closer to Norwegian than English, and also the fact that the official language at this factory is Norwegian.

Every interview was audio recorded in order to make most use of the data. It allowed the researcher to pay full attention to the participants, which made it easier to keep a good pace, ask follow-up questions and secure important information from not being lost. By recording,

the interviewer was able to pick up the non-verbal communication in which the recorder is unable to pick up. Every interviewee was informed of the recording and was explained the terms of use both when setting the day and time of the interviews and as part of the starting conversation. All participants agreed on the recording.

The interviews will be held anonymous and the team leaders and directors were made fully aware of this. Due to matter relating to company and employee confidentiality, this report will not directly name any individual or reproduce word for word anything that was said during the interview. The results will be based on the comparison of each answer and presented as perceptions and conclusions done by the interviewer.

## **1.5 Reliability and Validity**

### **Reliability**

Reliability is according to Silverman (2009) best explained as the degree of consistency found in the research. The results will therefore have stronger reliability when similar findings are found in several interviews. The author has made an effort to draw all conclusions based on more than one persons opinions, but must admit this might not have been fully accomplished.

Even though questions where to some degree edited from one interview to another, this were mostly improvements in structure and relevance, keeping the message unchanged. Also, the interviewer does not have any previous, present or future relations to this organization, and therefore no agenda or considerations.

One other important factor in ensuring the reliability of the results is the recording of every single interview. This way objectivity has been kept. Important points and connections have been preserved. The interviewer was able to repeat answers several times for better understanding and context.

Finally the reliability might have been affected when sometimes the interviewer tried to provoke answers. Even though practical answers were often asked for in order to underline answers, there might have been situations where interviewees have provided statements without backup.

### **Validity**

Validity is according to Silverman (2009) best explained as the degree of truth (accuracy) found in the research. To which degree does the study reveal and reflect upon the actual facts. Two aspects are most important to keep adequate validity in the interview process.

1. The first aspect is to which degree the participants are primary sources and qualified to represent the full and complete truth. The selection of interviewees represents most areas of the organization and consists of representatives from all levels of leadership.

Most of the group has been in this organization for a very long time, which might affect the validity. Answers might be affected by a generalized pervasive culture. In order to check for the validity of answers, additional examples were asked for to underline what was stated.

2. The second aspect is to which degree the interview guide contains questions broad and accurate enough to conduct “correct” and satisfying conclusions. The first couple of interviews suffered from questions not being adequately formulated. The interviewer spent much time between interview to continually improve formulations and contexts. Examples were added to several questions for better understanding.

## **1.6 Thesis Structure**

The Structure of this thesis is as follows:

Chapter 2 provides an overview of the organization in focus of the study. A short introduction, state of the art and future trends are explained.

Chapter 3 and 4 are literature studies giving an overview of development and fundamentals for the subject of ‘asset management and the following ISO 55000 suite. The various parts of the asset management system found in the ISO 55000 suite are discussed.

Chapter 5 is the research chapter where results from the interview process are presented.

Chapter 6 presents the main findings for the application of this organization and the ISO 55000 suite with areas for further studies to the alignment of land-based industrial organizations and the ISO 55000 suite

Chapter 7 discusses the results of the survey, highlight trends and other interesting observations and discuss some further studies

## Chapter 2 - Introduction to Kverneland Group: A land-based industrial organization



Figure 1 – The main facility at Klepp (Kverneland Group Klepp, n.d.)

### 2.1 Introduction

Kverneland Group is a well renowned organization both nationally and worldwide. Building on a proud and successful journey stretching over 3 centuries, they are still going strong. By staying innovative in technology, being a reliable supplier, and always reaching towards new markets, they have grown to be a worldwide organization.

The well-known expression “but they still need lunch” tells of the agriculture industry as steady and predictable. This is the industry in which Kverneland Group has always operated, by developing and producing equipment and services for agriculture. Kverneland Group also have interests in viticulture and other areas of food production, but with their new slogan “The future of farming” they are not afraid to show the world what is set to be their main focus, and that is agriculture. A steady focus on the agriculture industry, together with plenty of vision and continuity, has helped Kverneland Group become one of the worlds largest in what they do. Today, the vision statement is described as being a “Leading Broad Line Supplier of Agri-implements in Europe and targeting global positions in other areas of merchandised Agriculture” (Kverneland Group, 2014, p.3)

## 2.2 History

Based on Bergsrønning *et al.* (2004):

It all started with one man in 1879. Ole Gabriel Kverneland was a 25-year-old widower with small children and a farm to run. Powered by an entrepreneurial spirit, he saw great potential in a specific piece of land including a tiny waterfall, and went ahead and bought it. Here he established a watermill and a workshop in where he made agricultural implements, which was tested at his own farm.

The first serial production at O.G. Kvernelands Fabrik was the scythe reaching almost 8000 units yearly, and was powered by coal and hydropower from a nearby dam called ‘Stemmen’ by the locals. From the early days there has always been focus on technology and innovation in search of continual improvements and better solutions, how to make it possible to produce more with less. In order to gain needed capital for further development, Kvernelands Fabrik A/S was established in 1894, a corporation heading for more specialization within agricultural implements.

During the 20<sup>th</sup> century, the plow turned out to be the leading product coming from the factory. In 1902 Kverneland’s first patent was given on their horse plow named “Record”. And in 1928, even though only some hundred tractors existed in Norway at this time, the first plow for tractors was launched.

During the second half of the 20<sup>th</sup> century, the organization expanded across borders and factories in several countries were added to what was now named Kverneland Group. Today Kverneland Group’s main facility is still located at Klepp just across the water from the original workshop, and with the name Kverneland Group Organization Norway (KGON). This facility has developed to focus only on production of plows, and has become world leading in production and export of these products. It might also be worth mentioning that according to the world plowing organization, 28 out of the 29 contestants for the overall conventional discipline in the 2014 World Ploughing Contest relied on a plow from KGON (World Ploughing, 2014). This is a strong indicator of Kverneland being recognized as the highest valued brand of ploughs in the world, giving them both leading market position and reputation.

## 2.3 Success Factors

According to Bergsrønning *et al.* (2004) there are two main reasons why Kverneland Group has become a world leader with their plows:

1. Management of change

As mentioned already, there has always been high focus on technology and innovation in this organization. Not only were they quick to produce plows suited for tractors, they were also very responsive to the development of bigger and stronger machines.

This has often given Kverneland Group first access to new markets, and with smart solutions like the reversible plow they have been able to offer innovative products.

2. Material and curing technology

An important factor for the success of their plows is the quality of the steel. Strength is the most important factor in persevering through a lifetime of hitting stone after stone after stone. In order to meet with this harsh environment, Kverneland Group is using custom designed high-strength steel, which again is processed through a heat treatment program. Based on 130 years of experience, KGON has developed their very own heat treatment facility where nothing is left to chance. The result is their prestigious, tailor-made steel combination of strength and toughness. This again enables KGON to produce lightweight plows, and to have less consumption of raw materials.

## 2.4 Status of Today

Table 1 shows that KGON is now a worldwide organization supplier with sales in almost 50 countries, and are proud of their accomplishments and present position in this industry. Top management still does recognize the importance of preparing for the future. This will mean new products, new solutions, and even new technology and markets in the future.

Today, this organization seem to have a strong competitive advantage in steel and metallurgy competence, but this might also have been a stumbling block in recent years. Products are almost selling themselves, which creates a low pressure on seeking improvements and better solutions. This might have led the organization to loose some of the pioneer spirit that put them in the position they are today. But there are many internal signs showing new expectations and a strong will to move on further.

Employees	Approx. 580
Turnover 2014 (est.)	106 MEUR
Worldwide sales	45 countries
Production	5 000 units
Factory	72 000 m <sup>2</sup>
Consumption of steel	25 000 tons

Table 1 - Key figures 2014 (Kverneland Group, 2014)

The industry of agri-implements did also experience failing markets the last year, and therefore production and turnover did not turn out as expected. As will be explained later in this chapter, a strategy was set to double the plow production by 2020, which has now been adjusted. This has led to more internal attention by top management and more focus on existing processes. This is a critical time where foundation is set for how the future will look like. KGON still need to focus on gaining new markets, but freed resources from reduced production should be spent on reducing risk on crucial production equipment, remove unnecessary non-productive activity, optimize processes and systems, and so on and so forth.



## 2.5 The Future

Kverneland Group has an impressive history to look back on, but no one will stay successful very long if the focus isn't aimed towards the future. So what does the future look like?

Just recently, in May 2012, the Japanese tractor- and agriculture equipment manufacturer Kubota completed a full-ownership acquisition of Kverneland Group (Torrance, 2013). Yasuo Masumoto, The CEO of Kubota, said in an interview with Aftenbladet (2012a) that he wants to double the plow production by 2020. This is a huge vision and there are some big steps to be made in order to accomplish this. When Masumoto was asked how this is going to be made reality, he talks of three key areas:

### 1. New markets

98% of the plows produced at KGON are sold outside Norway, and Europe represents the biggest market by far. There is still great potential to gain new markets within Europe, but by the help of Kubota, KGON can also reach new continents like Africa and America. For instance, Kubota has over thousand dealers in USA where KGON now get to be represented. The plan is that KGON will sell plows to these new markets disguised in Kubota colors. There is also a new plow series being launched in 2015.

### 2. Strengthen existing technology and competence

Masumoto has great respect for the materials technology and competence that exists in KGON, and sees it important to invest in this further on, instead of just automate without regards to protect and motivate the knowledge and competence of that has been build up.

### 3. Invest in plant

First of all, there is a need to rationalize and make the production more streamlined. The old factory site is planned to be shut down, and all research, production and administration is to be gathered under the same roof. Among others a new main assembly line are on the schedule. Second, there is going to be a robot revolution (aftenbladet, 2012b). Plows produced at KGON has had a higher increase of production costs than competitors, and needs to automate in order to stay competitive in the future. Since 2012, an investment plan was set for the upcoming years with a budget of 35 MEUR. Important cues within this plan are renewal of old machines, robotizing to reduce salary cost per unit produced and take out bottlenecks. Their goal is of course increased profitability and production. These investments will double the amount of robots, and make KGON the most robotic industrial company in Norway. They aim to secure the existing jobs by increasing production (Kverneland Group, 2014).

## Chapter 3 - Asset Management: An Overview



Figure 2 - (Hobcraft, 2014)

### 3.1 Introduction

When looking into the subject of Asset Management, several arguments coming from highly recognized authors are pointing out that asset management will be of high importance for organizations wanting to achieve success in the future. John Woodhouse is a member of the Board of the Institute of Asset Management (IAM), and the project director for development of the BSI PAS 55 (British Standards Institution, Publicly Available Specification), which is the precursor of the ISO 55000 suite (International Organization for Standardization) and a checklist of good practices in physical asset management. He has stated that “there can be no real doubt that the emerging discipline of integrated, optimized, risk-based, whole-life Asset Management is here to stay” (Woodhouse, 2010a, p.216). Hastings (2010, p.2), Professor at the Queensland University of Technology in Brisbane and director of a consultancy firm in engineering asset management, writes that “Organizations in which physical asset management is of particular importance include all those involving extensive use of plant, machinery and infrastructure.”

According to Woodhouse (2010b) the oil and gas exploration and production sector has been one of the pioneers in the subject of asset management. The 1980s were challenging, and represented a more complicated production and accompanying increased cost. This, together with stronger competition and major accidents like the ‘Piper Alpha disaster’ had the North Sea oil and gas industry gagged. But in accordance with the saying “destiny is no matter of chance. It is a matter of choice” (Bryan, n.d) several organizations chose to survive, and

initiated the change needed to do so. Some would claim that this is when the asset management business model was born. One great example was the 1995 British Petroleum's Mature Assets Team (BP MAST) experiment. A cross-disciplinary group was given unrestricted permission to use whatever thinking, methods and actions they sought best in order to maximize value for some late stage reservoirs and infrastructure. This experiment, measured by the net present value for the remaining life of the reservoirs, showed such remarkable results that the created model was adapted and adopted to all facilities. Woodhouse (2010a) states that by becoming a fully asset-centered organization, BP had an incredible 80% reduction of total production cost.

According to Davis (2010) the former president of IAM, asset management is a long-term thinking always trying to deliver improvements in financial, social and environmental performance where physical assets are most important to success. It is all about aligning plans, decisions and activities against the organization's objectives with help of a risk-based approach. A great question to continually keep asking is 'does it support the business aim?' If the answer is no, then maybe the decision/activity shouldn't be accepted.

### **3.2 Assets - Definition**

Before moving further into the concept of asset management, the term 'asset' needs to be defined and understood. "Asset" is according to the Oxford English Dictionaries (n.d) an object/item with a certain value to its owners.

Historically, 'asset' was a term mostly used in the financial sector meaning entities with some degree of economical value to an organization. This implies asset management to have been another expression for accounting (Liyana, 2012).

Today the 'asset' term has evolved to include various other items recognized to have an impact to competitive success. The ISO 55000 (2014, p.2) emphasize on the word value when stating that "an asset is an item, thing or entity that has potential or actual value to an organization". In the Business Dictionary (n.d.a) several examples of items/objects bringing value to any organization are listed, such as fixed assets (property, buildings, production plants, machines), cash, materials, patents, labor, technology (ex: KGON's unique curing technology) and reputation.

The value of each object owned by an organization or person can constantly change over time and can vary between organizations and stakeholders.

### 3.3 Historic Overview

If we look at the history of asset management, it is not just a set of sunshine stories such as the BP MAST experiment, in fact it has a history of not being a well-identified subject, and all the areas of asset management have normally been treated independently. For instance, maintenance has often been viewed as cost only, and therefore to be minimized. Senior managers, which are often under pressure from stakeholders, have aimed their focus on short-term objectives instead of planning for the future. Hastings (2010, p.2) states that “the broader, holistic view of asset management has been a relatively neglected area in terms of general education and training”.

asset management did not just happen, and must be viewed as part of a longer history. It is not an idea that came out from nothing, but is a result of several decades of new thinking leading to where we are today. As we can see from figure 3, there was a shift in the 70s from command and control to a more project influenced thinking towards objectives. Then in the 80s quality control and continual improvement was introduced, and ended up in the ISO 9000 of quality management systems. In the 90s organizations started to discover the value of system thinking and organization-wide approaches. The Balanced Scorecard was introduced with a clear message; ‘if you can’t measure it, you can’t manage it’. The scorecard helps managers find the drivers that create value and generate future competitive success. It translates vision and strategies into operational terms by asking the right questions (Kaplan and Norton, 1996):

- How should we appear to our shareholders and customers?
- What business processes must we excel at?
- How will we sustain our ability to change and improve?

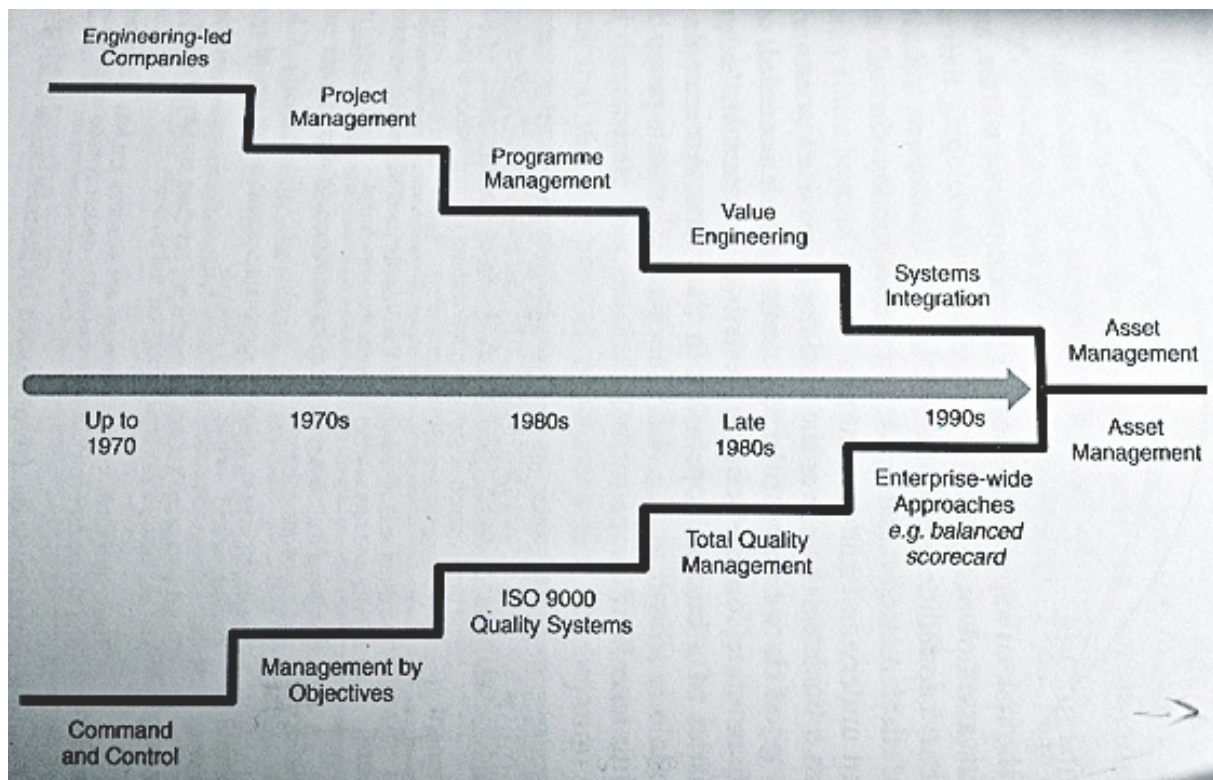


Figure 3 – The evolution of asset management (Pilling, 2010)

When the BSI PAS 55 was first introduced in 2004, it was developed as a response to the demand for a standard in managing physical assets. This publication was greatly appreciated and revealed a great demand for good practices in managing physical assets. Later, in 2008, this specification was revised with both new and revised definitions. The definition of asset management now developed to be the “...systematic and coordinated activities and practices through which an organization optimally and sustainably manages its assets and asset system, their associated performance, risks and expenditures over their lifecycles for the purpose of achieving its organizational strategic plan” (PAS 55, 2008, p.2)

Today, the subject of asset management has evolved even more, and is now more understood as using assets to deliver value and achieve organizational objectives instead of doing things to assets (IAM, 2014). The final draft on the ISO 55000 suite was published 10<sup>th</sup> Jan 2014 as the first set of international standards for asset management.

As Lloyd (2010a, p. xviii) puts it, asset management is “...not a new discipline so much as a new amalgamation of old disciplines aligned around whole-life principles of cost, risk and sustainable performance”. This statement is fundamental in the understanding of asset management as a discipline building on previous approaches and principles in reaching future development to meet the challenge of future manufacturing, production and processing. In this, the focus on asset management should still be to focus on modern approaches and integrated solutions rather than traditional function-based structures (Liyanage, 2012).

The attention to asset management is ever increasing, and is believed to grow in the future, especially now when recognized by the ISO. Woodhouse (2013) states that “good asset management is becoming an expected normal practice in mature organizations around the world”.

### **3.4 Asset Management Fundamentals**

According to ISO 55000 (2014) one can understand asset management as the optimal way of balancing costs, opportunities and risks towards achieving the organizational objectives and gain the best realization of value from each asset. This standard highlights four fundamentals in the presentation of asset management:

- Value: Focus is not on the asset itself, but rather on the realization of value each asset provides to the organization. This value is determined by the organization and its stakeholders, and includes a clear line of sight (how each decision and process align with overall objectives) and a whole-life management approach (evaluation of each service/product’s life-long trade-off between social, environmental and economic objectives).
- Alignment (line of sight) - This would mean alignment of technical, financial and operational decisions, plans and activities towards the organizational objectives. A smart and necessary move to ensure that these processes and activities are managed and realized is to design and specify a supporting Asset Management System (AMS). The AMS is an overarching document joining all relevant stakeholders and functional disciplines of each asset. The system gathers input from nearly all areas of the business and evokes a holistic picture. This way the managers are more confident when deciding on long-term plans and immediate priorities. The AMS will be explained more thoroughly in “Chapter 4 – The ISO 55000 suite: The Asset Management System”
- Leadership - There is no way to be successful in establish, operate and improve on asset management without the commitment and leadership from all managerial levels. Roles, responsibilities and authorities need to be delegated, and the people entrusted with these responsibilities need to consult and ensure that everyone in relationship with the organization is aware, competent and empowered regarding asset management.
- Assurance - It is important to effectively govern all assets, and to provide assurance to stakeholders that activities are in line with procedures. We need processes to assure capability and continual improvement, and to connect purpose and performance of each asset towards the organizational objectives.

### 3.5 Asset Management Building Blocks

IAM (2014) and Edwards (2010) present a conceptual model within the subject of asset management consisting of six distinct building blocks:

- Strategy and Planning
- Asset Management Decision Making
- Life Cycle Activities
- Asset Information
- Organization and People
- Risk and Review

These building blocks are in reality a more detailed presentation of the four fundamentals of asset management found in the ISO 55000 (2014) and are described in more detail by Edwards (2010) in the chapter “Asset management in the rail and utilities sector” and by IAM (2014) in their publication “Asset Management – an anatomy (Version 2)”.

Many of these building blocks are not new ideas, but by integrating them they will be able to deliver much demanded benefits (Edwards, 2010a). The IAM conceptual model for asset management (see figure 4) try to achieve integration of all activities within these key building blocks, and align them to the Organizational Strategic Plan (OSP) created on the basis of stakeholder demands, and will be discussed in the following sub-chapters providing great insight in the important areas of asset management. According to Woodhouse Partnership (n.d.a) the benefits of integrating all activities within these building blocks are:

- Alignment of processes, resources and functional contributions (instead of departmental silos and competing, short-term priorities)
- Creating a transparent audit trail for what is done, when and why.
- Better understanding and usage of data and information to provide informed and consistent decisions.
- Improved planning (especially capital expenditure)
- Consistent, prioritized and auditable risk management.
- Alignment and coordination of existing initiatives, including competency development.
- Greater engagement of the workforce, including leadership, communications and cross-disciplinary teamwork.



Figure 4 – The IAM conceptual model (IAM, 2014)

### 3.5.1 Strategy and planning

Every organization wanting to become successful should always try to spend less to get more. But is this really possible? Is it possible to achieve a clear connection (alignment) between the OSP and every individual everyday task? For a small organization, it is fairly easy for a manager to manage the workers and making sure values are respected and measurements are done to secure profit and development. When the organization is growing bigger and expands locally and geographically, it will be almost impossible for one person to be hands-on in every single process and relation. So what do a manager do then to ensure that the organization stay healthy and aligned with the organizational objectives? According to Edwards (2010a, p.3) asset management can help businesses achieve their objectives in the most cost-effective way by ensuring “...that every pound or dollar spent on assets is contributing to the overall goals of the business”.

The area of ‘strategy and planning’ is essential in the development of asset management within any larger organizations, and IAM (2014) argue that we find the core asset management activities within this group.

Based on Simons (2000) there is first of all a need to understand existing marked dynamics such as external opportunities and threats. The management must also understand their internal resources and capabilities (strengths and weaknesses). At this point we ask questions



like ‘how we can compete/stand out/differentiate in a defined product market?’ By doing this, the management should have better information about what should be focused on, where they can give strongest competition, and where to invest their resources. According to Goodrich (2013) such SWOT-analysis will help organizations to identify both positive and negative factors affecting new involvements or proposed actions, leading to better business awareness. SWOT is short for strengths, weaknesses, opportunities and threats.

When a thorough analysis of external and internal opportunities and capabilities are accomplished, the next step should be to develop an asset management policy. According to IAM (2014) this is the cornerstone for an organization in developing asset management, and sets the framework for ground personnel to trace operations all the way back to the OSP through plans, objectives and strategies. For this asset management policy to stay relevant, there is a need for continual development, consistency with OSP and risk management, compliance with regulations and laws, and appropriateness to the nature and scale of the organization (IAM, 2014). Favaro (2012) explain this phase of defining context and strategy as “the result of choices executives make, on where to play and how to win, to maximize long-term value.”

The output of such strategy and planning process should always end up with a Strategic Asset Management Plan (SAMP) and associated objectives, which according to ISO 55000 (2014) provide description of how assets are supposed to be managed in order to provide required level of service and outputs from what is invested. Based on reviews, this plan should normally include asset management activities and operational-, maintenance-, investment- and resource plans. This should help draw a picture of strengths and weaknesses of current asset management activities in order to set the future priorities. A risk ranking process can determine which are the critical assets. From development and through to the review of asset management plans the organization should, according to ISO 55000 (2014), consider:

- Who will be responsible?
- Who are to read it, and what is it they need to know?
- What are the asset’s environment and interdependencies?
- Current condition and performance, and future intended outcomes.
- Available funding and resources.

According to Burns (2010) the process of developing an asset management strategy is a three stage decision-making process:

1. Where do we want to go? At this stage the organization is focusing on vision and values in a long-term perspective. Goals will be tested against future scenarios and consequences in search for the best-suited vision.
2. How do we get there? This stage is all about structure. It is important to create a structure where every organizational element works together towards the overall vision. Also, activities should be ruled by overall decision-making, not the other way around.
3. How are we doing? This is an ongoing process were outcomes are monitored and values reinforced if necessary. The focus should always be long-term.

Top management decides on where to go (goals/strategy), and ground personnel know how to execute, and by whom. There is one essential key word in order to achieve a clear line of sight within an organization, and that is the “*why?*” Woodhouse (2010a) argue that it is insufficient just to document what needs to be done and, when, and by whom. There should always be documented reasons for every planned action. This approach provides every stakeholder with an understanding of reasons and consequences for doing and not doing, and is crucial when prioritization is needed. Best of all, an organization with great alignment opens up for a bottom-up structure where ground personnel can use their valuable experience in contribution to inputs and ideas on how to get even more out of scarce resources.

### **3.5.2 Asset Management Decision-Making**

Along with the change in economic climate the recent years, many organizations have experienced tougher times. We read daily about decisions being made to cut costs, and it does sound like a justifiable approach. But according to Burns (2010) this might not be the best solution after all. She argues that there will always be a limit to the extent of cost reduction, and therefore managers should try to gain from better effectiveness instead of chasing cost reduction. Instead of thinking ‘less’ spending, we should think ‘smarter’, more strategic spending.

Management must be able to look into the future and predict important changes and developments affecting the organization, and have the ability to improve or create new products alongside. We see that products, technology and processes change, and Frankel (2008b, p.13) states that “the future is less and less a reflection or extrapolation of the past.” Said in few words, an organization’s success depends on its ability to manage change effectively, and Frankel (2008b, p.12) lists 10 different organizational tensions we need to predict to make the right decisions:

1. Technological developments and own technology
2. Economic and market conditions
3. Competitors’ state and capability
4. Firm’s condition an capability
5. Product and process competitiveness
6. Firm’s resources, including manpower, skills, access to financial, technical, and other resources
7. Competitor’s resources
8. Threats and opportunities from within and without
9. Cross impact
10. External political, regulatory and other non-technical and non-market developments

Other characteristics of great asset management decision-making should be that (Frankel, 2008b)

- Everyone knows who does what
- Focus on efficiency and to take away waste: There is a detailed understanding of decisions allowing the organization to perform effectively and efficiently.
- Decision trees: Identifies relationships, information flows and triggers. Put in place when all event input and output information are defined and incorporated.
- Respect for others opinions: opinions and even advice from individuals at a lower level (less experienced) in the organization are paid attention to. These individuals will ask the basic questions and bring more unconventional approaches to the table.

### **Whole-life management**

Whole-life management (also known as optimized decision making) is an expression we often hear of within asset management. It represents a shift from buying a service/product at lowest possible procurement price to rather invest in a service/product that is giving the “...optimum trade-off that can be achieved between social, environmental and economic objectives” (Lloyd, 2010a, p.xiii). This type of management should be an integral part of the asset management decision-making and help organization in making long-term decisions.

By analyzing the costs and risks from inception through to disposal we minimize the risk of purchasing the seemingly cheapest option, and later discover surprisingly high operation and maintenance costs. Woodhouse (2010b) talks of cheap cell phones and printers to remind us that we shouldn't necessarily buy a product based on the acquisition cost. If we look at one example of a larger scale product, the acquisition cost of a Boeing 747 only represents about 5% of the whole-life cost. Therefore, if deciding to buy an airplane, acquisition cost should probably not be decisive factor if there are several options fitting the need. Good asset management would be to calculate all the “hidden” whole-life costs (operation, maintenance, training, etc.) in addition to acquisition cost before deciding on which product to buy (See figure 5).

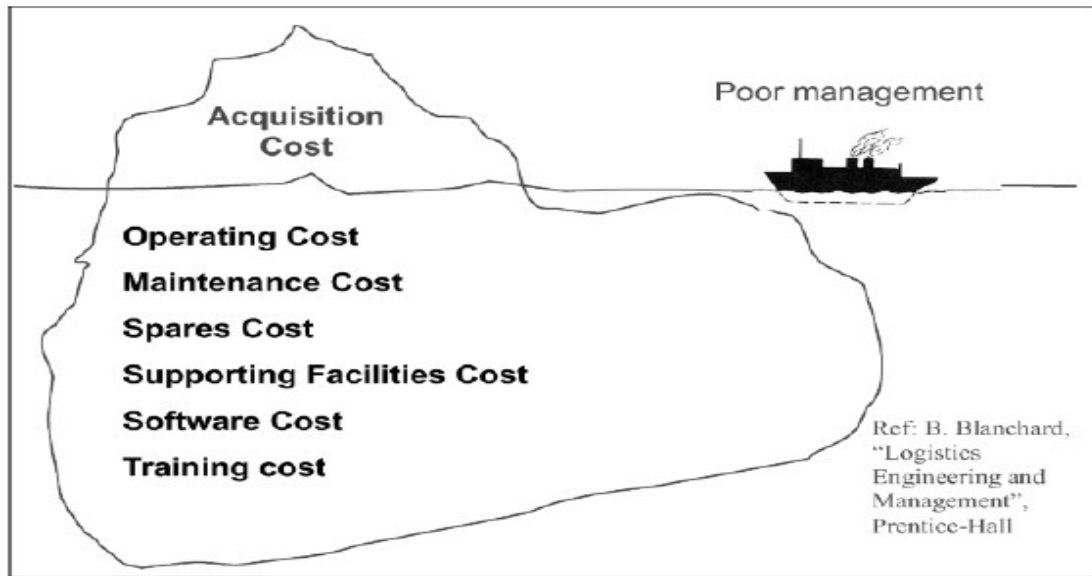


Figure 5 - Iceberg diagram (Hastings, 2010)

Clearly this will create economical benefits, and it will help managers justify strategic business plans when facing multiple stakeholders with competing objectives. By the use of techniques like Failure Mode and Effects Analysis (FMEA), Reliability Centered Maintenance (RCM) and Risk Based Inspection (RBI), managers will gain understanding on how different activities affect costs and risks during a specific time period. Edwards (2010a) argues that organizations can achieve up to 30% reduction in operational expenditure (OPEX) without increased risk by the use of such risk-based techniques.

Hawkins (2013) points out that another result of whole life management being employees thinking and fronting decisions in a longer perspective. They might also speak more in terms of value produced by assets instead of costs. Woodhouse (2010a, p.212) reminds us of the main obstacle in achieving good whole-life management, and that is "...annual cycles of budget approval, performance reporting and planning". This creates an internal fight for funds and departments are ending up working in functional silos (as explained in "3.5.3 Lifecycle delivery"), holding back information and prioritizing themselves in favor of the overall organization.

### **Life cycle cost analysis**

A decision will always trigger actions. A decision can be right or wrong, good or bad, long-term or short-term, and it can trigger stand-alone actions or chain effects. When a decision is made there is always uncertainties involved, but what is certain is that it also eliminates alternatives. This is putting pressure on the decision-maker, which then again can cause anxiety and indecisiveness. Napoleon (Brainyquote, 2014) once said: "Nothing is more difficult and therefore more precious than to be able to decide".

A Life Cycle Cost (LCC) analysis “...is intended to ensure that all relevant costs are identified, and that through life costs are considered at the planning, acquisition and budgeting stages” (Hastings, 2010, p.198). In other words it is an optimization model done to identify cumulative cost of each alternative in order to make the best economical decisions. By using whole-life cost templates (see figure 6) it will be easier to detect the optimum point of renewal and cumulative costs until that point.

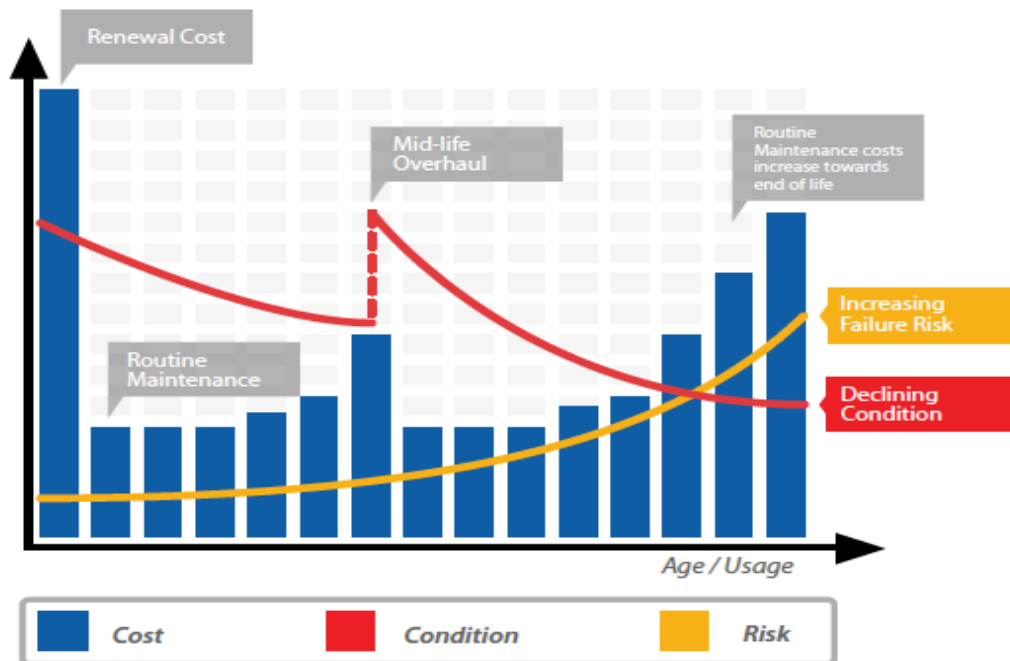


Figure 6 – Life cycle cost analysis (IAM, 2014)

Since this type of analysis is meant to be more than just a control tool to give an overview of cost, but rather a planning tool for optimized decision-making, we get the best results when it is done in the planning phase of a system or a component. According to Edwards (2010a) the opportunity to have an influence to the total cost is decreasing drastically over time. He states that even though typically 80% of total lifecycle costs of an asset are incurred in the long stretching operational and maintenance phase, typically 80% is already ‘locked in’ at the design stage (See figure 7).

Pilling (2010) refers to Network Rail as an organization harvesting great success after achieving a more systematic approach to asset management. They achieved £178 million of savings in 2007-2008 (representing a reduction around 8% of annual operating and maintenance budget) and improved their performance with higher punctuality by improving on their asset management decision-making.

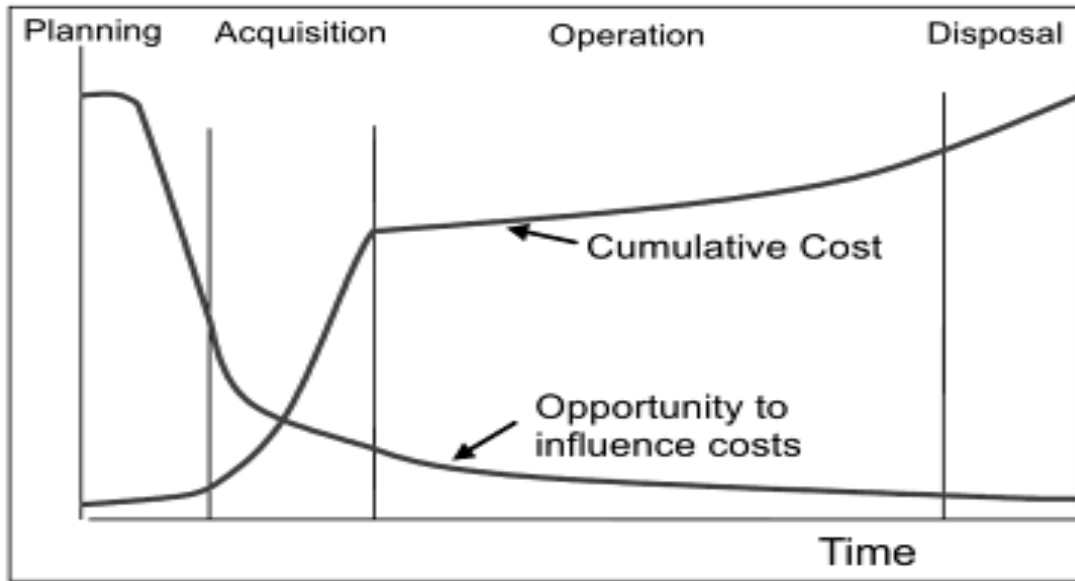


Figure 7 – Life cycle stages (Hastings, 2010)

Markeset and Kumar (2000) states that the LCC-analysis gives managers an opportunity to map the real need of operation, maintenance and environment, identify several alternatives and choose the one with lowest life cycle cost. Still, when presented to this way of thinking, it is crucial for decision-makers to understand that this only represents the economic perspective, not the total perspective (including risk analysis among others).

According to Morris, the president of the IAM, a great method for better asset management decision-making is the SALVO project (Strategic Assets: Lifecycle Value Optimization). This method is meant to be used for any asset management decision and tries to ensure that decision will have a strong audit trail to *why* it is the correct decision to provide optimal value. This project was originally founded with the purpose of managing aging assets and provides practical methods on how to ensure optimal investment and intervention plans (Woodhouse Partnership, n.d.b)

### 3.5.3 Lifecycle Delivery

All the activities found during the life of an asset (acquisition, operation, maintenance, disposal) should not be considered in isolation. Even though lifecycle- and risk analyses are already done and decisions are ready on what assets should be required, one should still pay fully attention to the further management through all phases. For instance, it is very important to continually manage what resources are needed at every time to best execute work. One should also ensure that maintenance issues are incorporated into the design (IAM, 2014)

Lets look at some of the key term within Lifecycle Delivery:

## Reliability Engineering

This is an ongoing process and should be present in all life cycle phases (acquire, maintain, operate, dispose) trying to achieve as low costs as possible. The purpose of reliability engineering is to make sure components and machines, etc. will meet requirement by identifying reliability problems as early as possible. A great tool to help identify such potential problems is the Failure modes, Effects and Criticality Analysis (FMECA). When collecting data, one should not strive to achieve more data, rather the quality of data. Therefore one should know how the information is planned to be used before collecting. Reliability engineering is not supposed to give answers to *why* problems occur, but rather *what* problems might occur and *where*. (Woodhouse, 2010b) (IAM, 2014)

## Holistic thinking

For every engineer, there will always be an underlying focus on creating value for the stakeholders. What differentiates asset management engineers from other engineers is their way of thinking. Asset management demands alignment of all technical and financial decisions, plans and activities towards the overall organizational objectives. Instead of decomposing into mechanical, electrical, construction, environmental etc. there is an understanding of problems so interconnected that you need to have a more holistic view.

The traditional mindset of functional thinking and departmentalization of functions (such as finance, production, health and safety, production, etc.) is often referred to as functional silos (see figure 8). This is a way of structuring where organizations are divided into specific functions based on specific task designations and roles, and is seen as the norm of structuring. The danger of such mindset is rivalry and secrecy between departments instead of cross-functional collaboration. Typical examples of such rivalry are cost decisions before safety and environment, and production decisions before maintenance interventions (Liyanage, 2012). It is a major challenge for organizations to overcome functional silos, but necessary in order to achieve good asset management. Woodhouse (2013) states that "...the removal of 'silos' and the consideration of assets in systems, along with the cross-functional optimization of their life cycles, are core principles of good asset management".



Figure 8 – Functional silos (Wurtz, 2015)

So, how do we create an environment of holistic thinking? How do we help ground teams and departments think of the organization as a whole, and not just what benefits their department? According to Lloyd (2010a, p.xiii) asset management presents an approach of managing the whole life of assets, and to bring decisions into a framework securing focus on organizational goals. These are decisions answering questions like:

- What are the most critical assets and processes?
- What needs to be known, and how should this information be captured and distributed?

The overall goals of holistic thinking as a counterpart to departmental thinking will typically be to (Lloyd, 2010a, p.xiv):

- Spend less to get more
- Managing risks instead of resources
- Thinking in whole systems and not their parts
- Stakeholders understanding the choices made
- Applying a whole-life perspective
- Everyone reading from the same page

While traditional engineers *trust* systems and applied laws, an asset management engineer *challenges* the system and applied laws. There is a shift of focus from outcome/result to systems (Parnell, Driscoll and Henderson, 2011). Woodhouse (2010b, p.31) also claims the importance of holistic thinking when arguing that “it is the net total output of all these systems and processes working together that represents the asset’s performance”.

## **Maintenance**

How does the area of maintenance fit into the subject of asset management? Is asset management just a new name for maintenance in order to get rid of all the associations of being a necessary evil? This seems to be one of the misconceptions made on asset management, but by the given definition of assets we understand that assets are much more than just machines and buildings, and therefore asset management should be more than just maintenance.

Now when it is established that asset management is not the same as maintenance, it is important to emphasize that maintenance is an important part in the subject of asset management. And by looking at maintenance through the eyes of an asset manager, we experience a shift of perspective. Ferreira (2012, p.31) states that “the contribution of maintenance to the success of organizations has been increasingly recognized”. Instead of treating maintenance as a necessary evil, it is more and more looked upon as a means to make optimum use of physical assets for the entire expected life cycle while ensuring operational and environmental safety.



Ferreira (2012) argues that the only way to improve on the return on investments (ROI), which is becoming more and more important in an increasingly complex economic world, is to improve on the return on assets (ROA). In a manufacturing organization, physical assets represent a large percent of the assets, and therefore physical asset management should be taken seriously.

There need to be a maintenance strategy to ensure that all performance requirements (including safety and environment) are reached in the best possible way at minimum whole-life cost. IAM (2014) recommends dividing maintenance into three groups:

- Inspection, Testing and monitoring
- Preventive Maintenance
- Corrective maintenance

‘The Asset Death Spiral’ introduced by Hastings (2010) is a clear example of failing to deliver a whole-life perspective. A specific physical asset central to business profitability is aging with the result of increased frequency of simple problems. Since it is aging, it is seen as less important and therefore total maintenance budget is cut. With this increase of problems, what is left of the total budget now need to be used at non-routine maintenance, giving no resources for routine maintenance and renewal. Because of less routine maintenance, even more breakdowns occur. This becomes a negative spiral resulting in no other choice than letting the plant die (see figure 9).

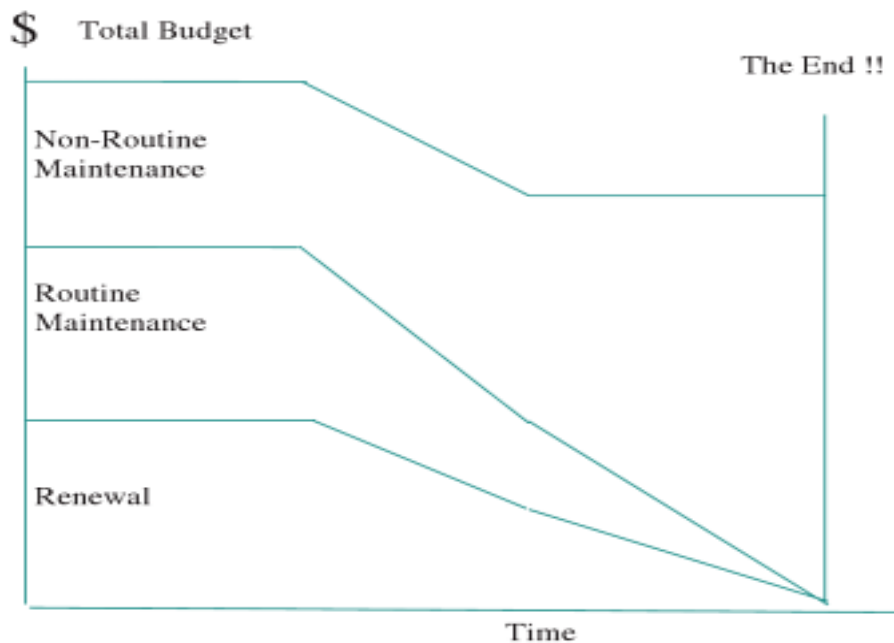


Figure 9 – The asset death spiral (Hastings, 2010)

### **3.5.4 Asset Information**

“Business today is increasingly managed and run by information flows. This information not only contributes to value, but actually constitutes the life of manufacturing and services” (Frankel, 2008a, p.25). The importance of continuously passing information forward and backward with high accuracy is termed the ‘Quick Response Approach’, and is essential for modern management. This has forced organizations to go from a structure with many layers of management, to a flatter structure giving employees more responsibility and decision impact. Employees are no longer just recognized as work force, but also as intellectual capital. By creating a higher employee participation and cooperation within pre-set boundaries and controls, the organization can accomplish much higher decision effectiveness.

First of all, there should be an asset information strategy in order to guide how the organization defines criticality of asset information. Based on this criticality, one should further define how structured, complete and accurate this data should be. This information strategy should also give guidance on how to collect, sort, maintain, store and dispose asset information to best support asset management objectives. The ISO 8000-001, on data and information quality, will be of good help and guidance to best support asset data and information (Edwards, 2010a). Hawkins (2013) argues that asset information makes a better understanding of how assets can create risks, opportunities and consequence to organizational value. Based on the assets condition, constraints, regulatory requirements and probability and consequence of failure this will make the organization better equipped to capture opportunities by making better decisions.

The next step is to establish systems to collect, store, process and analyze asset information (IAM, 2014). As a basis for these systems there should be an awareness and understanding of dependencies and specifications of assets. Hastings (2010) recommends a register of key assets in order for employees to understand the role and significance these assets have on the organizational objectives. This register should include capability, interdependencies, age and estimated remaining life, history, issues, plans, costs and replacement costs.

For larger organizations there is also a need for computer-based systems to provide adequate asset information with adequate quality at the right time to the right people. Systems like SAP and ONIX, which are examples of computerized maintenance management systems (CMMS) have potential to fulfill such demand. According to Campbell (1995) such systems includes the whole circle from identifying what needs to be done to analyzing and reporting job done. It will be fully customized to serve given asset. This could include a ranking system based on the criticality of given systems (safety threats, environmental threats, bottlenecks etc.).

Criticality analyses and block diagrams as shown in figure 10 are great tools in order to understand both role and criticality of assets. These diagrams will highlight assets of high criticality and bottlenecks. This will help engineers to build in redundancy, and managers to prioritize inspection and maintenance. Hastings (2010, p.238) lists five factors determining the criticality:

- Failure category
- Failure Impact
- Ease of repair
- Mean downtime
- Cost of breakdown

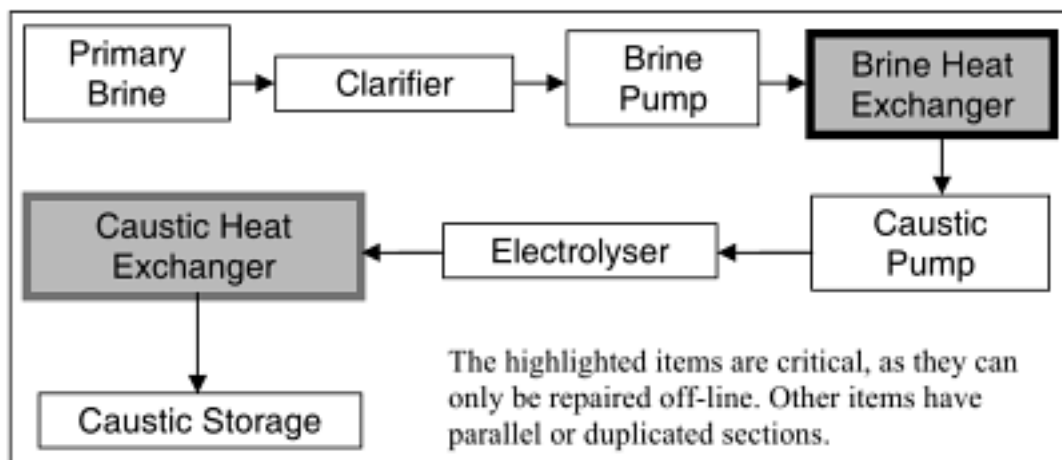


Figure 10 – Block diagram and criticality (Hastings, 2010)

### Asset knowledge

The final area of asset information is the asset knowledge. This is the area of experience, values and insight contained in management and work force. Based on the reliability and quality of such knowledge, decision-making will always be affected to some degree by it. Organizations should therefore make sure to map and document this knowledge and make it widely available to the organization. This way invaluable knowledge will not be lost as a result of people leaving the organization. This is a challenge, and therefore concepts like BIM (building information modeling) will be helpful (IAM, 2014).

### 3.5.5 Organization and People

The area of organization and people does not focus on roles, responsibilities and competences in itself, but rather on the awareness, understanding and aligning of how these roles and responsibilities contribute to the overall asset management goals and activities. Behind the scenes of successful asset management are always the commitment and engagement of top management, which is critical in order for asset management to reach its full potential. According to Hastings (2010) this commitment should first and foremost result in the

addressing of the so-called ‘gray area’ of asset management found between top management and operational management. In order to stop this gray area from being a busy garage of asset management initiatives, it should be replaced with managers having a clear understanding and awareness of asset planning, acquisitions and development projects, and in-service asset management. Leadership skills should be of equal importance for middle managers as for top management (Edwards, 2010a). Lloyd (2010b, p.142) underlines the importance of adequate competence in at all levels and functions by stating that “asset management organizations need to make sure everyone involved in delivering the asset management plan is not only committed but also competent to make the contribution expected of them”.

A very important component of great leadership in asset management is to create a culture among the workforce to collectively produce the desired performance. Woodhouse (2010a) underlines this by reminding us of the successful story of BP transitioning to a fully asset-centered organization (as explained in “3.1 introduction”). The reason why BP gained this remarkable effectiveness wasn’t because of revolutionized technology or tools, but from an integrated and motivated workforce providing loads of small ideas of improvement potential. This clearly tells us that human factors like motivation, communication, ownership, etc., are even more important than tools, methods and technology.

Deal and Kennedy (1982) established a popular definition stating that “culture is the way things are done around here”. It is known to be a strong internal force and should therefore be acknowledged by top management. In terms of asset management there should be certainty on how the culture should be and how to establish it (Johnson, 2010). Wiegmann *et al.* (2002, cited in Johnson 2010) has identified three main characteristics of culture:

- It refers to shared values of everyone in the organization
- It is relatively enduring, stable and resistant to change
- It impacts on the way staff behave and work

### **Stakeholders**

According to ISO 55002 (2014) there is no such thing as a typical stakeholder. Every stakeholder is unique, and think and interferes differently. The definition of a stakeholder is according to Business Dictionary (n.d.b) “...a person, group or organization that has interest or concern in an organization”. Typical examples of stakeholders are owners, employees, vendors/suppliers, community/neighbors, customers, regulators and unions. Often stakeholders can have significant impact on decisions being made (either directly or indirectly). Therefore we should as a rule determine, record and include in decision-making processes the opinions, needs, values, concerns and perceptions of stakeholders. By doing this we can avoid conflicts, establish the right priorities, and develop decision-making criteria. A service review can be a clarifying approach in order to understand stakeholders’ expectations.

### Multi-Disciplinary Teams

One last important aspect of the area of organization and people in asset management, are the multi-disciplinary asset management teams. These teams are important in order to prevent functional silos (as explained in “3.5.3 Lifecycle Delivery”) and to overcome departmental thinking and attitudes, and should be constructed with care. They need to contain competence and collective knowledge of all the important activities across the organization. These teams should play an important part in development of the asset management policy through to the asset management plans, and should be aware of roles and responsibilities. Hastings (2010, p.64) points to the RACI chart as a clear and convenient approach to determine who is responsible, accountable, consulted and informed for any given project (see table 2).

	Project Manager	Contracts Manager	Logistic Support Manager	Equipment User Support Representative
Meeting schedule and budget	RA	I	I	CI
Acquisition contract	A	R	I	I
Logistic support plan	A	C	R	I
Introduction into service	A	I	C	R
R = responsible, A = accountable, C = consulted, I = informed				

Table 2 - RACI chart for acquisition project (Hastings, 2010)

What may happen if multi-disciplinary asset management teams are absent, and disciplines being separated in functional silos, is territorial behavior including secrecy and different unique databases with valuable information being hidden (Johnson, 2010). It is therefore crucial to have these teams in order to overcome such thinking and attitudes, and to create holistic approaches and decision-making (Lloyd, 2010b).

### 3.5.6 Risk and Review

Liyanage (2012) and Edwards (2010b) tell of a risk evolution from mere financial and regulatory risk in the past to now also including social and environmental risks. Customers are becoming more and more concerned of potential and evident social and environmental impacts, which has created a more complex risk picture and forces risk managers to change the way risk is defined and managed. Edwards (2010b, p.196) argue that the well-known equation of risk, Hazard = severity x frequency, should be extended by adding the element of outrage. This will give the new equation of Hazard = severity x frequency + outrage. Outrage is explained as social anger amplifying focus on the hazard, and the only way to reduce the outrage is by action or counter-proof.

Balancing risk is part of asset management, and therefore risk should be analyzed for every unique situation. According to ISO 55002 (2014) every organization should be able to present a documented method of managing risks. According to Hastings (2010, p.159) the five-step-ladder of risk management is one such method of risk management (see figure 11).

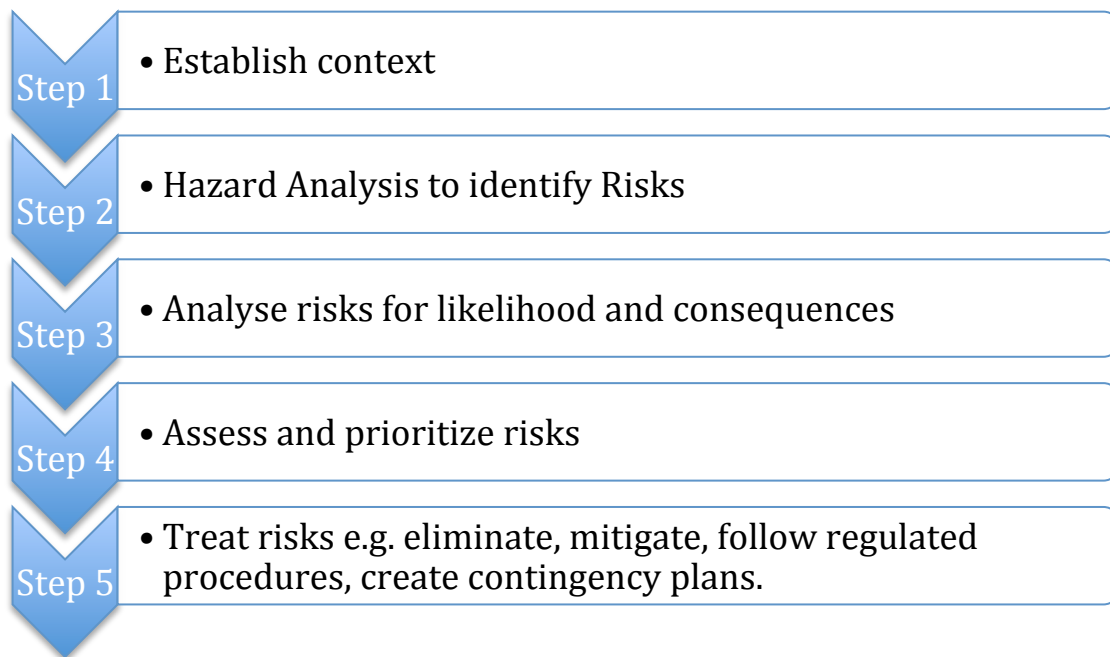


Figure 11 - Risk management outline (Hastings, 2010)

The first step should be to gain understanding of the assets condition in terms of control activities affecting current performance and the criticality, consequence and impact in case of asset failure. Both internal and regulatory requirements should be identified and collected. Also, the stakeholder engagement should be established. There is a statement saying that “the risk in a project is proportional to the square of the hype associated with it” (Hastings, 2010, p.157) meaning that higher engagement and expectation from stakeholders entails higher project risk. Titanic is the prime example of project failure caused by high profile.

Stakeholders and media had their eyes on this exceptional voyage, causing the captain to ignore risk he normally wouldn't take.

The second step in the five-step-ladder should be to perform a hazard analysis in order to identify risks. A list should be created including every potential failure and their causes. In order to do so, Hastings (2010) recommends that such a list is developed by persons with adequate knowledge and insight of plants and systems, and mention some examples of tools developed to assist in such hazard analyses:

- Hazard and operability Analysis (HAZOP)
- Failure Mode and Effects Analysis (FMEA)
- Reliability Centered Maintenance (RCM)
- Risk Based Inspection (RBI)

The third step is to analyze risks. This is done based on likelihood of occurrence and consequences for each event by establish a 5 x 5 risk matrix (One should keep in mind the outrage factor). This is a smart and highly recognized method for risk management. As shown in Figure 12 this is a matrix with likelihood of occurrence evaluated from low to high in one direction, and severity of failure evaluated from low to high in the other direction. This creates three regions of risk, which is acceptable, tolerable and unacceptable. This is a good method to rule out all the events found to have an acceptable risk level before moving on to the next step.

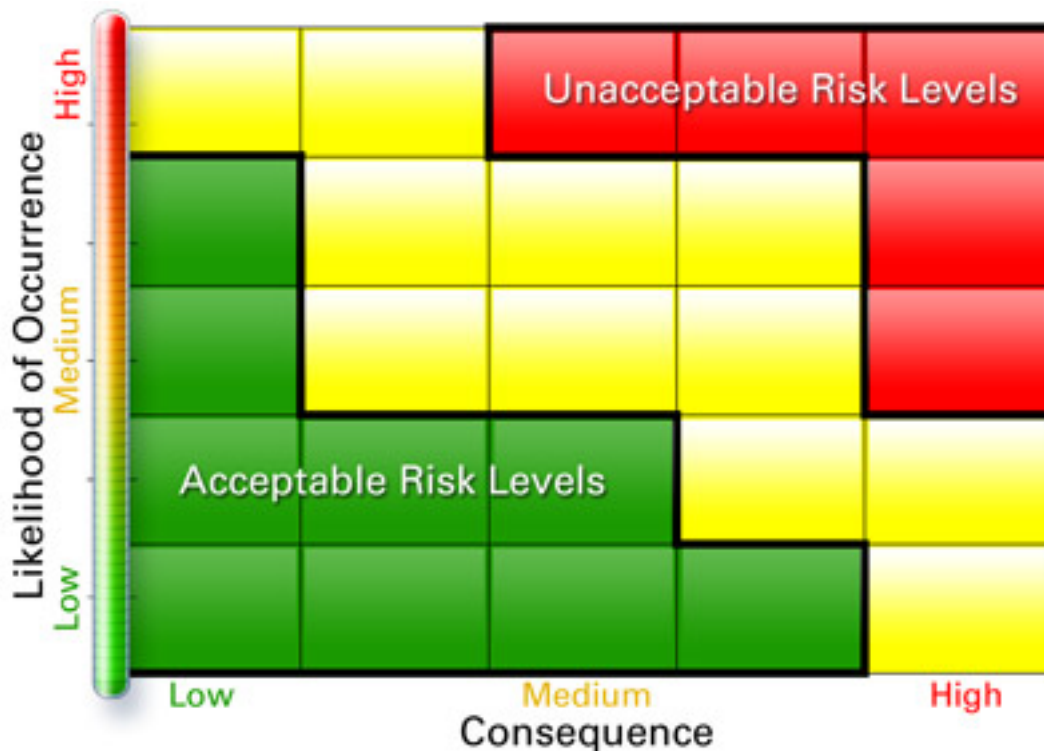


Figure 12 - Risk matrix (Parkinson, n.d.)

The fourth step should define the tolerability, and assess and prioritize risks. Since asset management is always trying to gain the perfect balance between cost, risk and performance over the lifecycle of assets, one should try to quantify risks (both safety and business) as realistic as possible. As mentioned already, modern risk quantification should consider an outrage factor in addition to the risk equation visualized in the 5 x 5 risk matrix. When risks are quantified, every single risk should be balanced with the cost of risk controls, and a priority list should be established based on this assessment. There should also be an assessment of the current and planned total tolerability of plants and systems. This should continually be faced with one crucial question, which is “How much risk are we able to live with?” (ISO 55002, 2014)

The fifth and final step in this five-step-ladder should evaluate how identified risk is to be treated in order to avoid undesirable consequences. The ‘As Low As Reasonably Practicable’ (ALARP) principle could work as a guideline for management to balance risk, cost and performance for the overall system of assets. For each individual risk there will be an evaluation whether to eliminate, avoid, reduce or tolerate.

### **Significant Events**

Every organization should be prepared for significant events. These are the events making huge impact on organizational objects, but with such low probability that it might never happen. According to ISO 55002 (2014) such events are often neglected in standard risk management. For these types of risk, there should be contingency plans in place to ensure business continuity and to provide procedures in case of such risk occurring. Contingency planning is a set of planned activities to ensure crucial operations and containment of damage, injury or loss of personnel and property. These plans are structured to ensure most effective and suitable progress (Business Dictionary, n.d.c)

### **Review**

When it comes to measures, it is most important to measure the right things. Many organizations believe good performance measurement depend on the amount of collected measures. Also from traditional performance management the focus is only put on finance with the goal to improve the ROI. Important aspects as customer-, employee-, shareholder-, social- and environmental relations are not given proper care. A smart question for all organizations to ask is this; “what measures are the most important?” These are called key performance indicators and are the measures most critical on the road to success. Examples of such indicators are cycle time, defects per unit, cost of nonconformance, product image and number of second-time buyers. Other important measures could be customer- and employee satisfaction. To make a high score on these measures, the organization is forced to continuously think; how can we improve? (Christopher and Thor, 1993) Although performance management should be done throughout the process, it would still be smart to have a more formal review once or twice a year. Why is this necessary? To provide basis for rating performance (e.g. pay-decisions) and to set focus on to important questions of ‘Where have we got to?’ and ‘where are we going from here?’ The performance review meeting should take form as an informal conversation with a purpose, and three objectives;



motivation, development and communication. In terms of assessment, there has been a shift in the way of thinking. Traditional thinking is based on achievements (what has been done), while modern thinking is also based on means (why/how it has been done) (Armstrong and Baron, 2005).

The review processes, audit programs and key performance indicators all need to be linked to the overall objectives of the organization. Christopher and Thor (1993, p8-4.6) are making it clear that “the linkage between performance measures, strategies and objectives is a critical management imperative”. If this is accomplished, such processes can be used as tools for providing feedback on progress towards the objectives. This will give assurance to stakeholders and provide management with opportunities for greater efficiencies (Edwards, 2010a,). According to IAM (2014) other areas of review should be the performance of people towards their personal objectives, effectiveness of processes, customer feedback and continual improvement on the risk profile.

In the world of reviews and audits, thorough documentation is of high focus. Expectations, objectives and performance should all be assessed, documented and continually updated. The well-known expression “You can’t manage what you can’t measure” tells of a principle of making both what has to be measured and what to measure against as concrete and measurable as possible.

## Chapter 4 – The ISO 55000 suite: The Asset Management System



Figure 13 – The ISO 55000 suite (IAM, 2014)

### 4.1 Introduction

All this theory on asset management can be overwhelming. Is there a management system that can help organizations towards the requirements found in the ISO 55001 standard, and provide assurance that asset management objectives can be developed, managed and reviewed on a consistent basis? According to ISO 55000 (2014, p.4) an asset management system (AMS) should be able to help organizations “...direct, coordinate and control asset management activities”. The AMS should also provide risk control and assurance that asset management objectives will be achieved on regular basis. Such system can coordinate and interact between the functional units within an organization. Basically, the AMS is the iterative process of organizational objectives into technical, financial and operational decisions, plans and activities.

Even though new practices and models always have appeared periodically, it has been proved very difficult to include the “line-of-sight” principal into one overarching structure. Woodhouse (2010b, p.27) points out that “...whereas many manufacturing industries have adopted a number of component methodologies and good practices, such as lean, total quality management (TQM) and total production maintenance (TPM), they often lack the overarching

model or structure to connect corporate long-term value strategies with day-to-day issues, actions and priorities.”

Even after a study of the AMS presented in ISO 55000 (2014) we will come to the conclusion that a perfect structure has yet to be developed. Will there ever be a structure, system or model able to formalize what leaders worldwide often refer to as “momentum”? You know if you have it, and you certainly know if you don’t, and you can even be aware that you are about to lose it without being able to do anything about it. How to formalize this “momentum” will still remain a challenge. This momentum is found in culture, motivation, behavior and leadership. Still, ISO 55000 (2014) remind us that every organization should still try to manage close-related aspects such as culture, motivation and behavior, but this should be arranged outside the AMS (see figure 14).

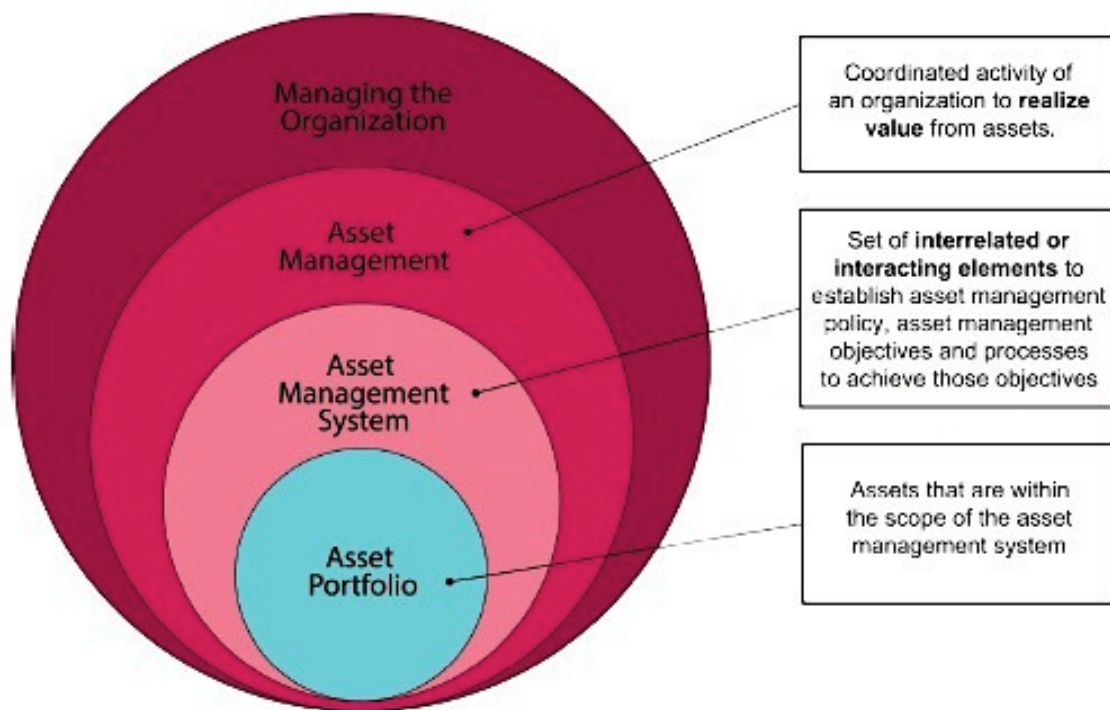


Figure 14 – Relationships between key terms (ISO 55000, 2014)

In 2004, the PAS 55 was published by the British Standards Institution (BSI) in collaboration with the Institute of Asset Management (IAM). It was the first attempt to meet the need of a standard on asset management. It focuses on physical assets and can be used as a checklist for good practices in organizations where physical assets are most important factor in achieving overall organizational goals. The PAS 55 was revised in 2008, and is a great document to use when defining what needs to be done. For about 10 years it has been recognized as the default global standard on asset management.

Based on PAS 55, a project committee within the International Organization for Standardization (ISO) launched the ISO 55000 suite in 2014. This is the first official standard in the subject of asset management, and has reached global consensus among several leading experts within the area of asset management. The ISO 55000 suite focus on how each asset can maximize the value they provide to the organization, and comprise three standards:

- ISO 55000 (2014) provides an overview of the subject asset management and terms and definitions.
- ISO 55001 (2014) defines all the requirements for a management system for asset management.
- ISO 55002 (2014) provides guidance for the application of a management system.

Note that a very important principle within the subject of asset management is continual improvement. This is underlined in ISO 55002 (2014, p.6) by stating that “compliance with all the requirements of ISO 55001 should be considered as achieving only the minimum starting point for an effective asset management system and should not be seen as the final goal.”

According to Woodhouse (2013) key themes from PAS 55 like alignment, whole life cycle planning, cross-disciplinary collaboration and risk-based decision-making are retained in the ISO 55000 suite. The most significant change is the target scope. While PAS 55 mainly focused on physical assets, the ISO 55000 suite is created to apply to any asset type. As for the ISO 55000 suite, there are no definitions on “how to” attached the requirements. It is therefore reasonable to expect future development of tools, techniques and guidance to the application of the requirements found in ISO 55001 (2014). IAM (2014) argue that as long as these tools and techniques provide added value, they could be used.

## **4.2 Structure**

According to Woodhouse (2013) all ISO management system standards are now required (and soon to be revised) to follow the new ‘ISO Annex SL’, which is a standardized template for terminology and layout. This will improve the integration of all the different standards for management systems, such as ISO 9001 for quality management and ISO 14001 for environmental management. Figure 15 includes the main elements and structure of the asset management system found in the ISO 55000 suite. Also, it is found to be handled and operated as a never-ending circle consisting of seven main elements:

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

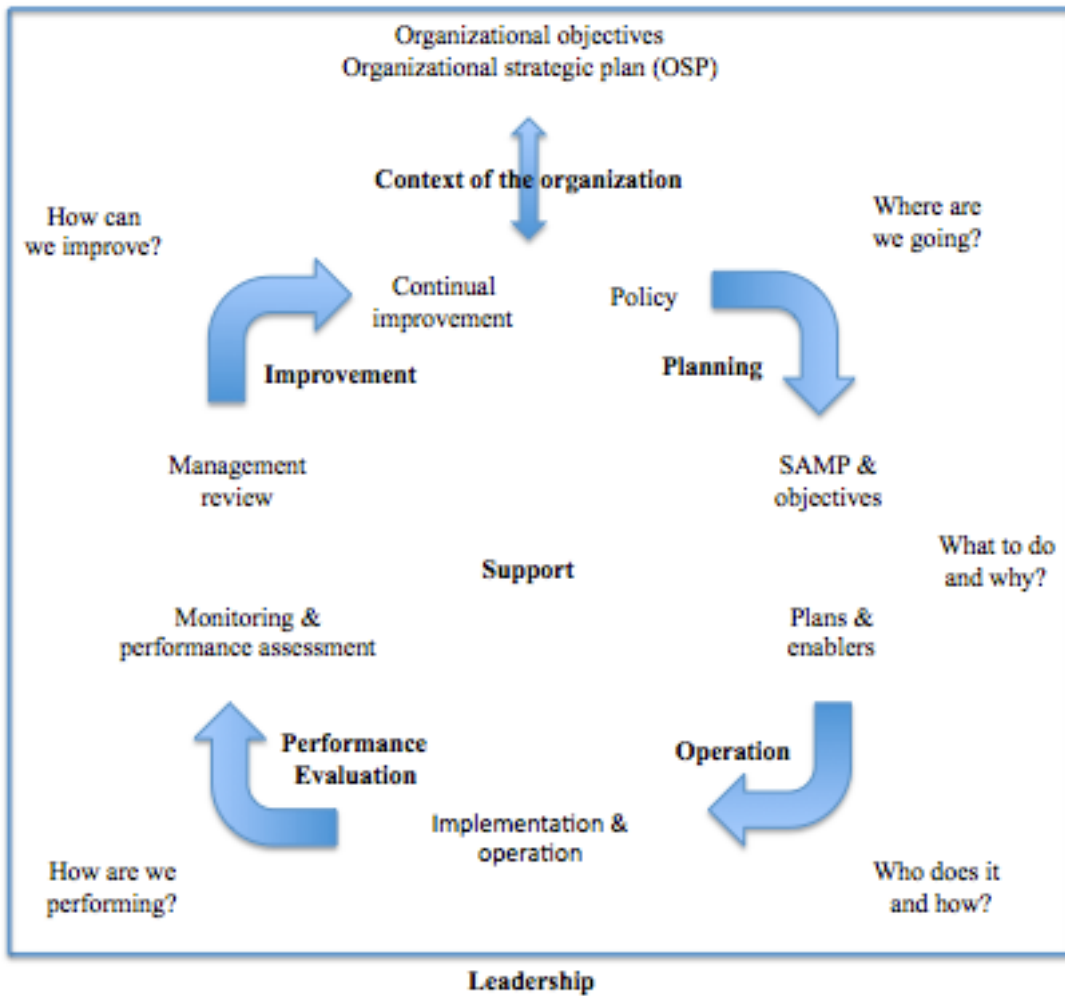


Figure 15 – Asset management system

The main elements of this AMS are further divided into 24 specific clauses, which will all be described in further detail in this thesis. This system is all about understanding the context of the organization, and the planning phase on how the organization can translate the needs and expectations of stakeholders and organization into a policy and strategy with clearly defined objectives and plans (what to do and focus on), and why this should be most important. This should be under top managements responsibility. Then there should be a development of plans on how operation is being managed, monitored and evaluated. Then focusing should be on management review and continual improvement based on the assessment and evaluation of performance. The improvements done, together with an updated context and OSP, create a need to start all over again. How will this process is conducted, depends on the influence from the overarching areas of leadership and support.

## **4.2.3 Context of the Organization**

### **Understanding the organization and its context**

Internal and external contexts are important to understand before establishing the AMS. Some recognized examples of internal contexts are organizational culture, environment, mission, vision and values, while examples of external context are social, cultural, economic and physical environments, and regulatory, financial and other constraints (ISO 55000, 2014).

### **Understanding the needs and expectations of stakeholders**

We also need to communicate with stakeholders in order to understand their influence in setting objectives and decision making, since this in turn will affect the asset management system. Stakeholders should be identified and reviewed to find needs and expectations. Typical internal stakeholders are owners, employees and other internal groups within the organization. Typical external stakeholders are customers, suppliers, service providers and investors. In modern times, one should also pay attention to stakeholders being socially, economical, and political active groups like local community, media, consumer organization so on and so forth. According to Liyanage (2012) this range of stakeholders provide a wide range of complex demands, which need to be considered when asset management policy and strategy are to be developed. Examples on such demands could be carbon footprint, security of economy, positive social impact and compliance to requirements (community, market, technical)

### **Determining the scope of the asset management system**

When the OSP is developed and agreed upon, the organization should now focus on two defining questions:

- Where are we going?
- What should we do, and why?

According to ISO 55002 (2014) every organization should establish the scope (focus, intention) of their AMS. The scope of the AMS should be aligned with and documented in the strategic asset management plan and formulated as a statement of boundaries and applicability. Every asset within this scope constitutes the “asset portfolio”. The scope needs to be reviewed on a regular basis, and should reflect:

- Boundaries and interdependencies of every single asset.
- What parts of the organization are involved?
- Responsibility of risks, environment, contract periods, etc.

### **Asset management system**

Before implementation of an asset management system, there should be a review of the organization’s processes to the requirements of ISO 55001 (2014). This review will reveal areas for further development in order to support the establishment of an asset management system. When the asset management system is developed there should be agreement to how it should be implemented, maintained and continually improved.

When the policy is agreed upon, everyone in the organization should be able to tell “where” the organization is heading and draw out the big picture on “how” to get there. Now, in order to draw a more detailed picture on how to succeed on the policy, there should be developed and documented a ‘Strategic Asset Management Plan’ (SAMP). The asset management system’s role to help achieve asset management objectives within any organization should be documented in the SAMP.

Woodhouse (2010b, p.33) explains the SAMP as a whole-life asset plan “...translating organizational objectives into asset-specific realities, opportunities and plans”, plans that are to be delivered and optimized by a multi-disciplinary group from nearly all areas of the business (logistics, maintenance, HR (human resources), HSE (health, safety and the environment), legal requirements, operating scope, engineering design, R&D, materials, etc.). After this is in place, everyone in the organization should be able to tell “what to do, and why”. The SAMP represent a powerful tool in gaining commitment from stakeholders in creating plans to gain optimal economical, social, environmental and reputational performance in the longer run. A typical set of scenarios could include a whole-life cost perspective, impact on climate change, technology, short- and long-term cost development, etc.

According to Edwards (2010b, p.185) there are two key driving factors when creating the SAMP. These factors are “output performance” and “asset management capability”, and are compared as equally important in achieving a sustainable and economical performance (see figure 16).

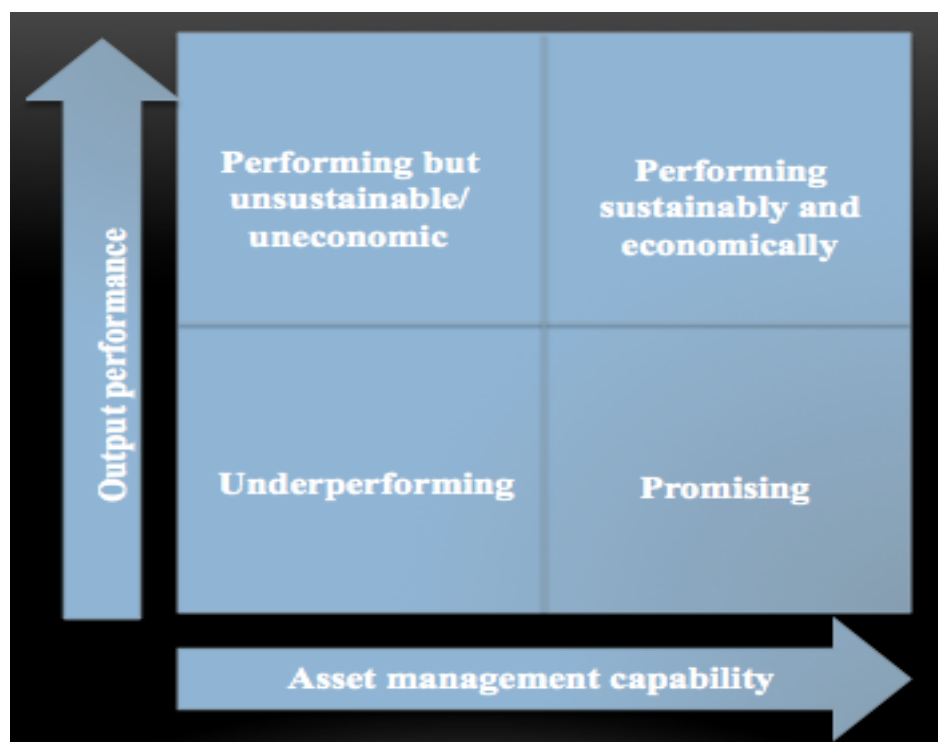


Figure 16 – Output Performance Versus Asset Management Capability (Edwards, 2010b)

Output performance is important in order to satisfy stakeholders' need for immediate results in terms of performance, cost and quality, while asset management capability will help the organization achieving sustainable performance in the long run by focusing on whole-life costs of investments, maintenance and renewal of assets. Stakeholders most often demand positive short-term outputs, and the success of an organization in creating the right balance between "output performance" and "asset management capabilities" is therefore determined on how the SAMP manages to argue the "why?" behind the "what?"

According to Woodhouse (2010b) the SAMP contains a clear description of asset systems and individual assets (its strengths, weaknesses, opportunities and threats (SWOT), its condition, uncertainties, risks and contingency plans, future generation of value, etc.). All these asset systems and individual assets should be considered and weighted, and then prioritized and included into long-term plans to ensure best-value delivery.

## **4.2.4 Leadership**

### **Leadership and commitment**

The everyday responsibility of overseeing the asset management system can be appointed to anyone within the organization qualified to do so. What is important is that the ownership and accountability of asset management never is lost from the level of top management. Some examples of top management showing commitment to asset management:

- Making reference to and communication of asset management principles
- Alignment of AMS to other organizational management systems
- Prioritize and resource-allocation to the achievement of asset management related objectives.

### **Policy**

Based on the organizational strategic plan (OSP) one needs to create an asset management policy as an answer to the question of where we are going. According to ISO 55002 (2014) this policy is to be created by top management and is defined as a short statement explaining commitment and expectation. In this case, the commitment and expectation towards decisions, activities, and behavior concerning asset management. An example of such commitment would be decision-making processes were several alternatives are documented based on benefits, different levels of risk, whole life costs, competence, etc. The policy should of course also be aligned to the organizational objectives, and communicable and understandable to everyone within the organization. Such organizational objective could for example be to reduce operating costs per product delivered, and subsequent the asset management policy statement could then be to adopt tools for better life cycle-analyses when making investments.



### **Organizational roles, responsibilities and authorities**

While top management is involved in defining vision, values, responsibilities, objectives, and the alignment of asset management objectives and policy with overall objectives, middle managers are needed in order to plan and evaluate the implementation and operation of activities, risk management, information management, etc. We also need leadership to carry out a two-way communication of asset management objectives and its importance with employees, customers, contractors, etc.

Every single role, responsibility and key function should be defined and presented in job descriptions and organizational charts, including who is responsible for such and such activity, what is the required experience and competence for each role, what are the expected tasks, achievements and workload, and the variability attached, what is the necessary support, and how intensive does this support need to be and with whom should the responsible leader of every role communicate (ISO 55000, 2014).

### **4.2.5 Planning**

#### **Actions to address risks and opportunities for the asset management system**

According to ISO 55002 (2014) risks and opportunities associated with change should be measured against their impact on the asset management system. Risk management should also be addressed when establishing and operating the asset management system. In addition to implementation and controlling of such risk processes, there should be documentation in place in order to prove that risk management processes have been executed as planned. Contingency planning should be established for significant events to ensure crucial operations (business continuity) and containment of damage, injury or loss of personnel and property.

#### **Asset management objectives and planning to achieve them**

The asset management objectives, together with the SAMP, link the overall organizational objectives to the asset management plan(s) describing how we plan to achieve these objectives (See figure 17). There is often multiple ways toward a product/service, and asset management objectives always try to detect the set of activities providing perfect balance between cost, benefit and risk. According to ISO 55002 (2014), asset management objectives can be both quantitative such as mean time between failures (MTBF), and qualitative such as customer and stakeholder satisfaction. Also asset management objectives shall be “SMART” objectives:

- Specific, who is involved, which factors needed for action, etc.
- Measurable, what to measure, how to measure, objectives linked to timeframes and achievements. Should be easy for everyone to gain overview of progress.
- Achievable, understanding and commitment achieved from all parts, don't aim too high, etc.
- Realistic, goals in line with overall vision and values, objectives guides in desired direction, etc.
- Time-bound, when goal should be achieved, when to move on to next phase, etc.

The organizational objectives of which asset management objectives are aligned to are produced from strategic planning. The SAMP should be held as a guide in both establishing and aligning the organizational objectives to asset management objectives at relevant levels and functions. The SAMP should also be used as guide when deciding what the asset management system should do to achieve these objectives (ISO 55000, 2014)

By studying the ISO 55002 (2014, p.4-5) we are able to recognize some fundamental questions working as guidelines on how to achieve the asset management objectives, which should be documented in the SAMP:

- What are the expectations and requirements from stakeholders?
- What are the criteria and methods for prioritizing and decision-making?
- What will be done?
- What resources will be required?
- Who will be responsible?
- When will it be completed?
- What are the maintenance requirements?
- How will the results be evaluated?
- What are the implications and the appropriate time horizon(s) for the AM plan(s)?
- How will risks and opportunities be identified, monitored and treated?

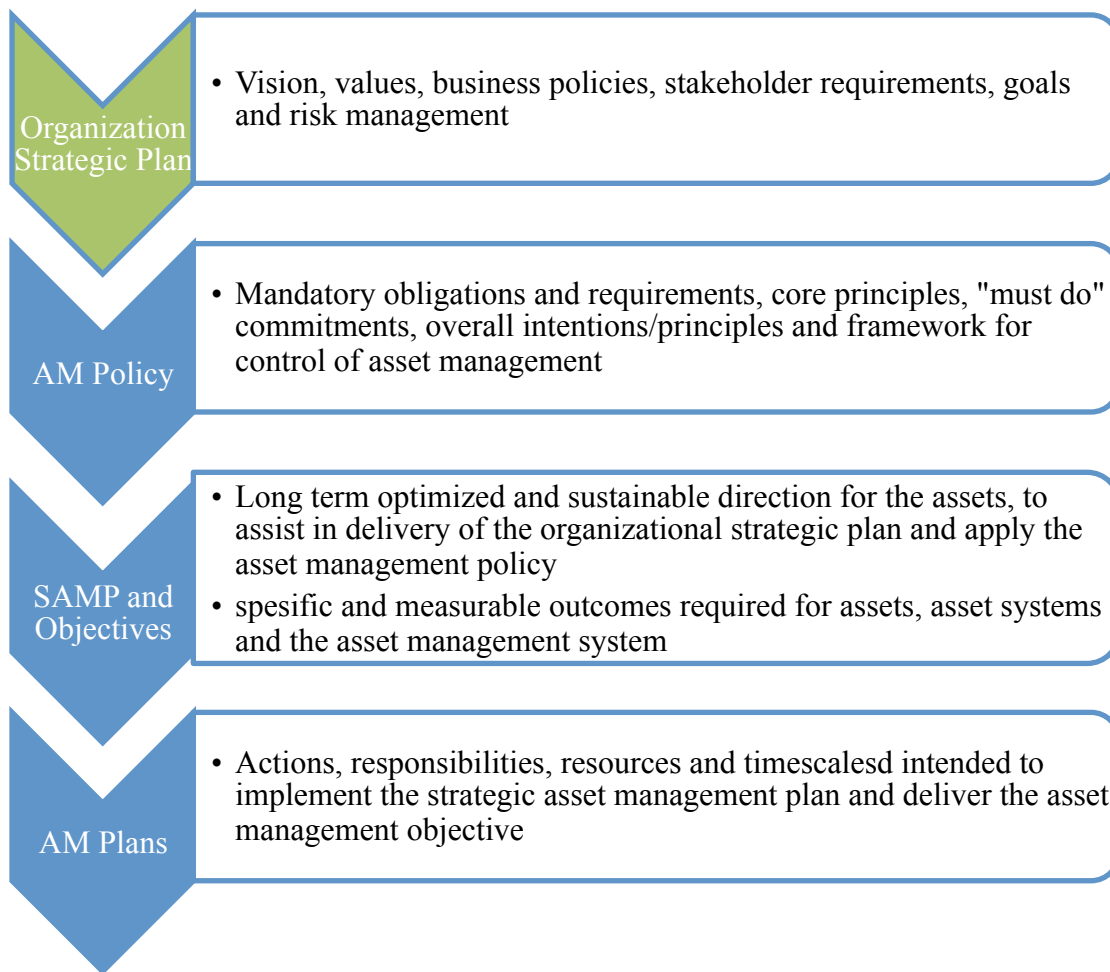


Figure 17 – Planning and implementation elements of an asset management system (BSI PAS 55, 2008)

## 4.2.6 Support

### Resources

According to ISO 55002 (2014) “During the development and the implementation of the AMS, including the asset management objectives and the asset management plan(s), the organization should determine the required resources.” When talking of resources we should be aware of the continuous tension between resources available and resources required. If an organization has a healthy culture of communication and will to cooperate, this will often be a positive tension for the organization. A smart place to start would be to map available resources and do a gap analysis on resources available and planned activities. This way the organization can better prioritize based on pre-determined criteria and processes.

Holistic thinking is an important part of resource allocation. Sometimes when resources are allocated, it creates repercussions causing other parts of the organization to gain and/or to give additional resources. As an example, an organization is considering hire an extra mechanic in order to reduce costly downtime. But after discussing with existing mechanics, they come to the conclusion that if one particular production line of high criticality is replaced with a new top-modern line, the organization could eliminate the need for a new mechanic AND increase production in all the production departments.

### **Competence**

According to ISO 55002 (2014) this should be addressed in all levels of the organization, and there should be alignment between competencies in specific asset management related activities and the understanding of how these activities affect other asset management activities undertaken by others. Each asset management role and responsibility should have requirements and competences attached (such as education, training, experience, awareness and skills). The organization should do mapping of current situation and a gap analysis towards future needs and requirements. When undertaking this analysis, the interdependency between asset management competences and organizational design, planning and business processes should be recognized. This should then develop into training, education and improvement plans. Everyone involved with roles and responsibilities impacting the AMS should be fully aware of this as a result of clear and distinct communication from top management.

AMS works as support to the development of activities and objectives for each asset. It also evaluates their effectiveness by controlling and documenting all asset information. When talking about the implementation, maintenance, evaluation and improvement of competency requirements involved in asset management, and also of personal competence, both AMS and HR should be mutually supportive (ISO 55000, 2014)

### **Awareness**

According to ISO 55002 (2014) every stakeholder (employees, service providers, suppliers, etc.) should be aware of:

- The organization's Asset management system, policy and activities.
- Why asset management is important
- Resulting impacts of changes in operations
- Benefits of great AMS performance, and their contribution to it.
- The consequence and behavior of asset management related risks from their work activities
- "How well the organization is performing in meeting its objectives"

How the organization can improve on awareness:

- consultation with staff regarding operation and changes to the AMS
- asset management discussions in internal newsletters and briefings
- Include asset management as topic in staff- and team meetings
- Briefings for top management, key suppliers and distributors.

### **Communication**

According to ISO 55002 (2014) it is important that relevant stakeholders are aware of asset management requirements and expectations, and how implementation and changes to AMS can impact stakeholders. In order for the organization to promote engagement and inform and influence relevant stakeholders, a communication plan should be created and function as an integral part of the organization's asset management activity and AMS. The content of such communication plan is typically:

- Practical; When and how to communicate, who should deliver specific communications, and which format to use
- Feedback and reporting, such as performance and key milestones
- Explanations, such as expected benefits and impact of planned improvements.

### **Information requirements**

According to ISO 55002 (2014) the organization should first determine information needs related to assets, asset management and AMS. Secondly, it should decide on a systematic approach on how to identify, prioritize, store and review information. Information requirements should include:

- Value and quality (accuracy, integrity and completeness should be determined by relevant stakeholders)
- Specified processes on how and when to collect, analyze, prioritize and evaluate
- Assignment and periodically review of the stewardship of specific information

### **Documented information**

According to ISO 55002 (2014) the organization should define its period of responsibility for every asset, and requirements for maintaining documented information beyond disposal of assets. Also the organization should determine documented information required to ensure effectiveness of its AMS, and to ensure that the complexity of assets and activities are being accommodated with approved, accurate, most up to date information. This is done by the implementation of controls.

## 4.2.7 Operations

The AMS is able to direct, implement and control the asset management activities. The implementation part is directed from standards, plans and functional policies. These guidelines should be fed back into the design and operation of the AMS. When operating the AMS, we sometimes need to change/improve processes and procedures. By doing so we expose ourselves to new risks. This points out the importance of risk assessment and change management. Even though activities are outsourced, they should not be removed out of control from the AMS (ISO 55000, 2014)

This is the first stage of the AMS where operators and technicians are involved. When moving into the stage of operation, the AMS is becoming much more detailed and all-inclusive. It is time to focus on two clarifying questions:

- Who does it?
- How to do it?

Operation is about the implementation, conduction and control of processes and activities previously planned. One need to:

1. Establish criteria. One need to define who is responsible, who is doing what, why it is done, determine procedures and ensure that a possible resource gap is dealt with.
2. Implement control mechanisms such as performance measures, risk management and scheduling reviews. This is of Importance in order two monitor and treat risk and deviations in the attempt to achieve balance between cost, risk and performance.

### **Operational planning and control**

While the SAMP is comparing and presenting a number of long-term scenarios (including work, volumes, costs, risks and expected outputs) to the stakeholders, the asset management plans are all about defining who does what, and how. The asset management plans are detailed plans including every single action, responsibility, resource and timeframe intended to implement the SAMP and deliver the asset management objectives. They express *how* and *who* to operate and control the whole portfolio of assets. Every single activity and process within the asset portfolio needs to be aligned with the overall organizational objectives, and monitoring of the performance should be in place to check how well the organizational objectives are being met.

### **Management of change**

According to ISO 55002 (2014) the organization should be proactive in evaluating internal and external, planned and unplanned changes (that can have an impact on the AMS) prior to implementation. This could be changes affecting procedures, responsibilities, new regulatory requirements, new technology, etc. This approach provides the opportunity for scenario thinking, mitigating actions and evidence-based decisions on proposed actions.

## **Outsourcing**

According to ISO 55002 (2014) outsourced activities should be documented and part of the AMS if they are influencing the achievement of asset management objectives. Regular management reviews should be undertaken to ensure that performance is as planned. If life cycle activities are outsourced, the organization should consider risks and impacts on its assets and the AMS, and what risks that cannot be transferred (like damage to reputation). The organization should also in situations of outsourcing consider the protection of corporate knowledge and technology, and intellectual property by contract or other agreement.

### **4.2.8 Performance Evaluation**

According to ISO 55000 (2014) the performance of the AMS should always be measured against objectives to see if they are being met or not. The primary purpose should always be to check if the system is effective and efficient in supporting the organization's asset management. The monitoring and periodic analysis, evaluations and audits should be a continuous process.

So far the AMS has been a useful tool helping top management develop asset management objectives supporting the vision and overall objectives of the organization. It has also been a great help in deciding who will do what, and how. But if the AMS were to stop at this point, it would be fair to state that given organization would be in need of some luck. It is rare to get it close to perfect the first time, and that's why we need continuous monitoring and performance assessment of operations and processes. Now it is time to ask the question: "Based on the objectives, how are we performing?"

### **Monitoring, measurement, analysis and evaluation**

According to ISO 55002 (2014) processes for monitoring and control of operations should be established. These processes should identify roles and responsibilities, procedures (how it will be executed), what risks are present and how this will be managed and controlled. There should also be an overview of planned resource allocation and competency development.

Also, the organization need to define what, how and when to monitor and measure, and should discuss the setting of performance indicators, compliance with requirements and detail of documented information. When setting the frequency and parameters of monitoring and measurement, all costs, risks and stakeholders' requirements should be considered and balanced. These indicators should create a pool of information large enough to determine both success and areas of improvement and corrective action. Also the outsourced activities should be monitored.

According to ISO 55002 (2014) the organization should consider need for changes to policy, objectives, strategies, and other elements of the AMS when evaluating. Outcomes from this process should reveal if:

- Management is proactive
- Sufficient training and competence exist among employees and management
- AM activities are aligned with overall processes
- Significant changes were reflected in AM processes in a timely manner.

### **Internal Audits**

According to ISO 55002 (2014) frequent internal audits should be implemented and maintained to ensure the effectiveness and suitability of AMS towards the requirements of the organization and the ISO 55000 suite. These audits should also promote active participation among employees in order to be successful in identifying opportunities for improvement. The results are used to prevent or correct specific nonconformities by giving guidance to how one can make sure this doesn't happen again. Audits should always be performed by competent and objective personnel within or outside the organization. The audit program(s) shall determine audit criteria, scope of each audit, frequency, methods, responsibilities, planning requirements, and reporting.

### **Management review**

According to ISO 55002 (2014) management review(s) provides top management with an opportunity to establish new and/or updated asset management objectives based on the evaluation of suitability, adequacy and effectiveness of assets, asset management and AMS. Included in the management review are:

- Status of actions from previous reviews
- Changes in the risks and opportunities portfolio, and in issues (external & internal) relevant to the AMS.
- Information on asset- and asset management activity, performance and condition (nonconformities, corrective and preventive actions, monitoring and measurement results, audit results)
- Opportunities for continual improvement

Output of the management review should be documented and include decisions related to continual improvement opportunities and any need for changes to the AMS. Relevant outputs should be used during reviews of the organizational plan.



## **4.2.9 Improvement**

### **Nonconformity and corrective action**

According to ISO 55002 (2014) when nonconformities occur, the organization should have processes established to manage nonconformities and their associated consequences, and to reduce likelihood for recurrence. A mindset to take action and react to nonconformities should be part of the culture and procedures. How should we react when a nonconformity occur:

- Determine cause
- Review scale and additional risks. Does similar nonconformities exist?
- Implement needed action
- Review effectiveness of action
- Make changes to system and routines to avoid recurrence if needed.

Undesired events related to assets that should have been controlled by the AMS are very important to give proper investigation and review. It is important to check if there is improvement to the system so that we can prevent such event from reoccurring (ISO 55000, 2014)

### **Preventive action**

Nonconformities, potential nonconformities and opportunities for improvement can be detected either by monitoring, management reviews and internal or external audits. We should be prepared both for preventive and corrective actions. Improvements need to be risk assessed first, then implemented. According to ISO 55002 (2014) tools and methods should implemented to identify potential failure and root causes. When something is identified and evaluated based on criticality, operators may chose to react. If a reaction is needed, operators should follow the recipe described in “corrective action”.

### **Continual improvement**

The AMS is an ongoing iterative process (not to be understood as cyclic) continuously seeking new opportunities, technologies and practices. In true spirit of asset management we should always aim for continual improvement. Especially if the performance of the AMS fails to meet the objectives, we should search for opportunities for improvement. Critical to success in the long run is the management’s ability to continually conduct performance assessment and review, hence the never-ending circle

Another way to find improvement potential is by studying performance trends, conducting audits and encouraging employees to come forward with suggestions. Mangers should also conduct competitor check-ups, research, consultations, and participate in network, clusters and forums (ISO 55002, 2014).

### 4.3 Benefits of having an Asset Management System

Possible benefits of an AMS could according to ISO 55000 (2014) be:

- Integration between functions (cross-functional)
- Supports long-term and sustainable approach to decision making
- Align all activities with the objectives
- Risk reduction (stronger stakeholder support)
- Identification of opportunities (stronger stakeholder support)
- Improve organizational knowledge and decision-making. Because of use of tools.
- New ideas of value creation from the use of assets
- Framework for integration of standards, guidelines and best practices.
- Support sustainability
- Balance between short-term, medium-term and long-term finance and activity plans.
- Many part of the organization connected to one system (HR, control systems, employees, suppliers, service providers)

Woodhouse (2013b, p.4) present some remarkable results coming from organizations converting their businesses to follow the AMS. Some examples of positives outcomes are listed:

- CLP Hong Kong: 90% reduction in system downtime (“customer minutes lost”), reducing tariff charges by 40% and increasing the network/asset portfolio by 20%.
- Nuon Holland: 30% ‘total cost of ownership’ savings
- Chilean copper mine (ore crushing plant): 3-10% increased throughput with 30% reduction in maintenance costs
- New South Wales government: A\$11M/year budget savings
- Baltimore power generation: 29% increased output at no extra costs

## Chapter 5 - Interviews



Figure 18 - (Hency, 2015)

### 5.1 Who

This whole interview process included the five directors in charge of finance, supply, production, HR and maintenance & invest at KGON. In addition, nine team leaders representing both supply, production and maintenance & invest participated. This group of 14 directors and team leaders should be representative for the organization. It gives the interviewer a possibility to check alignment from the overarching goals down to the weekly plans. It also gives the interviewer the possibility to test the level of cross-functional cooperation. This group is also large enough to provide sufficient information to each question with different views coming from different parts of the organization.

Note: In this chapter the term ‘top management’ refers to department directors, the term ‘team leader’ refers to all the middle managers in charge of teams, and the term ‘operator’ refers to all ground personnel also including technicians.

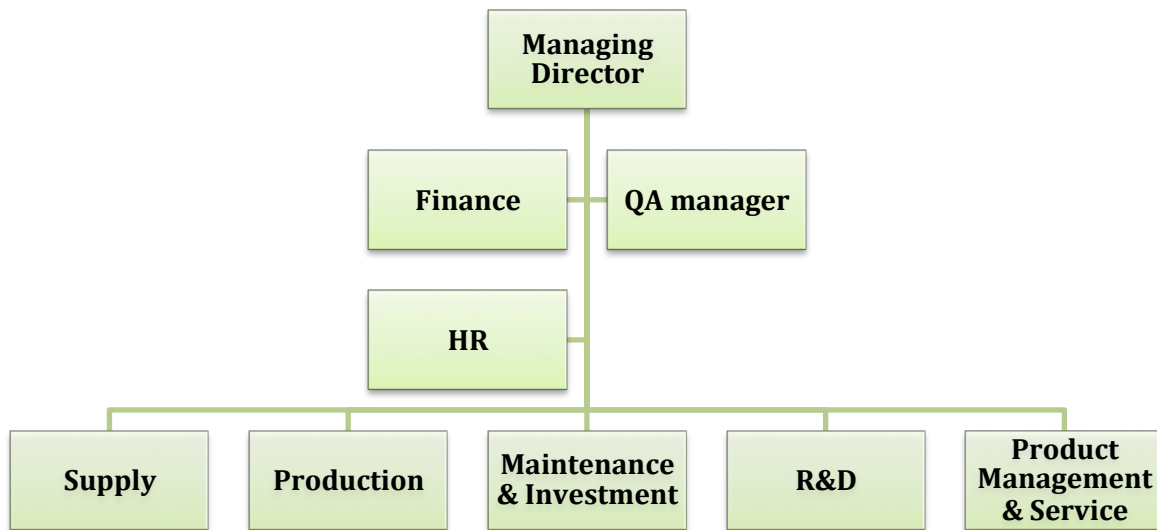


Figure 19 - KGON management

## 5.2 What

ISO 55002 (2014) states that “an initial review of the organization’s current processes against the requirements of ISO 55001 will determine the areas that need to be developed to support the functioning of a compliant asset management system”. The aim of this chapter is to conduct a review and detect both positive trends and areas of improvement for each clause found in the ISO 55000 suite.

This process of interviews is based on questions created from all the clauses in the ISO 55001 (except from a few with reasonable comments). The results from these questions will not be able to cover all requirements of the ISO 55000 suite and cannot be used as a means of certification. Still, it will help KGON and similar industrial organizations to the awareness of internal strengths and weaknesses regarding asset management and this standard. The author has made a thorough effort in translating the requirements (“shall do’s”) from the ISO 55001 (2014) and the answers provided during the interviews to align with the organization’s context.

## 5.3 Results

### 5.3.1 Context of the Organization

#### Understanding the Organization and its Context

##### *Positive trends:*

The directors show good understanding of both internal and external issues relevant to this organization. They dare to admit that not everything is as it should be, which is a crucial fundament of future improvements. A general strategy document (“Business Plan”) is developed each year with a 5-year focus. This document includes corporate strategy, trend analysis, and operational development and action plans for each department explaining main focuses for the next 5 years. For the upcoming years, this last section with operational development for each department should be made more detailed, including SWOT and risk/opportunity analysis, time horizons, requirements, responsibilities, etc.

##### *Areas of improvement:*

Top management need to make sure that the organizational objectives are being read, understood and memorized by every single leader within the organization. Several team leaders were unable to mention the six main objectives from last year, and some didn’t even recognize the booklet were the main objectives are presented. During these times of failing markets, top management tend to fall for short-term thinking like cutting costs and stalling investments in the pursuit of keeping positive results for the next period. This may put the organization in a position where they are unprepared to gain markets when suddenly trends are turning positive. In times of failing markets, the organization should focus on doing smarter, more strategic spending instead of “just” cutting costs. This year is the second year of developing a strategy document within the organization, and therefore top management need to make sure it is given required amount of attention from every single part of the organization. The most evident risk in the process of creating an extensive strategy document is spending all this time and resources in development, but failing to implement. The purpose of a strategy document is not the document itself, but rather strategic decisions and actions as a result of the document. Therefore this document need to be put on the desk for each director and team leader to see, and talked about constantly.

## **Understanding the Needs and Expectations of Stakeholders**

### *Positive trends:*

There is a good understanding of expectations coming from both external and internal stakeholders. Just recent this organization received new owners, and already most of the leaders have studied their new owners' practices and methods. Therefore when introducing new methods and new thinking, the top management are pro-actively trying to align with the expectations of the owners. Also, there is high focus on quality, innovation and delivery capability throughout the organization. As an example a user survey was executed recently in order to map if expectations on product and delivery was met.

### *Areas of improvement:*

The process of decision-making needs to be more extensive. According to ISO 55001 (2014) the stakeholders' perceptions should be determined and taken into account in the process of decision-making. This should be an iterative process where several competing options are to be presented and evaluated. There is a good understanding within the organization of the importance of such processes, but the lack of documented decision-making processes tend to be filled with assumptions and shortcuts. Checklists and documentation requirements are not satisfactory or simply absent when decisions are to be made. When in addition support and time is marginal, too often decisions end up being based on the experience and insight of the one person.

## **Determining the Scope of The Asset Management System**

### **Asset Management System**

*These two clauses are all about having a system for asset management and what should be included (scope) in such an asset management system. Since this organization does not have any references to the name "asset management system", it was first interesting to check if there was at all an overarching system before it was asked more specifically about limitations and intentions, and mapping of what already exists of elements in such a system.*

### *Positive trends:*

This organization is a certified ISO 9001 organization, which is a quality management system. In addition to this certification, there was also mentioned an orderly booklet with main objectives together with critical success factors, and a strategy document with main focus on ensuring that all departments are heading the same directions. This is a positive trend, showing a willingness to align the entire organization.

There has been developed a list called TOP40. This list is including the plants representing the highest criticality in achieving the objectives. The TOP40 list is used basis during the morning meetings for directing decisions.

*Areas of improvement:*

Although many of the main elements needed for an asset management system seem to be wholly or partly in place, the organization does not have the overarching system needed for all elements to be put in order. It will also be necessary to make sure that comprehensive guidelines for progress and control, together with active lines of communication, are in place. In order for an overarching asset management system to be established and operated, it has to be deeply rooted and agreed upon within top management.

Based on the high level of experience within the organization there is great confidence in understanding what processes are most critical and providing most immediate payback. Because of this high level of experience, one gets the idea that systems are not needed. This might be true in a world where everything happens as expected, but in the real world conflicts are always present within teams and departments because of unexpected trends, failures and other unforeseen challenges. Even expected challenges will often spark some degree of conflict. This is why there should be an overarching system to make sure that all conflicts and arguments are challenged in a long-term perspective.

## **5.3.2 Leadership**

### **Leadership and Commitment**

#### *Positive trends:*

Top management has established main goals, critical success factors and a strategy document as a fundament for the management of assets. This is crucial for the alignment of organizational objectives and everyday priorities and decision-making. In addition, a performance contract containing personal goals including focus and improvement is set out for each team leader. Another positive trend is that top management focus on more systematic work and to constantly finding smarter solutions. Several engineers have recently been hired to better help team leaders plan and coordinate activities and improvement initiatives.

#### *Areas of improvement:*

First and foremost, there is a need for more follow-ups on the team leaders in the factory. Top management's thinking and organizing is very much in line with how ISO 55001 (2014) recommend, but they fail to multiply this thinking and culture to the team leaders. There is currently great distance in focus and thinking between directors and team leaders, which results in teams mostly governed by each team leaders own preferences. Personal performance contracts and team performance contracts are great starting points, but without systematic governance and follow-ups to team leader's personal goals and to team objectives, they are of little use. There should be regular dialogue with each team leader focusing on a systematic approach to how this team can continually improve their processes and set goals and plans that best serve the main objectives of the company.

Another area with high potential of improvement is the cooperation between departments. Instead of trying to understand each other's worlds and intentions, the focus has mostly been on defending its own ways of doing things. Top management should better facilitate collaboration among team leaders in various departments.

### **Policy**

#### *Positive trends:*

The critical success factors found in the booklet "Hovedmål 2014" (Kverneland Group Operations Norway, 2014) can be viewed as the organization's policy. They are based on the overall objectives, and set the basis for smaller asset objectives. They are available to everyone, and are being continually worked on and updated. These are all very positive elements, and therefore there should probably be even more focus on communicating this policy to the team leaders within the organization.



*Areas of improvement:*

Although there is consensus to the policy established, there is far from consensus on how to approach this policy. For instance, there is great disagreement among top management to what will cause the lowest level of labor cost. Some say outsourcing of labor is most effective, while others argue that more hiring will be the most cost-effective solution. In order for directors to come to agreement on how to approach the policy, one must improve in the documentation of arguments. This way the communication will have a degree of being evidence-based instead of opinion-based. As for this example there should be an analysis in place including risks and opportunities for both alternatives, were both parties can come to a conclusion based on documented facts, and not just mere assumptions.

### **Organizational Roles, Responsibilities and Authorities**

*Positive trends:*

Just recently an updated organization map for this organization has been introduced. This map gives an overview of the whole enterprise with all directors and team leaders represented, which allows good control to who is the leader for each team and the responsibility attached to each team. This is an important map, and should be available and orderly presented to every single employee and stakeholder.

*Areas of improvement:*

Personal job descriptions should be better documented and followed-up. Flexibility rather than rigid roles is of course positive, but one need to ensure greater documentation, implementation and reporting of each employee's responsibilities and tasks by having more defined roles. Right now, this is a process being worked on, and top management should ensure that this process is finalized and implemented in every single team. For instance a false fire alarm was recently triggered and exposed why responsibilities and duties should be better documented and understood. This alarm resulted in high degree of confusion at the area of evacuation management. If one does not have clearly defined roles and responsibilities, there will also be a lack of ability to identify who is responsible for what went wrong. This way, there will be no basis for improvement, and unless one define these roles and responsibilities, the exact same confusion will reoccur next time a false fire alarm is triggered.

### 5.3.3 Planning

#### Actions to Address Risks and Opportunities for the Asset Management System

##### *Positive trends:*

The entire machine park of this organization was given a risk assessment a few years ago. Unique parts and equipment were surveyed, the operational and economical criticality was assessed, and consequences for the operation, safety and environment were identified. For the production department this resulted in regularly updated TOP10 and TOP40, which are list of the most critical plants. Another positive trend is the on-going back-up analysis of every single plant done in order to reveal risk magnitude in case of failure. The results of this analysis will be an extensive mapping, and if needed, implementation of effective preventive actions to minimize the risk magnitude. This is an important initiative, and top management should ensure that this is followed through.

##### *Areas of improvement:*

The average level of experience within this organization is considered very high. Employees tend to stick around. This has lead to an experience-based culture were high trust is placed on each individual to best figure out how to proceed in order to achieve objectives. This may lead to situations were unfamiliar opportunities and threats are overlooked in the absence of encouragement and routines needed to keep searching. Future threats and opportunities can be found in the strategy document, but only at the overarching organizational level. Threats and opportunities within each department are not clearly written down. This means that there exist no risk pictures as basis when setting internal long-term strategies. This again may lead to team leaders finding themselves in a position of fighting each other rather than cooperating, which again will cause frustration and fronts. There should also be more distinct frameworks and procedures on how the process of life cycle analyzes and risk assessments are to be performed. Assessments are in place, but the documentation is either superficial or absent. There have also been incidents were recommendations have been presented and without being followed up. There is a possibility this will be improved if one can demonstrate the reason behind a recommendation. One also needs to tighten the focus on implementation of preventive measures.

#### Asset Management Objectives

##### *Positive trends:*

As explained in chapter 5.3.1, the strategy document includes a section were all department leaders explain future areas of focus for their respective departments. This seems to be the first attempt of setting asset management objectives as a link between organizational objectives and every-day decision-making and activities. It is very important that this section ends up with specific and measurable asset management objectives, and not just further focus. As an example there should be a goal to reach 4% unexpected downtime for a specific plant

instead of a goal of “as low as possible”. This process should also include every team leader in setting concrete and measurable goals for their respectable teams.

*Areas of improvement:*

Top management has been thorough in the setting of organizational objectives, but within the departments and teams there is a certain lack of clear, strategic and measurable asset management objectives being monitored and analyzed regularly. Only one out of several team leaders were able to come up with such asset management objectives existing within their teams. It is very important that both the asset management objectives and the results for each team are documented. Only this way one will be able to ensure that every single team is heading in the same direction and working together in reaching the overall objectives set by top management. The documentation of asset management objectives will also be a motivation factor for continuous improvement within each single team. Today team leaders admit regular failure in routines, but fail to recognize opportunities to prevent this from happening yet again. By setting the right asset management objectives, teams will be more motivated to improve such failures. These asset management objectives should be able to find on the info-boards together with continually updated indicators.

### **Planning to achieve asset management objectives**

*This clause is mostly about how to create structured plans to achieve the specific objectives that have been set. Since it is not common practice in KGON to work towards specific asset management objectives, I rather presented a question focusing on how activities and projects are planned before execution is taking place.*

*Positive trends:*

As pointed out earlier in this chapter, there has been developed a TOP40 list of most critical plants based on the impact on the overall economic picture. Further on, a daily routine is held to ensure that the most optimal mix of orders is established considering each production joint. Based on this mix one knows which plant is most critical in achieving success and also the interdependence between each production joint. This is communicated to teams by having team meetings at the info-tables twice a week to inform about changes and fresh priority lists. Onix, which is a data portal for maintenance, equipment and personnel, is used to create work orders as well as the reporting and documentation of such work orders. New hires are in place to ensure better structure and planning of maintenance through this data portal.

*Areas of improvement:*

First of all, there should be made asset management objectives for each team, and then there should be made asset management plans including resources, methods, who is responsible, when it will be completed and actions to identify and treat risk and opportunities. Apart from that, there seem to be great potential for improvement in the planning stages. The high level of experience and routine held among the company employees is a strength, but it can also be

a stumbling block for non-routine jobs and activities. It turns out that these non-routine work orders are prepared without identifying and mapping the significance of risks and opportunities and how this should be treated. There is no doubt that contingency planning for non-routine jobs should be given more focus in the planning phase. See “3.5.6 Risk and Review” for how to best practice risk management.

### **5.3.4 Support**

#### **Resources**

##### *Positive trends:*

Some of the teams in production update the mix of orders weekly to best suit resources available. A routine capacity- and resource analysis is done to minimize any gaps between required and available resources. This way it is possible to check in advance if there are any deviations from what is requested, which again results in the mix either being approved or changed. This is of course based on flexibility from dealers and customers, and some times changing the mix is not preferred, and initiatives like extra shifts will be scheduled to resolve any discrepancies.

##### *Areas of improvement:*

Poor resource planning can be considered a result of not having documented asset management objectives and action plans. Since this factory does not have documented asset management objectives and action plans, one should assume a short-term perspective with no basis for identifying human, equipment and facility needs. Apart from the resource analysis done for routine production, this seems to be the situation at this factory. Main reasons for this is attitude and lack of competence among project managers. This attitude is expressed in two ways. The first is the acceptance of gaps, that there will always be gaps in this area. The second is the confidence in own abilities to deal with the nonconformities when they occur, that all nonconformities can be fixed. This may not look like a challenge in a short-term perspective, but certainly is for a long-term perspective.

#### **Competence**

##### *Positive trends:*

The HR department has established an organization-wide ‘request to recruit’ - program, which means that all external and internal recruitment has to be guided and documented through the HR department. There will be a thorough review of candidates to ensure that necessary education, training and/or experience are tested against specific demands. Also, an effort to identify any competence gap has taken place. It is positive that the company acknowledges that a competence gap exist, and that this gap to some extent will always be

relevant because of constantly change in competence demands. This shows a proactive attitude. One recent initiative from the HR department is an onboarding project to ensure better training of new hires. There will then be a check after 3 and 6 months to map the gap against required competency requirements. This way, one will be in a position to secure and take action if needed to ensure that further necessary competence is achieved. This will also give an opportunity to evaluate the effectiveness of the training provided in each team.

#### *Areas of improvement:*

There is great potential for improvement in the area of follow-up. Ground personnel and team leaders are invited to attend independent single courses, but are not regularly followed up to ensure that their roles and competencies are constantly challenged and developed. In fact, many present team leaders have been hired internally as former operators without a plan to ensure satisfying competence level in leadership. A recurring theme is that several of these team leaders spend too much time in doing the operator's job instead of delegating responsibility and activities to the actual operators within the team. To have this shift of team leaders focusing on training staff and preparing asset management objectives and action plans for achieving the goals, there is a need for a higher level of leadership competence. Another challenge is the variation of quality and relevance for each written job description. Some were able to memorize parts of their job descriptions, while others could not remember having a good description reflecting their actual responsibilities and duties attached to the role. This makes the job of mapping any competency gaps very hard and imprecise. One does not have adequate documentation of future needs and requirements to be held as standard for the mapping. Especially for team leaders and directors, it is important to spend time to regularly review the job description. This will ensure maximum performance within the factory because wanted skills and focuses are secured in any leadership roles.

#### **Awareness**

*This clause is mostly about the awareness of requirements and contribution to an asset management system. Since KGON does not have any references to the name "asset management system", it was more interesting to ask a question to check awareness to the big picture, and understanding of contribution to achievement.*

#### *Positive trends:*

First of all, several critical success factors found in the policy where mentioned by many as important focus areas on the way to success. Some of the leaders mentioned communication and collaboration between teams as important, which is showing a willingness to be exposed to more involvement and risk in pursuit of better evaluations, decision-making and resource planning.

### *Areas of improvement:*

It is a positive trend that leaders point to main objectives, and even mention the optimization of processes. Still, the potential for improvement has to be even more strategic and specific. Every single team should know what specific actions, processes, investments, routines and asset management objectives should be in place the next period for the team to best contribute to the organization succeeding on the main objectives. There should then be continually updated KPI's in place and linked to the asset management objectives.

## **Communication**

### *Positive trends:*

In the area of communication there are many good practices mostly developed through experience. Employees know the business and staff well, which contributes to some sort of order in terms of communication. One communication tool used to some degree today is the information board communicating information visible for each and every team to see. These boards have plenty of potential, but there has to be some guidelines to the quality and presentation of the information.

### *Areas of improvement:*

What should be put in place, is an overall and authoritative guide for communication lines that specifies *what, when, how, and who* should be communicated to. Too often shortcuts or detours are taken in regards to important lines of communication. If a possible conflict can be avoided by doing so and so, many will be tempted to that, often to face an even bigger problem down the road. From the interviews it was revealed that operators and team leaders tend to exclude or even hold back information from the leader in charge in order to avoid disagreements. Also decisions may be taken without making sure that all the parties involved have been contacted. It also happens that information does not reach out to those being affected by decisions, whether being e-mails not being sent to all parties involved, or finalized maintenance work not reported to the production manager.

## **Information Requirements**

### *Positive trends:*

When speaking of how, when and what information should be collected, analyzed and evaluated, there has just recently been hired some engineers working to systematize this better. One great focus is to make sure that reporting programs such as ONIX are understood and used by everyone. If a genuine and thorough reporting is in place, this will help make information more accessible and also increases the quality and availability of information as a foundation for decisions.

*Areas of improvement:*

The challenge is to convince every single employee to use the system, which is a big challenge. It will require stamina and a lot of *whys*. There will be reluctance from many to give a genuine evaluation because one does not want to expose personal errors. This will also mean there is a threat of low willingness to cooperate on reporting and thoroughness in collecting information. The challenge is to develop satisfactory dialogue with operators and team leaders where all parties understand why this is to be done and what can be achieved by getting this right. It is also very important to evaluate the reporting documents on a regular basis; Are they too standardized? Are they capable of revealing what really happened? And so forth.

## **Documented Information**

*Positive trends:*

Legal and regulatory requirements both in the financial and non-financial work (such as cranes and heat exposed work) are identified and documented adequately. Frequent sampling is in place to test if the routines are satisfactory. Especially in finance there are great practices for storing and protecting documents, in addition to mature procedures on how one are to treat confidentiality.

*Areas of improvement:*

When looking at the internal documentation in the organization, there is an evident potential for improvement. Although this is a present focus area, there is still no consensus on how work should be documented in Onix. There is also a lack of control in ensuring that operators submit information that is approved, accurate, and up to date. One must have controls in place to ensure that all work is documented, and that the correct information like errors and cause is documented. What may happen as a worst-case result of documentation not being in place is that the operator sent to perform periodic maintenance to one specific machine arrives only to discover that this machine has been removed. It also occurs that operator errors are documented as another type of error as a cover up attempt. If this is successful, one might end up doing costly and demanding actions without achieving anything, only the sabotage of preventing it from happening again in the future.

### **5.3.5 Operation**

#### **Operational planning and control**

##### *Positive trends:*

This organization has done a satisfying job with organization and structure of teams in recent years, and now everyone should be able to understand who is responsible for the ordinary operation and maintenance. Every process and every operator is subjected to a team leader who at all times is responsible for what is to take place within this team. In addition, there has been done a good job of ensuring good procedures for documentation of procurement, quality and assembly, which in turn ensures that the quality and legal requirements are satisfied. One example is the requirement to submit a test piece for each product together with the certification of quality coming from the Lab. (Note that this specific document should not be confused with the documentation of communication described in the previous clause.)

##### *Areas of improvement:*

Part of what prevents the best balance between *cost*, *risk* and *performance* in operational planning and control is the lack of resources and systems being too vulnerable. There is too often placed low priority to the planning for maintenance and projects to ensure systematic and methodical processes. Instead of systematic planning and doing things properly one end up with quick fixes. This seems to be amplified when processes are being made more complicated than necessary. Advanced technical solutions are implemented in the pursuit of better optimization of processes, but such solutions most often produce a higher risk of unforeseen downtime as a result of shortages in resource and expertise.

#### **Management of Change**

##### *Positive trends:*

This organization is continually improving in evaluating *planned* changes and to ensure compensating measures prior to implementation. One example is the handling of orders changing on a regular basis both in terms of size and composition. A checklist including parts availability and capacity of plants has been created and is being reviewed in relation to every single mix of plows before confirmation is sent to customers. This checklist has helped in strengthen the on-time delivery, which is one of the main goals of the organization. Another example is the handling of new technologies and systems. Team leaders mentioned several examples were new technology is first tested on a small part of the system in order to collect valuable feedback on the potential for further development before implementation to the whole system.



### *Areas of improvement:*

Even though there is continual improvement in the evaluation of planned changes, this does not seem to be the case of *unplanned* changes prior to implementation. The demand for products is constantly changing, and is often difficult to predict. Nevertheless, one should always want to be one step ahead and strive to detect threats and opportunities of decisions about to be made, which is best done by asking strategic questions like; “How do we operate if current demand fails?” Are we immediately cutting costs at all levels of the organization in order to "save" the next period, or do we first evaluate how these immediate cost reductions will affect the plant's competitiveness in the long term. At present time, this organization seem to be most concerned on cutting costs to come out with decent short-term results. By doing evaluations like this one will be in a better position to make on reasoned decisions and not to fall for short-term demands.

### **Outsourcing**

This organization do have some outsources processes, and outsourcing procedures in case of breakdown. Still, this is a unique organization with almost all its production gathered under the same roof. There are proud traditions of steel going in at one end, and plows coming out the other end. Because of this, the interviewee chose not to focus on outsourcing during the interviews.

### **5.3.6 Performance Evaluation**

#### **Monitoring, Measurement, Analysis and Evaluation**

##### *Positive trends:*

There is an increased focus on operational efficiency among top management. The drivers behind the results are given more focus. As for production there is increased focus on ‘overall equipment effectiveness’(OEE) measurements, which is a method of measuring the efficiency in percent of maximum production capacity, which again provides a better basis for evaluation.

Weekly and monthly reports are to some extent prepared and presented at the info boards strategically placed in production sites.

There is also increased focus on finding root causes and the following initiatives for improvement. For instance, low flexibility among operators was found to be one of the reasons to high wage costs. Cross-functional initiatives between operators and team leaders have resulted in more flexible operators and better communication among team leaders, which again has led to more similar fluctuations between wage cost and production.

##### *Areas of improvement:*

In the subject of performance indicators and comprehensive presentation of these indicators, there is an immediate need for improvements. This organization is in the very beginning of collecting measurements and evaluating effectiveness of preventive maintenance among others. Some key performance indicators are currently being developed and presented at information boards in the maintenance and invest department (which is a positive initiative). In order to reach an adequate level, one should first ensure consensus, cooperation and distinct communication between maintenance and production department on what, how, the frequency, documentation and reporting of measures. Then a strategic plan should be developed and implemented based on these agreements.

There is also great potential in the operator based monitoring and measurement, but in order to improve in this area there has to be clear guidelines and instructions available to every operator in order for them to know what to be done and when. These instructions need to be crystal clear, self-explanatory and visual at plants and machines. There will also have to be a change of culture among operators. Today operators (and even team leaders) tend to overlook already existing checklists by ticking the boxes without controlling. One need to get rid of this type of culture in order to obtain genuine measurements, and the first step should be to explain *the why* behind the what. It is crucial that team leaders first, and then operators, understand the importance of collecting and reporting on measurements regularly.

## **Internal Audit**

*This clause is all about making internal audits to check the fulfillment of both internal organizational requirements and the requirements from ISO 55001 (2014) concerning the success of implementation and maintenance of the asset management system. Since this organization does not have any reference to an asset management system, the focus in this clause is mainly internal audits within the company.*

### *Positive trends:*

The only positive finding with the process of internal audits within this company is the fact that they are conducted. These audits are done to check whether nonconformities found in external audits are improved or not. The improvements coming from these audits are usually improved awareness, quick fixes and minor tweaks.

### *Areas of improvement:*

Unlike external audits, the internal audits gain very little authority within the organization, and fail to be rooted in management. The biggest hinder is that internal audits do not pose a risk of losing certifications or immediate shutdown of plants or processes. The negative consequences of internal audits are not immediately visual, but will make a stronger appearance in the long run. It is therefore important that top management stands united behind these internal audits with clearly defined criteria, scope, intervals, reports and objectivity. It is also important that the results of internal audits are taken as seriously as external audits, and that each team leader commits to delve into such audits and do necessary analyzes and initiatives afterwards.

## **Management Review**

### *Positive trends:*

KGON's internal strategy document "Business Plan 2015-2020" (Kverneland Group Operations Norway, 2015) includes an overall analysis with both external and internal issues concluded as a SWOT-analysis. A risk-picture is presented, and should be reviewed and updated each year. This analysis is held as basis for the long-term action plans for each department.

### *Areas of improvement:*

There is no tangible review or report on present condition and trends in nonconformities and corrective actions to each facility, routine activity, process, etc., It has been asked for, and for some facilities there is a trial system in place grading the overall condition and performance from 1 to 5.

### **5.3.7 Improvement**

#### **Nonconformity and Corrective Action**

##### *Positive trends:*

In order to create adequate systems and methods for the detection of root causes and improvement initiatives when nonconformity or incident occur, both production- and maintenance analysts have been hired recently. Further on, whoever is facing a problem must set aside time to do a documented evaluation based on these methods. This is a positive step, but the hiring itself will not be the final solution. These analysts need to create adequate methods, which need to be prioritized and followed up wholeheartedly to achieve any improvements. One important step is therefore to explain the *why* behind all this “extra work” Also, the quality team regularly works with initiatives to minimize nonconformities on products.

##### *Areas of improvement:*

There exist a strong culture of dealing with the problems as they occur. It is admitted that familiar mistakes, errors and nonconformities occur regularly, but as long as one manage to fix the error or quickly track down missing parts, one should be satisfied and proceed. It is a known problem that the same error or nonconformity occurs again and again, but without any systems in place to build on previous experiences. Corrective measures are only made when there is a big problem, which seems to apply to most areas of business.

If great methods and a systematic process of preventing repetitive nonconformities are established, it is very important that top management are involved and regularly check if these processes are followed through. They also need to communicate the importance and benefits of such processes, and ensure that genuine root cause analyses are prepared.

One more challenge is that when great initiatives are promoted, they tend to float on to nowhere without anyone making sure it is implemented. Therefore such initiatives must be clear on who is responsible, how progress will be secured and when this should be documented. There should also be a proper database where description of initiative and documentation of progress can be stored and presented in a proper way.

#### **Preventive Action**

##### *Positive trends:*

Due to an aging machine park and constant flow of corrective jobs, it has proven difficult to prioritize preventive maintenance. Corrective action always seem to get in the way, but what is positive is that this organization seem to utilize this period of failing market as an opportunity to reduce this gap by making 3 shifts maintenance when production only runs 2 shifts.

In terms of machine availability there is a struggle with the availability of several critical facilities. The attention to preventive maintenance from top management is increasing, which is proven in the hiring of analysts to strengthen the work on preventive maintenance.

*Areas of improvement:*

First of all, one must become much better at maintenance specifications when purchasing, and retrieval of information from plants during production. As an example one should conduct a more thorough assessment on the option of systems with automatic measurements before purchasing. Operators should also have a greater role in gathering performance measurements. Since operators often prefer corrective jobs rather than preventive jobs, supervision and motivation to preventive work should come from the team leader. Secondly, it is a challenge that implementation of preventive action often is not carried out even if the results from the evaluation of information available shows that it should be done. The reason for this is often that corrective actions are given higher priority, leaving no time for already planned preventive actions.

## **Continual Improvement**

*Positive trends:*

Top management is aware of the importance of continual improvements. More recently, there has been some organization wide initiatives, such as internal 5S certification focusing on what should be kept, where it should be stored, and how. Such initiatives have resulted in improved efficiency and security, but need to continually improve. Such initiatives should not be motivated by certificates, but by the opportunity to improve in itself.

Also, some team leaders have created a culture within their teams where new ideas and initiatives are continually being proposed from their operators. These operators are motivated by the influence they make and by the responsibility given. These team leaders can show for better solutions and several improvements as a result of operators participating in continual improvement.

*Areas of improvement:*

Although top management is aware of the importance of continual improvements, there seem to be little expectations and active communication with team leaders in this area. Mostly it is the team leaders personal preferences and focus on continual improvement that decide, and not the top management's viewpoint. Some team leaders embrace the potential, while others look at continual improvement as just doing what is done better. Some even believe maximum potential is reached within their teams. There will always be great potential for improvement, and this organization should be more actively seeking opportunities, new knowledge, new technology, new methods and new techniques, and this has to be more rooted in top management. As a start, top management could be more strategic in ensuring that every team leader participates in relevant networks and professional bodies.

## Chapter 6 - Main Findings



Figure 20 – (Oldinsuranceguys, n.d.)

### 6.1 Strengths

#### 6.1.1 Context of the organization

The internal business plan found within this organization has a 5-year focus and show a good understanding of internal and external context, stakeholders and needs, trend- and SWOT-analysis, and how the strategy should be made to achieve success. One important factor in achieving success is also for top management to admit that everything is not as it should be. This way new and different thoughts, methods, and directions will have a chance. This factor seems to be found in this organization.

#### 6.1.2 Alignment part 1

Based on the business plan, top management has established a good fundament for the management of assets by creating a booklet including main organizational objectives and critical success factors. This booklet is regularly updated and available to every manager within the organization. Every department leader is also obliged to write 5-year focus for their respective departments. These documents and objectives have only been available the last couple of years, and a culture of improvements to make them even more thorough and cross-functional should of course be in place. As for the alignment of everyday tasks to the Organizational Strategic Plan, these documents and methods constitute a proper fundament in the achievement of this.

### **6.1.3 Quality**

This organization has a good focus on quality. Areas such as procurement and assembly have good procedures for documentation, and improvement initiatives like the 5S-programme are given high authority from top management. User surveys and routine checks are established to maintain and document the quality standards and user satisfaction. This organization obtains an ISO 9001 certification for quality management. As explained in “4.2 structure” all ISO management standards are now revised to follow equal terminology and layout, which helps organizations in understanding terminology and layout used in ISO 55000 suite.

### **6.1.4 Organizational structure**

An updated organizational map was recently created in order to better present an overview of the entire enterprise with its teams, leaders, and accompanying relations and responsibilities. This map should be available and orderly presented to every single employee and stakeholder. This will help every single team and person within the organization acknowledge that they are part of a bigger picture, which again strengthens internal collaboration, communication and information flow.

## **6.2 Weaknesses**

### **6.2.1 Alignment part 2**

It might seem strange to highlight the area of “Alignment” as both a strength and weakness. The author has chosen to divide this area into part 1 and part 2 in order to better explain it. While part 1 is about top management’s effort to establish proper documents and methods for organizational goals and long-term strategy, part 2 is about aligning these objectives and strategies to every activity and process within the organization. This second part has major potential for improvement.

First of all, several team leaders were unable to mention the six main objectives set for this organization the last year, and did not recognize the booklet where these main objectives were presented. It is top management’s responsibility to make sure both the strategy document and main objectives are continually read and understood by middle management. It must be available at each single team leader’s desk. One consequence of not aligning middle management with overall strategy is often teams having different focus and cultures based on chance and each team leader’s own preferences.

The purpose of a strategy document is not the document itself, but rather strategic decisions and actions as a result of the document. The second part of alignment should be of very high priority. Only one out of several team leaders were able to come up with specific asset management objectives existing within their teams. There is lack of clear, strategic and

measurable asset management objectives (work environment, delivery, sick leave, improvement initiatives, competence level, etc.) being monitored and analyzed regularly within the teams. These asset management objectives need to be SMART, and very clear on who is responsible, how progress will be secured and when this should be documented.

### **6.2.2 Leadership**

Leadership skills are not given as high value as it should within this organization. First and foremost, there is a need for more follow-ups on team leaders in the factory. Several team leaders have been hired internally from being former operators, but there has been no plan on how to ensure adequate leadership competence and practice. The leadership title in itself is not adequate, and one should never think that a leader would educate and motivate himself/herself on his/her own. What is most likely to happen, is that the team leaders will be doing the same work as the rest of the team, just harder. Instead, team leaders should focus on training and motivating staff, preparing asset management objectives and plans, and create awareness and cross-functional collaboration.

Top management need to spend more time on middle management. There is a need for regular dialogue with each team leader focusing on a systematic approach to how each team can continually improve their processes and set goals and plans that best serve the main objectives of the company. Each team leader need to better understand the strategy so that middle management does not end up being a busy garage of asset management initiatives. Managers need to have a clear understanding and awareness of asset planning, acquisitions and development projects, and in-service asset management. Leadership skills should be of equal importance for middle managers as for top management, and should be ensured by top management.

### **6.2.3 Documentation**

Documentation is an area providing strong opinions. A typical comment would be: “Why should we spend all this time on documentation? No wonder we have such high cost levels.” Most often the reason for statements like these are lack of understanding. Therefore rule number one in terms of documentation should be to ensure that everyone involved understand the *why* behind the *what*, and what can be achieved by getting the documentation right.

Documentation is crucial for direction, decision-making and improvements. It is very important for top management to understand the potential in this. It should not be done just to obtain a certificate in quality management, but it should be done from a culture of continually trying to improve. Except for quality management, there is a tendency to make decisions based on assumptions and shortcuts instead of evidence-based documentation. Checklists and documentation requirements are not satisfactory or simply absent when decisions are to be made. When in addition support and time is marginal, too often decisions end up being based on the experience and insight of the one person.



Job descriptions need to be relevant and better documented explaining competency needs and responsibilities. One does not have adequate documentation of future needs and requirements to be held as standard for the mapping of any competency gaps. If one does not have clearly defined roles and responsibilities, there will also be a lack of ability to identify who is responsible for what went wrong. This way there will be no basis for improvement, and unless one define these roles and responsibilities, the exact same confusion will reoccur.

Policy, asset management objectives, asset management plans, and framework for risk assessment and life cycle analyses need to be documented and easy to follow. This way each person within the organization will have a better understanding and tools on where to focus and how to get there. Following this, there is also a need for better controls to ensure appropriate submission of information that is approved, accurate, and up to date. There will very often be reluctance from many to give a genuine evaluation because one does not want to expose personal errors or simply do not understand the value of doing so. It is also very important to evaluate the reporting documents on a regular basis; Are they too standardized? Are they capable of revealing what really happened? Etc.

#### **6.2.4 Short-termism**

Since this organization seems to lack documented asset management objectives and action plans, one should assume a short-term perspective with no basis for identifying human, equipment and facility needs. Every single team should have specific, documented and visual asset management objectives and action plans for the next periods in order for the team to best contribute to the organization succeeding on the main objectives.

In a time of failing markets, focus seems to be towards cutting costs and stalling investments in the pursuit of positive result for the next period. Instead of just spending less and end up in a position being unprepared for future positive trends, one should instead focus on doing smarter, more strategic spending. Reasoned decisions need to be made by first identify and evaluate future threats and opportunities. A side effect of the absence of documented decision-making processes tends to be assumptions and shortcuts. Checklists and documentation requirements are not satisfactory or simply absent when decisions are to be made. When in addition support and time is marginal, too often decisions end up being based on the experience and insight of the one person

There is a strong culture and confidence in own abilities to deal with the nonconformities when as they occur. This may not look like a challenge in a short-term perspective, rather a strength of having a skilled and solution-oriented work force. But in a long-term perspective this is not a preferred culture. Instead of systematic planning and doing things properly one end up with quick fixes.

Based on a high level of experience within the organization, together with the TOP10 and TOP40 lists of critical plants, there is great confidence in own judgment and ability. This might be sufficient in a world where everything happens as expected, but in the real world conflicts are always present within teams and departments because of unexpected trends, failures and other unforeseen challenges. Even expected challenges will often spark some degree of conflict. This is why there should be an overarching system in place to make sure that all conflicts and arguments are challenged in a long-term perspective.



realization of value? In the author's opinion, this organization is now at a crossroad where crucial decisions will be made, and where foundation will be set for how the future will look like. Senior managers under pressure from stakeholders often tend to aim their focus on short-term objectives instead of planning for the future, and the senior managers of KGON are now under a lot of pressure.

The second area of scope was to conduct a literature study on the subject of asset management including the main ideas and fundamentals. For the introduction and further work with an asset management system, all parties involved should have a basic understanding of the scope of asset management and what is meant by key terms such as assets, alignment, whole-life management, etc. Hastings (2010, p.2) states that "the broader, holistic view of asset management has been a relatively neglected area in terms of general education and training", and therefore the author hopes that this overview of the subject will provide a better understanding to the readers. Main findings in this overview include an understanding of:

- 'Assets' as something with potential or actual value to an organization. This goes beyond physical assets and should also include intangibles such as human intellect, technology and brand.
- 'Asset management' as optimal decision-making and value creation by balancing cost, risk and opportunity with a clear line of sight between organizational objectives and everyday activities and processes.

The third area of scope was to include an unpacking of the new ISO 55000 suite, which is the first official standard in the subject of asset management and is based on its forerunner, the PAS 55. First of all, this standard differs in the way that compliance should not be considered the goal for any organization. Continual improvement is a very important principle, and organizations should therefore never cross a finish line, but rather use these requirements as a starting point in achieving excellent asset management. This standard should therefore be viewed as a guide/help, not a target. Instead of asking 'what does it take?', we should rather ask 'how can this help us to better improve?'.

One of the key terms within asset management is 'alignment' (line of sight). What is meant with this term is the connection between the corporate long-term objectives and the everyday issues, activities and priorities. As expected, the author could not detect a system for such alignment within KGON, which should not be seen as shocking or immature. In fact, Woodhouse (2010b, p.27) argue that "...whereas many manufacturing industries have adopted a number of component methodologies and good practices, such as lean, total quality management (TQM) and total production maintenance (TPM), they often lack the overarching model or structure to connect corporate long-term value strategies with day-to-day issues, actions and priorities". This overarching model, the Asset Management System, is found in the ISO 55000 suite and should be able to help organizations obtain this line of sight and to "...direct, coordinate and control asset management activities" (ISO 55000, 2014, p.4).

This management system follows the new 'ISO Annex SL', a standardized template for terminology and layout, which includes the seven main elements:

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

These main elements are further divided into 24 specific clauses containing all the 71 requirements, or "shall statements". The author has taken time to unpack each clause in order to better understand context and important expressions like strategic asset management plan (SAMP), asset management objectives and asset management plans.

One remaining challenge is that factors like motivation and behavior have not yet been included within this system and will need to be managed outside this system. These are factors with potential of substantial influence to objectives. There is also no 'how-to's included and therefore application of requirements will need further studies to find adequate tools, techniques and guidance.

The fourth area of scope was to carry out an interview process with the purpose to detect both positive trends and areas of improvement for KGON to align with the ISO 55000 suite. The aim of this chapter is to conduct a review and detect both positive trends and areas of improvement for each clause found in the ISO 55000 suite. The author has conducted 14 interviews with contestants being department leaders or middle managers representing several departments and teams within KGON. By interviewing both top management and middle managers, the author was able to analyze the organizations alignment (line of sight) between overarching goals and weekly plans. Most questions were based on the author's interpretation of the requirements found in the ISO 55001 (2014). Instead of interpreting directly, a huge effort was made to catch the essence of the requirements. Therefore these results found during research cannot be used as a means of certification. Still, it will help KGON and similar industrial organizations to the awareness of internal strengths and weaknesses regarding asset management and this standard. The author justifies for this approach by the very important principle of not having compliance as the final goal. In order to obtain reliability and validity, each question was asked to more than one contestant in search for similar findings.

The goal of this thesis is to detect some major strength and weaknesses - “hot points” – between KGON and the requirements of ISO 55000 suite. The importance of doing so is found in the statement: “an initial review of the organization’s current processes against the requirements of ISO 55001 will determine the areas that need to be developed to support the functioning of a compliant asset management system” (ISO 55002, 2014, p.5). These hot points can further be used as a guide for KGON on where to start focusing in a future processes of leaning towards improved asset management. It is the author’s opinion that these objectives are achieved.

Main findings (hot points) are presented in “Chapter 6 – Main findings” and are as follows:

Strengths

- Context of the organization
- Alignment part 1
- Quality (and ISO 9001)
- Organizational Structure

Weaknesses

- Alignment part 2
- Documentation
- Leadership
- Short-Termism

## **7.2 Challenges Encountered**

There have been some challenges along the course of writing this thesis.

There were some familiarity with thinking and concepts within asset management coming from lectures and assignments, but all in all the author was not very familiar with the subject of asset management, and was in position of little knowledge prior to the study. During the study it became a challenge to find adequate variety of textbooks and articles to accomplish an overview on the subject. In the early stages, a lot of time was spent on reading and gaining basic knowledge. It was also a challenge to decompose and extract principles and requirements from the ISO 55000 suite.

Due to the limited scale of this thesis, generalizations and prioritizations had to be made in order to come through with satisfying results. The scope of this thesis turned out to be of a larger scale than expected. A study on both the subject of asset management and the ISO 55000 suite was demanding in addition to a qualitative research phase including 14 interviews.

One last challenge was met in the process of creating the question form and to decide who to interview, and how many. Several interviewees were also short on time, and the researcher had to focus on specific questions. It was also a big challenge to catch the essence of each clause, and to gain understanding of each single requirement. Because of time constraints, the researcher had to draw the big lines and create well-formulated questions able to provide adequate feedback.

### **7.3 Areas for Further Study**

This thesis is focused on finding positive trends and certain areas of improvement, what needs to be changed, and where to start. On the recommendation of ISO 55002 (2014, p.5) “an initial review of the organization’s current processes against the requirements of ISO 55001” has been achieved in a generalized matter. Still, the greatest challenge might still be unsolved, and that is to figure out how this organization should proceed in order to improve on these areas and better support the functioning of a compliant asset management system. This thesis should be able to provide basis for further studies in this field. So far there are a lot of identified what-to-do’s, but no identified how-to-do’s. Further studies should try to find techniques, tools and structures that will help manufacturing organizations improve.

Another area for further studies would be to identify existing structures, processes, systems, techniques, competence and tools and how the organization can better utilize what already exist for better value-creation. This could for example be better cross-functional collaboration and better integration of systems such as quality and risk.

This thesis does not provide a review based on every single requirement in the ISO 55001 (2014). For an organization already operating after asset management principles, a more thorough review could be conducted in order to help such organizations getting even further, and accomplish a higher level of improvement in every single area of the asset management system.

## Chapter 8 - Conclusion

The industry of agri-implements has experienced failing markets the last year, resulting in lower production and turnover than expected and organizational objectives being adjusted. This has led to more internal attention by top management and more focus on existing processes, which makes this period a very critical time for how the future will look like.

Senior managers, which are often under pressure from stakeholders, often tend to aim their focus on short-term objectives instead of planning for the future. Such periods reveal more than ever the need for an adequate overarching systems to safeguard long-term and holistic thinking.

According to ISO 55000 (2014), one can understand asset management as the optimal way of balancing costs, opportunities and risks towards achieving the organizational objectives and gain the best realization of value from each asset.

This study aims to contribute to the research of asset management within the manufacturing industry and should help create a basis for managers in the implementation of an asset management system and the requirements found in the ISO 55000 suite.

The purpose of this thesis is to map the current status of Kverneland Group's production facility at Klepp towards the requirements of the recently published ISO 55000 suite. The final results will be presented as positive trends and improvement potentials.

This study has aimed to contribute to the research of asset management, and help managers within the manufacturing industry to detect main focus areas in order to implement an asset management system based on the requirements found in the ISO 55000 suite. This has been done by first conducting a study on the subject of asset management, and then by identifying the scope, context and requirements of the ISO 55000 suite. Then, an interview process was conducted in order to map the current status of Kverneland Group's production facility at Klepp towards the requirements of the recently published ISO 55000 suite. The interview process was conducted with five department leaders and nine middle managers based on qualitative interviews. Answers were later analyzed, compared and amalgamated as positive trends and areas of improvements for each clause within the ISO 55000 suite.

It should be brought to the reader's attention that these results are subjective and based on the author's interpretation of both requirements and interview research. Also, the results coming from this study are not a guarantee for every single requirement and cannot be used as a means for certification. That was never the purpose of this thesis, rather to reveal main areas for the organization to give focus to. In other words, this thesis should work as a tool for



KGON and similar organizations as a kick-start and guideline towards better asset management.

It is important to understand that a certification toward the ISO 55000 suite should never be the goal of any organization. Continual improvement is a major area within the concept of asset management, and therefore organizations should never try to reach a certain level of satisfaction. This standard is created with the sole purpose of providing help and guidance towards better value-realization. Every organization wanting to align with asset management and the ISO 55000 suite need to first understand that the organization is not to serve this standard, it should rather be the standard serving the organization. Compliance with all the requirements should therefore be seen as a starting point, and not the finish line.

The author has made a thorough effort in translating the requirements (“shall do’s”) from the ISO 55001 (2014) and the answers provided during the interviews to align with the organization’s context. Still, it will help KGON and similar industrial organizations to the awareness of internal strengths and weaknesses regarding asset management and this standard.

This thesis has contributed to the understanding of Asset Management and the ISO 55000 suite. It has given insight to internal challenges and main areas of improvement within KGON, a land-based manufacturing organization with long tradition and a well-established culture.

As for further studies and progress, there are no “how to’s” attached to the requirements. The author has provided areas for improvement and some overall conclusions on how to approach, but no tools or techniques are given as guidance to the application of the requirements found in ISO 55001 (2014). It would have been interesting to see what effects implementation of such tools and techniques gives to the total realization of assets within this organization or similar organizations.

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## **Appendix A - Questions**

### **1. Context of the Organization**

#### **Understanding the organization and its context**

Q1: What should KGON focus on (direction) to achieve success over the next five years?

Q2: How do you ensure that all the secondary objectives within the teams are related to the major overarching goals, and where is this documented?

Q3: Can you mention some of the main objectives for KGON in 2014?

#### **Understanding the needs and expectations of stakeholders**

Q4: What must have been thought of/mapped before major decisions will be adopted?

Q5: What does the owners and customers of KGON expect?

Q6: What do stakeholders expect from your team? Is this written down clearly?

Q7: Are customer and user surveys in place to see how well expectations are met?

### **Asset Management System**

#### **Determining the scope of the AMS**

Q8: Do you have an overarching management system to ensure that all departments and organizational levels are coordinated in regard to the scope, direction and the understanding of why you do what you do?

Q9: When multiple jobs are requested without having enough resources, is there some kind of template/method to determine the priorities?

### **2. Leadership**

#### **Leadership and commitment**

Q10: As head of this department, what do you want your employees to be most focused on?

Q11: To what extent do you collaborate with your manager about both setting goals for the team and to measure the achievement of these?

Q12: When decisions are being considered, how is the culture of communicating with team leaders this might affect?

#### **Policy**

Q13: Is there a clear government policy as a backdrop for goals, decisions and behavior?

#### **Organizational roles, responsibilities and authorities**

Q14: Is it clearly defined who has authority and responsibility for key roles and functions within the teams? Where do I find this?

### **3. Planning**

#### **Actions to address risks and opportunities for the AMS**

Q15: Once the goals are agreed upon, which methods are in place to identify future threats and opportunities to the machine park and employees?

Q16: Are life cycle analysis and risk assessments conducted during the process of implementation and change? Are preventive actions executed based on such analysis?

#### **Asset management objectives**

Q17: What are some of the key objectives for your team? How is present status measured and presented?

#### **Planning to achieve asset management objectives**

Q18: Are there any plans on how jobs are to be performed and what is needed of resources, information and people?

Q19: Do you know at any time which machines, processes and plans that are most critical, and that have the greatest potential to affect the objectives?

### **4. Support**

#### **Resources**

Q20: When planning an activity, are available resources and deviations from what is needed being mapped? How is this resolved?

#### **Competence**

Q21: When roles and tasks are given, how are assessment of experience, competence, training and possible conflicts with other responsibilities and duties associated with this person secured?

Q22: What will be done to increase management skills to the team leaders?

Q23: Are necessary/required competence periodically being measured against current skills?

Q24: Have your role and your responsibilities been clearly communicated to you? What is it?

#### **Awareness**

Q25: What role and responsibility do your team have to help KGON succeed?

#### **Communication**

Q26: With projects, improvements, changes, etc. - How do manage what is to be communicated to whom, and how and when this is to be done?

#### **Information requirements**

Q27: Are there guidelines on how information will be treated in KGON?

#### **Documented information**

Q28: Do you have control of which documentation is required by different agencies, and how and how long this information must be protected and stored?

### **5. Operation**

#### **Operational planning and control**

Q29: Unplanned downtime happens quite often, which leads to delays in delivery. Why are you not able to put an end to this?



Q30: When a non-routine activity are to be executed, what must be agreed on before you set off? Is this being documented?

### **Management of change**

Q31: Do you perform an impact assessment for upcoming changes that may threaten the objectives (both planned and unplanned)?

## **6. Performance evaluation**

### **Monitoring, measurement, analysis and evaluation**

Q32: How is the focus on monitoring, measurement and analysis in the planning process – Is there an overall assessment of what, how and how often the measurement and analysis are to be conducted?

Q33: Do you have a plan on what is to be monitored and measured, and how often?

Q34: What methods are used in monitoring, measurements and analysis?

Q35: Do you have any indicators on how you are keeping up with the objectives?

### **Internal audit**

Q36: Is there internal audits at specified intervals?

Q37: What consequences usually comes from such internal audits?

### **Management review**

Q38: Can you show me a tangible report on the condition of each facility here at KGON?

Q39: Are you doing regular assessments/reviews of the suitability, adequacy and effectiveness in regards to assets, activities, plans, etc?

## **7. Improvement**

### **nonconformity and corrective action**

Q40: If the same deviation or error occurs several times, what is then done to prevent this from happening again?

### **Preventive action**

Q41: How important is focusing on preventive maintenance in relation to corrective maintenance?

### **Continual improvement**

Q42: Is there focus on continuous improvements, or is it good enough as long as it works? Is there any monitoring of trends in performance? Are corrective actions considered? Is there room for workers to propose suggestions and ideas?

Q43: Are you given the opportunities and resources to apply knowledge and increase competence?

## **Appendix B - Questions as Asked in Norwegian**

### **1. Context of the Organization**

#### **Understanding the organization and its context**

Q1: Hva bør KGON fokusere på (retning) for å oppnå suksess de neste 5 årene?

Q2: Hvordan sikrer dere at alle delmålene innad i teamene er knyttet mot de store overordnede målene, og hvor dokumenteres dette?

Q3: Klarer du å nevne noen av hovedmålene for KGON i 2014?

#### **Understanding the needs and expectations of stakeholders**

Q4: Hva må dere ha tenkt på/kartlagt før større avgjørelser blir vedtatt?

Q5: Hva forventer eiere og kunder av KGON?

Q6: Hva forventer interessenter (eierne, ledelsen, kunder) av ditt team? Er dette skrevet ned konkret og tydelig?

Q7: Gjøres det kunde- og bruker-undersøkelser og lignende for å se hvor godt forventninger møtes?

### **Asset Management System**

#### **Determining the scope of the AMS**

Q8: Har dere et overordnet styringssystem som sørger for at alle avdelinger og organisasjonsnivå er samkjørte hva gjelder omfanget, retningen OG FORSTÅElsen av hvorfor dere gjør det dere gjør?

Q9: Når flere jobber er etterspurt og en ikke har nok ressurser, hva er det som bestemmer prioriteringene? Finnes det en mal/metode?

### **2. Leadership**

#### **Leadership and commitment**

Q10: Som øverste leder for denne avdelingen, hva ønsker du at dine ansatte skal være mest fokusert på?

Q11: I hvilken grad samarbeider du med din leder om både å sette mål for teamet og å måle oppnåelse av disse?

Q12: Når avgjørelser blir vurdert, hvordan er kulturen for å kommunisere med andre teamledere dette kan påvirke?

#### **Policy**

Q13: Finnes det en klar og tydelig forvaltningspolitikk som er et bakteppe for målsetninger, avgjørelser og oppførsel

#### **Organizational roles, responsibilities and authorities**

Q14: Er det klart definert hvem som har ansvar og myndighet for viktige roller og funksjoner i teamene? Hvor finner jeg dette?

### **3. Planning**

#### **Actions to address risks and opportunities for the AMS**

Q15: Når målene er satt, hvilke metoder er på plass for å kartlegge fremtidige trusler og muligheter blant maskinpark og ansatte?

Q16: Når avgjørelser om implementering og endring skal vedtas, gjøres det livsløpsanalyse og risikovurderinger? Utføres preventive tiltak basert på slike analyser?

#### **Asset management objectives**

Q17: Kan du komme opp med et par av styringsmålene i ditt team? Hvordan måles og presenteres det hvordan dere ligger an?

#### **Planning to achieve asset management objectives**

Q18: Finnes det tydelige planer på hvordan jobbene skal utføres og hva som trengs av ressurser, informasjon og personer?

Q19: Vet dere til enhver tid hvilke maskiner, prosesser og planer som er mest kritiske, og som har størst potensialet til å påvirke målsetningene?

### **4. Support**

#### **Resources**

Q20: Under planlegging av en aktivitet, blir det kartlagt hvilke ressurser som er tilgjengelig og om det er avvik fra hva som trengs? Hvordan blir dette løst?

#### **Competence**

Q21: Når roller og oppgaver gis, hvordan sikres grundig vurdering av erfaring, kompetanse, trening og mulig konflikt med annet ansvar og oppgaver tilknyttet denne personen?

Q22: Hva bli gjort for å øke lederkompetansen til teamlederne?

Q23: Blir nødvendig/påkrevd kompetanse med jevne mellomrom målt opp mot dagens kompetanse?

Q24: Har du fått din rolle og ditt ansvar tydelig kommunisert? Hva er det?

#### **Awareness**

Q25: Hvilket ansvar og rolle har ditt team for å bidra til at KGON lykkes?

#### **Communication**

Q26: Ved prosjekter, forbedringer, endringer, ressurser, osv. – hvordan holder dere kontroll på hva som skal kommuniseres til hvem, og hvordan og når dette gjøres?

#### **Information requirements**

Q27: Finnes det retningslinjer for hvordan informasjon skal behandles i KGON?

#### **Documented information**

Q28: Har dere kontroll på hvilken dokumentasjon som kreves av forskjellige instanser, og hvordan og hvor lenge denne informasjonen må beskyttes og lagres?

## **5. Operation**

### **Operational planning and control**

Q29: Uforutsett nedetid skjer ganske ofte, noe som fører til forsinkelser på levering. Hvorfor klarer en ikke å få slutt på dette mener du?

Q30: Når en ikke-rutine aktivitet skal utføres, hva må dere bli enige om før dere setter igang? Blir dette dokumentert?

### **Management of change**

Q31: Gjør dere konsekvensutredning for kommende endringer som kan true målsetningene (både planlagte og ikke planlagte)?

## **6. Performance evaluation**

### **Monitoring, measurement, analysis and evaluation**

Q32: Hvordan er fokuset på overvåking, måling og analysemetoder i planleggingsprosessen - blir det gjort en helhetsvurdering av hva, hvordan og hvor ofte målinger og analyser skal gjennomføres?

Q33: Har dere en plan på hva som skal overvåkes og måles, og hvor ofte?

Q34: Hvilke metoder brukes til overvåking, måling og analyse?

Q35: Har dere noen indikatorer for hvordan dere ligger an i forhold til målene som er satt?

### **Internal audit**

Q36: Utføres det internrevisjon ved gitte intervaller?

Q37: Hvilke konsekvenser kommer vanligvis fra en slik internrevisjon?

### **Management review**

Q38: Klarer du å vise meg en håndfast rapport om tilstanden til hvert anlegg her på KGON?

Q39: Gjør dere faste vurderinger/gjennomganger av egnethet, tilstrekkelighet og effektivitet hva gjelder assets, aktiviteter, planer, osv?

## **7. Improvement**

### **nonconformity and corrective action**

Q40: Dersom samme avvik eller feil oppstår flere ganger, hva gjøres da helt konkret for å hindre at dette skjer igjen?

### **Preventive action**

Q41: Hvor viktig er fokus på forebyggende vedlikehold i forhold til korrektivt vedlikehold?

### **Continual improvement**

Q42: Er det fokus på stadig forbedring, eller er det godt nok så lenge det virker? Gjøres det overvåking av trender i ytelse? Gjøres korrigerende tiltak? Er det rom for arbeidere til å fremme forslag?

Q43: Blir det gitt mulighet og ressurser til å søke kunnskap og øke kompetansen?