Maintenance within Physical Asset Management

Janez Tomažin, Stockholm 2019
What are:
Terminology:
ISO 5500X – family standards,
EN 16646-1 and pr.EN 16646-2

Asset Management?
Physical Asset Management?
Maintenance?

What is Maintenance within Asset Management?

What is Asset System?
What is Asset Management System?
Examples of Asset Management standard


EN 16646-1: 2014 ”Maintenance within Physical Asset Management”

prEN 16646-2:”Maintenance within Physical Asset Management”. A framework for improving the value of physical assets through their whole life-cycle
Physical Asset Management

European Federation of National Maintenance Societies experts have preferred the following definition (EFNMS 2009):

“Physical Asset Management is the optimal life-cycle management of the physical assets to sustainably achieve the stated business objectives”.

European Federation of National Maintenance Societies vzw
## Who are we?

What are our Vision, Mission, Strategy
What are our objectives? What are our products?

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<td>Minutes, procedures</td>
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<td><strong>BoK „think tank“</strong></td>
<td>Alan Wilson (UK)</td>
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<td>Aline with EFNMS and ISO 55001, ISO15288, ISO 31000</td>
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<td>Maintenance within Asset Management</td>
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<td>(different lengths, audience)</td>
<td>Kari Komonen (Finland)</td>
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<tr>
<td><strong>Data management</strong></td>
<td>Danjan Maletič (Bosnia and Herzegovina)</td>
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<td>Ondřej Stejskal (Czech Republic)</td>
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<td>Activities at LinkedIn</td>
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<td>Ondřej Stejskal (Czech Republic)</td>
</tr>
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<td><strong>Sharing - connecting</strong></td>
<td>Paul Daugalis (Lithuania)</td>
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<td>Monthly newsletter website and Calendar, Awards</td>
<td>Paul Daugalis (Lithuania)</td>
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<tr>
<td><strong>Customer voice</strong></td>
<td>Giel Jurgens (Netherlands)</td>
</tr>
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<td>Customer orientation</td>
<td>Giel Jurgens (Netherlands)</td>
</tr>
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**EAMC Chairman**

Wout Theuws (Netherlands)

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**EFNMS**

European Federation of National Maintenance Societies vzw
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<th>Framework topics for messages</th>
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<td>1. Importance physical AM today (Why)</td>
<td>1. Turbulence in the business environment, increased requirements and more complex technical systems from ISO5500x and EN16646. The benefits of qualified asset management.</td>
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</tr>
<tr>
<td>2. What is Asset Management System?</td>
<td>2. The structure and main issues of ISO 55001. Asset hierarchy and its organisation specific applications. Specific features of each level</td>
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<tr>
<td>3. What is PAM (What)?</td>
<td>3. Differences between AM and PAM.</td>
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<td>4. What is maintenance within PAM?</td>
<td>4. The holistic picture of Physical asset management (prEN16646)</td>
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<tr>
<td>5. What are the internal and external influencing factors?</td>
<td>5. How technological and business environment influences PAM: schematic presentation (prEN16646-2)</td>
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<tr>
<td>6. The role of the maintenance function within organisations’ strategic planning process.</td>
<td>6. Stages of organisations’ strategic process and the role of maintenance at each of them (EN16646).</td>
<td></td>
</tr>
<tr>
<td>7. A path from strategic organisational plans to asset management and maintenance strategies</td>
<td>7. What is SAMP (ISO55002). Schematic path from organisations’ strategic plans to SAMP and maintenance strategies.</td>
<td></td>
</tr>
<tr>
<td>8. The role of life-cycle management as a main content of PAM</td>
<td>8. The main elements of Life Cycle Management (LCM). Description of LCM as a part of PAM.</td>
<td></td>
</tr>
</tbody>
</table>
## 2 Framework topics for messages

**Relationship between Maintenance and other processes**

1. What are the contents of life-cycle processes?
2. What are maintenance processes?
3. The contributions between the maintenance process and other life cycle processes
4. How to manage contributions between life cycle processes?
5. How to develop relationship between maintenance and other processes (maturity)?
6. Building up an effective asset management and maintenance management organisation

**Dedicated messages**

1. Describe life cycle processes: acquisition process, operation process, maintenance process, modernization process, disposal process, management process and supporting processes (EN16646).
2. Description of maintenance processes
3. List of contributions (information, instructions, actions etc,) between maintenance and other life cycle processes
4. Methods, procedures and organisations to improve contributions and cooperation between life cycle processes in theory and practice
5. How to measure maturity of cooperation and the level of ‘silo-behaviour’ and how to raise maturity level
6. Requirements from Asset Management System (ISO55001) Different organisational models (ISO55002), good procedures and principles to develop ‘non-silo behaviour’, information from practical cases prEN16646-2
## Framework topics for messages

<table>
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<tr>
<th>Life Cycle Management</th>
<th>Dedicated messages</th>
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<tbody>
<tr>
<td>1. What are the life cycle stages and life cycle activities?</td>
<td>1. Life cycle stages, PAM includes all the stages and not just maintenance, key activities of each stage (EN16646).</td>
</tr>
<tr>
<td>2. How to derive requirements for physical assets?</td>
<td>2. Key success factors a path to requirements, contributions of various asset systems to requirements, additional analyses (prEN16646-2 + Alans’ additional information)</td>
</tr>
<tr>
<td>3. How to choose the best option for the acquisition?</td>
<td>3. Fundamental approaches for choice: AHP, QFD, Kepner-Tregoe Decision Model</td>
</tr>
<tr>
<td>4. How to carry out effective decisions for acquisitions?</td>
<td>4. Economic indicators and their match to different situation, multi-goal approaches, the best fit circumstances for LCC/LCP approaches.</td>
</tr>
<tr>
<td>5. Life cycle costing</td>
<td>5. Elements of life cycle costing, uncertainty consideration with LCC, NPV and LCC/LCP, challenges with NPV-method (ISO 15663-2 and IEC 60300-3-3)</td>
</tr>
<tr>
<td>6. What are the triggers for life cycle activities during utilisation stage?</td>
<td>6. Description of five triggers (prEN16646-2)</td>
</tr>
<tr>
<td>7. Life cycle activities for each trigger</td>
<td>7. List of activities for each trigger with methodological examples -prEN16646-2</td>
</tr>
<tr>
<td>8. What are the tools for performance management?</td>
<td>8. Life cycle status monitoring, monitoring actual LCC, principle causes monitoring, key performance indicators, monitoring implementation of maintenance strategy</td>
</tr>
<tr>
<td>9. Monitoring the modes of operations</td>
<td>9. Monitoring maturity level and development</td>
</tr>
<tr>
<td>10. Auditing management systems</td>
<td>10. Purpose of auditing within asset management system, procedures; basics of risk management within asset management system. The main issue is the quality of life cycle management.</td>
</tr>
<tr>
<td>11. Continuous improvement</td>
<td>11. Main categories for improvement within life cycle management, summary of tools for improvement</td>
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## Asset management WORKSHOP

### The main chapters

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<th>Framework topics for messages</th>
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</table>
| **Sustainability in Maintenance management** | 1. Decision making criteria resulting in better sustainability  
2. The best practices within life cycle management to promote sustainability  
3. Circular economy at the acquisition and disposal stages  
4. The characteristics of the mature PAM | 1. The impact of technological and business environment on sustainable decision making.  
2. When the extension of useful life is an appropriate strategy  
3. The ideas of circular economy  
4. The significance of mature PAM in creation of sustainability in PAM and maintenance management |
EFNMS Asset Management Workshop

Workshop 2: Top management / Middle Management / Asset Owners in Asset Management Training

Physical Asset Management in front of fast changing business environment and new technological horizons

Over the last two decades, professional Asset Management has moved from being initially a financial discipline in the business world to a cross-functional process. Number of initiatives, open forums or methodologies has emerged to facilitate or promote the Asset Management importance to the business. The industry at large has had discussions on how to adapt the traditional Asset Management terminology, to cope with definitions and classifications within the corporate business models.

EFNMS with their vision of being “The International recognised source of innovation, leadership and excellence in the sector” for the last 15 years have dealt with the importance of the Asset Management for industrial applications. Hence the EFNMS established the EFNMS European Asset Management Committee with the objective to contribute to development of the global opinion on Asset Management principles and further promote the EFNMS mission throughout the European countries.

The National Maintenance Societies in the countries that have joined EFNMS have the privilege to use this training package that is already used by our members. The training material are also available to RMI to offer their members competence building and certifying in Physical Asset Management (PAM) competences.

The National Maintenance Sosocieties in the countries that have joined EFNMS have the privilege to use this training package that is already used by our members. The training material are also available to RMI to offer their members competence building and certifying in Physical Asset Management (PAM) competences.

In parallel, number of AAM standards has emerged for various engineering disciplines over the last years but without providing the whole components that would allow appraising the developed standards across industries. The workshop on "Overcoming the limitations of standards and how to create a sustainable framework" will discuss crucial aspects of how to create a sustainable framework for Maintenance within Physical Asset Management. ISO 55000, OHSAS 18001 Maintenance - Baseline Management. Personal care for the very useful, new, safe and cost effective tools.

Whether operating in stable or dynamic industry environments, all the business organisation are actually driven by the opportunities and threats of the market. The workshop on "Freeing the corporate management to exploit the market opportunities" will discuss on how to exploit the market opportunities in a smarter and more effective way.

The National Maintenance Societies have joined EFNMS because they are aware that their members have the duty and assistance of EFNMS to create awareness with them, and present the AAM concept to them.

Participants

The Job positions who should attend are:

- Asset Manager
- Maintenance Manager
- Production / Factory Managers
- Technical / Engineering Managers
- Site Managers
- Maintenance Coordinator
- Purchasing managers
- Facility managers
- Project Managers / Leaders
- General Managers

Workshop Content / Chapters

Maintenance within Asset Management

- Strategies between maintenance and other processes
- Maintenance process description - roles & responsibilities
- Life cycle management
- Life cycle evaluation
- Maintenance and investment decisions
- Reducing & Retirement strategies
- Innovations with auditable quality organisations
- Sustaining YouTube maintenance management
- Innovation and technology in maintenance
- Maintenance and sustainability
- The maintenance workshop in a day course as an open and interactive workshop with robust speakers.

The unique content of workshop is adaptable to fit your needs learning for in-service courses. The workshop content could be adapted to fit your needs learning for in-service courses. All include Asset Management for one day course with interactive workshops in groups.
Project 20: Maintenance Framework
Revision to Second Edition

October 2019
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<th>Name</th>
<th>Role</th>
<th>Country</th>
<th>Organization</th>
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<td>Pascoli</td>
<td>Jean-Pierre</td>
<td>Canada</td>
<td>PEMAC - Plant Engineering &amp; Maintenance Association of Canada</td>
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<tr>
<td>Shammasi</td>
<td>Nezar</td>
<td>Saudi Arabia</td>
<td>GSMR - Gulf Society for Maintenance &amp; Reliability</td>
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<td>Matsuda</td>
<td>Zensuke</td>
<td>Japan</td>
<td>JIPM - Japan Institute of Plant Maintenance</td>
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<tr>
<td>Tomažin</td>
<td>Janez</td>
<td>Slovenia</td>
<td>EFNMS (EAMC – European Asset Management Committee)</td>
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<tr>
<td>Wheeler</td>
<td>Rick</td>
<td>USA</td>
<td>SMRP - Society of Maintenance &amp; Reliability Professionals</td>
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<tr>
<td>Kohler</td>
<td>Peter</td>
<td>Australia</td>
<td>AMC - Asset Management Council</td>
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<tr>
<td>Al Ulaimi</td>
<td>Saad</td>
<td>Saudi Arabia</td>
<td>GSMR - Gulf Society for Maintenance &amp; Reliability</td>
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The development of asset management framework should provide the following benefits to the members of the GFMAM member societies (here only two from many quotes):

➢ common definitions relating to **Asset Management** and how **Maintenance** contributes to **Asset Management**;

➢ help to bring **Maintenance** and **Asset Management** to the boardroom.
Why revision?

ALIGNMENT WITH GFMAM OBJECTIVES

The creation of the Maintenance Framework publication is to support all of GFMAM subjects, in particular to facilitate the exchange and alignment of Maintenance and Asset Management knowledge and practices.
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<td>Strategic Planning</td>
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<td>Asset Management Planning</td>
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<td>Capital Investment Decision-Making</td>
<td>Asset Management Decision-Making</td>
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<td>Operations &amp; Maintenance Decision-Making</td>
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<td>Lifecycle Value Realisation</td>
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<td>Resourcing Strategy</td>
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<td>Shutdowns &amp; Outage Strategy</td>
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<td>Landscape Subject</td>
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<td>18 Resource Management</td>
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<td>19 Shutdown &amp; Outage Management</td>
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<td>21 Asset Decommissioning and Disposal</td>
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GFMAM: 39 SUBJECTS

The Asset Management Landscape

Landscape Subject | Landscape Subject Group
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22 Asset Information Strategy | Asset Information
23 Asset Information Standards |
24 Asset Information Systems |
25 Data & Information Management |
26 Procurement & Supply Chain Management |
27 Asset Management Leadership |
28 Organizational Structure |
29 Organizational Culture |
30 Competence Management |

Organisation & People
GFMAM: 39 SUBJECTS
The Asset Management Landscape

Landscape Subject
31 Risk Assessment and Management
32 Contingency Planning & Resilience Analysis
33 Sustainable Development
34 Management of Change
35 Assets Performance & Health Monitoring
36 Asset Management System Monitoring
37 Management Review, Audit & Assurance
38 Asset Costing & Valuation
39 Stakeholder Engagement

Landscape Subject Group

Risk & Review

European Federation of National Maintenance Societies vzw
Asset Management and Maintenance

What is the difference?

Janez Tomažin

An asset is an item, thing or entity that has a potential or actual value to an organization.

Asset Management

ISO 55000  ISO 55001  ISO 55002  ISO 55010  ISO 55011

is coordinated activities of an organization to realize value from assets in its whole lifecycle.

Physical Asset Management

ISO 19650-1:2018

Physical Asset hierarchy

Asset Portfolio

Asset System

Asset
pr EN16646-2: The assets can be hierarchically structured within the asset management system in asset portfolio level, asset system level and (individual) assets.
4. SUPPORT (ISO 55001 – chapter 6)

Physical asset hierarchy (EAMC)

Physical assets location hierarchy

CMMS: MAXIMO

New factory (2005)

Production line 1

Spare parts
Remark ISO 55002: The organization should ensure that there is a traceable link between the technical asset data inventories and the accounting records. The information system should be mapped out to ensure that all defined information requirements can be supplied.

PHYSICAL ASSET LOCATION HIERARCHY

- STEKLARNA HRASTNIK
  - 01 OFFICE BUILDING
  - 02 FACTORY SPECIAL
    - 0202 PRODUCTION: HOT PLANT
      + 020201 REGENERATOR
      + 020202 FURNACE
      + 020204 FOREHEARTH
      + 020205 ROOMS: PRODUCTION LINES
      + 020206 PRODUCTION LINE 1
        - 02020601 IS1 MACHINE
          - 02020602 CONVEYER 1
          - 02020603 WARE TRANSFER 1
          - 02020604 CROSS CONVEYER 1
          - 02020605 ANEALING LEHR 1
        + 020207 PRODUCTION LINE 2
        + 020208 PRODUCTION LINE 3
        + 020209 PRODUCTION LINE 4
      + 0203 PRODUCTION: COLD PLANT
        + 0204 ENERGY LINES
      + 0205 FURNACE UNDERNEATH
      + 0207 BASEMENT
      + 0207 OUTSIDE
      + 0208 WORKSHOPS
    + 02 FACTORY VITRUM
    + 02 FACTORY OPAL

PHYSICAL ASSET HIERARCHY at IS1 MACHINE location

<table>
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<tr>
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<th>ASSET NAME</th>
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<td>FEEDER MECHANISM</td>
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<td>0000002</td>
<td>MECHANISM: SPINE</td>
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<tr>
<td>0000003</td>
<td>MECHANISM: FIREBRICK CYLINDER: UP/DOWN L1</td>
</tr>
<tr>
<td>0000004</td>
<td>MECHANISM: FIREBRICK CYLINDER: ROTATION L1</td>
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<tr>
<td>0000005</td>
<td>MECHANISM: FIREBRICK CYLINDER: SCISSORS L1</td>
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<td>0000006</td>
<td>MECHANISM: GOB DISTRIBUTOR: SCISSORS L1</td>
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<td>0000007</td>
<td>IS1 MACHINE</td>
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<td>0000008</td>
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<td>MECHANISM: SECTION 8: IS1</td>
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<td>0000017</td>
<td>VALVE: PROPORTIONAL VALVE: FINAL BLOW 1</td>
</tr>
<tr>
<td>0000018</td>
<td>VALVE: PROPORTIONAL VALVE: COUNTER 1</td>
</tr>
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SPARE PARTS OF THE PARTICULAR ASSET (e.g.)

<table>
<thead>
<tr>
<th>SPARE P. NUMBER</th>
<th>SPARE PART NAME</th>
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<tbody>
<tr>
<td>10001</td>
<td>BALL BEARING 6202-2RSL</td>
</tr>
<tr>
<td>10002</td>
<td>BALL BEARING 62202-2RS1</td>
</tr>
<tr>
<td>10003</td>
<td>BEARING 22210</td>
</tr>
<tr>
<td>10004</td>
<td>V-BELT SPC5000</td>
</tr>
<tr>
<td>10005</td>
<td>V-BELT 22×5000</td>
</tr>
<tr>
<td>10006</td>
<td>SEALING RING BAU 15×24×5</td>
</tr>
<tr>
<td>10007</td>
<td>SEALING RING BAFUDSL 15×24×7</td>
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</table>

Challenge: Right alternative spare part name?

Pricing, delivery times, suppliers, detailed documentation, ..

Challenge: WHEN?

Before asset order
Asset Management and Maintenance

What is the difference?

Janez Tomažin

Asset Management

is coordinated activity of an organization to realize value from assets.

ISO 55000   ISO 55001   ISO 55002   ISO 55010   ISO 55011

Physical Asset Management

is coordinated activities of an organization to realize value from assets in its whole lifecycle.

ISO 19650-1:2018

An asset is an item, thing or entity that has a potential or actual value to an organization.

Physical Asset hierarchy

Asset Portfolio

Asset System

Asset
An Asset Management system is a set of 7 interrelated and interacting elements whose function is to establish AM objectives to achieve those PROCESSES.

1. Scope
2. Normative reference
3. Terms and definitions
4. Context of the organization
5. Leadership
6. Planning
7. Support
8. Operation
9. Performance evaluation
10. Improvement

An Asset Management System modified from ISO 55001
The Structure of ISO 55001 requirements
First element of the Asset Management System: **Context of organization**

- **INTERNAL**
  - CULTURE and ENVIROMENT
  - MISSION
  - VISION
  - VALUES
  - STAKEHOLDER inputs, concerns and expectations

- **EXTERNAL**
  - SOCIAL
  - CULTURAL
  - ECONOMIC
  - PHYSICAL
  - REGULATORY
  - FINANCIAL
  - and other constraints

- Consistent decision making and setting of organizational Policy, Strategy, Objectives
- Design and scope of its Asset Management system

Modified from ISO 55001
The Structure of ISO55001 requirements
First element of the Asset Management System: Context of organization

VISION: We are an innovative and dynamic group of world-renowned glassmaking engineers. We are united by our passion to develop and manufacture glass products and solutions that boast modern design and are adapted to their target groups.

MISSION
1. We support our business partners in their marketing activities by consistently meeting their demands and by constantly promoting development.
2. We create an innovative corporate environment
3. We strive towards ethical business practices and are environmentally responsible.
4. We award proprietors with competitive yields for their investment into the Company. We are dedicated to serving the Company’s long-term interest and existence.

VALUES
PURITY: pure glass, open communication, honest and transparent relationships, clean working environment, pure thoughts, respect
PASSION: dedication to work, desire for progress, trust in yourself and your co-workers, in success, persistence, drive, willingness to make sacrifices
HEART: connectedness, commitment and love of work, kindness, people are the heart of business
4 Physical asset management system

Main physical assets (furnaces, IS machines, presses, inspections machines, fans) are top priority for their performance abilities for long-term operations. As top quality products are essential, there is no place for high investment risks. There is a hierarchy of all physical assets with quite a lot of redundancy equipment. Glass production stops are only every 10 years, so these assets sustainability is top priority.

24 hour/week/year production, continuous process control, intense energy consumption, strict environmental policy, very flexible production, market oriented production, and other process issues demand adequate asset management systems. To support this, the factory uses and has introduced among others:

- LCC and continuous improvements approach;
- OEE and Energy management system as a combined system;
- 6 SIGMA approach;
- CMMS (Maximo);
- Various kinds of glass making on-line inspection machines, labs, measurements, SCADA’s.
The Structure of ISO55001 requirements

Second element of Asset Management System: **Leadership and commitment**

Fundamentals

Leadership and commitment from all managerial levels is essential for successfully establishing, operating and improving asset management within the organization.

Reporting back to top management (continuous improvements)

Appointing people at a suitable level to be responsible for the AMS

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**Organization**
- Short and long-term Strategical plans

**Key Performance indicators**

**Asset management Policy**

**Asset Management Systems**

- **Board of directors:** regular meetings
  - General manager
  - Director of finance and accounting
  - Director of maintenance
  - Director of QM and HSE department
  - Sales manager
  - Marketing manager
  - Head of human resources
  - Director of production
  - Director of purchasing and logistic

Modified from ISO 55001
Comparability of data is very important in audits.

Target values

“L” e.g. CMMS

Minimal requirements

Results of auditing

“A” e.g. Leadership and Commitment

“I” e.g. Physical Asset hierarchy
Asset Management and Maintenance

What is the difference?

Top management are things it performs:
- Accounting and Finance
- Marketing & Sale
- Production
- Maintenance
- Purchasing
- Research & Development
- Design & Investment
- Information technology
- Human resourcing

The organizational structure defines the relationship and interactions between the parts of business.

Stakeholders
- Market
- Technology
- Community

Strategic Asset Management Plan
- AM Policy, strategy, objectives & CSF's

Requirements for physical asset management

Physical Asset Management Plan
- Policy, strategy, objectives & KPI's

Maintenance Management
- Policy, strategy, objectives & KPI's

Asset Management is coordinated activity of an organization to realize value from assets.

Physical Asset Management is coordinated activities of an organization to realize value from assets in its whole lifecycle.

Asset Portfolio

Asset System

Asset

An asset is an item, thing or entity that has a potential or actual value to an organization.
The purpose of Asset Management is to manage an organisation’s assets effectively in order to deliver the objectives of the organisation’s strategic plan. Therefore, the organisation should prepare a **Strategic Asset Management Plan (SAMP)** for the assets.

Various combinations of organisational, market and technological influencing factors affect SAMP including:

- required asset solutions,
- operative policies,
- **maintenance strategies**,  
- replacement/modernizations needs  
- and finally asset disposals.
A process to create SAMP (strategic asset management plan) and Maintenance strategies

**Determine and describe your business segments**

**Identify critical success factors of the organization based on influencing factors and organizational strategic plan**

**Define weight of each critical success factor**

**Identify supporting elements at Asset Management and maintenance level**

**Consider opportunities**

**Identify importance of each supporting element**

**Identify critical requirements at Asset Management and maintenance level**

**Asset Management objectives**
- Maintenance objectives

**Asset Management strategy**
- Maintenance strategy

**Asset Management plans and execution**
- Maintenance plans and execution

**KPIs for Asset Management**

**KPIs values**
Determination of critical success factors

Example case: Excel helping tool

**Context of the organization**

**INTERNAL**

**EXTERNAL**

**Design and scope of its asset management system**

**Cooperation between all levels and functions within organisation.**

### Define business segments

<table>
<thead>
<tr>
<th>Business segment 1</th>
<th>Business segment 2</th>
<th>Business segment 3</th>
<th>Business segment 4</th>
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**Business segment 1**
- Short description:
- Descriptive factors:
- Critical success factors:
  1. Low price
  2. High Volume
  3. Prompt deliveries
  4. Short delivery time
  5. Additional services
  6. Volume flexibility
  7. xxx

**Business segment 2**
- Short description:
- Descriptive factors:
- Critical success factors:
  1. High flexibility
  2. High availability
  3. Safety
  4. Ecology
  5. Digitalization
  6. Image

**Business segment 3**
- Short description:
- Descriptive factors:
- Critical success factors:
  1. Low price
  2. High Volume
  3. Prompt deliveries
  4. Short delivery time
  5. Additional services
  6. Volume flexibility
  7. xxx

**Business segment 4**
- Short description:
- Descriptive factors:
- Critical success factors:
  1. High flexibility
  2. High availability
  3. Safety
  4. Ecology
  5. Digitalization
  6. Image
From critical success factors to requirements
(all the figures in the tables are imaginary and are not meant to be statements about the
importance and influence of issues in the reality)

With modifications from prEN16646-2

Organisations should determine the critical success factors for their business activities. The identified set of critical success factors (portfolio and asset system level) defines the requirements for the management of the assets.

An example of supporting tool for asset system or homogenous (business and technological point of view) asset portfolio.

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In order to diminish silo behaviour, organisations should fill the matrix of the critical success factors and requirements using expert judgement.

Top management, financial management, marketing and product management, technical management, production management, maintenance management.
Simplified QFD-framework to determine the contribution of different asset systems to the requirements

(all the figures in the tables are imaginary and are not meant to be statements about the importance and influence of issues in the reality)

With modifications from prEN16646-2

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Contributions of the asset systems and respective investment costs (from the previous Table)
Identify potential items and technical solutions for improvements
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</tbody>
</table>
Improve technical solutions in order to better fulfil the requirements
Identify the most potential development objects using cost-benefit ratio
(all the figures in the tables are imaginary and are not meant to be statements about the importance and influence of issues in the reality)

<table>
<thead>
<tr>
<th>Asset system 1</th>
<th>Asset system 2</th>
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<td>40</td>
<td>60</td>
</tr>
</tbody>
</table>
Choose the best option - holistic consideration

Scoring against the requirements

NPV

535,69 €
389,88 €
125,38 €
0,00 €
100,00 €
200,00 €
300,00 €
400,00 €
500,00 €
600,00 €
700,00 €

0,0 50,0 100,0 150,0 200,0 250,0
Life-cycle management activities

Kari Komonen, Janez Tomažin

Modified from prEN16646-2

Needs and feasibility assessment for assets. Determination of critical factors.

Concept definition. Requirements for assets.

Determination of (available) asset solution.

Technical specification which consider maintenance needs.

Design of physical assets.

Construction or acquisition of physical assets.

Installation and commencing.

Utilization of physical assets.

Maintenance of physical assets.

Loop: Improvements, modifications, replacement of phy. assets.

Decommissioning, retirement or/and disposal of physical assets.

Physical asset revision, refurbishment, re-use, modification, upgrade, or replacement.

Change in technological and business environment

Need for improvements, modifications or modernization.

Replacement plan due to: different useful lives of assets.

Gap analysis between planned and actual performance.

Opportunities due to technological advances.

Need for modernization of physical asset.

Need for improvement, modification and standardisation of physical asset.

Identify/modify critical success factors and requirements.

Modernization

Market – Community – Technology

Maintenance policy, strategy, plan

SAMP AM policy, strategy, objectives, plan & CSF’s

Maintenance objectives & KPI’s

Cooperation between all levels and functions within organisation.

Triggers for greenfield or brownfield investment.

Changes in the:
market, technology, community, organization require new objectives, strategies, plans and competences.

CAPEX

OPEX

CAPEX/OPEX

Extension of the physical asset life

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Asset Management and Maintenance

What is the difference?

Top management

are things it performs:
Accounting and Finance
Marketing & Sale
Production
Maintenance
Purchasing
Research & Development
Design & Investment
Information technology
Human resourcing

Business functions within the organisation:

The organizational structure defines the relationship and interactions between the parts of business.

ORGANISATIONAL STRUCTURE

Maintenance

Electro
Mechanical
Mechatronic
Civil
WO management
Other

is coordinated activity of an organization to realize value from assets.

Asset Management

ISO 55000  ISO 55001  ISO 55002  ISO 55010  ISO 55011

is coordinated activities of an organization to realize value from assets in its whole lifecycle.

Physical Asset Management

Physical Asset hierarchy

Asset Portfolio

Asset System

Asset

Spare parts connected to assets

Maintenance management

Inventory management

Corrective, Reactive, Run to fail, Preventive, Periodic, Predictive, Time based, Condition based (CMB), Failure Mode and Effects Analysis, Reliability Centered (RCM), TPM, Value driven (VDM), Business Centered, Maintenance 4.0, IoT and BIM driven, .................

The right stock, at the right levels, in the right place, at the right time, and at the right cost.

+ other maintenance SUPPORT processes

Knowledge, BoK

pREN 155341:2019 Maintenance KPIs
EN 13460:2019 Documentation in maintenance
EN 16991:2018 Risk-based inspection framework
EN 13306:2017 Maintenance terminology
EN 17007:2017 Maintenance process and indicators
EN 13269:2016 Maintenance contract
EN 15628:2014 Qualification for Maintenance personal
EN 15331:2011 Maintenance for buildings

CONTINUAL IMPROVEMENTS


Sustainable Asset Management

MARKET  TECHNOLOGY  COMMUNITY

Strategic Asset Management Plan
AM Policy, strategy, objectives & CSF’s

Requirements for physical asset management

Physical Asset Management Plan
Policy, strategy, objectives & KPI’s

Physical Asset Management

Policy, strategy, objectives & KPI’s

Controlled by Asset Management System

STAKEHOLDERS

European Federation of National Maintenance Societies vzw

Janez Tomažin

43
The Structure of ISO55001 requirements

Second element of Asset Management System: **Leadership and Commitment**

Planning

Support

Operation

Performance evaluation

Improvement

Modified from ISO 55001
Organization of information about construction works — information management in Building Information Modelling processes

BIM ISO 19650
aligned with
ISO 55000, ISO 21500, ISO 9001

BIM is effective tool for quality control, lean management and data management
### Data and Life cycle management

<table>
<thead>
<tr>
<th>3D Model</th>
<th>4D Scheduling</th>
<th>5D Estimating</th>
<th>6D Sustainability</th>
<th>7D Operations Management</th>
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<td>Full discipline integration</td>
<td>Project phasing simulations</td>
<td>Quantity extraction to support detailed cost estimated</td>
<td>Energy analysis</td>
<td>TFM asset naming conventions and hierarchy</td>
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<td>Animations, renderings, walkthroughs</td>
<td>Constructability analysis</td>
<td>Trade verifications from scheduling</td>
<td>Sustainable element tracking</td>
<td>BIM maintenance plans and technical support</td>
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<tr>
<td>BIM driven prefabrication</td>
<td>Lean scheduling</td>
<td>Value engineering</td>
<td>Leadership in Energy and Environmental Design (LEED) tracking</td>
<td>BIM As Builts</td>
</tr>
<tr>
<td>NS3451 Building part classification</td>
<td>Just in Time (JIT) equipment deliveries</td>
<td>Prefabrication solutions</td>
<td>Optimise life cycle solutions</td>
<td>BIM embedded O&amp;M manuals</td>
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<tr>
<td>ISO 29481 BIM Information delivery</td>
<td>Detailed simulation installation</td>
<td>Cost change analysis</td>
<td>RAMS Analysis</td>
<td>Spare part and supplier identification</td>
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<tr>
<td>Internal design standards and concepts</td>
<td>Autodesk Revit</td>
<td>Maintenance cost forecast</td>
<td>Autodesk Insight</td>
<td>Technical history</td>
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<td>Clash detection</td>
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<td>Autodesk BIM360 OPS</td>
</tr>
<tr>
<td>Autodesk Revit</td>
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<td></td>
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</table>

- Autodesk Revit
- Autodesk Navisworks
- Autodesk Navisworks
- Autodesk BIM360 OPS

**Paul Daugalis, Hugaas Engineering (Lithuania)**

[Video]
Data and Life cycle management

BIM provides the ability to exchange information digitally from design through to operations using a Common Data Environment (CDE) such as IFC.

The Internet of Things (IoT) enables integrated asset data connections into the automation systems used to control the environment.

These concepts although have been well developed in the building industry are readily transferable to industrial assets such as refineries, mining, power and water utilities.
BIM

Updating the As-built model with additional data and creation of Asset Information Model

The BEXEL Manager collects and stores all required data and documents of any format, contained within the model file or linked to the agreed CDE and accessible to authorized stakeholders on the project, which, among other data, includes:

- pictures;
- drawings/project documentation;
- detailed item/asset information;
- warranties and guaranties;
- technical/project documentation;

Created AIM contains all required documents linked to their respective elements in the 3D model accessible with a mouse-click and clearly noticeable in the main and Level Map views

A.I.M. - Application Implementation Method
Effective monitoring of the commissioning process.

The As-built record model is ready for integration with the FM platform and facility maintenance plans.

Historical database of the project:
- maintain up-to-date facility and equipment data including operating instructions;
- specification;
- technical / project documentation.

Tracks use, performance, and maintenance of a building's physical assets for the owner, maintenance team, and financial department.

Project HSE — Case study
Introducing ISO 55001 with SAP EAM

HSE COMPANY  HSE GROUP  CORPORATE SOCIAL RESPONSIBILITY  NEWS

POWER OF ENERGY

64% of total production in Slovenia
7.5 TWh total production in 2018
More than 80% of entire electricity from renewable sources in Slovenia

European Federation of National Maintenance Societies vzw
Project HSE — Case study
Introducing ISO 55001 with SAP EAM
Proof of the concept (before final decision and utilization start up)
Process harmonization across industries on ISO 55001, ISO 14001, and ISO 45001.

Managing cost, risk and performance holistically.

Balancing capital expenditure (CAPEX) with operational expenses (OPEX) with focus on asset lifecycle costing.

Collaboration of engineering, procurement and construction (EPC) contractors, OEMs, service providers, and operators.

Empowerment of users with simplified applications.

Increasing stakeholders expectation that require operating safely and reliably under cost pressure.

Cloud – to establish an asset network.

Big Data to predict behavior of assets, people, and processes.

Analytics – to monitor performance of assets, people and processes.

Enterprise Mobility – to be more effective and efficient as well to empower employees.

Internet of Things (IoT) - to connect the assets to the business (IT/OT) convergences.

Machine-to-machine (M2M) communication - to build cyber-physical systems.

Business Challenges

Technology Enablers

European Federation of National Maintenance Societies vzw
Fact: keeping records of documentation and history of physical assets (maintenance activities, spare parts, locations of spare parts, ..), issuing work orders, planning and scheduling maintenance activities and the like is recorded at this „Asset system level of the hierarchy”,

Next step: Breakdown of the hierarchy down to individual assets
Advantages (some of them):
• planning and scheduling of the maintenance activities - WO;
• reservation of spare parts on WO;
• less chance of error;
• accurate accounting of WO;
• linking the WO to the procurement department and the warehouse;
• connection with accounting: depreciation, cost centres, data base, OS inventory, ..
• effective management of spare parts;
• pursuing history, analysis, continuous improvement;
• higher maintenance efficiency, operational reliability, lower costs,

Case study:  
Front bearing of the electric motor: 6213.C4
Back bearing of the electric motor: 6213.2RS1

Bearing 1: 21313E
Lubrication interval: B2
Grease quality: yyy
Amount: yy gr/cycle

Bearing 2: 21313E
Rotor type: xxxxx, D=190 mm

Shaft: type xxxxx

Mechanical seal: typ xxxxx

Entries into CMMS
Manuals: for transport, installation, safety and health, operation and maintenance.
Technical information
List of spares
Drawings
Nedeed tools
Guarantees

Spare part management
The right stock, at the right levels, in the right place, at the right time, and at the right cost.
Project HSE – Physical Asset hierarchy
SAP Asset Intelligence Network

Collaboration between OEM, service provider, and operator

- Nameplate info
- Maintenance strategy
- 3D parts # / BOM
- Service bulletins & revs
- Failure modes
- Recalls
- Safety controls
- Process controls
- Service bulletin
- Designs and drawings
- Design improvements
- Sensor definition
- Licensing
- Operating instructions
- Maint instructions
- Safety instructions
- Product training

- Service bulletin receipt
- Service bulletin processed
- Usage information
- Installation information
- Failure / incident data
- Design recommendations
- Risks and controls
- Measurement documents
- Telemetry

Manufacturer | Service provider | Operator
------------|----------------|-----------
efnms       |                |          
Asset Management processes and the role of Maintenance

Zero Role
Consultative
Plan, Do, Check, Act

Informative
Active
Responsible
# Asset Management processes and the role of Maintenance at asset portfolio level

<table>
<thead>
<tr>
<th>Process stage</th>
<th>Role of Maintenance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organization's business strategy</td>
<td>Informative</td>
</tr>
<tr>
<td>Business key success factors</td>
<td>Informative</td>
</tr>
<tr>
<td>Requirements for physical assets</td>
<td>Consultative</td>
</tr>
<tr>
<td>Physical Asset policy and strategy</td>
<td>Consultative/Active</td>
</tr>
<tr>
<td>Allocation of the task roles to the asset m. systems</td>
<td>Consultative/Active</td>
</tr>
<tr>
<td>Key success factors for the physical asset system</td>
<td>Active</td>
</tr>
<tr>
<td>Determination of physical asset solution</td>
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<td>Design of the asset systems within a. portfolio</td>
<td><strong>Active</strong></td>
</tr>
<tr>
<td>Creation of physical asset management system</td>
<td><strong>Active participation</strong></td>
</tr>
<tr>
<td>Creation of maintenance management system</td>
<td><strong>Active participation</strong></td>
</tr>
<tr>
<td>Planning of maintenance support resources</td>
<td><strong>Active participation</strong></td>
</tr>
<tr>
<td>Maintenance planning at the portfolio level</td>
<td><strong>Responsible for task</strong></td>
</tr>
<tr>
<td>Performance evaluation and improvement</td>
<td><strong>Responsible for task</strong></td>
</tr>
<tr>
<td>Disposal and acquisition of asset systems</td>
<td><strong>Consultative</strong></td>
</tr>
</tbody>
</table>
What are Asset Management?

Terminology:
ISO 5500X – family standards,
EN 16646-1 and pr.EN 16646-2

What is Maintenance within Asset Management?

What is Asset System?

What is Physical Asset Management?

What is Asset Management System?
EFNMS Asset Management and Maintenance professionals

From LinkedIn – join us
European Asset management Committee

Thank You