15th INTERNATIONAL OPERATIONS & MAINTENANCE CONFERENCE IN THE ARAB COUNTRIES
UNDER THE THEME: **"SMART MAINTENANCE"** CONICIDE WITH THE 15TH ARAB MAINTENANCE EXHIBITION

# Slovenian experience in operations and maintenance

**Janez Tomažin, Samo Ulaga, Viktor Lovrenčić**

# Some facts about Slovenia

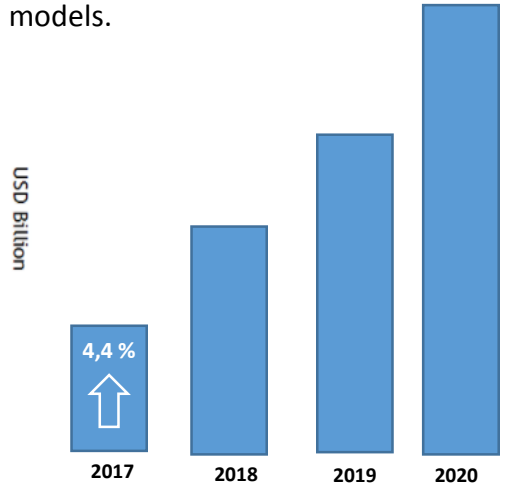
Slovenija officially the Republic of Slovenia is a nation state located in the southern central Europe, variously classified as part of eastern and southern Europe. The country is located at the crossroads of main European cultural and trade routes. It is bordered by Italy to the west, Austria to the north, Hungary to the northeast, Croatia to the south and southeast, and the Adriatic Sea to the southwest. It covers 20,273 square kilometres (7,827 sq mi) and has a population of 2.06 million. It is a parliamentary republic and a member of the United nations, European Union, and NATO. The capital and largest city is Ljubljana.

I FEEL SLOVENIA

# Some facts about Slovenia

Main industry in Slovenia is automotive (car production, production of different car parts), steel, machining and metal working, electrical and electronics, chemicals & pharmaceuticals, paper and glass, logistics & distribution and some wood processing as we are a country whose 58 % of its territory is covered by forests.


GDP in Slovenia is expected to be 45.31 USD Billion by the end of this quarter, according to Trading Economics global macro models and analysts' expectations. In the long-term, the Slovenia GDP is projected to trend around 56.58 USD Billion in 2020, according to our econometric models.




## Maintenance and Asset Management is Slovenia

We are aware that we have some world-class companies owned by Slovenian or foreign owners but there are a lot of opportunities in many physical asset intensive industry which are not performing well. The importance of the maintenance in those companies is still much underestimated, whereas on the other hand, the definitions and terms of maintenance function and maintenance within asset management are still ignored by all managerial levels.

# Slovenian maintenance society and collaboration to EFNMS and Global Forum

**Fact**: In every European country, there exists a National Maintenance Society which has been established for professional people and companies associated with the business of maintenance.


The EFNMS, the European Federation of National Maintenance Societies, was established in 1970. The EFNMS transformed to a formal non-profit organization according to Belgian law created on January 18, 2003, in Amsterdam.

The EFNMS objectives are the following: the **improvement of maintenance** for the benefit of the peoples of Europe.
By the term **'maintenance'** is meant: the combination of all technical
administrative and
managerial
actions during the lifecycle of an item intended to retain or restore it to a state in which it can perform its required function.
Maintenance is of utmost importance for **trade** and **commerce**, for the **environment**, and for **general health and safety**. In order to pursue its goals, the EFNMS shall be an umbrella organization for the non-profit National Maintenance Societies in Europe.

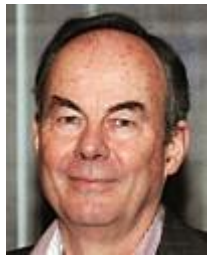
# EAMC
## European Asset Management Committee

Wout Theuws

Paul Daugalis

Drago Frkovic

Kari Komonen



Lex Daan

Christos Emman-ouilidis

Luis Ferreira

Petr Tulach

**EAMC has produced workshops on Physical Asset management**

Erik Helms

Alan Wilson

Janez Tomazin

## Project MORE4CORE (**M**aintenance, **O**verhaul and **R**epair **for CO**mpetiveness of the “North West European” **RE**gion)

Project was carried out by several maintenance societies and **EFNMS**, development agencies, institutes and economic associations published in 2016, some very clear results were presented.

Quote from the summary: *It the entire asset intensive industry were to perform at the top performer level, this would result in the following added value for Northwest Europe:*

- *increase in the industry’s competitive strength with a 30 % EBIT-DA1 improvement;*
- *savings of 25% in investment costs due to lifetime extensions instead of replacing aging assets;*
- *increase of 3% in employment in MRO (Maintenance, Repair, Overhaul) activities;*
- *better living environment with a reduced probability of the occurrence of health & safety and environmental incidents;*
- *increase of 1,8 % in the industry’s share of the collective Gross Domestic Product (DGP) of Northwest Europe.*

# Where is Slovenia?

## How can Slovenia compare with MORE4CORE?

Unfortunately, we do not carry out such surveys or projects but undoubtedly, we still have a lot of work to do, first to reach the existing performance level in the field of maintenance and asset management of the NWE countries and then achieve additional added values as described above in MORE4CORE.

Slovenian maintenance society in collaboration with some universities and specialist from the industry started to introduce maintenance function and maintenance within asset management to the common industry last year. New Technical Committee TC319 Maintenance and Asset Management at the Slovenian Institute of Standardization (SIST) was introduced at the beginning of this year. Its main goals are translations and introduction of management standards for asset management ISO 55000, ISO 55001, ISO 55002 and all CEN TC319 maintenance standards.

**Note**: CEN stands for European Committee for Standardization or originally in French - Comité Européen de Normalisation.

# Slovenian Institute for Standardization and collaboration with CEN

Contact us

European Committee for Standardization

CEN COMMUNITY | TECHNICAL BODIES | STANDARDS EVOLUTION AND FORECAST | SEARCH STANDARDS

Technical Bodies › **CEN/TC 319**

## CEN/TC 319 - Maintenance

General | Structure | Work programme | Published Standards

EN FR DE

### CEN/TC 319 Scope

Standardization in the field of maintenance as far as generic standards which are generally applicable are concerned

### Officers

| | |
|---|---|
| **Secretary** | Mr Fabrizio Tacca |
| **Chairperson** | Mr Franco Santini |

### Further information

| | |
|---|---|
| **CEN Technical Secretariat(s)** | UNI |
| **CCMC Programme Manager** | Ibido Monica |
| **Business Plan** | |

### TC Electronic Platform

| | |
|---|---|
| **Platform** | |

# Slovenian Institute for Standardization and collaboration with CEN

Technical Bodies › **CEN/TC 319**

## CEN/TC 319 - Maintenance

General | Structure | Work programme | Published Standards

EN FR DE

### CEN/TC 319 Subcommittees and Working Groups

| Working group | Title | |
|---|---|---|
| CEN/TC 319/WG 10 | Maintenance within physical asset management | EN 16646:2014 / EN 16646/2:2018? working draft |
| CEN/TC 319/WG 11 | Condition assessment methodologies | prEN 16991:2016 |
| CEN/TC 319/WG 12 | Risk based inspection framework (RBIF) | FprEN 16991 (ENG) or FprEN 16991:2017 |
| CEN/TC 319/WG 13 | Maintenance process | |
| CEN/TC 319/WG 14 | Maintenance engineering | |
| CEN/TC 319/WG 4 | Terminology | EN 13306:2010 |
| CEN/TC 319/WG 6 | Maintenance performance and indicators | EN 15341:2007 prEN 15341 |
| CEN/TC 319/WG 7 | Maintenance of buildings | EN 15331:2011 |
| CEN/TC 319/WG 8 | Maintenance functions and maintenance management | |
| CEN/TC 319/WG 9 | Qualification of personnel | EN 15628:2010 |
| CEN/TC 319/WG 2 | | EN 13460:2009 |

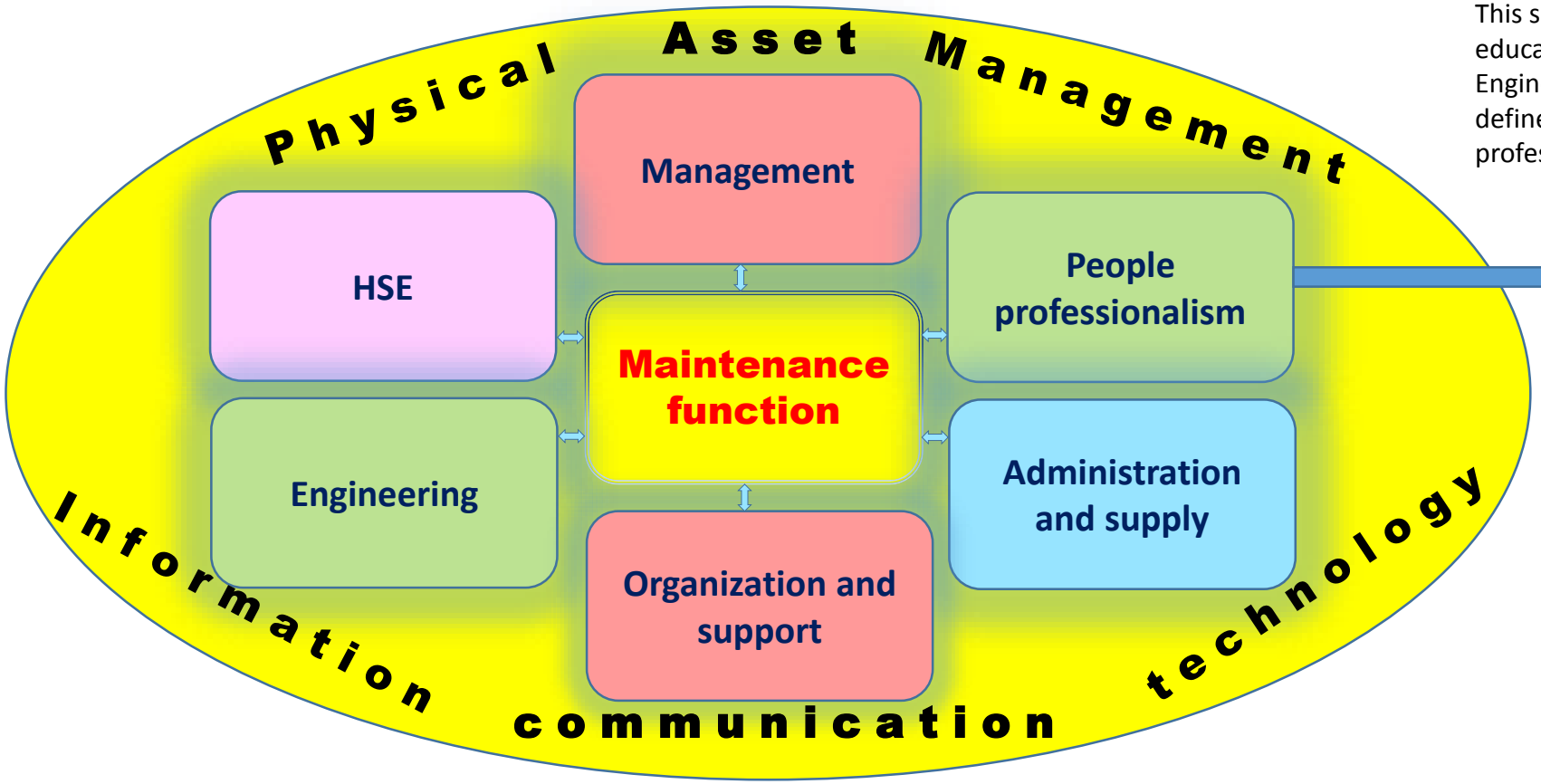
Is there an influence from ISO 55000 family standards?

# Maintenance

# Maintenance function

Is there a difference?

According to the proposal (draft) of the new European Standard prEN 15341 – „Maintenance – Maintenance Key Performance Indicators“ is **Maintenance function** an integration of 8 sub-functions with the methodology of physical asset management and the information communication technology.




This sub-function involves constant education of Managers, Engineers/Work Supervisors and defines Education plans to provide professionalism at work

# Slovenian Institute for Standardization and collaboration with CEN

European Committee for Standardization

CEN COMMUNITY | TECHNICAL BODIES | STANDARDS EVOLUTION AND FORECAST | SEARCH STANDARDS

Technical Bodies › **CEN/TC 319/WG 10**

## CEN/TC 319/WG 10 - Maintenance within physical asset management

General | Work programme | Published Standards

### CEN/TC 319/WG 10 Scope

### Officers

| | |
|---|---|
| **Secretary** | Mr Kimmo konkarikoski |
| **Convenor** | Mr Kari Komonen |

### Further information

| | |
|---|---|
| **CEN Technical Secretariat(s)** | SFS |

**EN 16646:2014**

Maintenance within Asset Management

Methodology to improve life cycle performance and to achieve a sustainable physical asset

**prEN 16646/2:2018?**

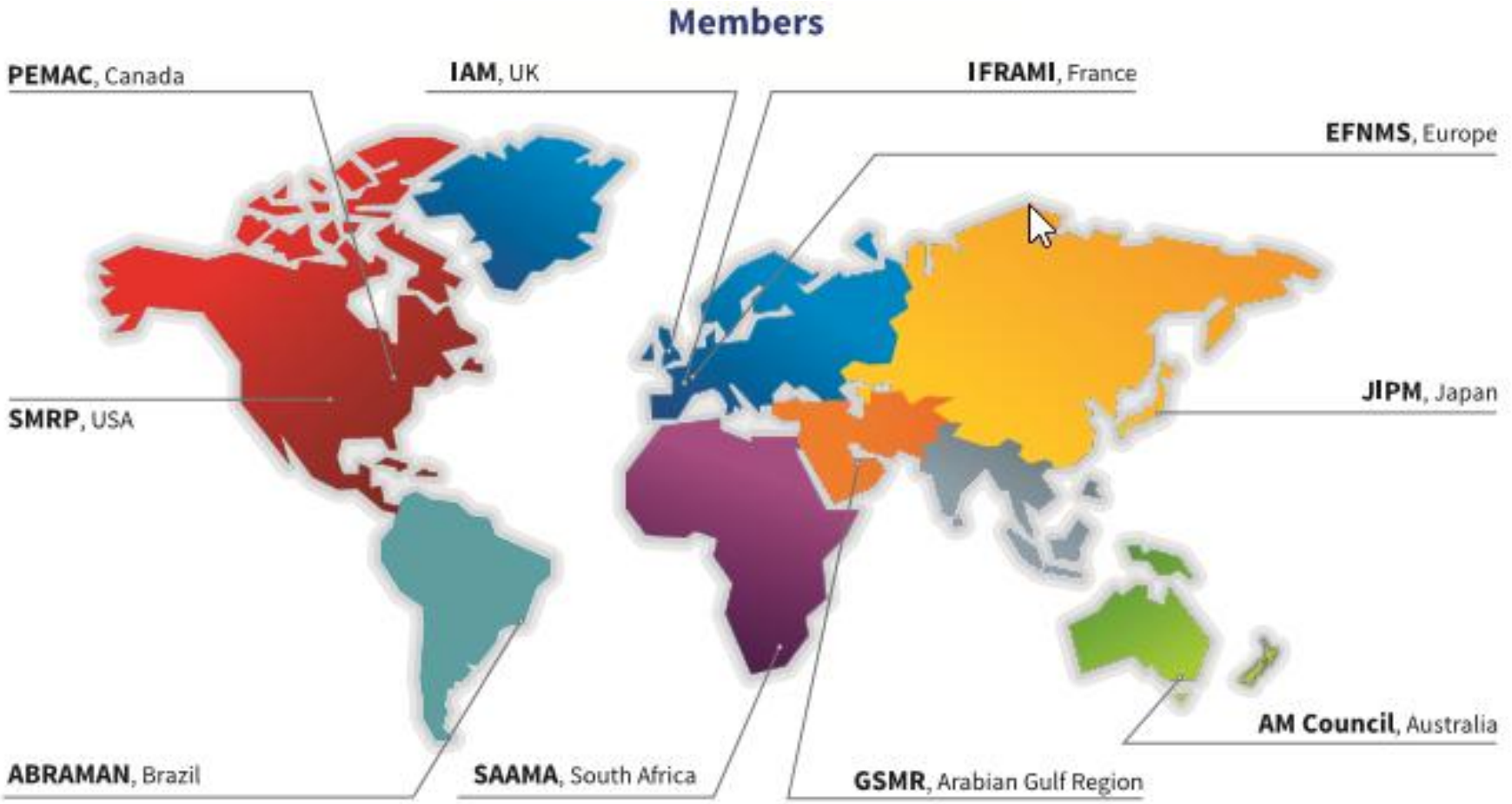
## The objectives of prEN1666/2 standard are to:

- Create and systematize link between business, physical asset management and maintenance activities
- Indicate external and internal influencing factors and their effect on physical asset and maintenance management
- Prevent silo behavior (including contracting) and promote cooperation between different functions
- Promote transparency in organizational decision making
- Promote visualization as an effective tool
- Promote uncertainty management (including risk management)
- Promote simulation as a standard helping tool
- Improve information management as a tool to achieve the above-mentioned objectives
- Focus on sustainability

## **Maintenance function** (one of the statements in prEN 16646/2):

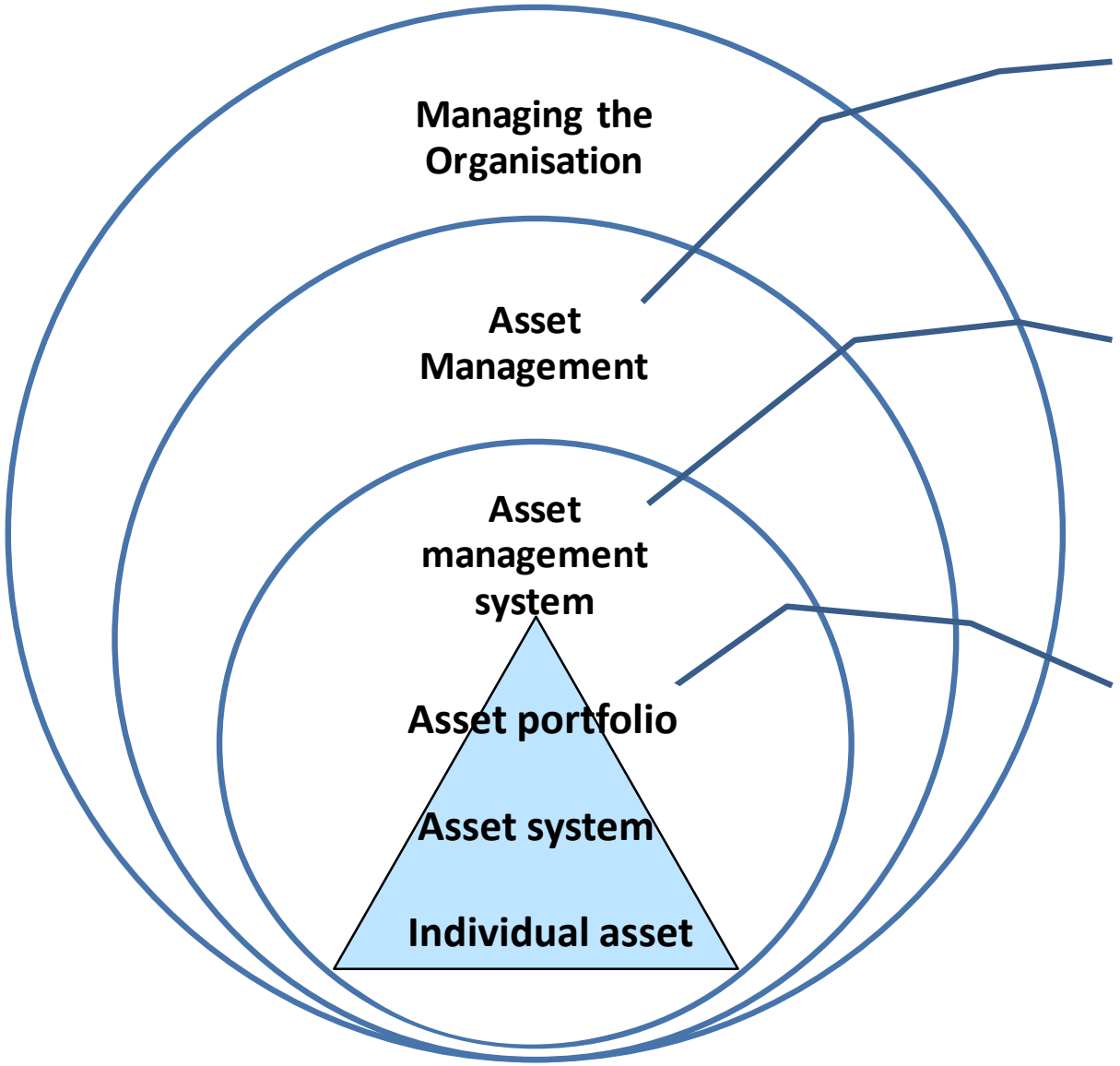
The maintenance function has an important role also when planning and scheduling coordinated corporate wide maintenance activities (e.g. major shutdowns) for the whole fleet of the asset systems.

# Slovenian maintenance society, EFNMS and collaboration with GLOBAL FORUM




GFMAM
Global Forum on Maintenance & Asset Management

# Framework of Asset Management concepts




Coordinated activity of an organization to **realize value** from assets

Set of **interrelated or interacting elements** to establish AM policy, AM objectives and processes to achieve those objectives

Assets that are within the scope of the asset management system

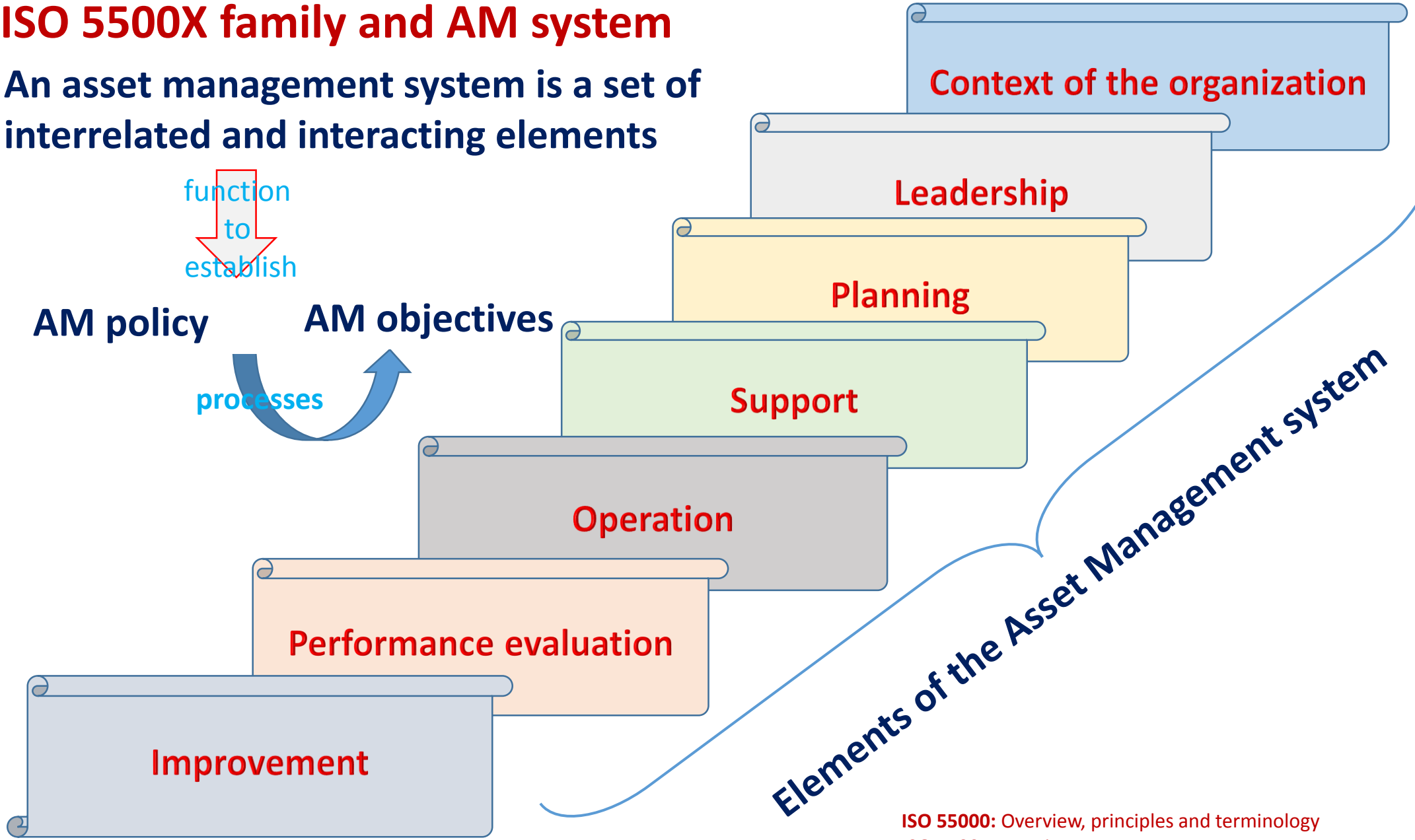
# ISO 5500X family and AM system

**An asset management system is a set of interrelated and interacting elements**

function to establish

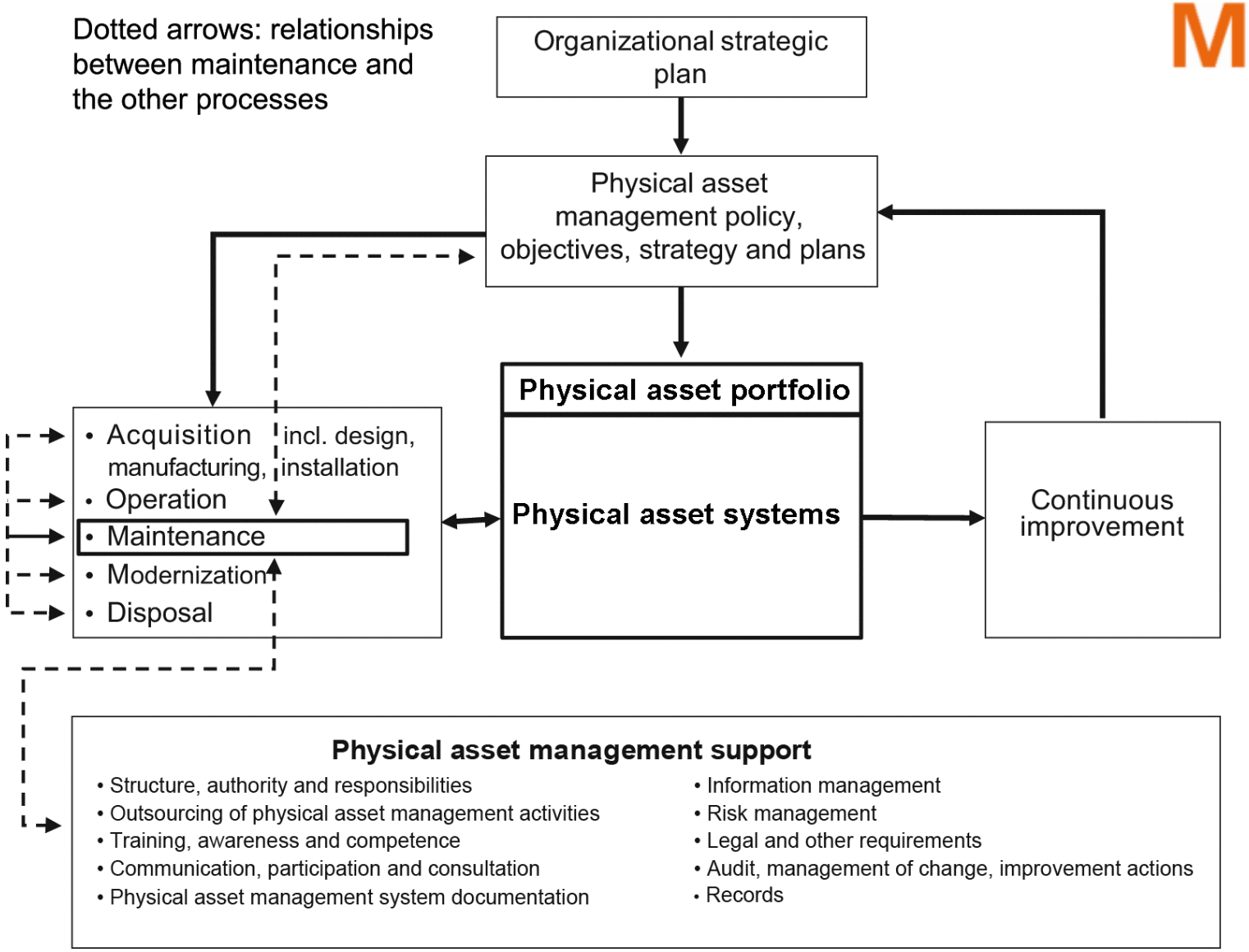
**AM policy** **AM objectives**

processes




**ISO 55000:** Overview, principles and terminology
**ISO 55001:** Requirements
**ISO 55002:** Guidelines for the application

# Life-cycle processes and their interaction with the maintenance process



# Case study: Slovenian glass factory

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PURITY · PASSION · QUALITY

From manual production

to fully automated production

# Element of the Asset Management System: Context of the organization

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## 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

# Element of the Asset Management System: Context of the organization

## Understanding needs and expectations of stakeholders

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**STAFF DEVELOPMENT:** We are well aware of the fact that **well-motivated** staff, equipped with expert knowledge and our Company's vision, present our **competitive advantage**. Therefore the progress of Steklarna Hrastnik's employees is based on:

1. Stimulating **entrepreneurial** and **learning culture** at the Company.
2. Carefully **planning the employees' career** progress.
3. Shaping an **attractive working environment**.

**FAMILY FRIENDLY COMPANY:** In the context of an advisory - audit process it was estimated that the set measures introduced in the basic certificate were implemented and the goals were achieved, therefore Steklarna Hrastnik received the full certification. With respect to the basic certificate, the glassworks introduced 16 measures benefited by at least 80% of all employees. In the context of the full certificate, 3 new measures will be added to the existing 16 measures.

**ENVIRONMENTAL PROTECTION:** Care for the environment is our top priority when it comes to strategy and business. Environmentally friendly measures have become part of our daily operations. We meet all legal requirements, and what is more, we follow the laws of nature, which are much stricter.

# Element of the Asset Management System: Context of the organization

## Determining the scope of the physical asset management systems

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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.

## Focus of the Physical Asset Management System

24/7 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.

# Element of the Asset Management System: Leadership

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Vision Mission Values → Leadership and Commitment | Organization Short and long-term Strategical plans | Key Performance indicators | Asset management Policy | Asset Management Systems

Board of directors: regular meetings

## Fundamentals

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

# Element of the Asset management System: Leadership

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**STAFF DEVELOPMENT**

We are well aware of the fact that **well-motivated staff**, equipped with expert knowledge and our Company's vision, present our **competitive advantage**. Therefore the progress of Steklarna Hrastnik's employees is based on:

1. Stimulating entrepreneurial and learning culture at the Company;
2. Carefully planning the employees' career progress;
3. Shaping an attractive working environment.

We develop entrepreneurial and learning culture through:

1. **The competence model,** enabling targeted development of knowledge and competence of our employees and to manage their work performance, while the employees know what the Company expects of them.
2. **The learning system,** which includes:

- The Learning Centre (internal library and lecture room);
- Internal mentors;
- Internal coaches.

# Element of the Asset Management System: Planning

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## Factory long timeframe strategic objectives for main ASSETS (furnaces, production lines,..)

When considering actions that address risk and opportunities, the organization determines the approaches and actions for individual asset, assets systems or asset portfolios.

**Glass quality (seeds/100 gr glass)**

**Pollution risk management:**

- Low emission rate: $NO_x$ (mg/Nm³);
- Low emission rate: $CO_2$ (t/year);
- BAT: water treatment system;
- Fire protection systems.

**Energy management:**

- low furnace energy consumption (kcal/kg) and EUR/kg melted glass over whole LC;
- low electrical consumption kW/t product;
- BAT heat recovery systems.

**Extended furnace life time**

**Financial:**

- ROI, LCP calculation;
- Growth and market performance;
- Profitability & overall financial health;
- cost saving;
- impact of business end product.

**Achieving sustainability**

- Setting sustainability KPI targets
- Measuring sustainability KPIs
- Controlling/optimising performance


**Sustainability KPIs: The Triple Bottom Line**

3Ps: people, planet and profits.

**Legal and regulatory requirements**

- production capacities;
- emissions;
- waste management;
- risk management reports.

**Human capital:**

- health and safety
- values;: purity, passion, heart;
- Know- How, experiences, final technical proposals, installation and start up supervision;
- evaluation of suppliers and consultants information;
- business visiting, training, FAT, commissioning
- team work;
- production optimization and continuous improvements.

**Communities**

**Equal opportunities**

**Quality of life**

# Element of the Asset Management System: Support

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**Communication** Organization develops a communication plan that is designed to develop awareness, understanding and desire of the asset management (system) requirements and expectation. Transparency is vital as part of the asset management system.


**Many proactive maintenance processes fail not because of poor implementation tools but because of the lack of a good communication plan.**

Periodical meetings and minutes:

- all stakeholders are writing their remarks, information,…… between meetings;
- most information for the meeting minutes is written in advance;
- information is supported by pictures, graphs, statements, …
- there is a list of planned visits from visitors (companies): date, name, reason, responsible person;
- all stakeholders dealing with asset management are present;
- meetings are intended to report on minutes issues and their progress;
- no new issues are open during meeting (except critical ones);
- responsible area managers are obliged to inform their teams about meeting conclusions, information and related tasks.

Information: **ACCURATE, UNDERSTANDABLE, VISIBLE**
Repeatedly, in a coordinated way and periodically reapplied

# Element of the Asset Management System: Support

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## Physical assets location hierarchy

CMMS: MAXIMO

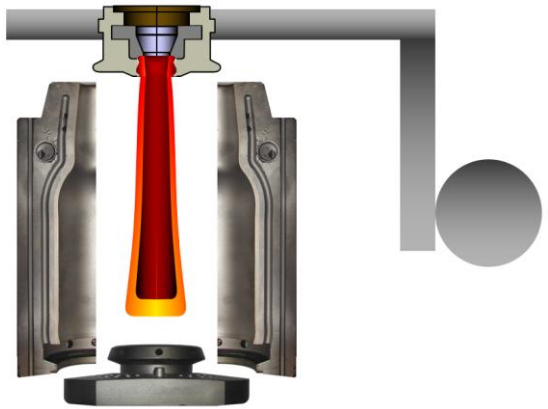
- 0:STEKLARNA HRASTNIK
  - 01:UPRAVNA ZGRADBA
  - 02:SPECIAL
    - 0201:CENTER VODENJA B PEČI
    - 0202:PROIZVODNJA - VROČI DEL
      - 020201:REGENERATOR
      - 020202:B PEČ
      - 020203:FEEDRI (KANALI)
      - 020204:PROIZVODNE LINIJE:PROSTORI
      - 020211:PROIZVODNA LINIJA 1
        - 02021101:LINIJA 1: STROJ IS1

PHYSICAL ASSETS

| Asset | Description |
|---|---|
| 1102 | UPS: GENERAL ELECTRIC SITEPRO 20 KV |
| 1103 | FEEDER MEHANIZEM |
| 1104 | MEHANIZEM: TRN L1 |
| 1105 | MEHANIZEM: ŠAMOTNI VALJ DVIH/SPUST |
| 1106 | MEHANIZEM: ŠAMOTNI VALJ VRTENJE L1 |
| 1107 | MEHANIZEM: ŠKARJE L1 |


Production line 1

Spare parts



# Element of the Asset Management System: Support

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**Information support** The organization ensures that there is a traceable link between the technical asset data inventories and the accounting records. The information system is 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

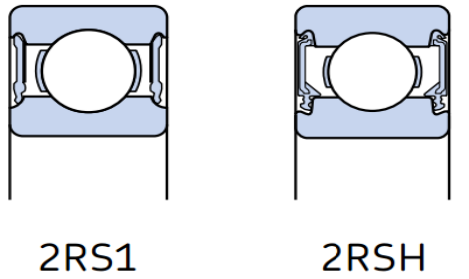
**Only asset specialist can give right „full“ asset (spare part) name**

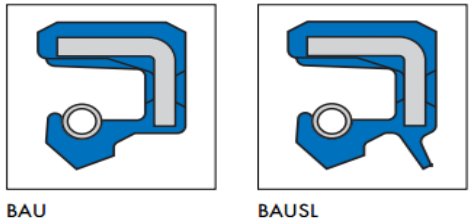
**PHYSICAL ASSET HIERARCHY at IS1 MACHINE location**

| INVENTORY NUMBER | ASSET NAME |
|---|---|
| 0000001 | FEEDER MECHANISM |
| 0000002 | MECHANISM: SPINE |
| 0000003 | MECHANISM: FIREBRICK CYLINDER: UP/DOWN L1 |
| 0000004 | MECHANISM: FIREBRICK CYLINDER: ROTATION L1 |
| 0000005 | MECHANISM: FIREBRICK CYLINDER: SCISSORS L1 |
| 0000006 | MECHANISM: GOB DISTRIBUTOR: SCISSORS L1 |
| 0000007 | **IS1 MACHINE** |
| 0000008 | PIPES AND FIXTURE |
| 0000009 | MECHANISM: SECTION 1: IS1 |
| 0000010 | MECHANISM: SECTION 2: IS1 |
| 0000011 | MECHANISM: SECTION 3: IS1 |
| 0000012 | MECHANISM: SECTION 4: IS1 |
| 0000013 | MECHANISM: SECTION 5: IS1 |
| 0000014 | MECHANISM: SECTION 6: IS1 |
| 0000015 | MECHANISM: SECTION 7: IS1 |
| 0000016 | MECHANISM: SECTION 8: IS1 |
| 0000017 | VALVE: PROPORTIONAL VALVE: FINAL BLOW 1 |
| 0000018 | VALVE: PROPORTIONAL VALVE: COUNTER 1 |

**SPARE PARTS OF THE PARTICULAR ASSET (e.g.)**

| SPARE P. NUMBER | SPARE PART NAME |
|---|---|
| 10001 | BALL BEARING 6202-2RSL |
| 10002 | BALL BEARING 62202-2RS1 |
| 10003 | BEARING 22210 |
| 10004 | V-BELT SPC5000 |
| 10005 | V-BELT 22×5000 |
| 10006 | SEALING RING BAU 15×24×5 |
| 10007 | SEALING RING BAFUDSL 15×24×7 |




**Challenge: Right alternative spare part name?**
Pricing, delivery times, suppliers, detailed documentation, ..

**Challenge: WHEN?** ⟹ **Before asset order**

**Beside dimensions, other information are essential**

# Element of the Asset Management System: Operation

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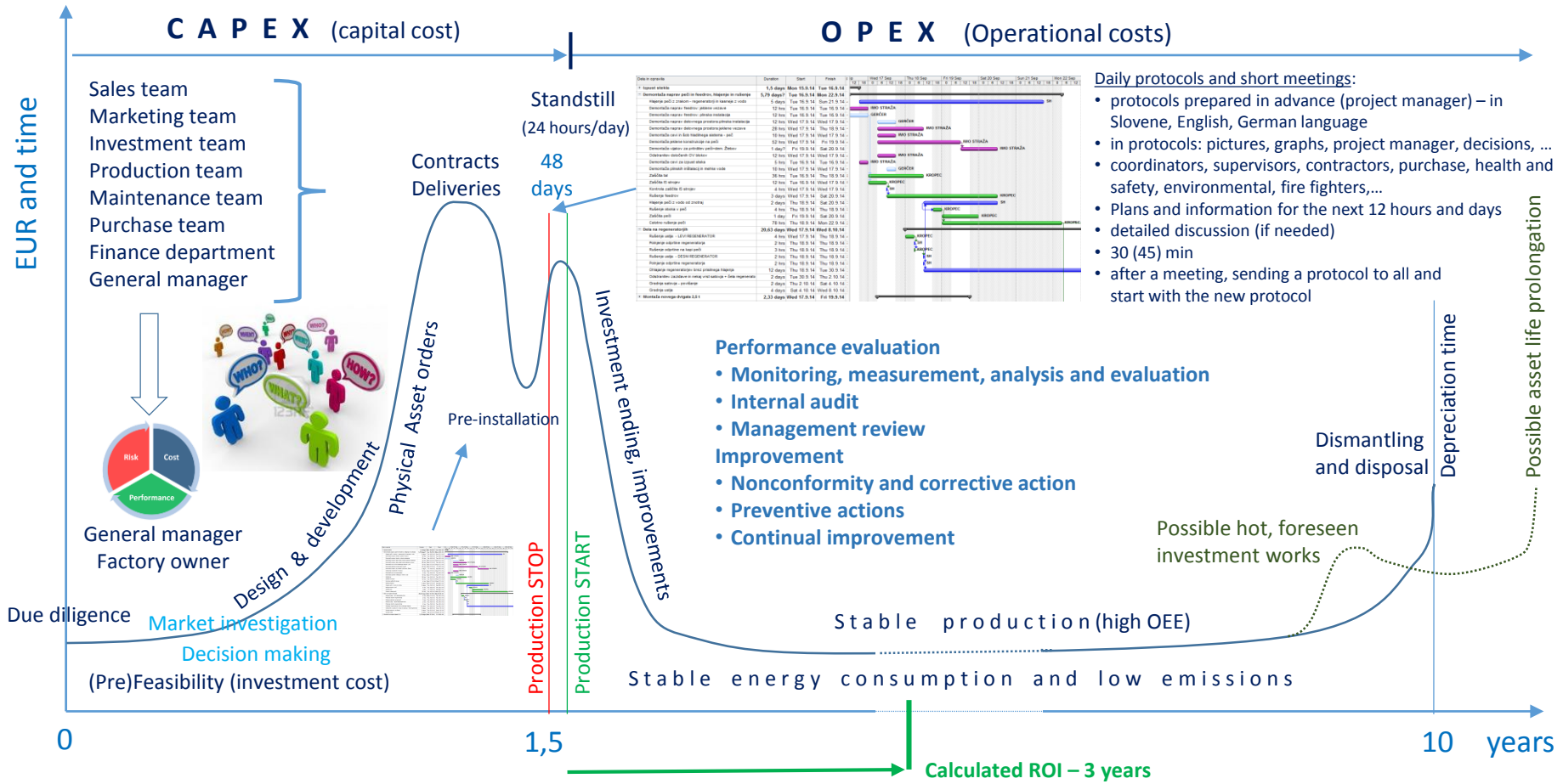
## Life cycle physical asset management plan



# Element of the Asset Management System: Performance evaluation

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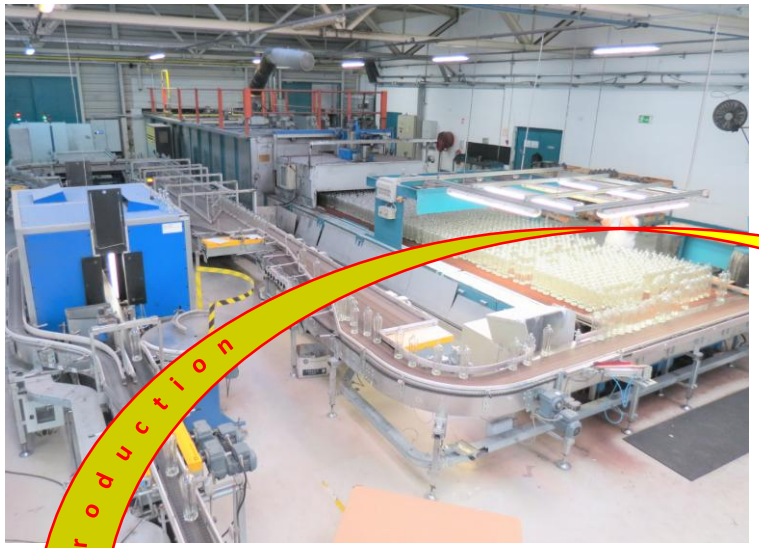
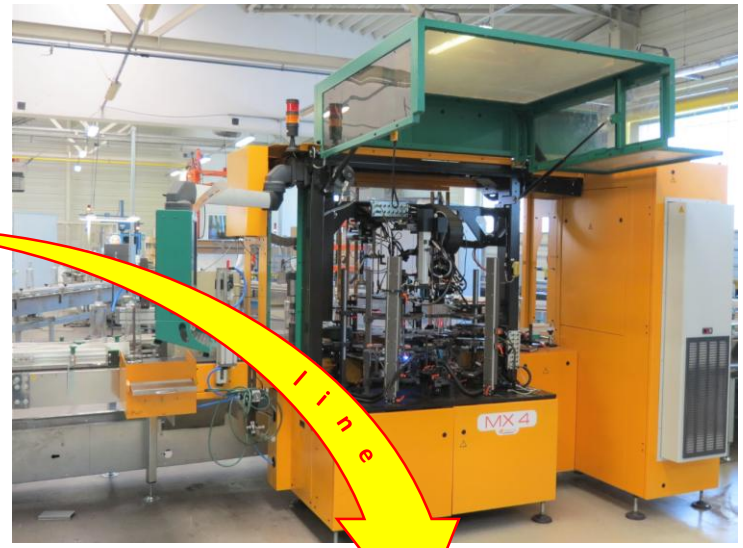
**Remark ISO 55002:** Monitoring, measurements, analysis and evaluation cover some of the most complex and important areas which need to be addressed by an asset management system. In many cases multiple legal and regulatory requirements relating to monitoring, measurements, analysis and evaluation have to be considered, proper understood, and fully adhered to.

Glass from the furnace

1st sensor:
gob counting pcs/min



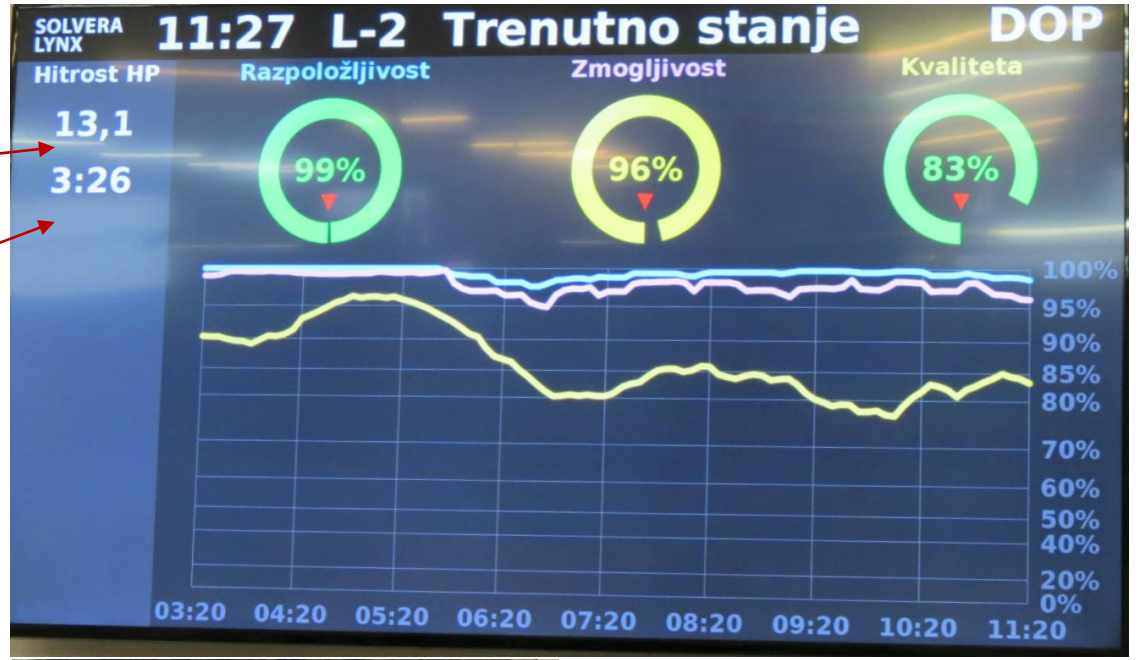
14 sensors in one (1) production line

# Element of the Asset management System: Performance evaluation

HRASTNIK 1860
PURITY · PASSION · QUALITY


**Measuring OEE – container production.** All data are connected to factory main computerized management system.

**Availability × Performance × Quality**




**Speed of the annealing in cm per minute**

**Time in the annealing lehr for the container in hours**



**ON-LINE screens in the production**

# Element of the Asset Management System: Performance evaluation

HRASTNIK 1860
PURITY · PASSION · QUALITY


- Natural gas „melting – furnace“ (Nm³)
- Natural gas „factory“(Nm³)
- Electricity „factory“ (kWh)
- Compressed air HP (Sm³)
- Electricity „melting - furnace“ (kWh)
- Compressed air LP (Sm³)
- Water (m³)

There are several KPI monitored on-line: **MIN MAX AVG TARGET ACTUAL**

| Podatek | MIN | MAX | AVG | Cilj | 28.09.2017 |
|---|---|---|---|---|---|
| ZP Talilni prostor B peč [Nm3]<br>Energenti --> Zemeljski plin | 17.633,0 | 19.711,0 | 18.815,5 | 18.988,5<br>Drugi vir | 18.752,0 |
| ZP MRP Podkraj [Nm3]<br>Energenti --> Zemeljski plin | 24.548,0 | 26.858,0 | 25.742,9 | 27.189,0<br>Drugi vir | 25.489,0 |
| EE Obračunski števec SPECIAL [kWh]<br>PE_Special --> EM03_UPS | 47.482,2 | 51.122,4 | 49.165,1 | 49.935,8<br>Drugi vir | 48.481,2 |
| Proizvodnja komprimiranega zraka VT SH [Sm3]<br>Energenti --> Komprimiran zrak | 4.801,5 | 6.051,5 | 5.209,6 | 6.000,0<br>Konstanta | 4.596,0 |
| Elektrokurjenje B peč TP skupno [kWh]<br>PE_Special --> Preračuni | 11.841,0 | 13.957,0 | 12.831,0 | 13.352,1<br>Drugi vir | 12.762,0 |
| KZ Proizvodnja komprimiranega zraka NT - preračun [Sm3]<br>Energenti --> Komprimiran zrak | 88.825,8 | 126.050,1 | 113.031,1 | 125.000,0<br>Konstanta | 107.489,0 |
| Skupna poraba vode PE Special [m3]<br>Energenti --> Voda | 27,9 | 128,1 | 60,6 | 70,0<br>Konstanta | 43,9 |

**Detailed monitoring**

VO PES tehnologija [m3] - september, 2017

**Fresh water in m³**

| Ura / Dan | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 01:00 | 1 | 3 | 3 | 0 | 1 | 0 | 3 | 1 | 0 | 3 | 0 | 2 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |
| 02:00 | 0 | 2 | 2 | 1 | 1 | 1 | 2 | 0 | 1 | 4 | 1 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | |
| 03:00 | 1 | 4 | 1 | 0 | 0 | 0 | 3 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | |
| 04:00 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 3 | 1 | 2 | 2 | 1 | 2 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | |
| 05:00 | 1 | 1 | 1 | 0 | 2 | 0 | 1 | 2 | 0 | 1 | 0 | 0 | 0 | 4 | 1 | 0 | 3 | 0 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | |
| 06:00 | 2 | 0 | 1 | 2 | 0 | 2 | 0 | 0 | 1 | 0 | 1 | 1 | 1 | 2 | 0 | 2 | 2 | 1 | 1 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | 0 | |
| 07:00 | 2 | 1 | 1 | 0 | 2 | 2 | 1 | 1 | 0 | 1 | 0 | 0 | 0 | 3 | 1 | 1 | 3 | 1 | 0 | 0 | 1 | 14 | 0 | 1 | 0 | 0 | 2 | 1 | 1 | |
| 08:00 | 2 | 3 | 7 | 1 | 1 | 3 | 0 | 2 | 4 | 2 | 2 | 1 | 1 | 2 | 1 | 0 | 2 | 1 | 2 | 2 | 0 | 42 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | |
| 09:00 | 2 | 10 | 11 | 0 | 3 | 0 | 1 | 6 | 0 | 5 | 5 | 1 | 13 | 2 | 2 | 1 | 4 | 2 | 0 | 7 | 1 | 42 | 1 | 1 | 0 | 0 | 1 | 1 | 2 | |
| 10:00 | 1 | 9 | 8 | 1 | 2 | 1 | 0 | 17 | 1 | 0 | 12 | 3 | 15 | 1 | 1 | 2 | 2 | 10 | 1 | 10 | 1 | 37 | 0 | 2 | 12 | 2 | 0 | 1 | 5 | |
| 11:00 | 0 | 1 | 0 | 1 | 12 | 1 | 4 | 5 | 6 | 1 | 9 | 2 | 36 | 0 | 1 | 3 | 1 | 11 | 0 | 11 | 0 | 37 | 0 | 3 | 39 | 2 | 3 | 6 | 11 | |
| 12:00 | 1 | 1 | 1 | 1 | 7 | 29 | 1 | 8 | 11 | 0 | 4 | 4 | 19 | 1 | 12 | 3 | 0 | 2 | 0 | 12 | 1 | 38 | 1 | 0 | 40 | 6 | 11 | 5 | 10 | |
| 13:00 | 1 | 1 | 0 | 0 | 2 | 1 | 1 | 9 | 10 | 2 | 0 | 4 | 12 | 2 | 11 | 1 | 1 | 1 | 1 | 12 | 0 | 7 | 0 | 1 | 40 | 2 | 12 | 3 | 2 | |
| 14:00 | 3 | 0 | 1 | 1 | 0 | 0 | 0 | 9 | 5 | 3 | 2 | 2 | 2 | 0 | 10 | 1 | 1 | 2 | 0 | 3 | 3 | 3 | 1 | 2 | 41 | 3 | 10 | 2 | 0 | |
| 15:00 | 0 | 1 | 3 | 2 | 1 | 1 | 1 | 2 | 0 | 3 | 0 | 2 | 1 | 1 | 11 | 0 | 0 | 3 | 0 | 0 | 2 | 3 | 2 | 3 | 41 | 2 | 2 | 3 | 2 | |
| 16:00 | 1 | 1 | 3 | 3 | 0 | 1 | 1 | 5 | 1 | 2 | 1 | 0 | 1 | 1 | 12 | 1 | 1 | 2 | 1 | 1 | 2 | 2 | 3 | 2 | 41 | 1 | 0 | 2 | 3 | |
| 17:00 | 0 | 1 | 2 | 3 | 1 | 3 | 2 | 11 | 1 | 4 | 0 | 2 | 0 | 0 | 13 | 0 | 1 | 3 | 1 | 0 | 0 | 3 | 2 | 3 | 31 | 0 | 1 | 1 | 2 | |
| 18:00 | 2 | 0 | 4 | 0 | 1 | 1 | 2 | 11 | 0 | 1 | 1 | 0 | 1 | 3 | 7 | 2 | 1 | 2 | 2 | 3 | 1 | 2 | 3 | 0 | 2 | 1 | 0 | 1 | 0 | |
| 19:00 | 0 | 1 | 2 | 1 | 0 | 0 | 3 | 11 | 0 | 0 | 0 | 1 | 0 | 0 | 3 | 1 | 3 | 1 | 3 | 4 | 0 | 3 | 1 | 2 | 0 | 2 | 1 | 1 | 1 | |
| 20:00 | 1 | 1 | 3 | 1 | 1 | 1 | 4 | 7 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 2 | 0 | 0 | 3 | 1 | 0 | 0 | 1 | 1 | 0 | 0 | 2 | 0 |
| 21:00 | 0 | 1 | 2 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 2 | 1 | 0 | 3 | 0 | 2 | 1 | 0 | 2 | 0 | 1 | 1 | 1 | 0 | 1 | 1 | 0 | 0 | |
| 22:00 | 1 | 1 | 3 | 1 | 1 | 3 | 0 | 1 | 1 | 0 | 1 | 3 | 1 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | |
| 23:00 | 1 | 0 | 0 | 0 | 0 | 3 | 1 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 0 | 1 | 1 | 1 | |
| 00:00 | 2 | 1 | 2 | 1 | 1 | 2 | 2 | 1 | 2 | 1 | 3 | 1 | 1 | 2 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | | |
| Skupaj | 26 | 47 | 60 | 21 | 41 | 55 | 31 | 110 | 47 | 45 | 36 | 108 | 29 | 100 | 23 | 36 | 47 | 17 | 73 | 18 | 238 | 20 | 27 | 296 | 28 | 49 | 33 | 42 | | |

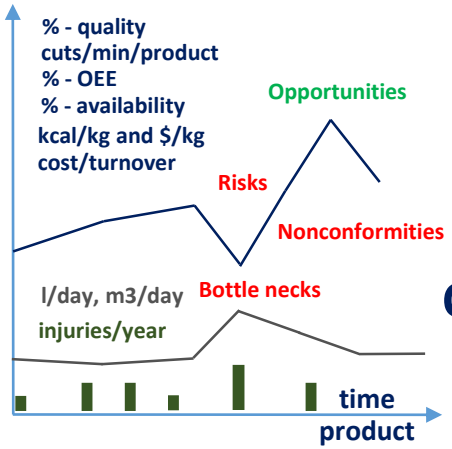
**Alarming**

# Element of the Asset management System: Improvement

HRASTNIK 1860
PURITY · PASSION · QUALITY

## Nonconformity and corrective action

**Remark ISO 55002:** The organization should be aware of the fact that nonconformity will occur in assets, assets management and asset management systems and, as such, should determine how to minimize adverse effects.




Corrective actions

Evaluation

Continuous improvements


**Information: ACCURATE, UNDERSTANDABLE, VISIBLE**
Repeatedly, in a coordinated way and periodically reapplied

# Standards and rewards

HRASTNIK 1860
PURITY · PASSION · QUALITY

- ISO 9001:2008
- SMETA 4 Audit Report
- HACCP Certificate
- SQP Certificate
- Vitrux Certificate
- Cerfiticate of Excellence AAA
- EBA National Champion
- Family Friendly Enterprise
- Red Dot Design Award

2015

AAA®

Highest Creditworthiness Rating
©Soliditet

A Bisnode Solution

Bisnode Slovenia has the honour
to certify that:

STEKLARNA HRASTNIK d.o.o.

Company's Name

5254132

Business ID

belongs to the highest class of credit worthiness in Slovenia.

The company has fulfilled credit worthiness criteria for 2015
and therefore belongs to the top Slovene companies that are allowed to use the status AAA
as a symbol of high Credit Rating Excellence.

Date: Ljubljana, November 17th, 2015

Bisnode d.o.o.
Maria Anselmi
General Manager

Bisnode

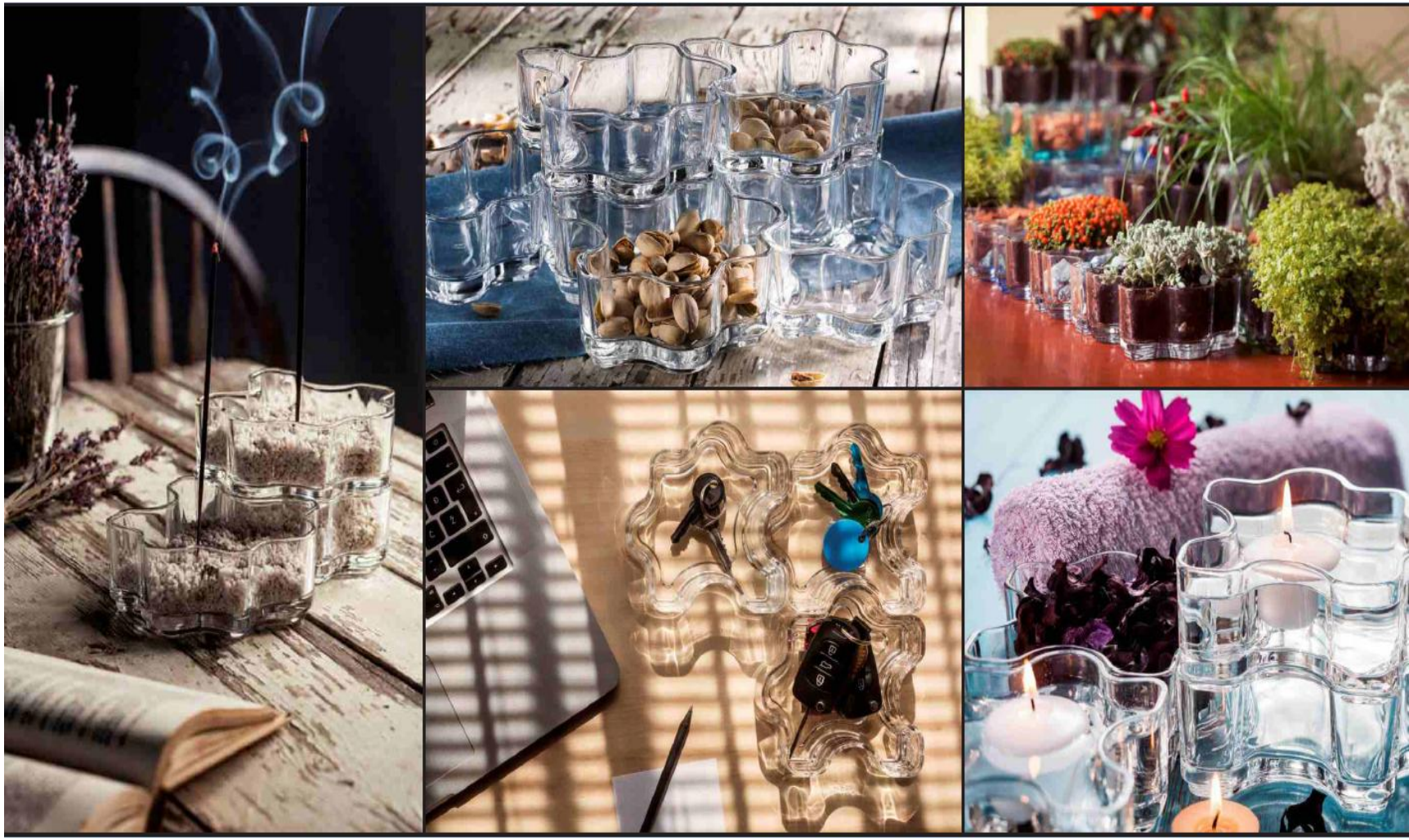
Bisnode d.o.o., Likozarjeva ulica 3, 1000 Ljubljana, T: 00386 80 39 03, E: info@bisnode.si, www.bisnode.si/aaa

# Novelties

HRASTNIK 1860
PURITY · PASSION · QUALITY

## Puzzle - Bowl

reddot design award
product design



15th INTERNATIONAL OPERATIONS & MAINTENANCE CONFERENCE IN THE ARAB COUNTRIES
UNDER THE THEME: **"SMART MAINTENANCE"** CONICIDE WITH THE 15TH ARAB MAINTENANCE EXHIBITION

# Slovenian experience in operations and maintenance

**Janez Tomažin, Samo Ulaga, Viktor Lovrenčić**

# CM methods in Slovene industry – practical examples

**Samo Ulaga**

# What is the role of CM?

- Potential failures are identified in advance.
- Assessment of equipment performance. Establishing compliance with legal requirements.
- Severity of consequences is substantially diminished by reducing or preventing potential secondary damage (cost of safety hazards, cost of the lost production, cost of restoring equipment under crisis situation, cost of environmental impact, cost of lost reputation …).
- Important source of information needed for finding the root cause of the problem (reduced product quality, increased energy consumption, increased production cost, extensive wear…).
- Measure of maintenance task quality control.
- …

# What is reality in Slovenia?

Appreciation and attitude regarding CM are often branch of industry dependent.

# Example - steelworks

# Some cognitions

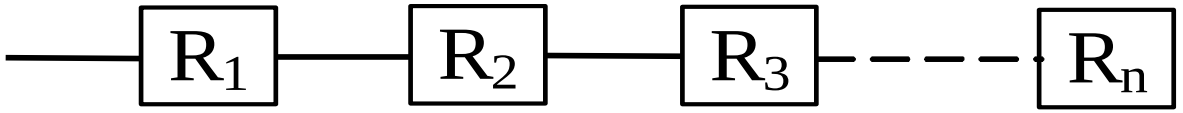
- Introduction of new condition monitoring techniques into daily maintenance routine is often underestimated and therefore not very successful project.
- Benefits of applying such methods are not well explained to the staff to be accepted as powerful tool in improving AM efficiency. Activities are regarded as additional workload. Consequently staff is often not cooperative and difficult to stimulate => no initiative for CM.
- It is necessary to clearly define goals, advantages, work loads, tasks and responsibilities before the process can be initiated.
- It is a question of evolution process, no step-change in attitude should be expected!

# Some typical applications of CM

- CM **as preventive measure**. By performing measurements periodically using portable devices or using on-line systems potential failures are identified in advance.

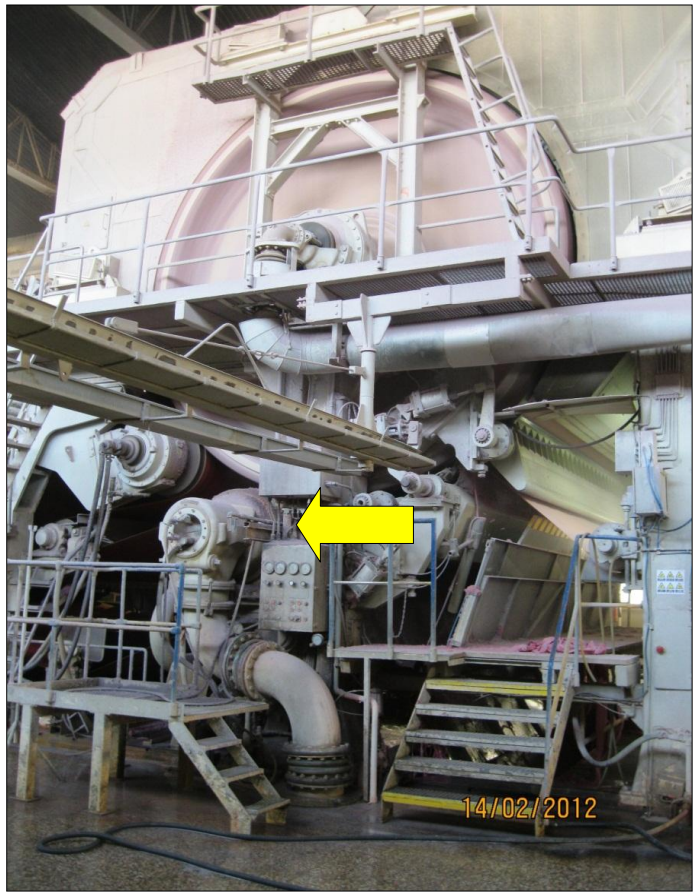
# CM – preventive measure

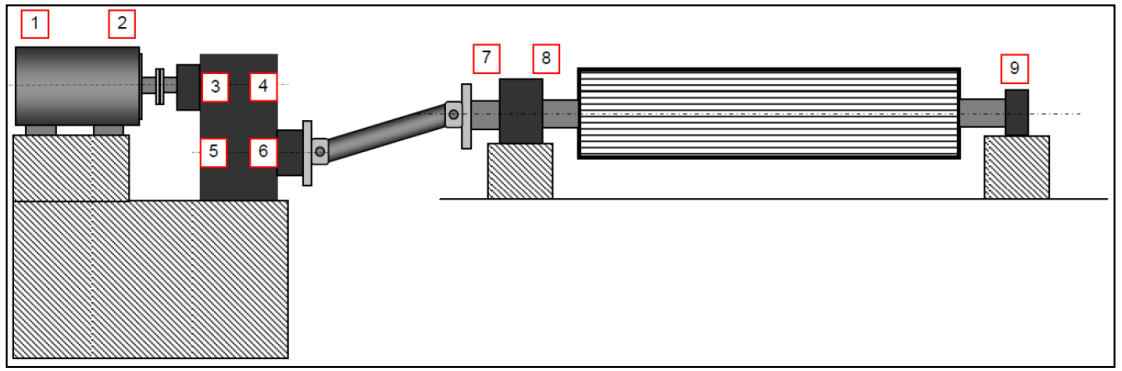
- Paper machine is a typical system with components in a serial configuration.




$$R_s = R_1 \times R_2 \times \ldots \times R_n$$

Failure of **any** element means **immediate production stoppage**.


14/02/2012


1
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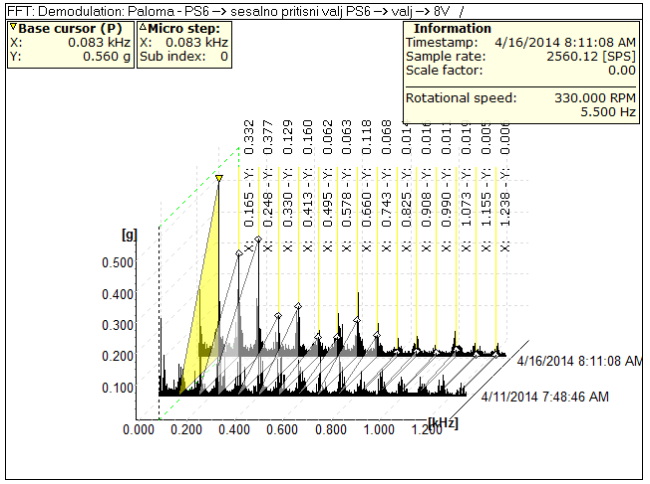
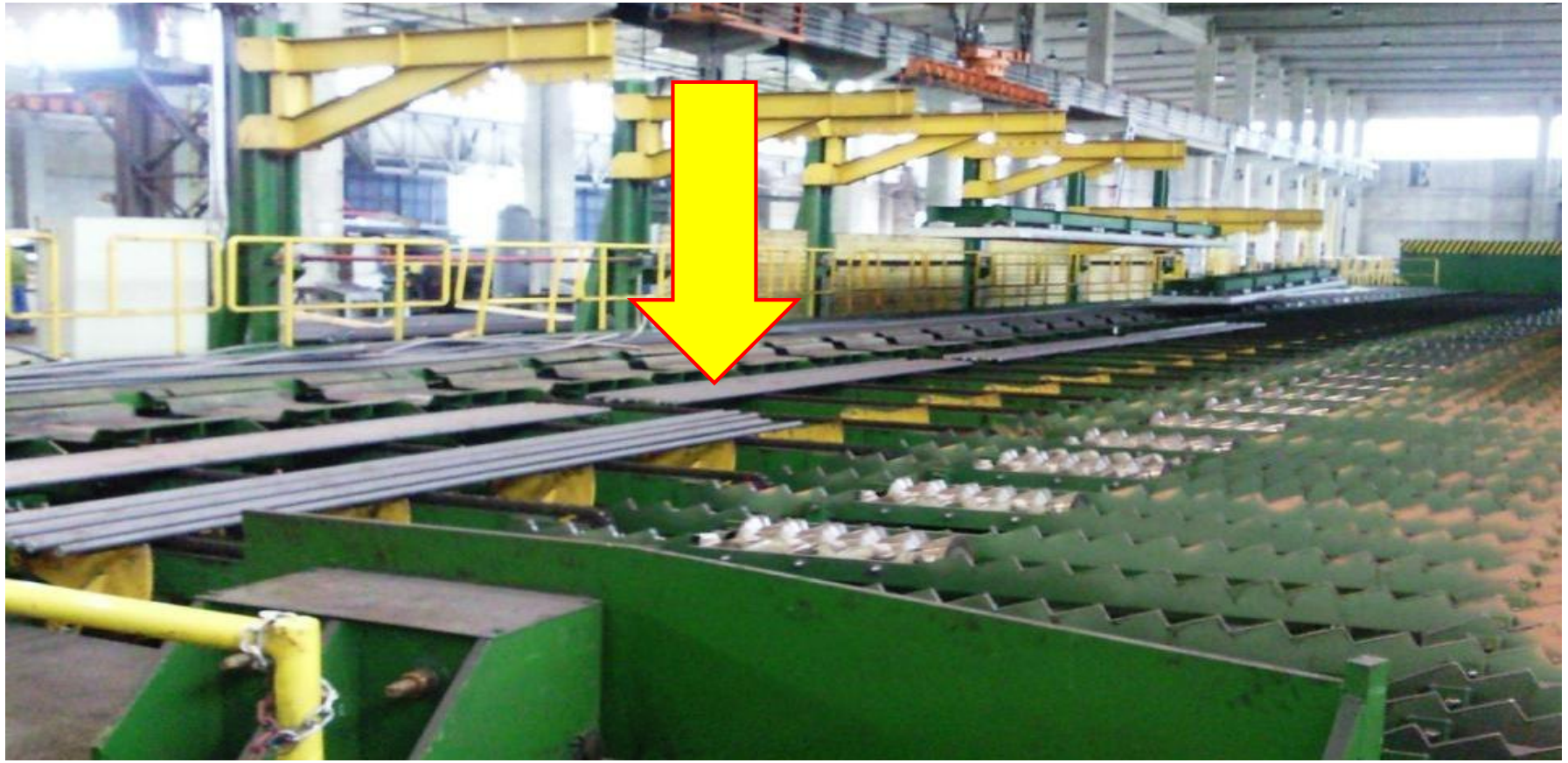

FFT: Demodulation: Paloma - PS6 –> sesalno pritisni valj PS6 –> valj –> 8V /
Base cursor (P)
X: 0.083 kHz
Y: 0.560 g
Micro step:
X: 0.083 kHz
Sub index: 0
Information
Timestamp: 4/16/2014 8:11:08 AM
Sample rate: 2560.12 [SPS]
Scale factor: 0.00
Rotational speed: 330.000 RPM
5.500 Hz
[g]
0.500
0.400
0.300
0.200
0.100
0.000
0.200
0.400
0.600
0.800
1.000
1.200
[kHz]
4/16/2014 8:11:08 AM
4/11/2014 7:48:46 AM

# Some typical applications of CM

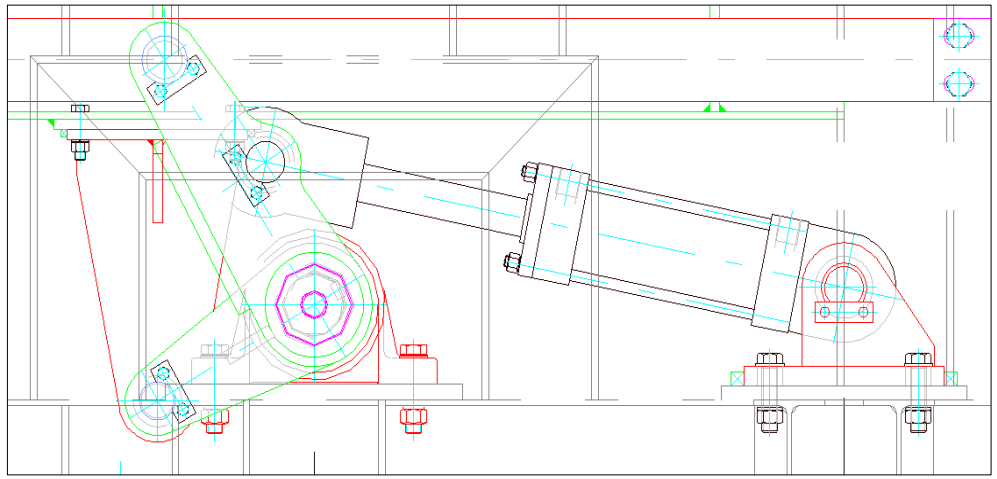
- **Troubleshooting**: CM methods are used when problems already appear.

# Continuous casting machine

- Frequent breakdowns of piston rods due to bad design and installation.

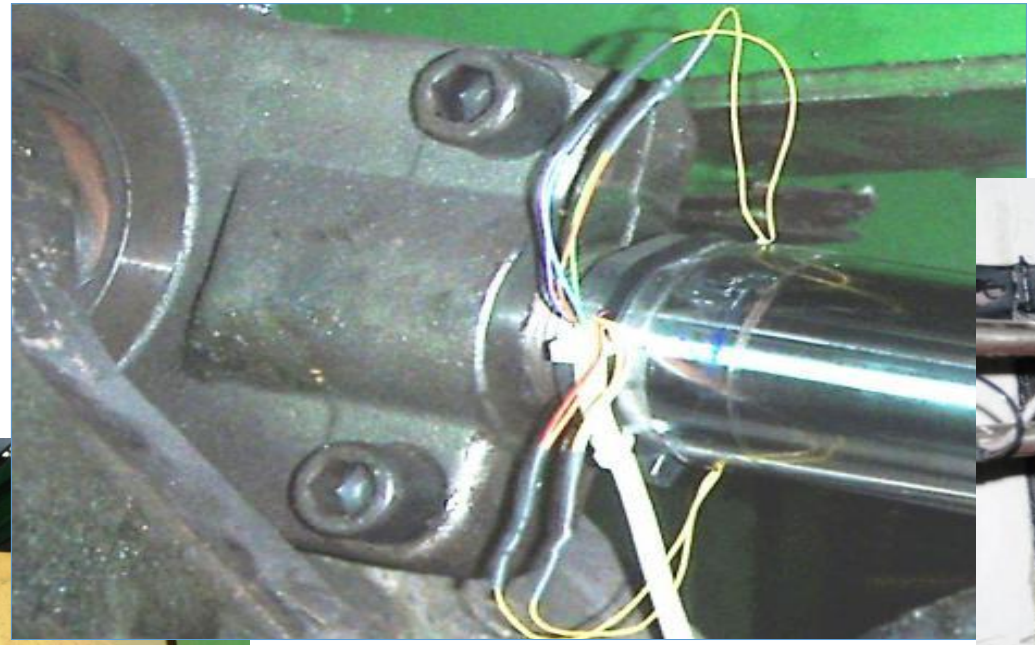


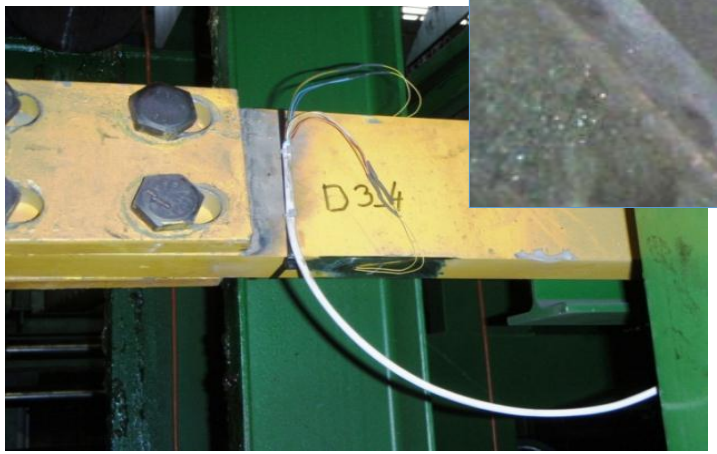
- Five hydraulic cylinders for lifting bar mechanism.

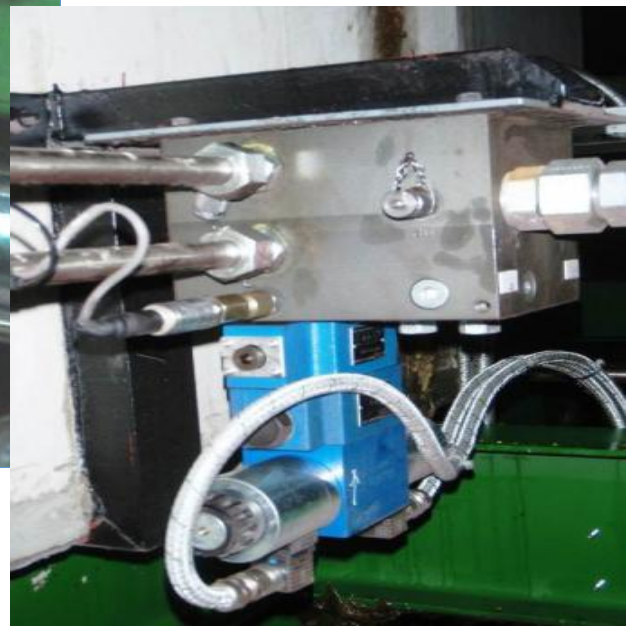


# Applied CM method

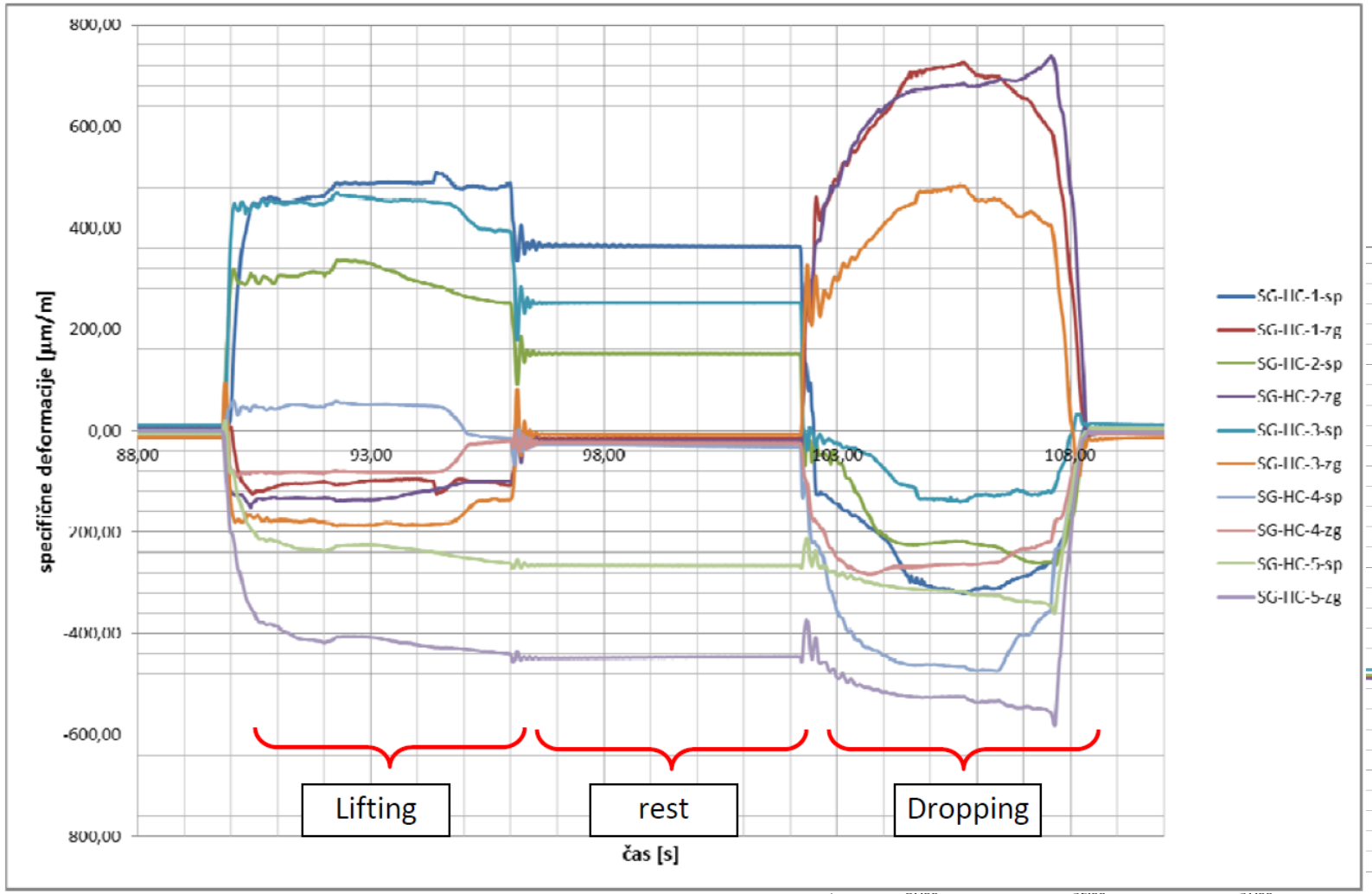
- Strain gauges installed on piston rods and connecting beams.
- Oil pressure sensors installed.





# Findings


800,00
600,00
400,00
200,00
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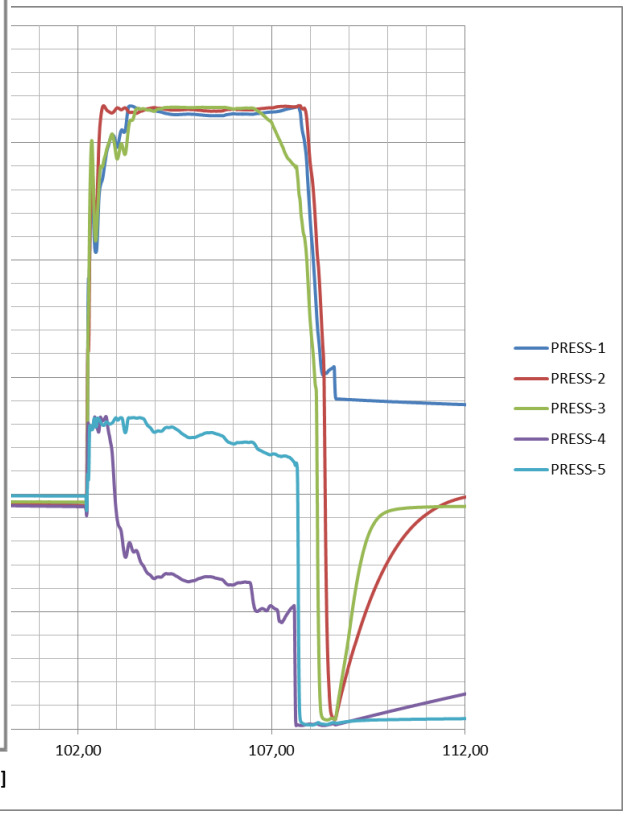
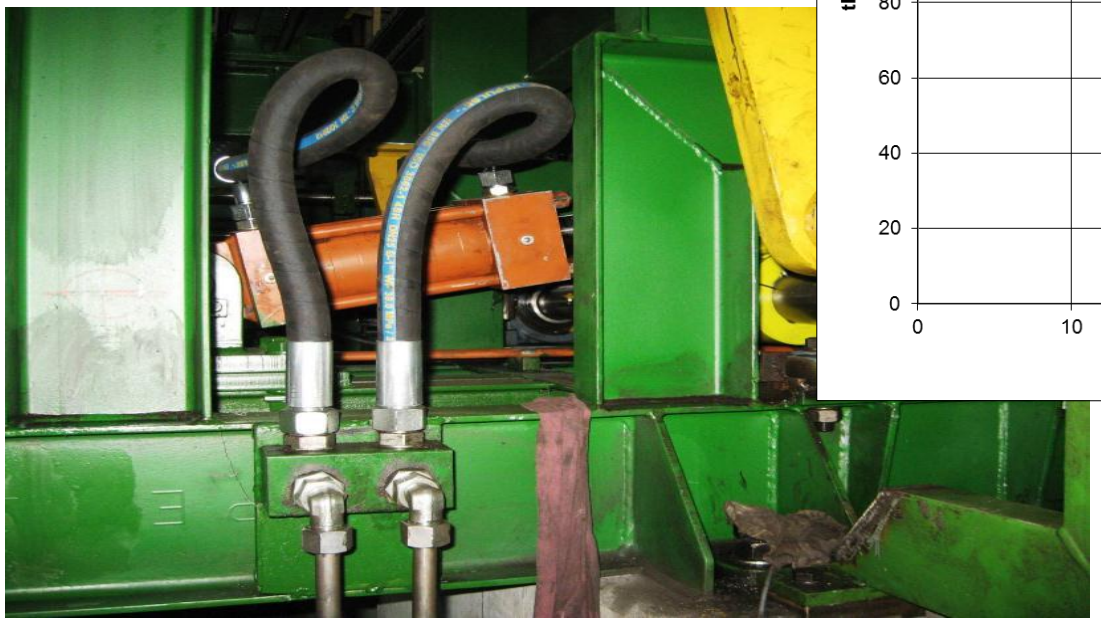
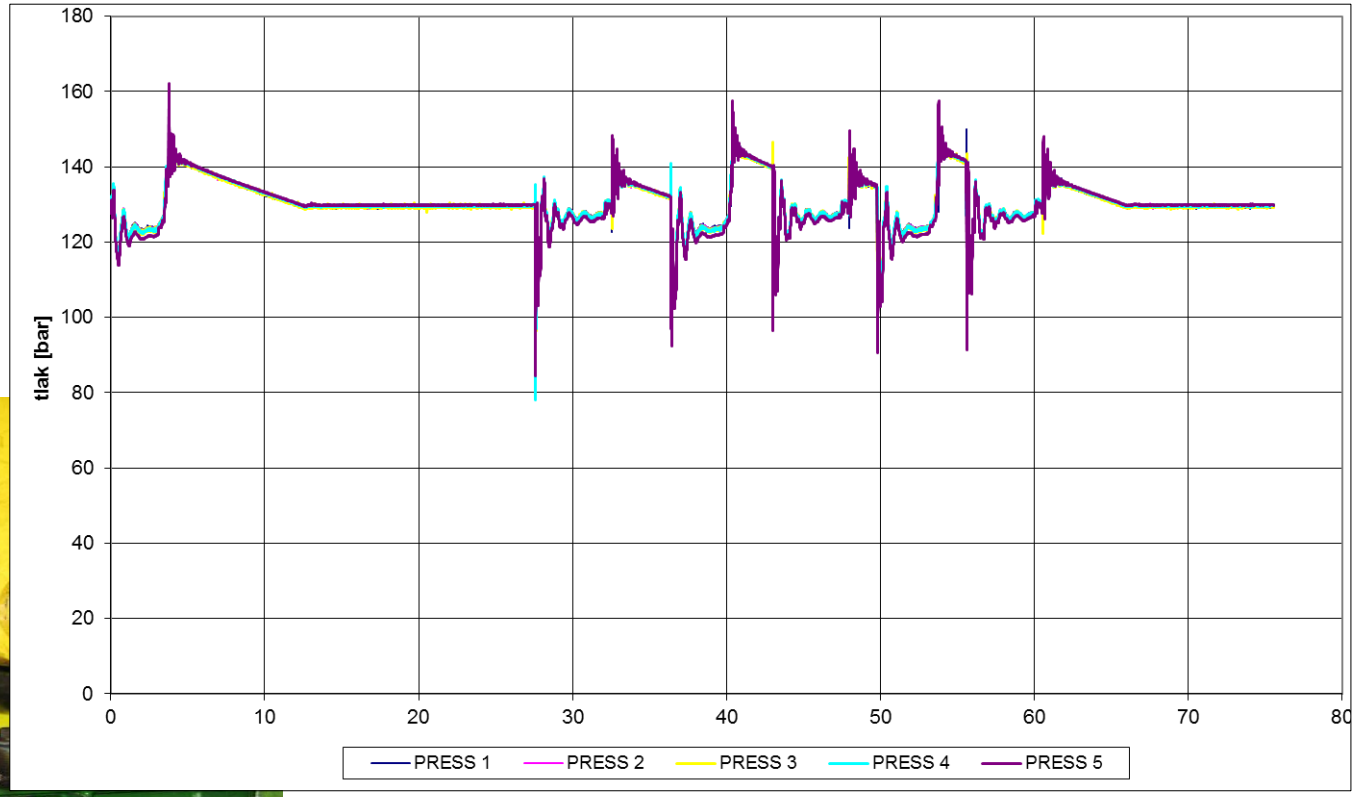
-400,00
-600,00
-800,00
88,00
93,00
98,00
103,00
108,00
specifične deformacije [µm/m]
čas [s]
Lifting
rest
Dropping
SG-HC-1-sp
SG-HC-1-zg
SG-HC-2-sp
SG-HC-2-zg
SG-HC-3-sp
SG-HC-3-zg
SG-HC-4-sp
SG-HC-4-zg
SG-HC-5-sp
SG-HC-5-zg


102,00
107,00
112,00
čas [s]
PRESS-1
PRESS-2
PRESS-3
PRESS-4
PRESS-5

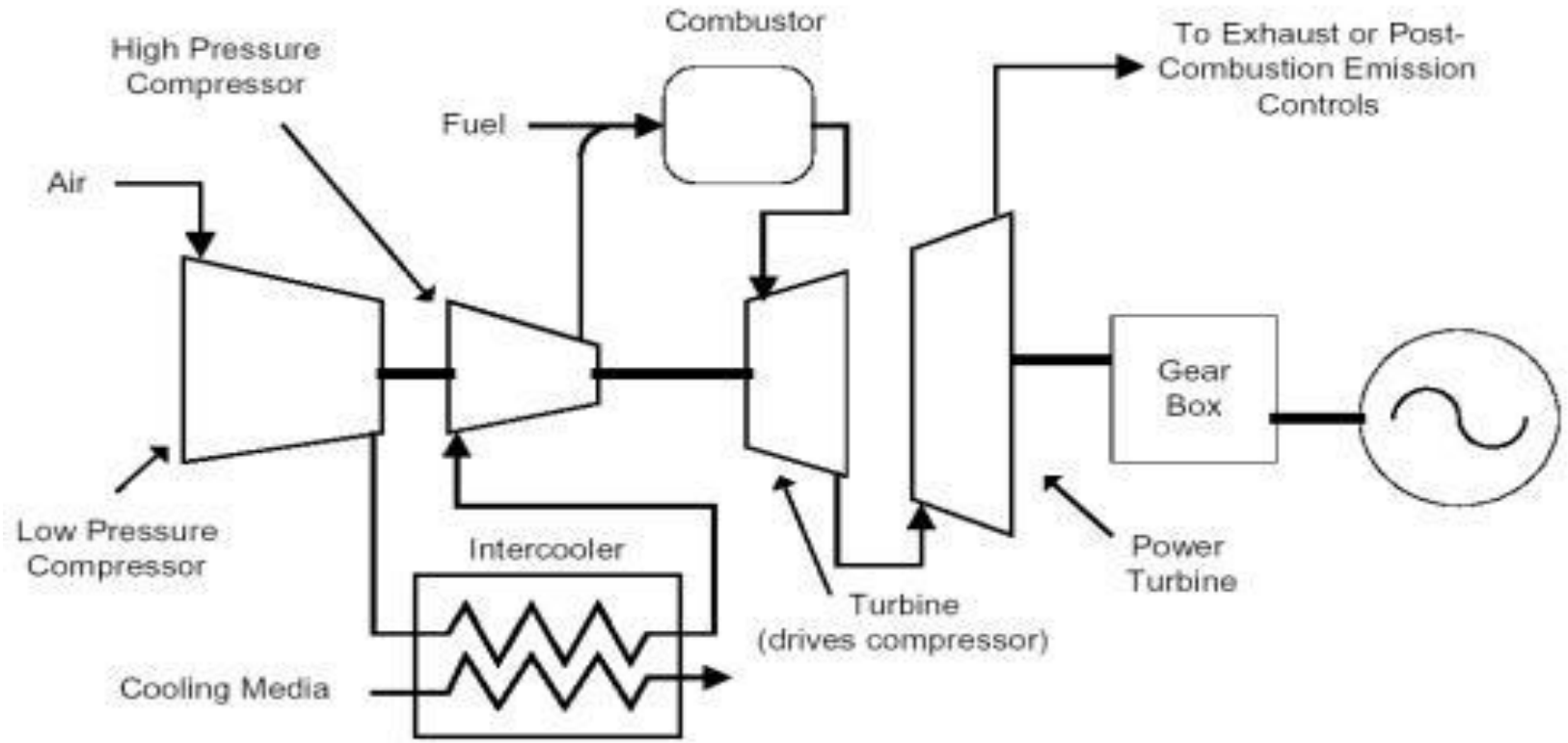
# Redesign and setup





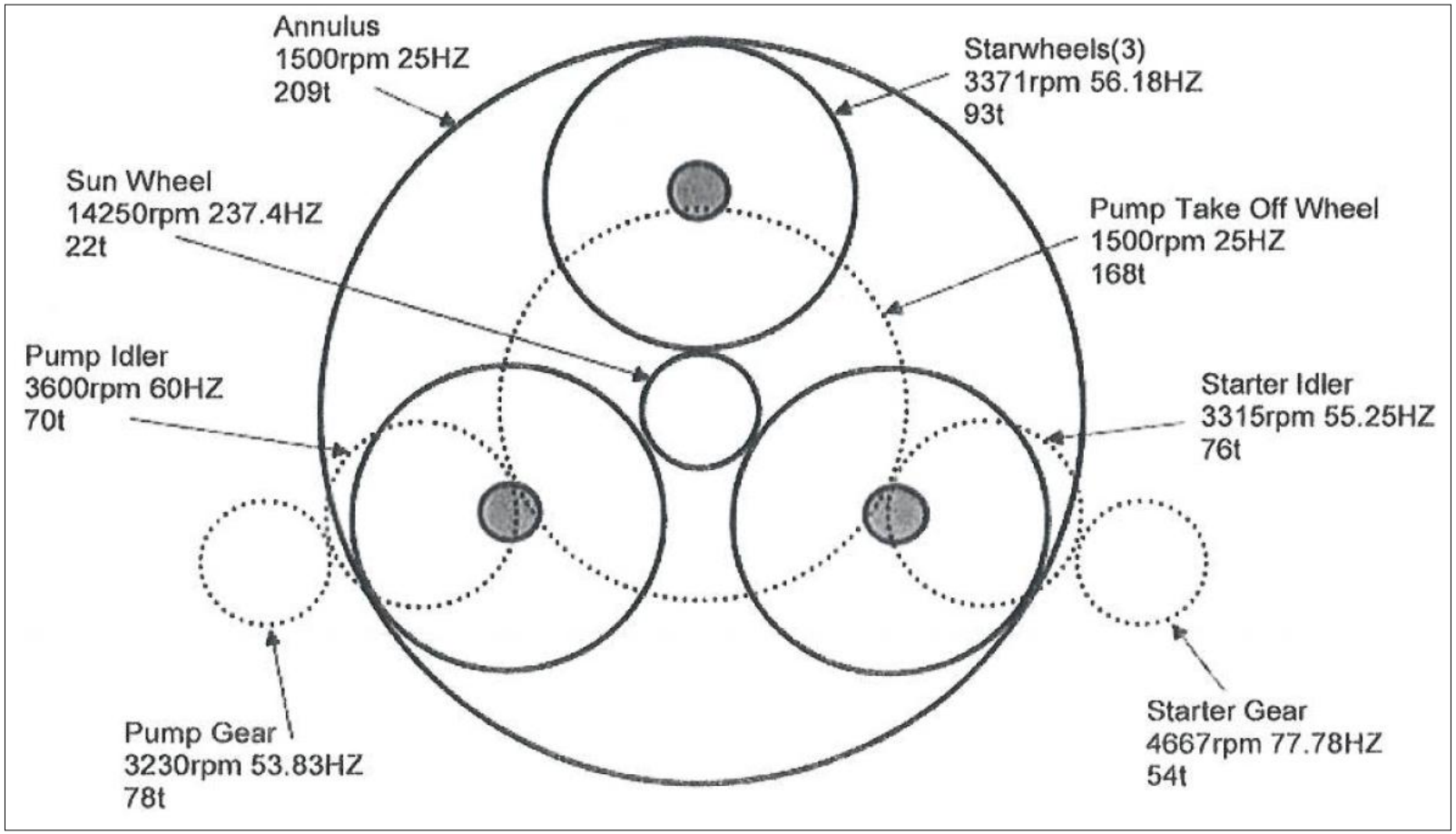
# Gas turbine

- Increased vibration, noise.

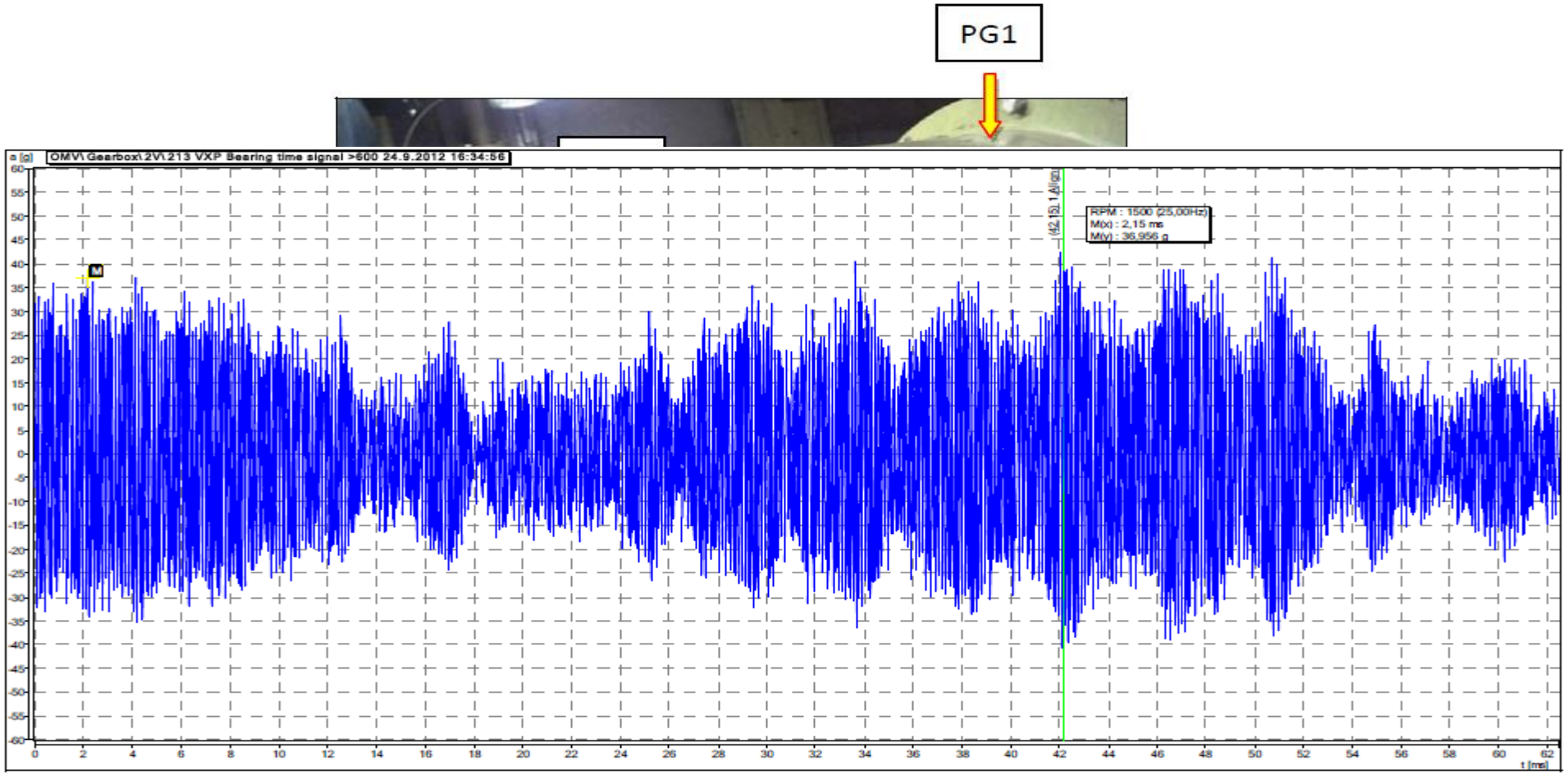


# Applied CM method

- Vibration measurements.

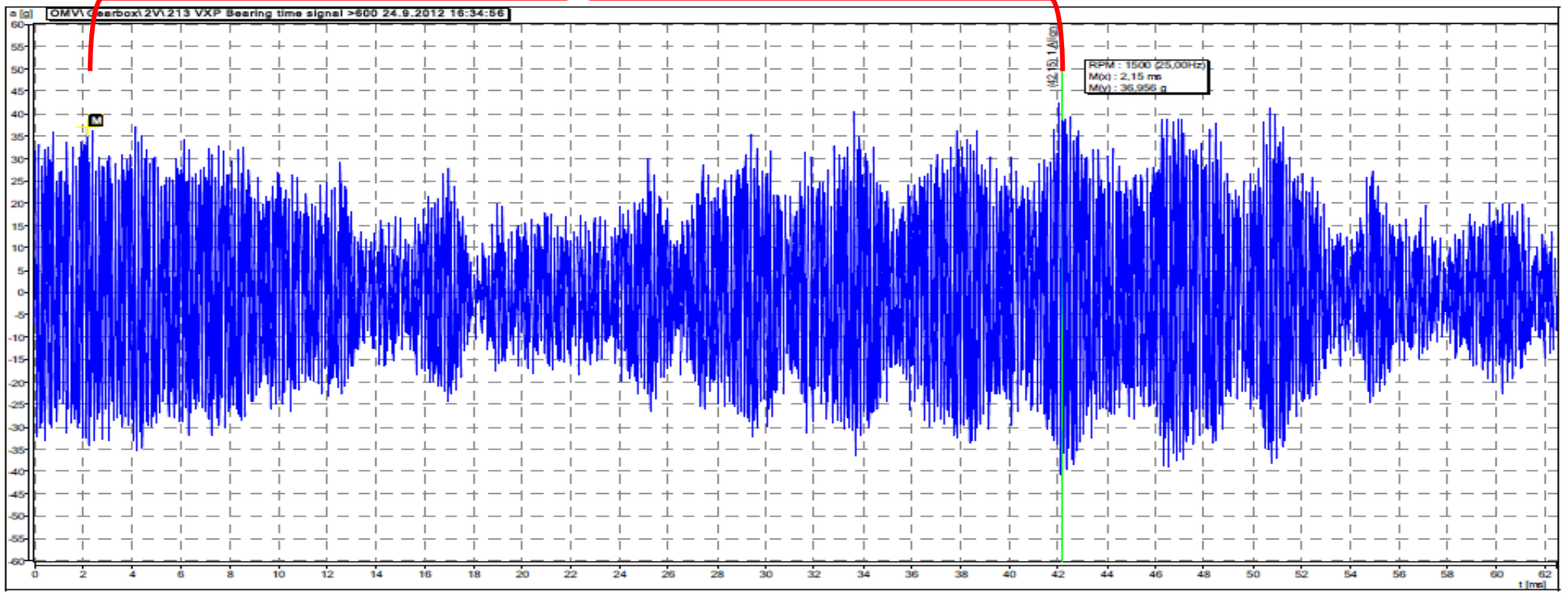


# Findings


PG1
OMV\ Gearbox\ 2V\ 213 VXP Bearing time signal >600 24.9.2012 16:34:56
RPM : 1500 (25,00Hz)
M(x) : 2,15 ms
M(y) : 36,956 g

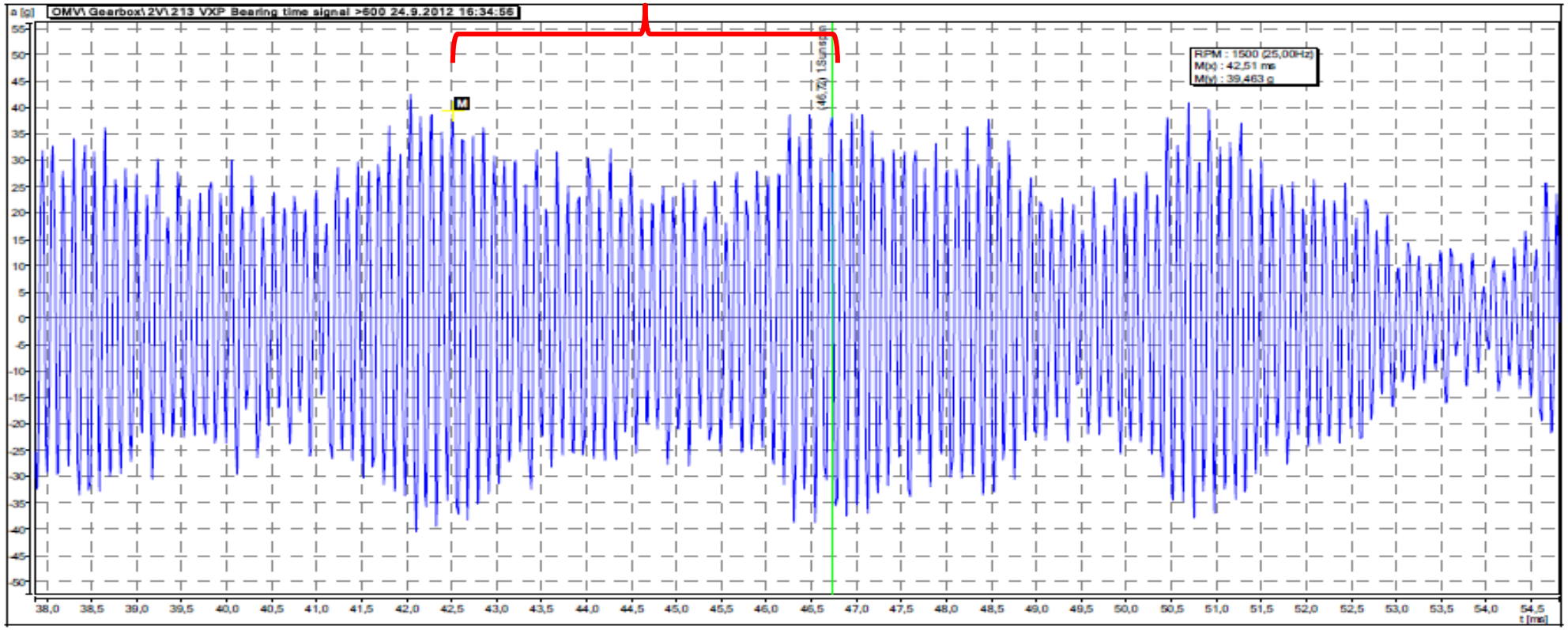
# Findings

Generator shaft frequency



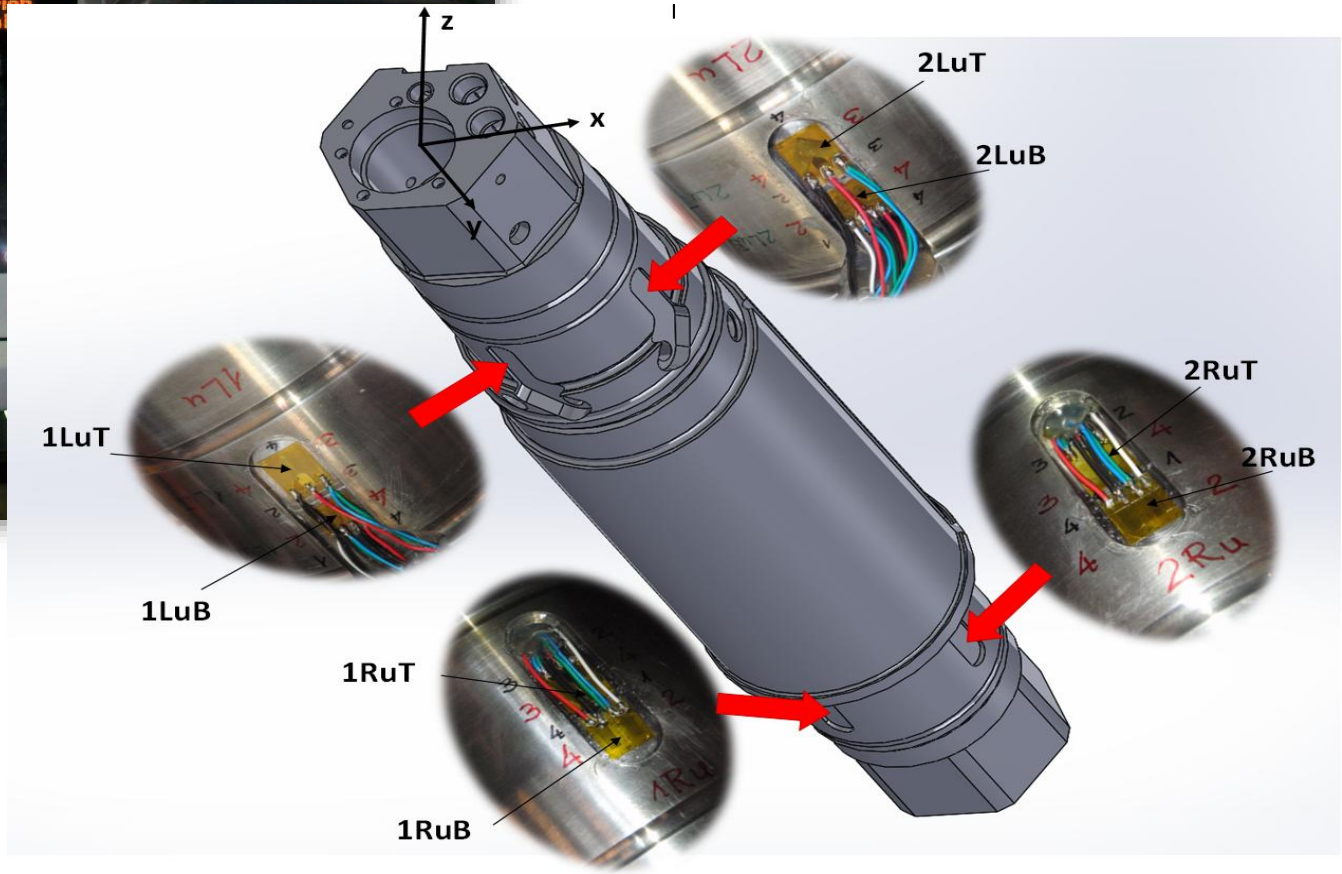
# Findings

Sun wheel frequency

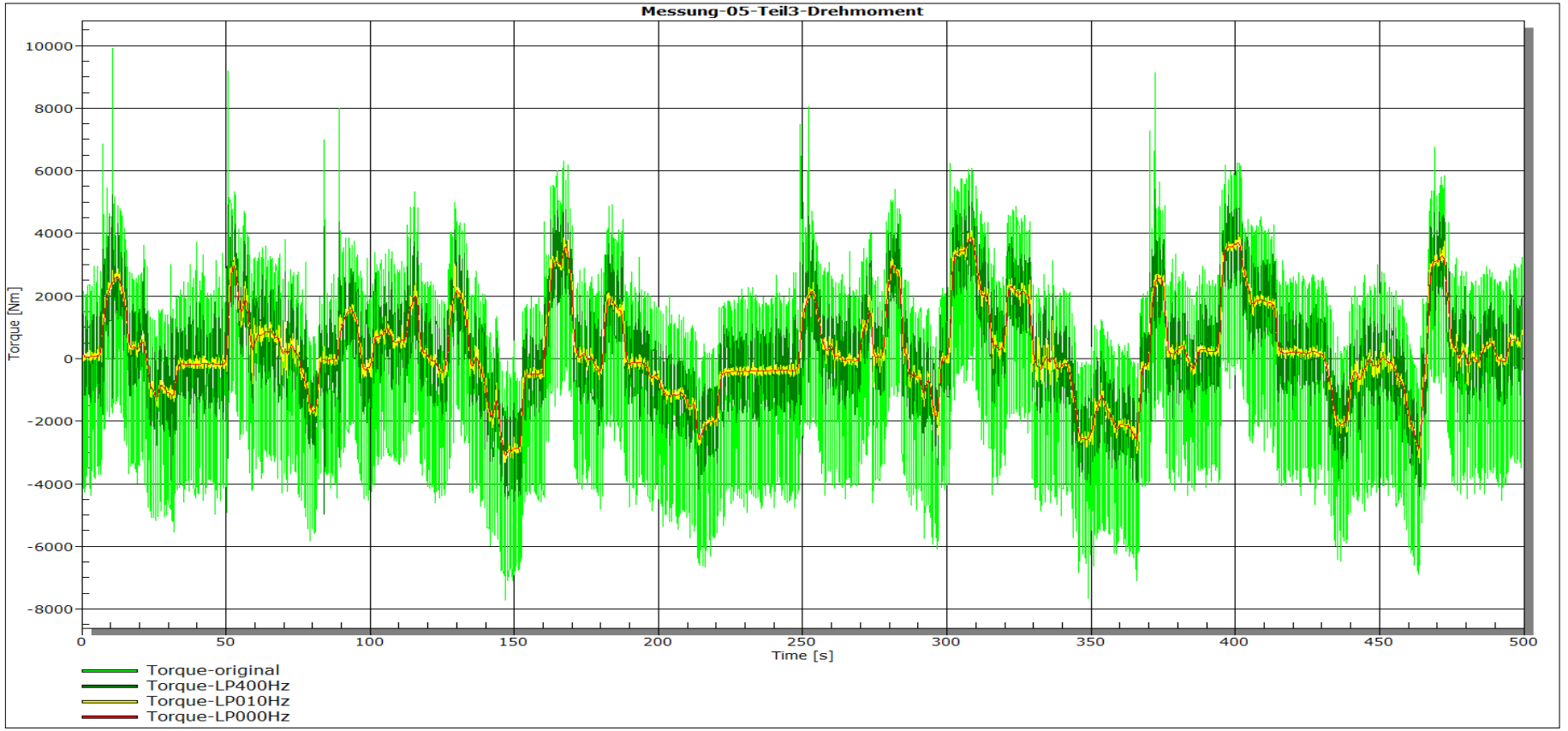


# Damaged gear wheels

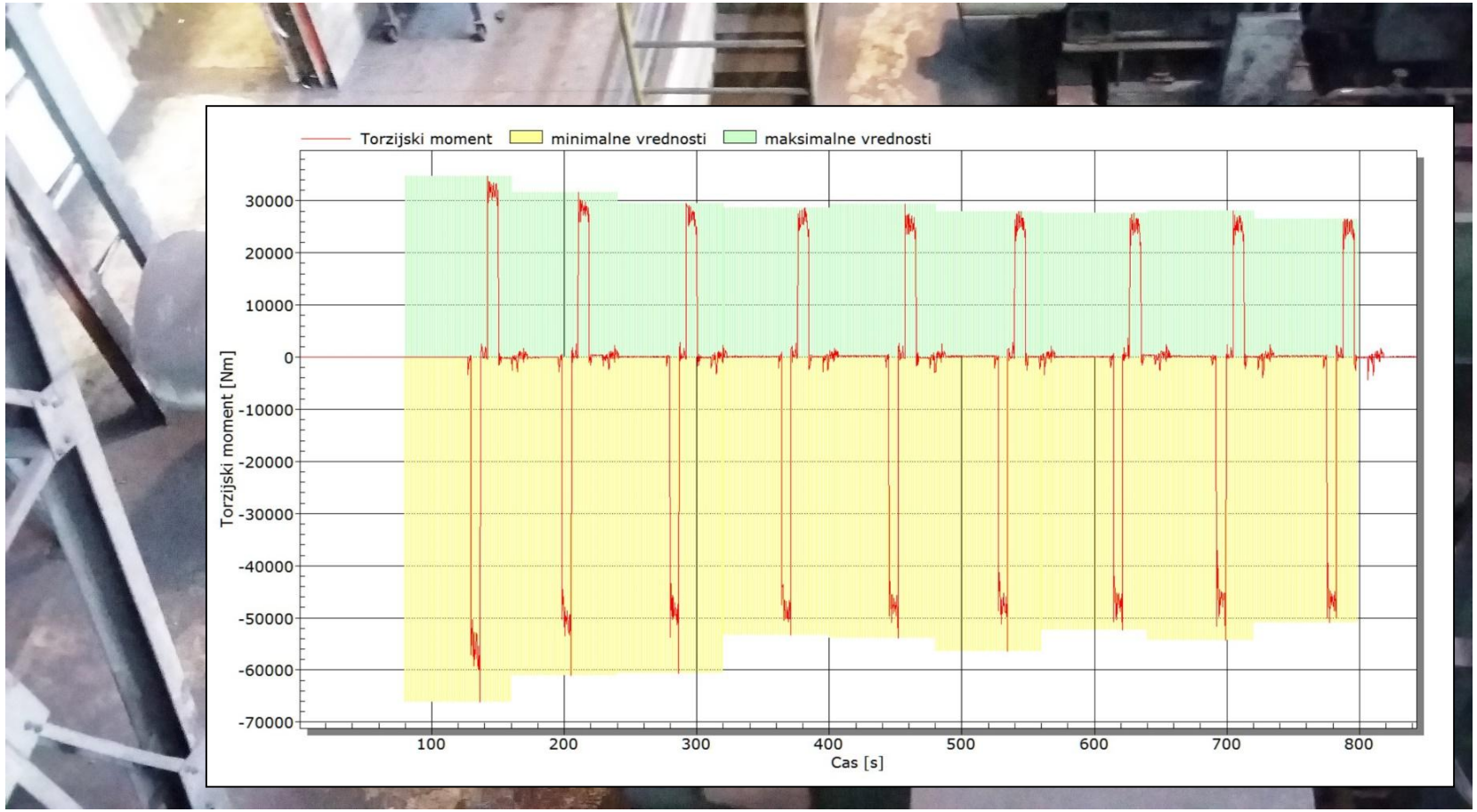
# CM as an instrument to prevent overloading or to measure actual loading of the machinery.

# CM as an instrument to prevent overloading or to establish actual loading of the machinery.



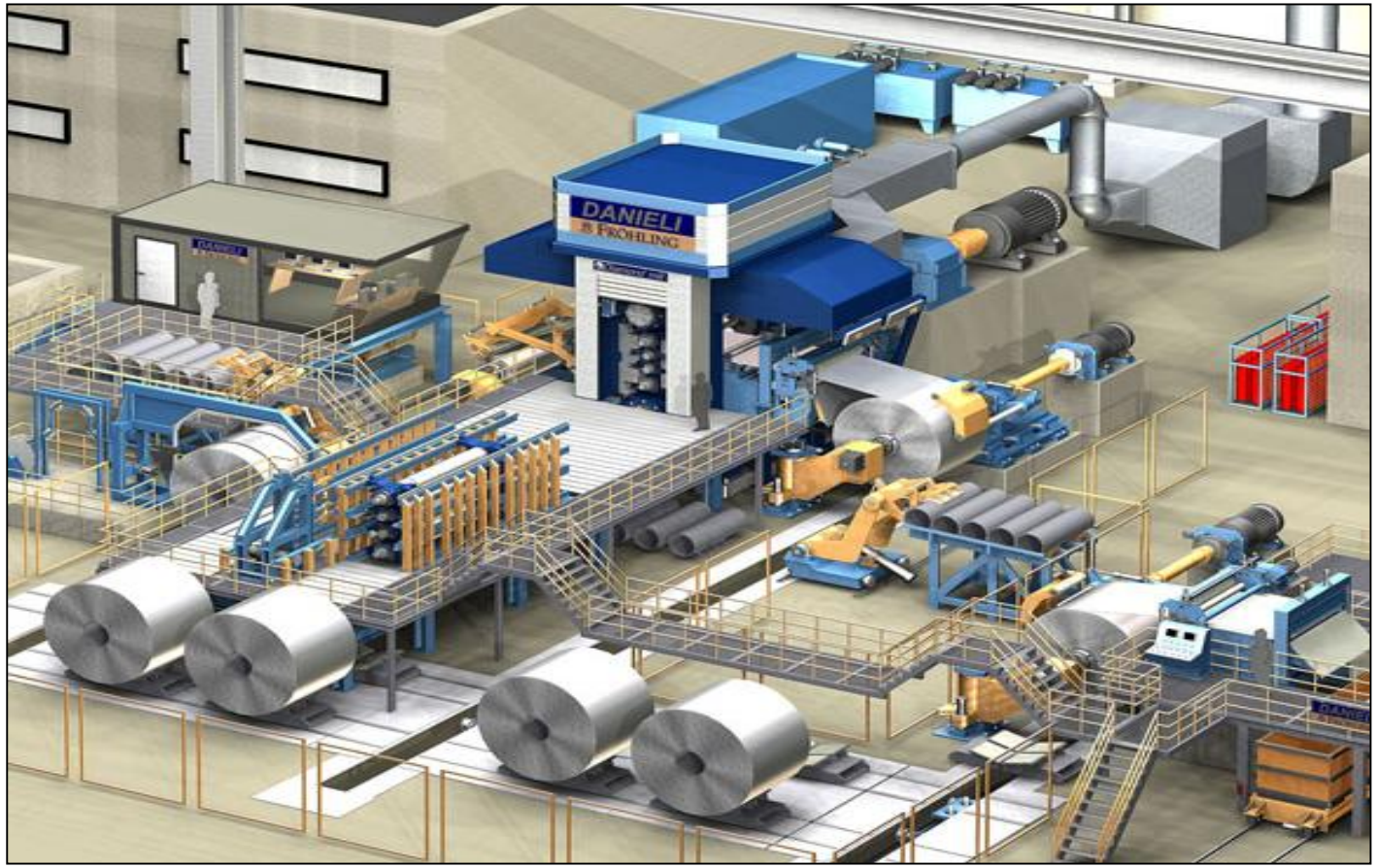
# CM as an instrument to prevent overloading or to establish actual loading of the machinery.



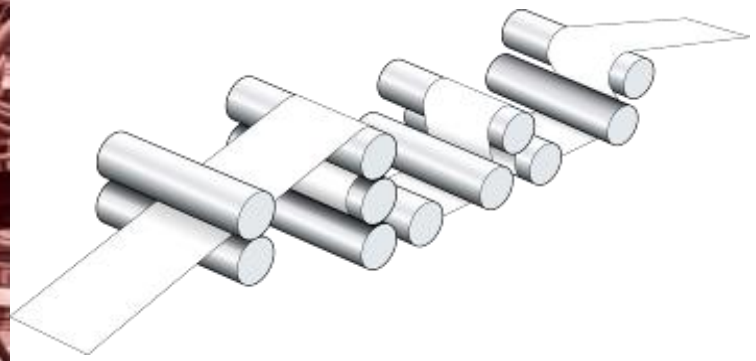
# Some typical applications of CM

- Finding the root cause of the problem (reduced product quality, increased energy consumption, increased production cost, extensive wear…).

# Rolling mill alignment

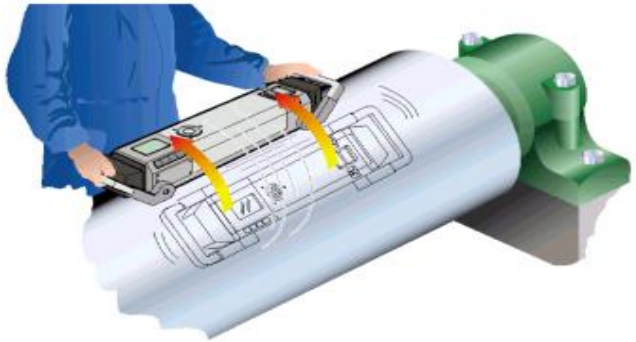


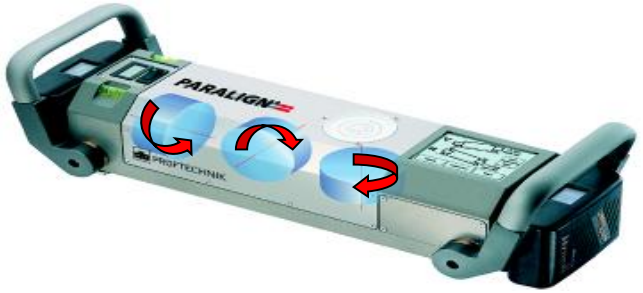
# Why roll alignment



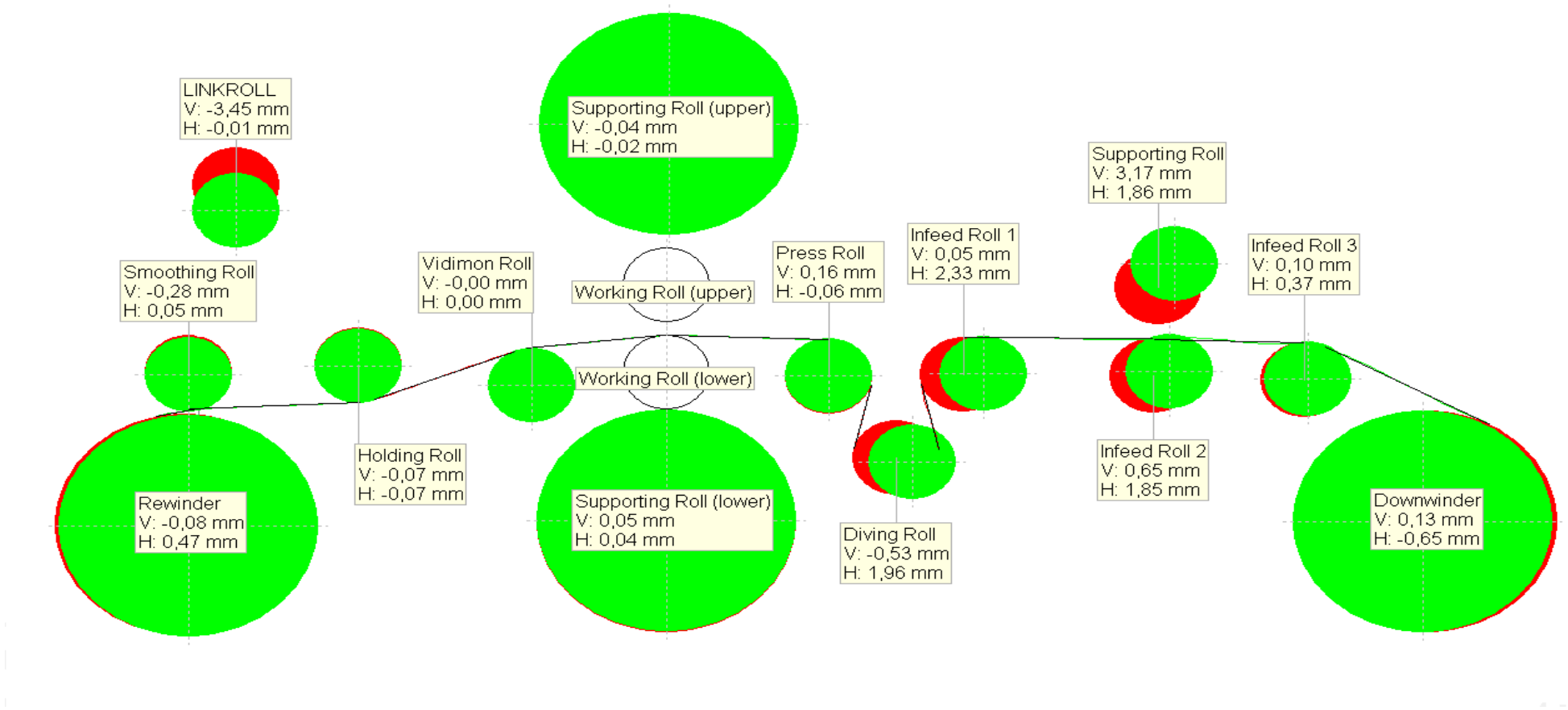
- Increasing product quality
- Increasing machine availability
- Increasing production speed
- Evenly distributed forces on the production line

# Paralign® measurements

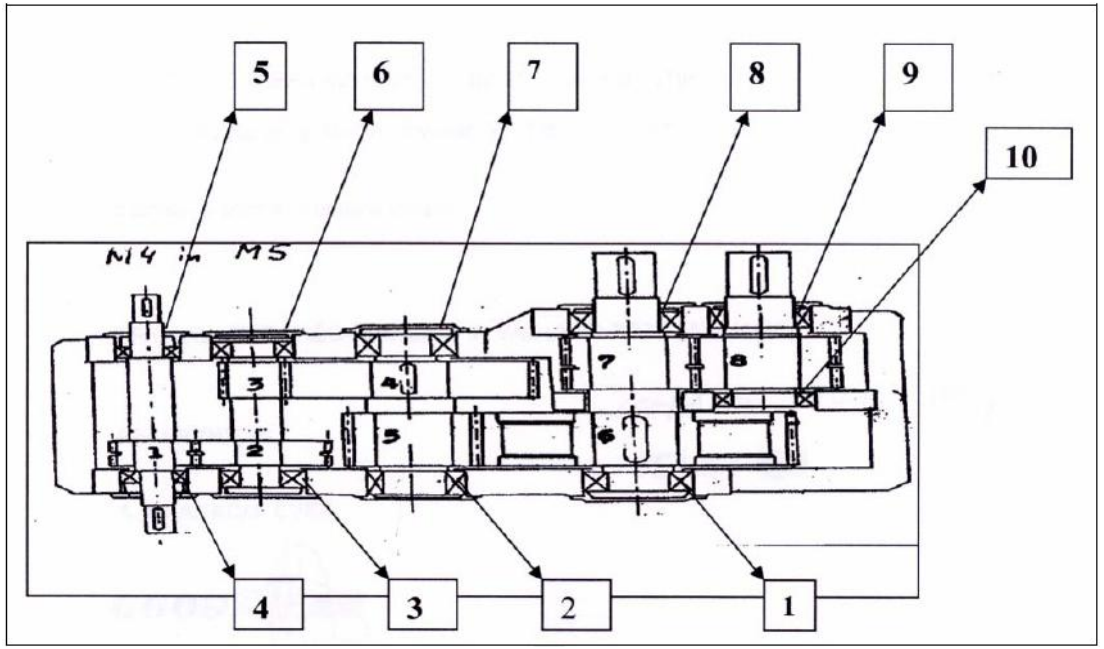


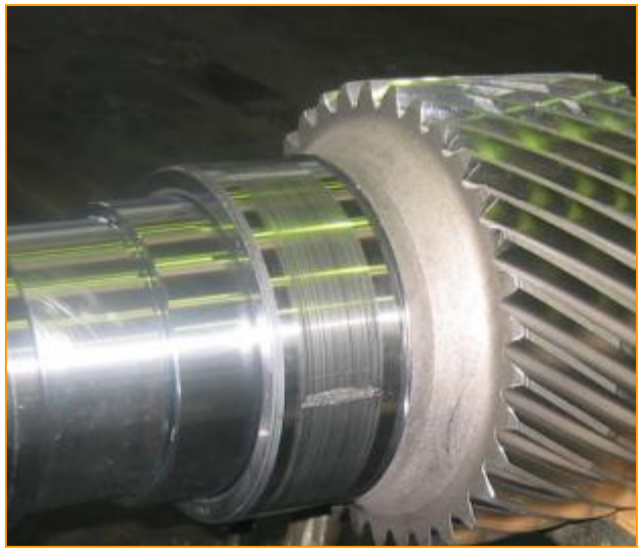


# Results


LINKROLL
V: -3,45 mm
H: -0,01 mm
Supporting Roll (upper)
V: -0,04 mm
H: -0,02 mm
Supporting Roll
V: 3,17 mm
H: 1,86 mm
Smoothing Roll
V: -0,28 mm
H: 0,05 mm
Vidimon Roll
V: -0,00 mm
H: 0,00 mm
Working Roll (upper)
Press Roll
V: 0,16 mm
H: -0,06 mm
Infeed Roll 1
V: 0,05 mm
H: 2,33 mm
Infeed Roll 3
V: 0,10 mm
H: 0,37 mm
Working Roll (lower)
Rewinder
V: -0,08 mm
H: 0,47 mm
Holding Roll
V: -0,07 mm
H: -0,07 mm
Supporting Roll (lower)
V: 0,05 mm
H: 0,04 mm
Diving Roll
V: -0,53 mm
H: 1,96 mm
Infeed Roll 2
V: 0,65 mm
H: 1,85 mm
Downwinder
V: 0,13 mm
H: -0,65 mm

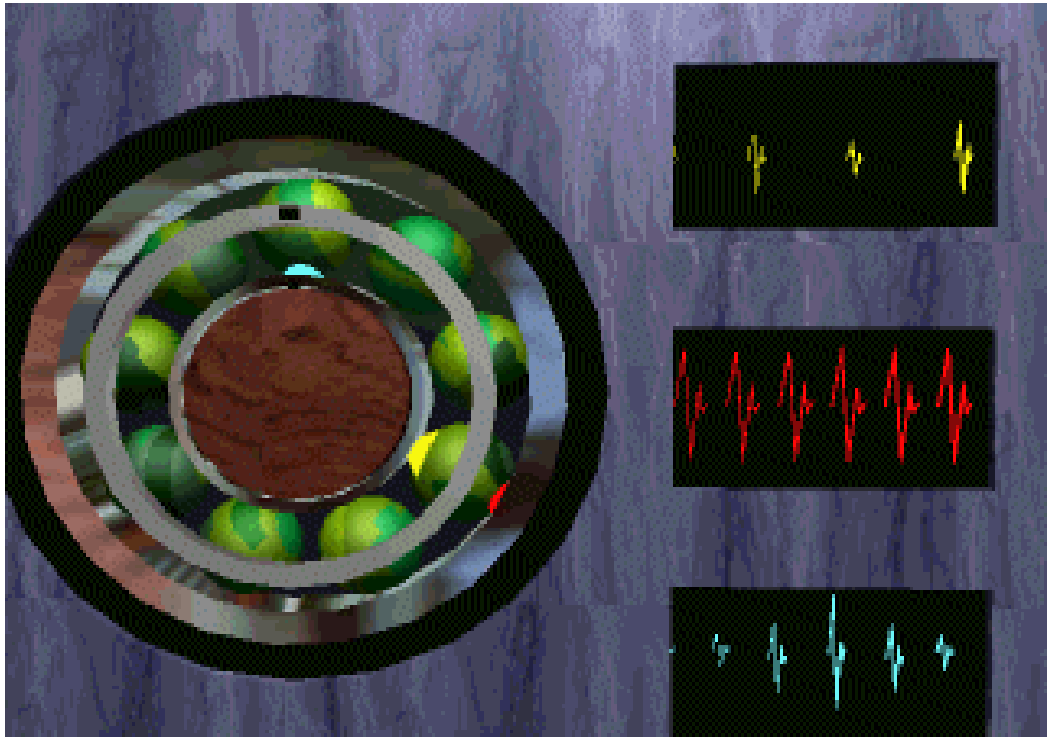
# How important it is to understand what you do?

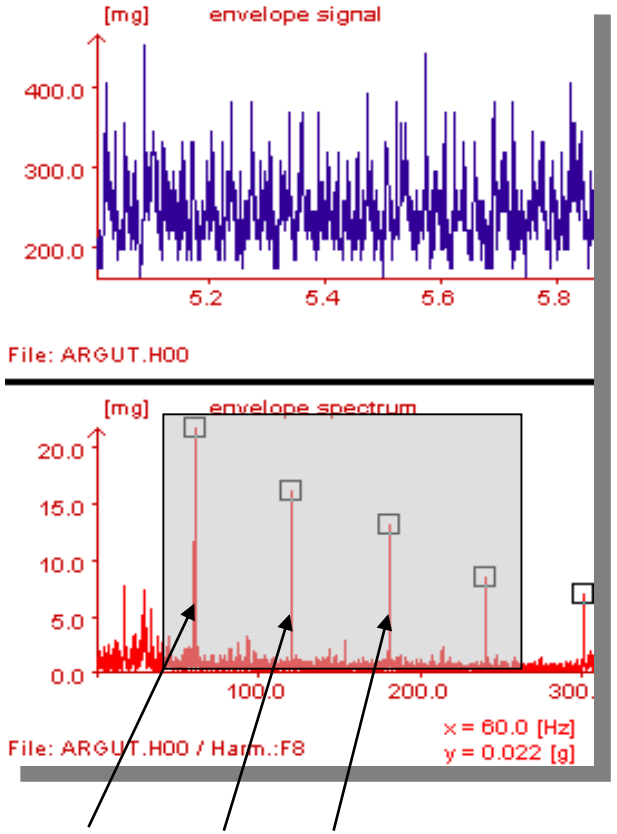


| Position | RMS_1 [mm/s] | RMS_2 [mm/s] | T_1 [°C] | T_2 [°C] |
|---|---|---|---|---|
| 1 | 0.64 | 0.68 | 38 | 37 |
| 2 | 0.79 | 0.65 | 40 | 39 |
| 3 | 0.60 | 0.75 | 54 | 47 |
| 4 | 0.64 | 0.67 | 51 | 50 |
| 5 | 0.55 | 0.66 | 53 | 52 |
| 6 | 0.58 | 0.57 | 54 | 52 |
| 7 | 0.50 | 0.73 | 45 | 44 |
| 8 | 0.39 | 0.38 | 38 | 39 |
| 9 | 0.51 | 0.41 | 37 | 37 |

# How important it is to understand what you do?





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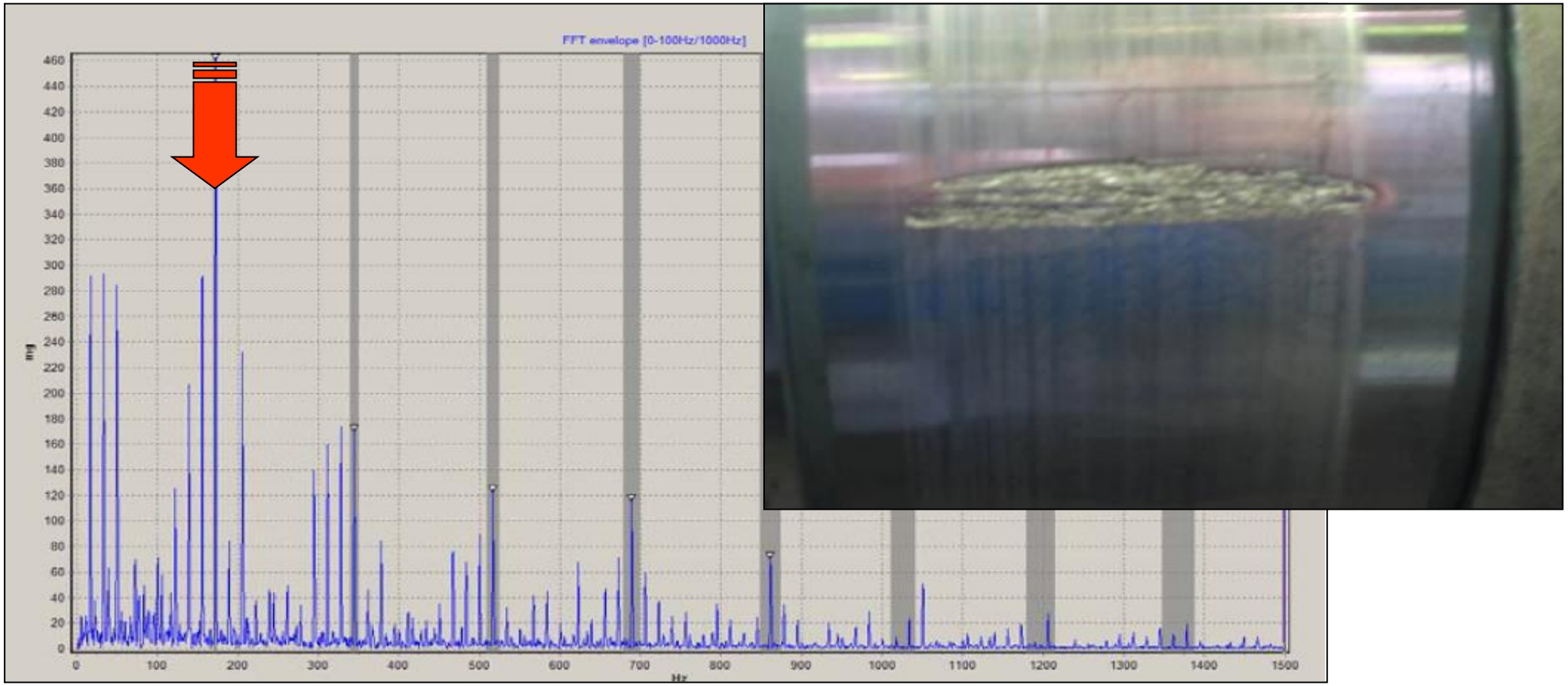

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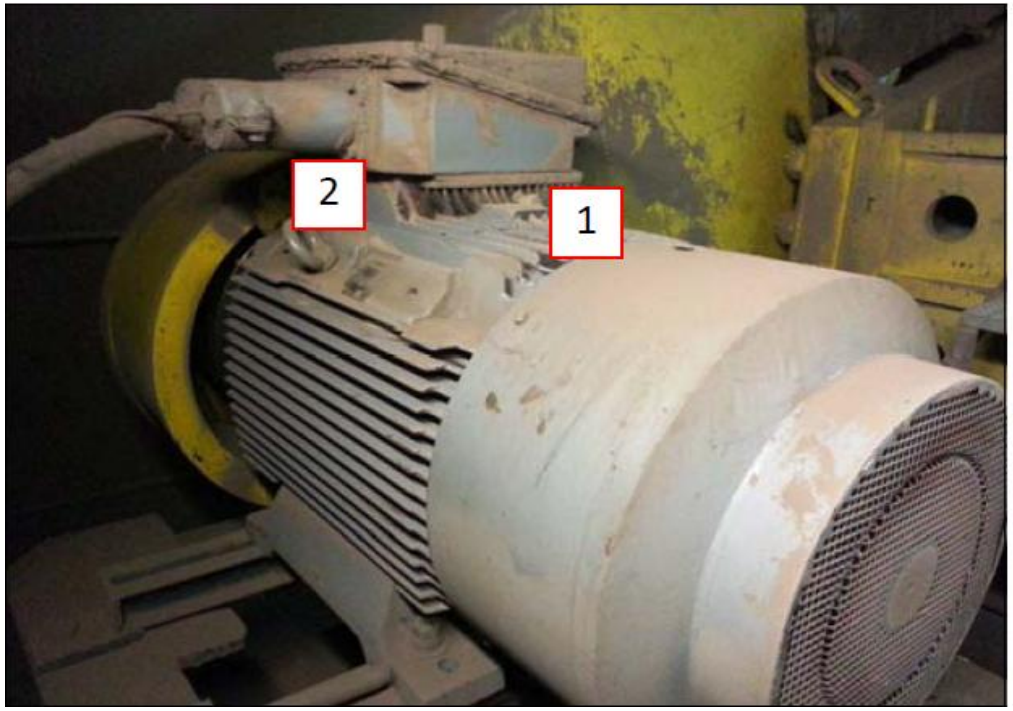
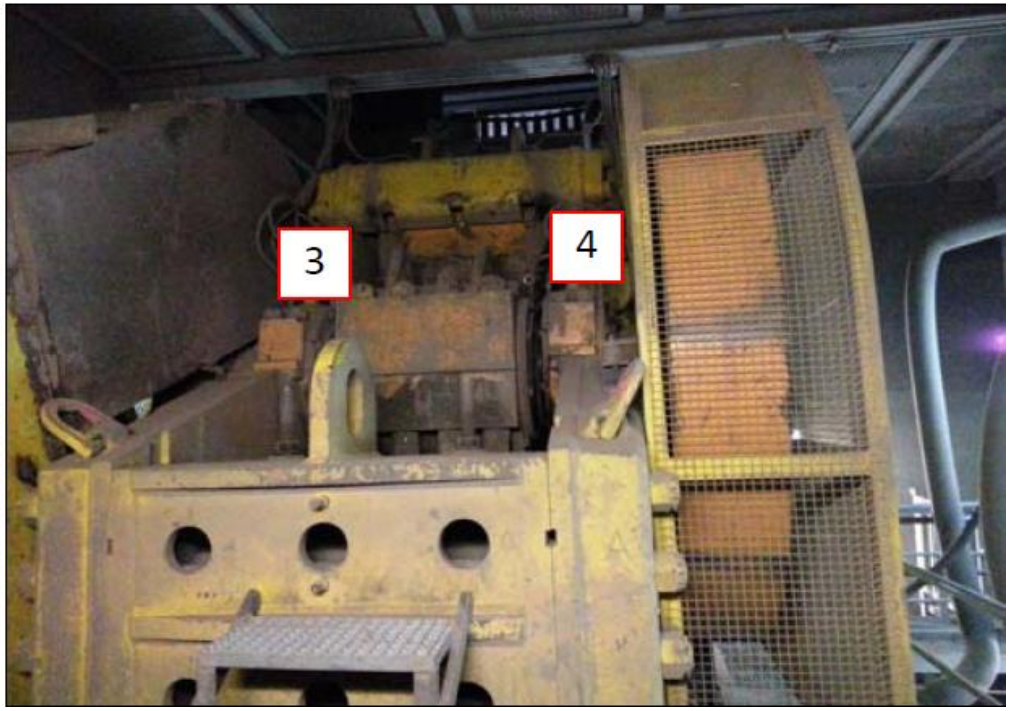
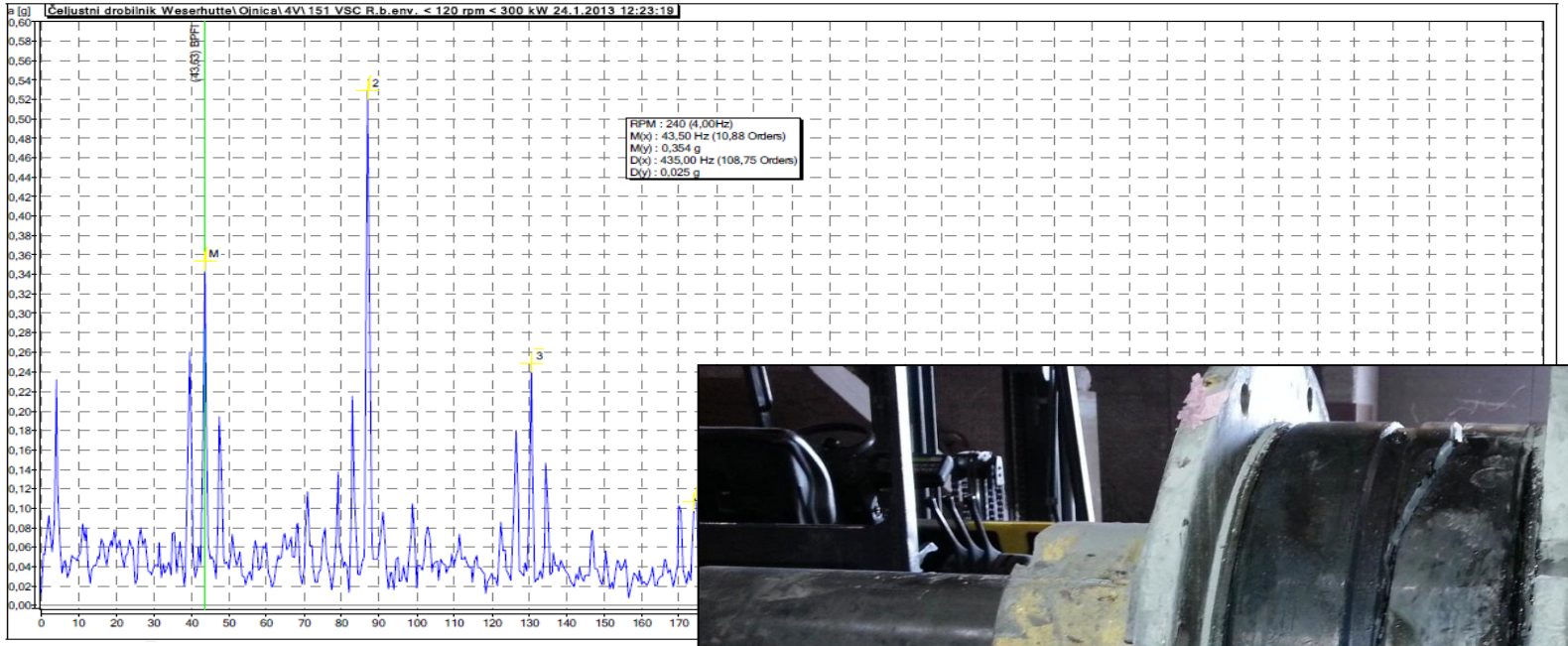


# How important it is to understand what you do?

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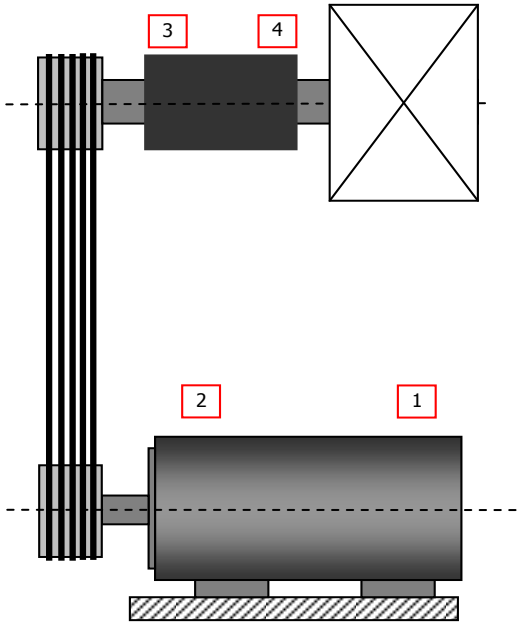


# How important it is to understand what you do?

# Concluding remark

I keep six honest serving-men
(They taught me all I knew);
Their names are What and Why and When And How and Where and Who.

Rudyard Kipling - "Just So Stories" (1902): "**The Elephant's Child**"

15th INTERNATIONAL OPERATIONS & MAINTENANCE CONFERENCE IN THE ARAB COUNTRIES
UNDER THE THEME: **"SMART MAINTENANCE"** CONICIDE WITH THE 15TH ARAB MAINTENANCE EXHIBITION

# IMPLEMENTATION OF LIVE WORKING ON LOW VOLTAGE IN SLOVENIAN UTILITIES & INDUSTRY

**Mr.sc. Viktor Lovrenčić, C&G d.o.o. Ljubljana, SLOVENIA**

# DEFINITION OF LIVE WORKING

**EUROPEAN STANDARD EN 50110-1:2013**

Operation of electrical installations – Part 1: General requirements

Working procedures are divided into three different procedures: dead working, **live working**, working in the vicinity of live parts.

All these procedures are based on the use of protective measures against electric shock and/or the effects of short-circuits and arcing.

# DEFINITION OF LIVE WORKING

**EUROPEAN STANDARD EN 50110-1:2013 (point 3.4.4)**

**live working**

all work in which a worker deliberately makes contact with live parts or reaches into the live working zone with either parts of his or her body or with tools, equipment or devices being handled

Note: At low voltage, live working is carried out by the worker, when making contact with bare live parts. At high voltage, live working is carried out by the worker, when entering the live working zone, regardless of whether contact is made with bare live parts or not.

[SOURCE: IEC 60050-651:1999, IEV 651-01-01 modified]

# DEFINITION OF LIVE WORKING - Working methods

**EUROPEAN STANDARD EN 50110-1:2013**

**Hot stick working – Safe clearance working**

**Insulating glove working**

**Bare hand working**

# LIVE WORKING IN THE WORLD & EUROPE

**LW has a hundred year tradition in the world**
**(many different sources – Looms (USA), D.E. Garcia (Argentina), Žuravlev (Rusia)**

1913 the first carrying out of LW was documented in the USA and
1920 in Canada
1920 – 1930 in Germany, Sweden, SSSR (Rusia), Switzerland
1932 in Australia
1933 (1975) in Poland
1939 in Great Britain
1945 in Chile
1952 in China
1963 in France
1971 in Argentina and …
19xx … Brazil, Spain, Italy, Hungary, Ireland, Colombia, Peru, Ecuador, Uruguay, Venezuela, Romania, Czech Republic, Slovakia, Portugal, Norway, Belgium, New Zealand, India, etc.
20xx … Croatia, Slovenia, Turkey … Kuwait… Saudi Arabia

# LIVE WORKING IN THE WORD & EUROPE

**LW has a hundred year tradition in the world.**


# LIVE WORKING IN THE WORD & EUROPE

STRASBOURG APRIL 26TH TO 28TH
ICOLIM 2017
INTERNATIONAL CONFERENCE ON LIVE MAINTENANCE

IEEE PES
Power & Energy Society™

GLOBAL ESMC 2016
THE POWER IS IN YOUR HANDS

cier
COMITE ARGENTINO

CITTES

cigré

IEEE

cen

CENELEC

IEC

issa | INTERNATIONAL SOCIAL SECURITY ASSOCIATION

# ACTUAL INFO - LIVE WORKING IN THE WORD & EUROPE

**ICOLIM 2017** - 12th International Conference on Live Maintenance, France, 26-28 April 2017, Strasbourg, http://www.icolim2017.org/

**VIII Congreso** Internacional sobre Trabajos con Tensión y Seguridad en Transmisión y Distribución de Energía Eléctrica, 8 al 11 de Mayo de **2018**, Ciudad de Paraná, Entre Ríos, República Argentina, www.cacier.com.arntina

**IEEE PES ESMO 2019** - 14th International Conference on Transmission & Distribution Construction, Operation & Live-Line Maintenance, 9/24/2018 - 9/27/2018, Hyatt Regency Columbus, Columbus OH, United States, http://www.showsbee.com/fairs/IEEE-PES-ESMO.html

ICOLIM2020 TURIN

**ICOLIM 2020**, Torino Italija http://www.icolim2020.org/

cigré

**WG B2.64 Inspection and Testing of Equipment and Training for Live-Line Work on Overhead Lines (from 2016 – 20xx)**

http://b2.cigre.org/WG-Area/WG-B2.64-Inspection-and-Testing-of-Equipment-and-Training-for-Live-Line-Work-on-Overhead-Lines

# LIVE WORKING & ASSOCIATION

**LWA: Live Working Association**

**CIGRE**: Conseil International des Grands Réseaux Electriques (Council on Large Electric Systems)

**IEEE**: Institute of Electrical and Electronics Engineers

**CIER**: Comisión de Integración Eléctrica Regional

**ICOLIM: International Conference on Live Line Maintenance (LWA)**

# LIVE WORKING IN SLOVENIA

**In 2009 in Slovenia LW on LV:**

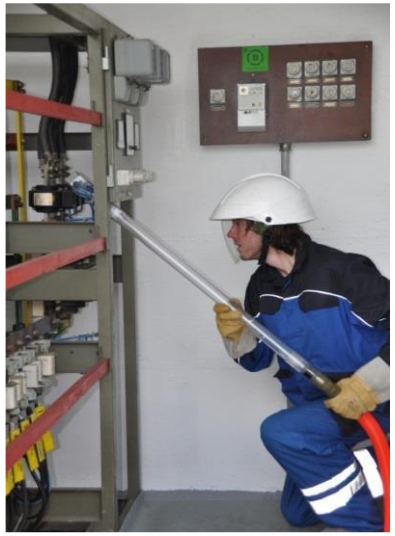
- from 2009 in nuclear power plant Krško,
- from 2010 in paper mill Vevče
- from 2011 in distribution & transmission
- from 2011 in University Medical Centre Ljubljana …!

**In 2013 in Slovenia LW on MV:**

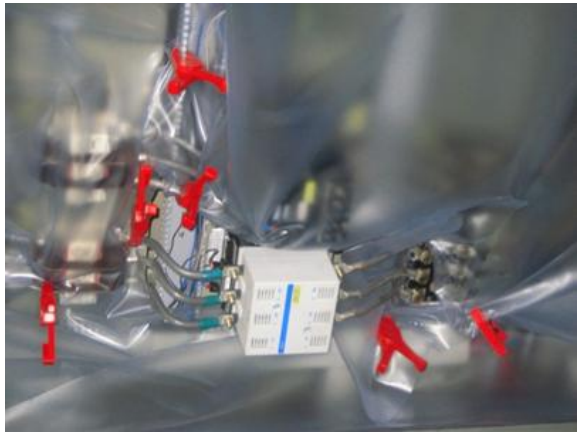
- from 2013 in distribution

# LIVE WORKING in SLOVENIA on LV (0,4 kV)

DISRIBUTION



# LIVE WORKING in SLOVENIA on LV (0,4 kV)



# LIVE WORKING in SLOVENIA on MV (distribution)

# LIVE WORKING on MV (> 10-20 kV)

# LIVE WORKING on HV (> 110 kV)

# LIVE WORKING quality of electricity power

**The impact of LW on the quality of electricity can be measured by the satisfaction of customers:**

**- uninterrupted supply of electricity by distributor**

**or**

**- uninterrupted supply of electricity by work on internal electrical installations.**

# LIVE WORKING & OHSA & ZERO ACCIDENTS

**Live Working as an Example of**
**Electrical Installation Maintenance with**
**the Zero Accidents Philosophy**

**LW can be considered a contribution to**
**safety and quality**
**of electrical installation maintenance procedures on all voltage levels.**

# LIVE WORKING & OHSA & ZERO ACCIDENTS

**There have been quite a few attempts around the world to promote the concepts of maintenance work**

**without accidents or with "zero accidents".**

**Organisations with an integrated management system**

**(ISO 9001 & OHSAS 18001)**

**have excellent organisational conditions for safe implementation of live working and can therefore achieve the goal of "zero defects" or the idea of "zero accidents" or "zero injuries" at work due to electrical shock.**

# THANK YOU

## GREETINGS FROM SLOVENIA