



“Industrial plant maintenance management best practices”

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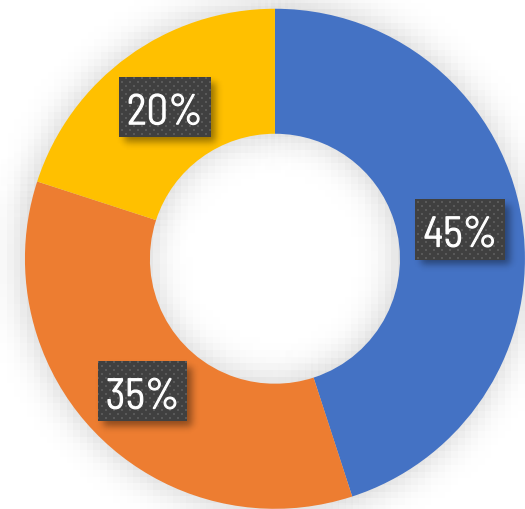
MAINTENANCE MANAGEMENT

- Plant reliability as key success factor for production optimization and company competitiveness
- Reliability standards increase product quality and throughput
- Maintenance Management can boost plant reliability if executed in the right way



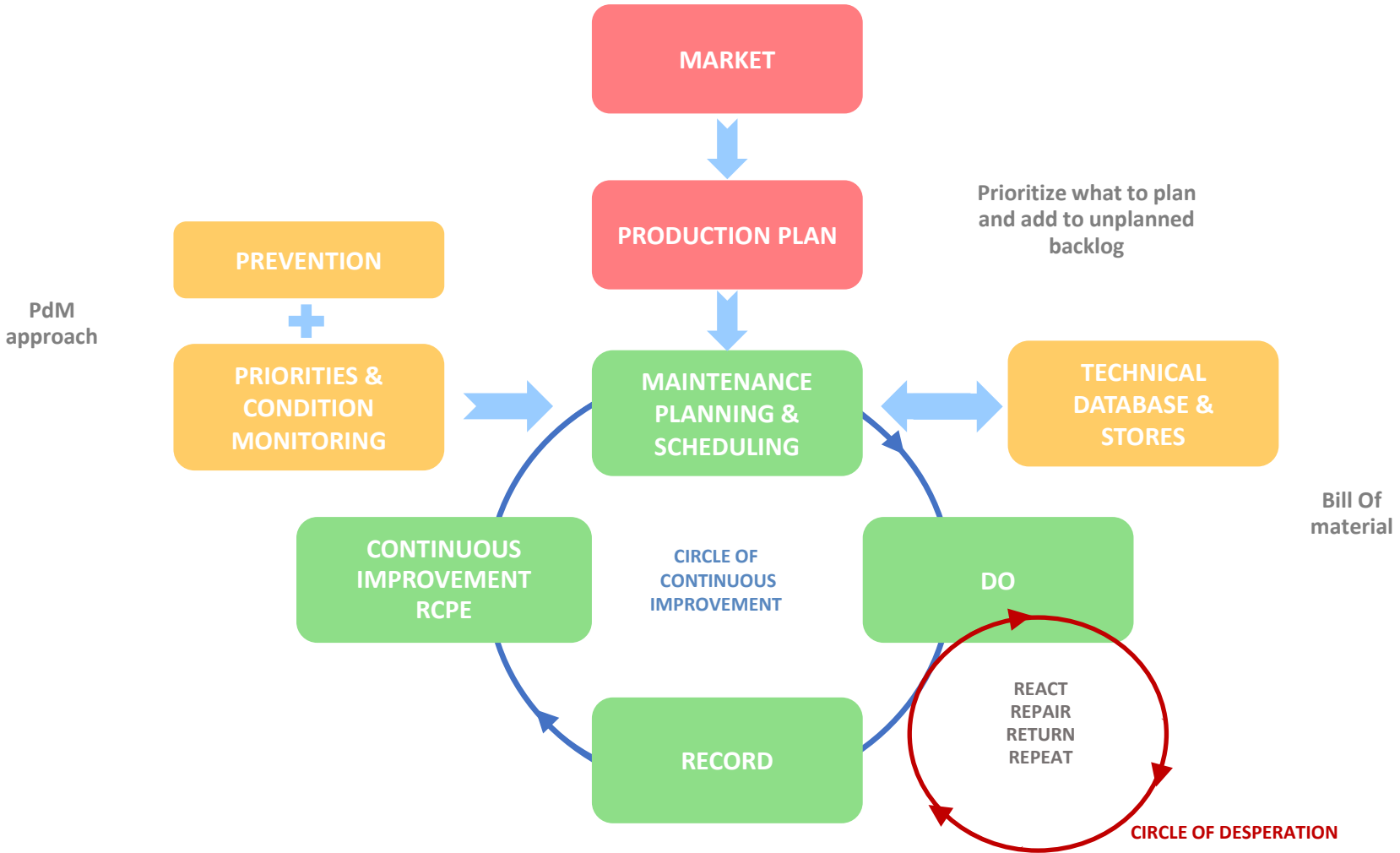
MAINTENANCE MANAGEMENT

- Challenge: corporate reliability and plant maintenance managers has to decide how spend their budget to optimize plant reliability
- How it is possible to find the right mix between maintenance policies?
- How we can reach better plant reliability performance?

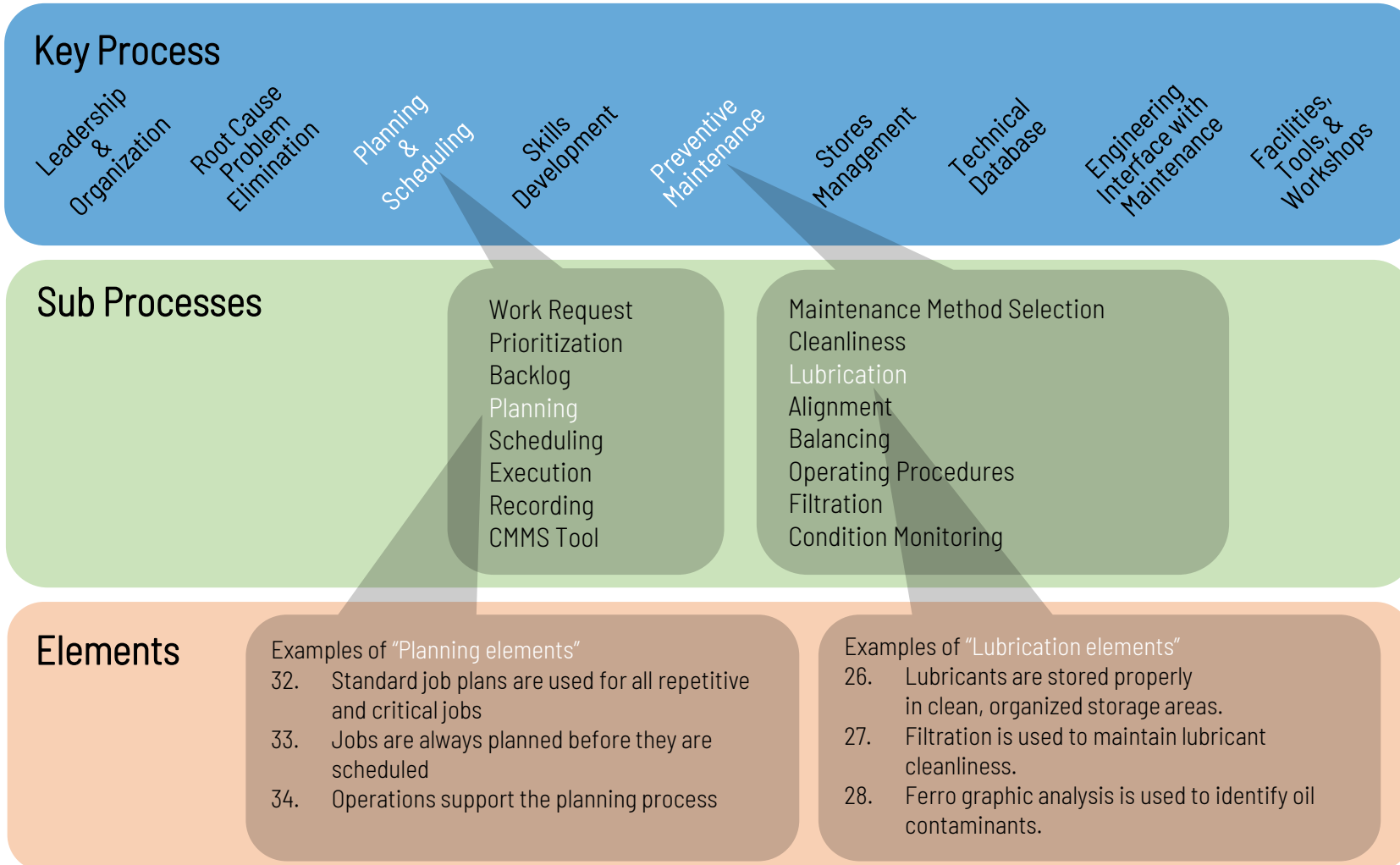


■ Corrective maintenance ■ Preventive maintenance ■ Predictive maintenance

MAINTENANCE MANAGEMENT

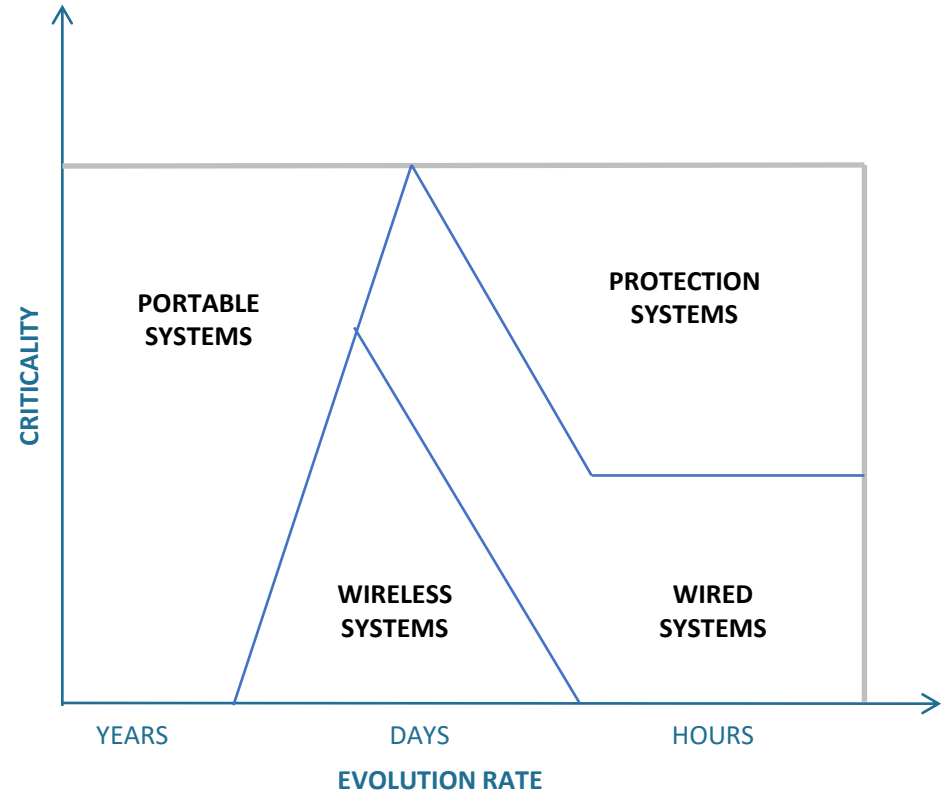


MAINTENANCE MANAGEMENT



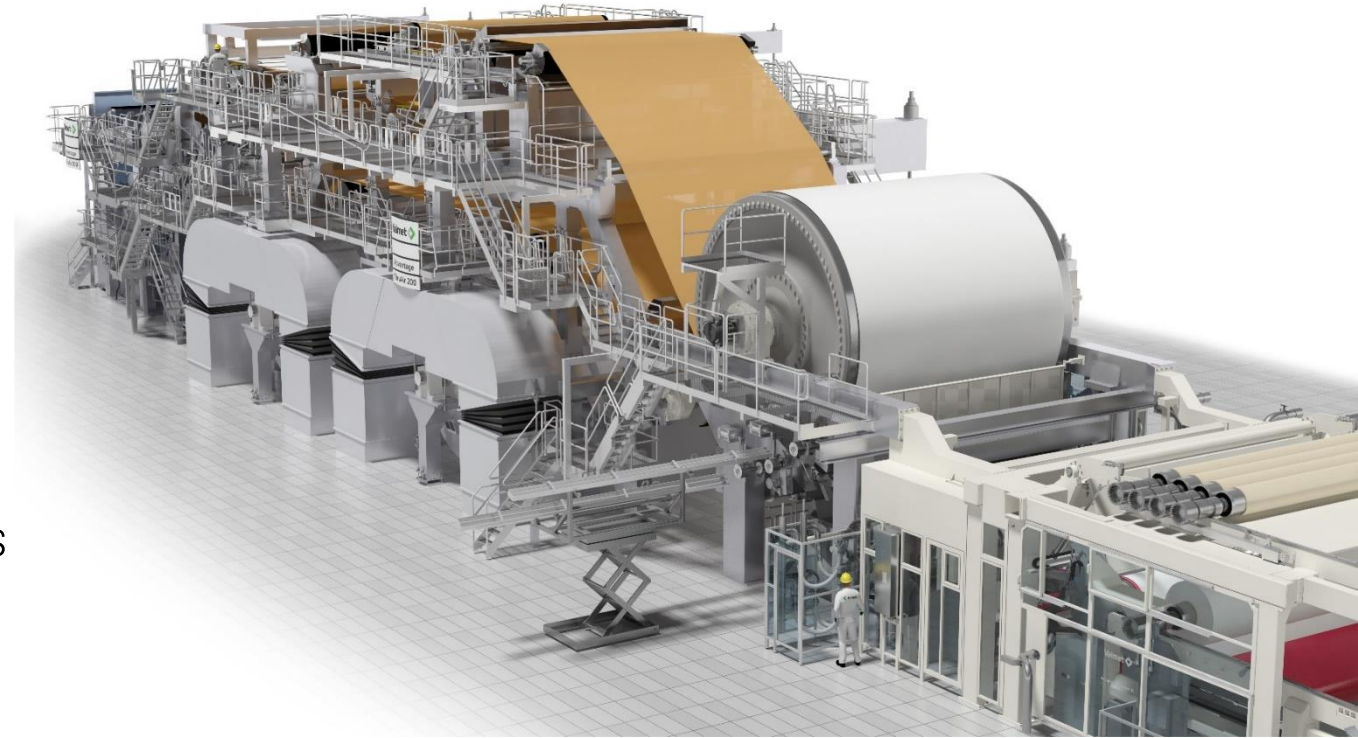
MAINTENANCE MANAGEMENT

- PdM technologies
 - Vibration analysis
 - Infrared analysis
 - Electrical measurement
 - Acoustic Emission
 - Ultrasound
 - Oil analysis
 - NDT
 - Etc.
- Key factors: commitment, scope of the work, technical skills & technologies



PdM PAPER MILL CASE STUDY

- **Industry:** Pulp & Paper
- **Paper machine:** high speed Tissue paper machine
- **Asset:** Yankee roll
- **Criticality ranking:** high for unplanned production losses and maintenance procedures
- **Business interruption value:** up to 6-8 Keuro/h



PdM PAPER MILL CASE STUDY

- Tissue paper machine
 - Linear speed: 1900 m/min
 - 6,4 meters of paper width
- Yankee cylinder
 - 4,5 meters of diameter
 - 7-8 steam bar internal pressure



PdM PAPER MILL CASE STUDY

- Bearings as main components of those paper machines
- Bearing diagnostic methodologies
 - Vibration analysis
 - Shock pulse method
 - Acoustic emission
 - Oil analysis
 - Etc.



PdM PAPER MILL CASE STUDY

- Yankee bearings:
 - Spherical roller bearings
 - Heavy loads in radial and axial directions
 - Self-aligning for accommodate misalignment and shaft deflections
- Bearings type: 23068 CAC
 - Width: 133 mm
 - Inner diameter: 340 mm
 - Outer diameter: 520 mm



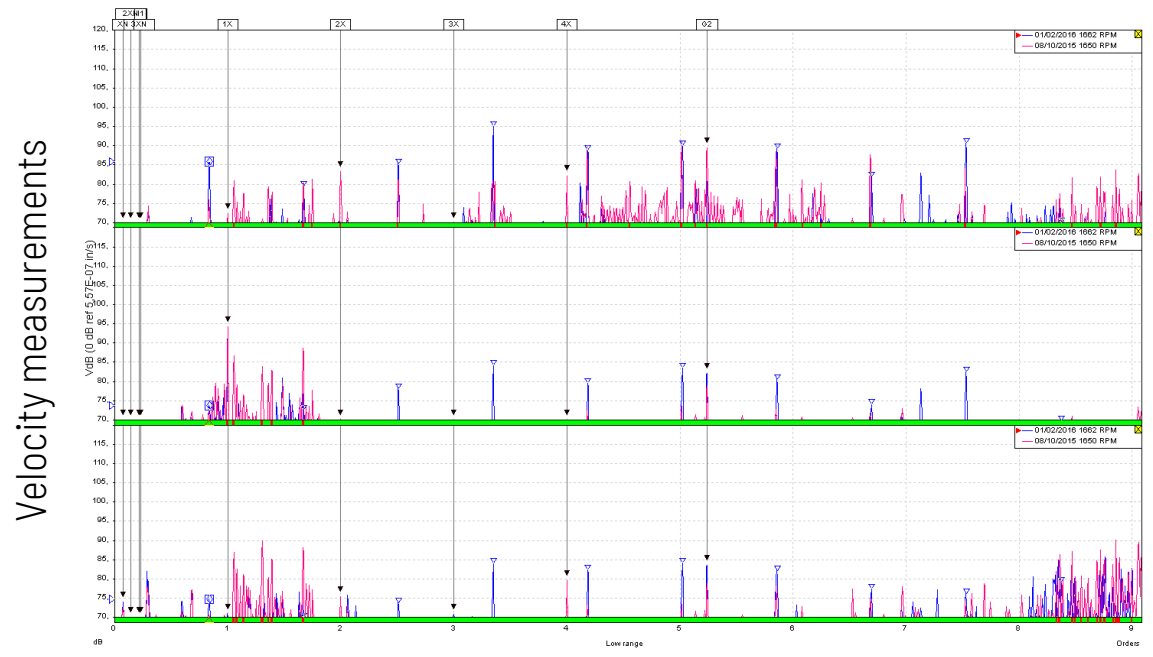
Frequencies

Designation	Rotational frequency				Frequency of over-rolling		
	Inner ring	Outer ring	Rolling element set & cage	Rolling element about its axis	Point on inner ring	Point on outer ring	Rolling element
	f_i (Hz)	f_e (Hz)	f_c (Hz)	f_r (Hz)	f_{ip} (Hz)	f_{ep} (Hz)	f_{rp} (Hz)
■ 23068 CAC/W33	1	0	0.449	4.79	14.327	11.673	9.581

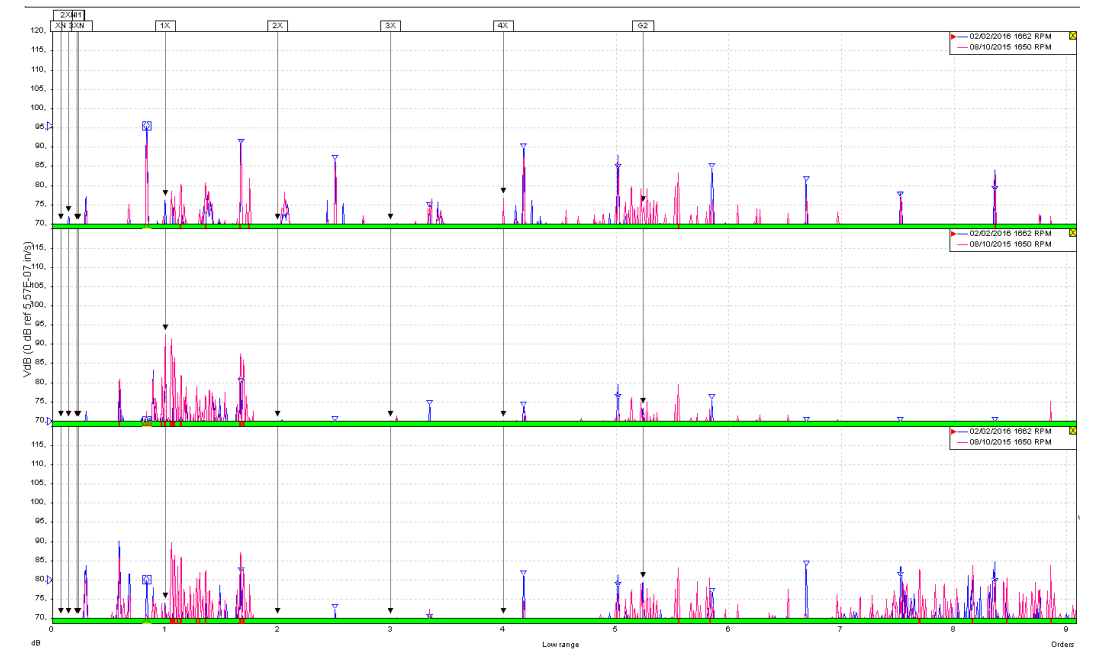
PdM PAPER MILL CASE STUDY

- Bearing issue found by periodic measurement (time waveform and FFT)

Transmission-side bearing measurements



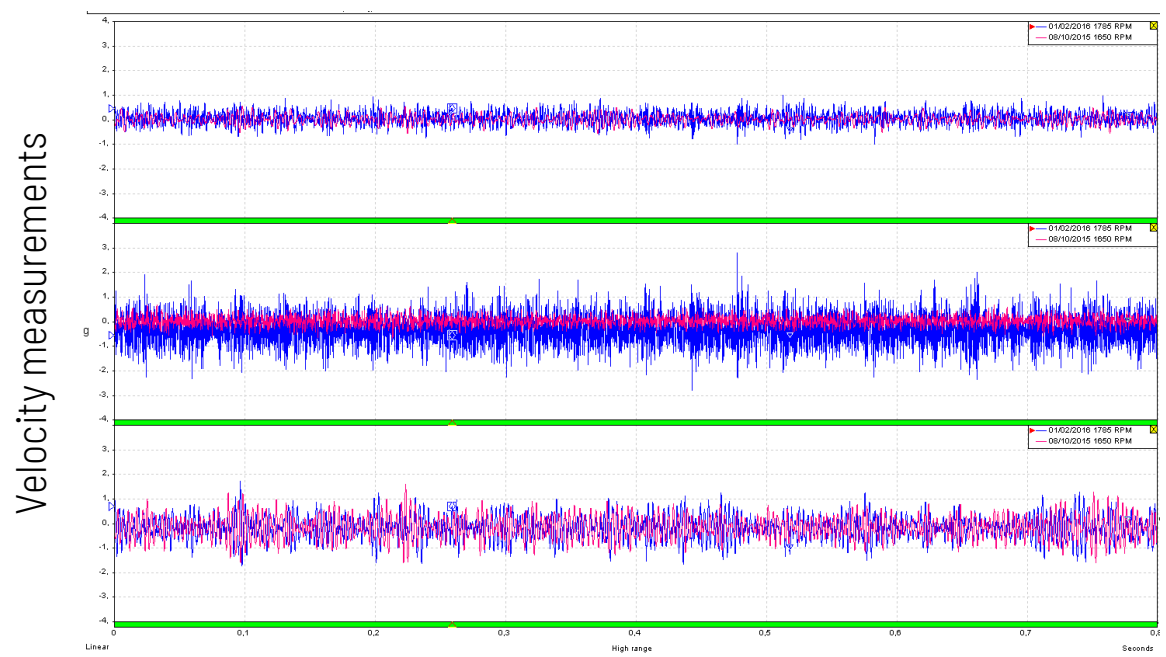
Operator-side bearing measurements



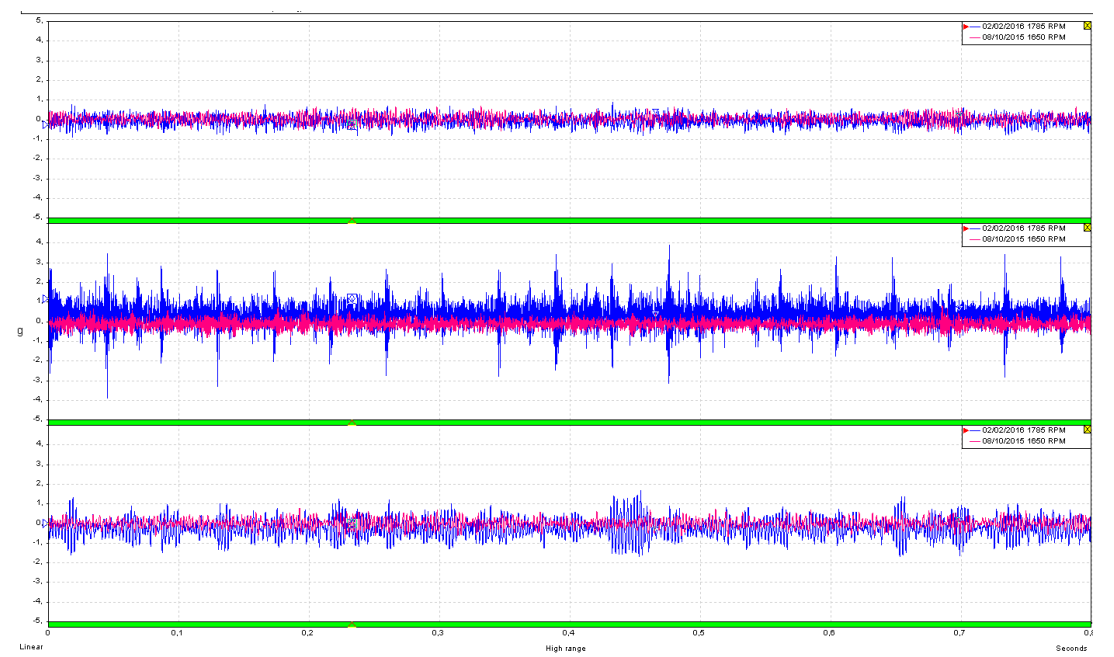
PdM PAPER MILL CASE STUDY

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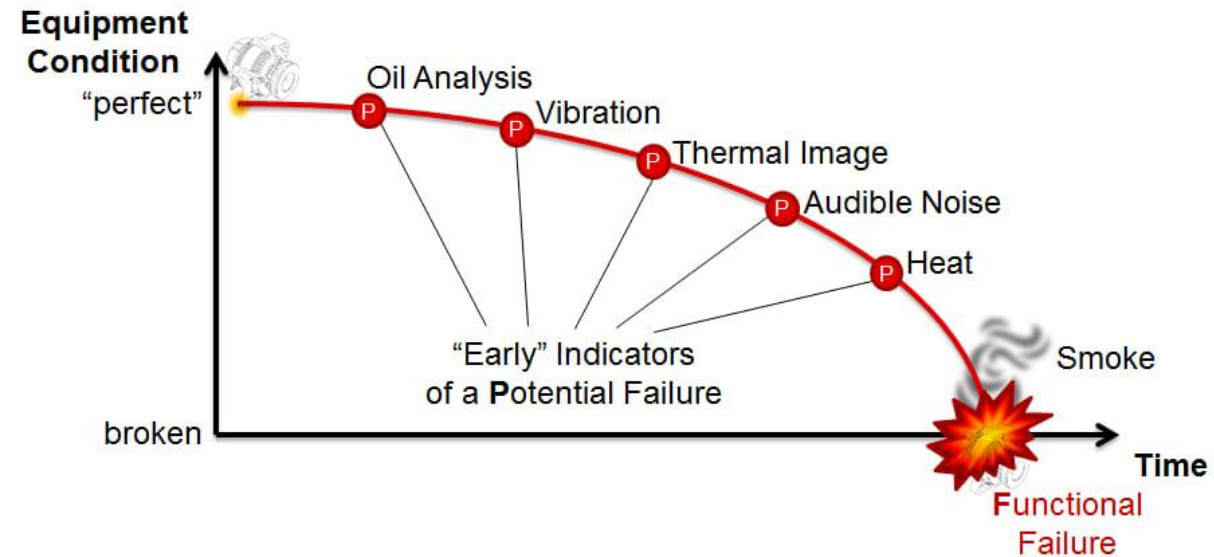


Operator-side bearing measurements



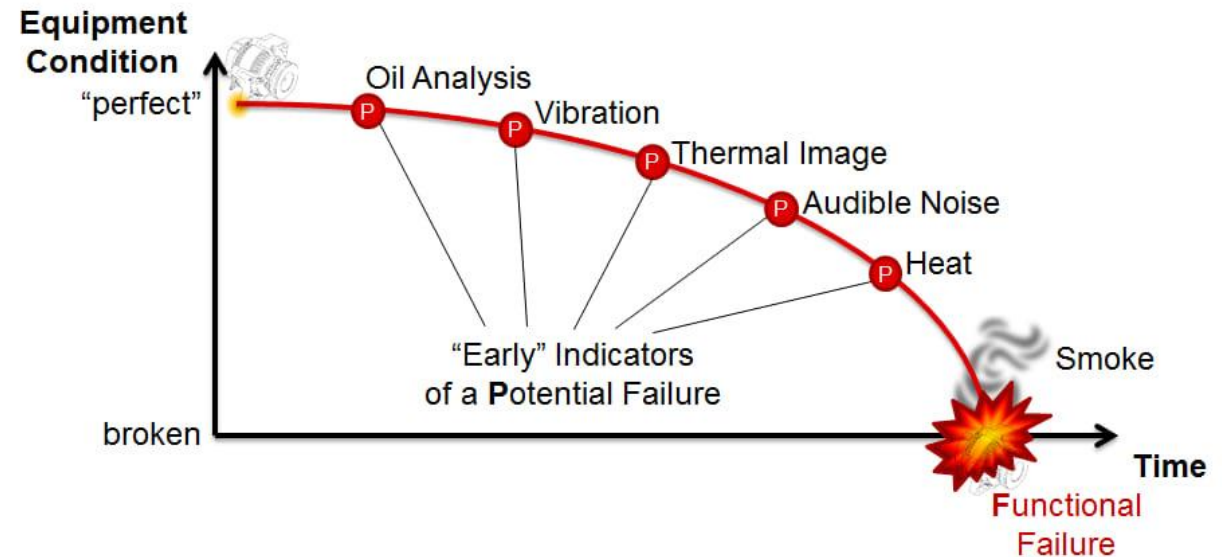
PdM PAPER MILL CASE STUDY

- **Diagnosis:** outer race severe damage with secondary bearing failure modes
- **Severity:** serious damage
- How can we estimate RUL (Residual Useful Life)?
- How we can estimate the risk of sub-sequent failure modes ?



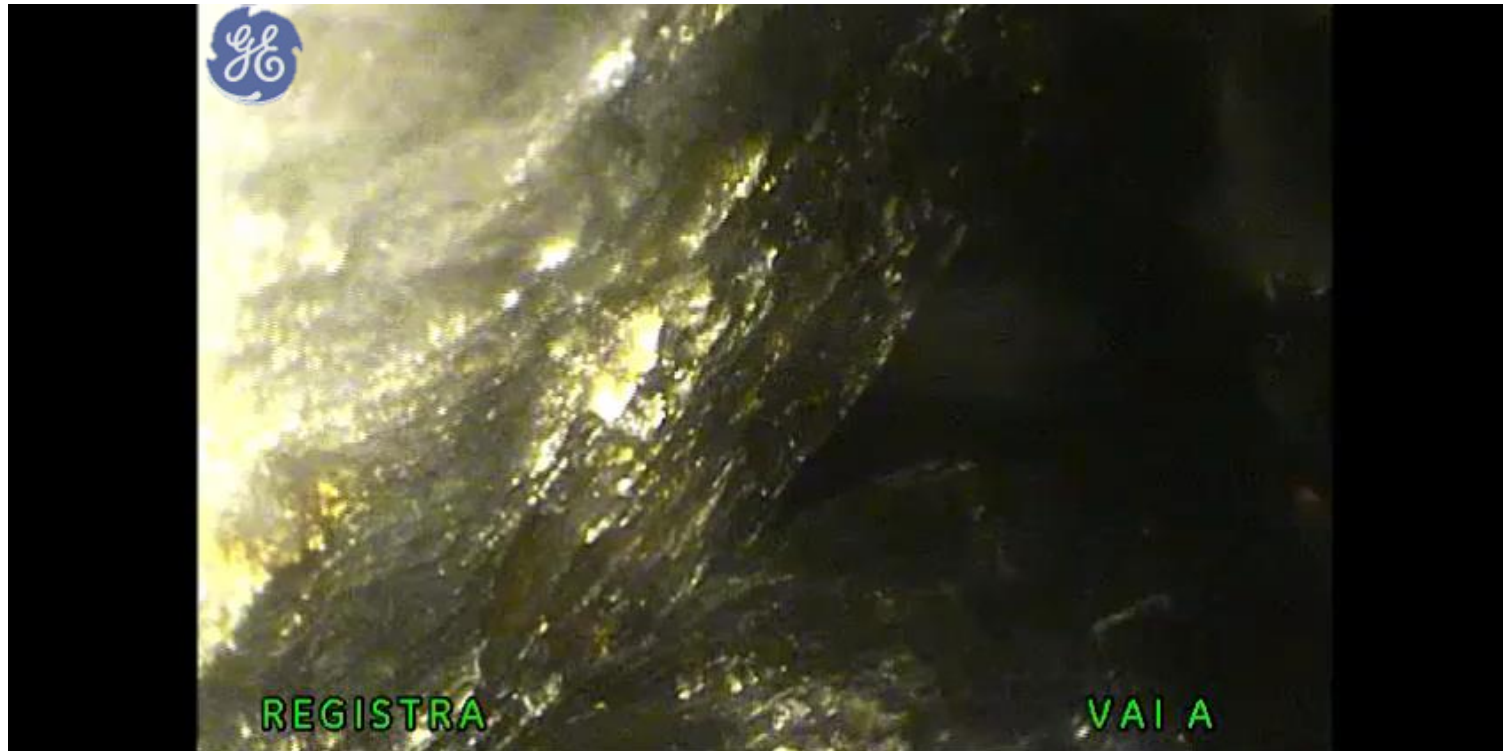
PdM PAPER MILL CASE STUDY

- P1 - Potential failure: outer race bearing damage failure mode
- P2 - Temporary on line measurement: for 4 weeks
- P3 - Severity evaluation during maintenance shutdown, before bearings replacement
- P4 - New measurements after bearings replacements



PdM PAPER MILL CASE STUDY

- Video-endoscopic inspection before bearings replacement



PdM PAPER MILL CASE STUDY

➤ Problem understanding:

- What is the problem?
- When did it happen?
- Where did it happen?
- implications of the problem

➤ RCFA steps:

- Step 1. Identification and sharing of the problem under analysis
- Step 2. Preliminary analysis of the problem and selected components
- Step 3. Detailed analysis of the causes and effects of the failure
- Step 4. Identification of possible solutions

➤ RCFA activities:

- Problem statement
- Chronology of events
- Collection facts and info
- Description of potential failure causes
- Description of the most significant critical issues
- Description of possible solutions and corrective actions

PdM PAPER MILL CASE STUDY

Summary and Conclusion

- Advance PdM programs by off line and on line measurements are important to predict critical equipments failure and consequent economic losses
- RCFA is required in order to understood the root cause and plan specific corrective plan

ECONOMIC LOSS WITHOUT PDM IMPLEMENTATION	
Loss of production due to unplanned shutdown	2-3 Days
Economic loss due to loss of production	~ 250 K€

THANK YOU

GRACIAS
ARIGATO
SHUKURIA
JUSPAXAR

DANKSCHEEN
TASHAKKUR ATU
SUKSAMA
EKKHMET
MEHRBANI
PALDIES
BOLZIN

BIYAN
SHUKRIA
TINGKI
MERCY

SPASSIBO
SNACHALHUYA
NURUH
CHALTU
YAQHANYELAY
WABEEJA
MAITEKA
YUSPAGARATAN
HUI
UNALCHEESH
HATUR
GUL
EKOJU
SIKOMO
MAKETRI
MINMONCHAR
ATTO
ANBIA
MERGI
DENKAUJA
NENACHALHYA
DHIANYABAD
MERASTAWHY
GAEJTHO
AGUYJE
FAKAUE
SANKO
KOMAPSUMNIDA
MAAKE
LAH

GOZAIMASHITA
EFCHARISTO

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