

Asset Management & Predictive Solutions

*Reliability is our
concept!*

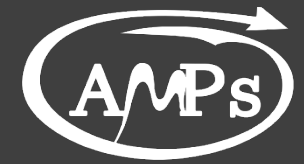




Tommy Glesnes

Managing director, **AMPs AS**

- ✓ Certifications, PdM; VA category III / MLA 1 / IRT 1 / US / HV-PD
- ✓ Certifications, AM; European expert in Maintenance management by EFNMS, Reliability Engineer by Mobius, Lean
- ✓ 30 years experience as service supplier & consultant



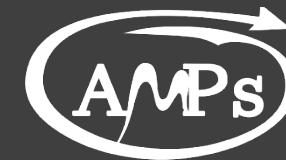
AMPS med Tommy Glesnes tar oss med inn i vibrasjonsanalysenes verden. Hvordan lykkes med sensorer og analyser.

Tommy har over 25 års erfaring med vibrasjonsanalyser og gir oss innsikt i hva som må på plass for å få verdi fra sensorene og vedlikeholdet over fra korrektivt til tilstandsbasert og kanskje helt til prediktivt. Vi får høre om noen som har lykkes, men også om hva det var som gikk galt der verdien uteble.

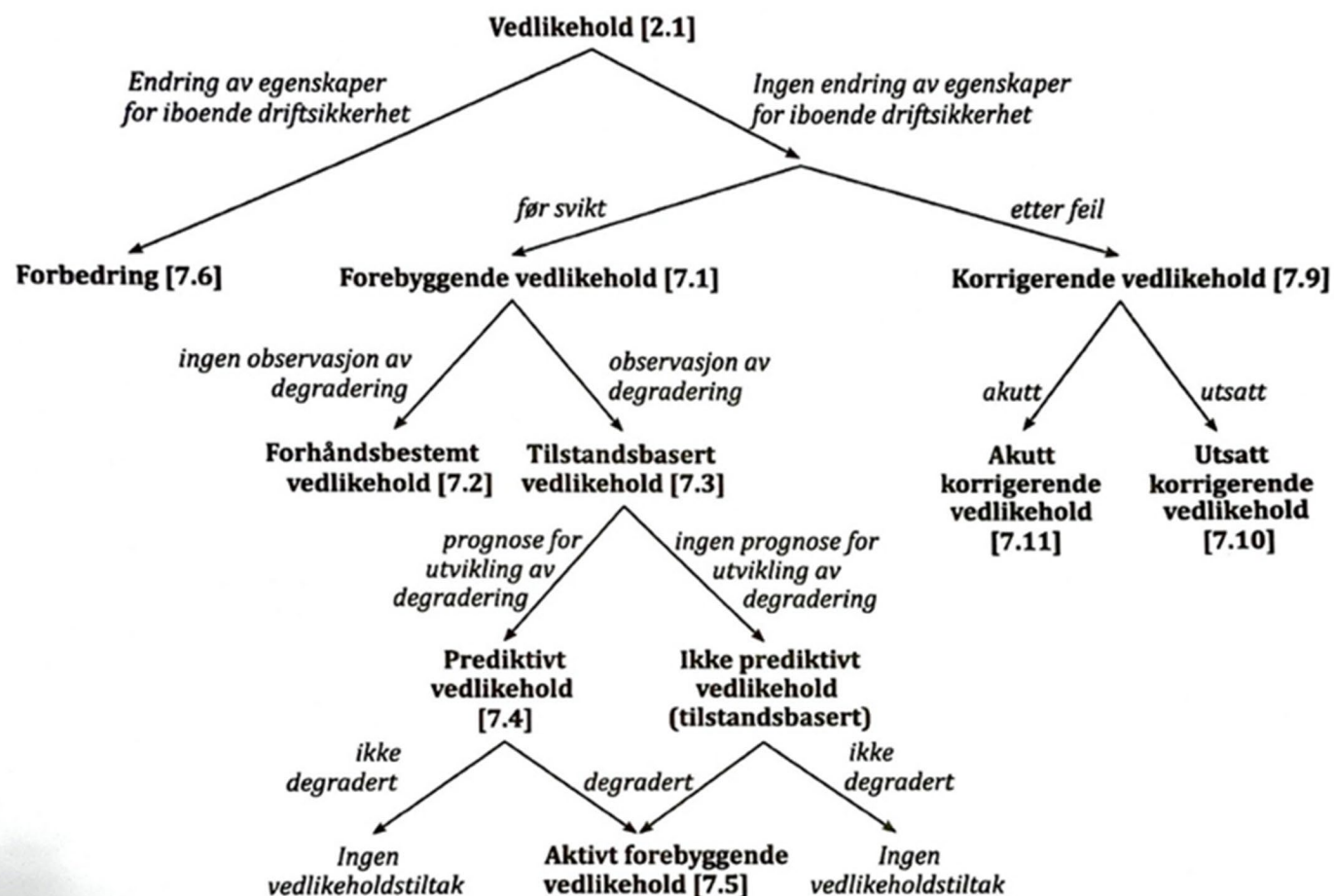
Tilstandsbasert eller prediktivt?



Prediktivt Versus Tilstandsbasert

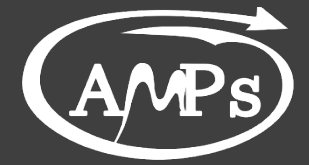


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Figur 1 Vedlikeholdsterminologi (NS-EN 13306, 2017)

Prediktivt versus Tilstandsbasert



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Tilstandsbasert vedlikehold

Forebyggende vedlikehold som omfatter vurdering av fysisk tilstand, analyse og mulige påfølgende vedlikeholdstiltak.

Prediktivt vedlikehold

Tilstandsbasert vedlikehold som utføres etter en prognose utledet av gjentatt analyse eller kjente egenskaper og evaluering av de vesentlige parameterne for degradering av enheten.

Prescriptive

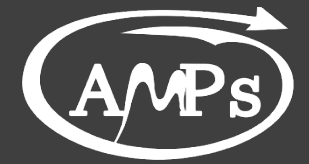
While predictive maintenance provides valuable insights into when a failure might happen, **prescriptive maintenance goes beyond, offering actionable steps**. These steps might include; **root cause analysis, optimal repair schedules, or even operational adjustments aimed at extending equipment lifespan**



Reliability is our concept!



Vibrasjonsanalyse – Prediktiv !



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Stage one

- Minor damage
- Could be subsurface
- High frequency techniques
- 10-20% of L10 life
- Continue monitoring
- Look for root cause



Stage two

- Still minor damage
- High frequency techniques
- Acceleration spectra/ waveforms
- 5-10% of L10 life
- Continue monitoring but look at availability



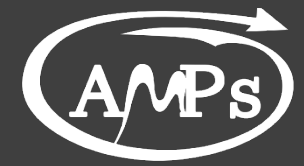
Stage three

- Damage easily visible
- Most vibration techniques will work
- <5% of L10 life
- Replace soon



Stage four

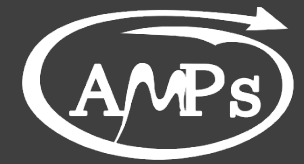
- Serious damage
- Vibration will turn to noise
- <1% L10 life remains
- Replace now



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Litt historie

Historie



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1939 – Year zero of predictive maintenance with vibration measurement – the Rathbone curves

1950 – Frequency analysis (analog)

1965 – proximitors and permanent monitoring of turbomachinery

1971 – The ICP accelerometer

1975 – Frequency analysis with a portable FFT analyzer

1980 - bearing failure detection – SPM

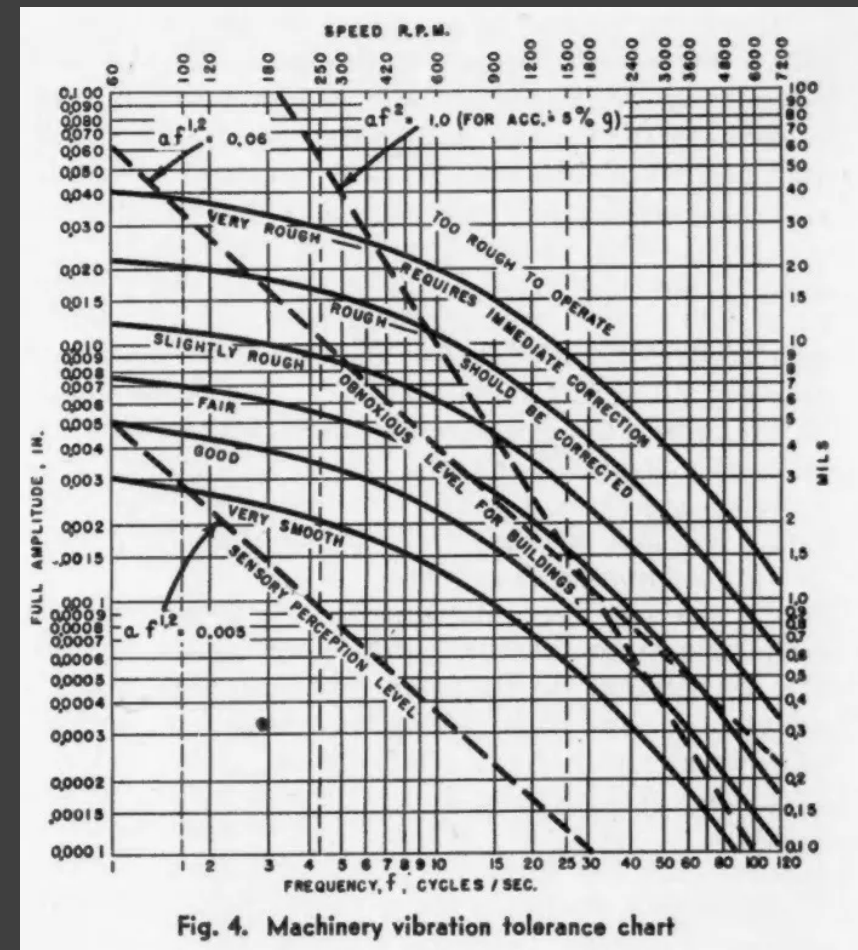
1982 – The first data collector

Years 90 of the 20th century – the integration of technologies –

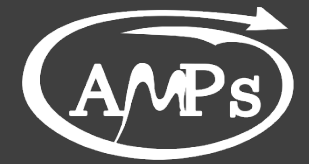
2005 – Første generasjon av trådløse sensorer

2003 – The certification of vibration analysts

2020 – Andre generasjon av trådløse sensorer (MEMS) inkludert tidlig deteksjon av lagerskader.

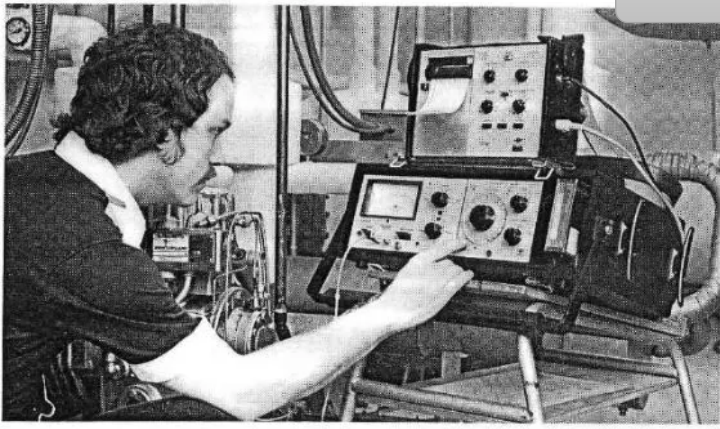


Historie



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Analog FFT / 1950



Accelerometer / 1972



Portable FFT / 1975



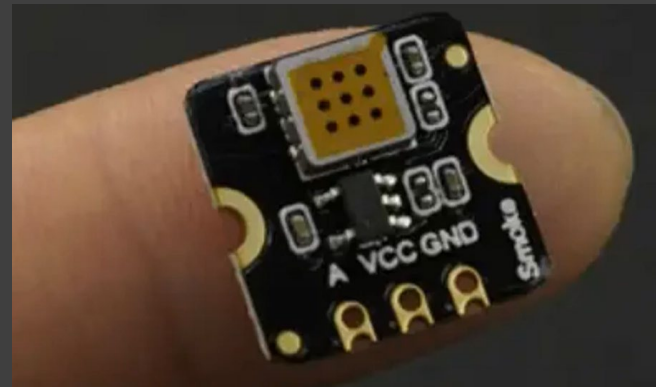
Brg detection
SPM/ 1980



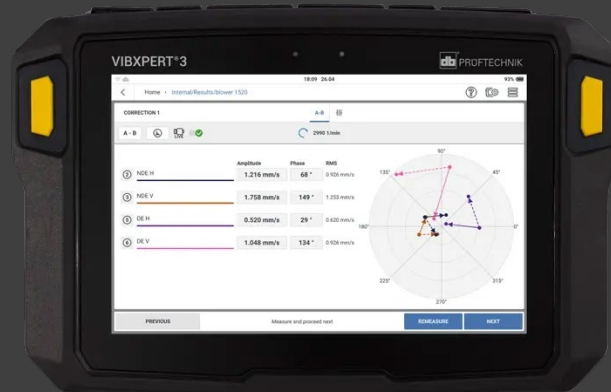
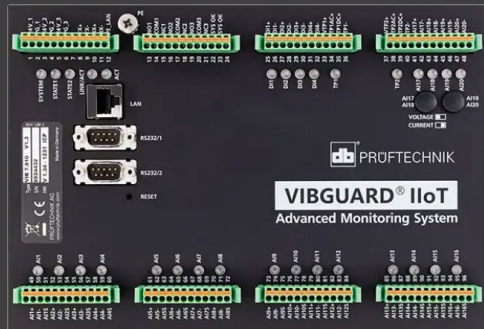
FFT Datacollector 1982

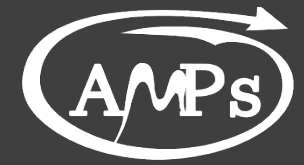


MEMS sensor teknologi / 2020



High quality wireless / 2020





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Hvorfor Tilstandsbasert vedlikehold

Reliability Centered Maintenance



"THE WADDINGTON EFFECT"

"RCM IS ALL ABOUT CONDITION MONITORING"

"MOST RCM PROJECTS FAIL"

Vibration condition monitoring can provide information for the following purposes:

- to increase equipment protection;
- to improve safety for personnel;
- to improve maintenance procedures;
- to detect problems early;
- to avoid catastrophic failures;
- to extend equipment life;
- to enhance operational efficiency.

Condition Monitoring and Control Maintenance is considered best practice as the principle means of managing the condition of assets.

- MCBM* is applicable to all shipboard items
- Due dates are removed and replaced by condition-based maintenance audited annually.
- MCBM enables the machinery intelligence gathered using structured CBM strategy to be a basis for survey credit.
- MCBM removes the requirement for carrying out unnecessary maintenance and component replacement.
- MCBM supports a living criticality assessment and review process.
- MCBM demonstrates accepted practice and is an award that demonstrates a clear commitment to reliability.
- MCBM will demonstrate compliance with TMSA 4, ISM 10, and remains in line with existing guidance etc.

Machinery CM (Condition Monitoring)

Information to owners/operators with a condition based maintenance strategy

Due to the increased focus on machinery-related issues, DNV has developed Machinery CM, intended for owners/operators with an implemented CBM (Condition Based Maintenance) strategy. DNV believes that condition based maintenance is the optimal strategy for maintaining machinery. Providing both safety, operational and financial benefits.

Machinery CM is a survey arrangement based on audits of an implemented and approved CM programme.

All ships operating under Machinery CM¹⁾ will have unique and "ship-specific" operational criteria. The minimum requirements for equipment and systems are presented stipulated by DNV.

Owners/operators must be operating according to a CBM strategy when they apply for Machinery CM. Machinery CM allows the manager to adjust maintenance intervals based on the condition monitoring of applicable components.

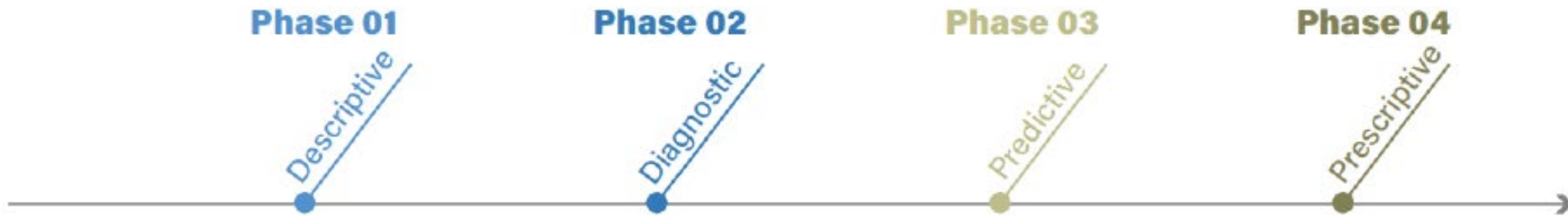
>>>

¹⁾ See DNV rules for classification of ships Pt.7 Ch.8 Sec E and Classification Note 10.2 "Guidance for condition monitoring" for detailed information.

BENEFITS FOR OWNERS/OPERATORS

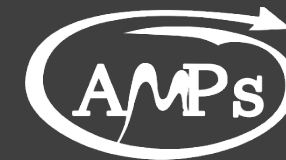
- Assessment of the Condition Based Maintenance scheme as implemented.
- Flexibility, Machinery CM is a survey arrangement tailor-made for owners utilising Condition Based Maintenance.
- Avoid opening up selected machinery components and optimise maintenance intervals with class acceptance.
- 3rd party verification of the present machinery status continuously updated.





	Reactive	Preventive	Condition Monitoring
Asset Mangement Strategies	• Maintenance on failure • High risk of unplanned downtime • High-pressure environment in case of asset breakdown • Production cost of asset maintenance	• Planned maintenance as per schedule • Savings of 12-18% over reactive methods • Production cost of asset failures • Improves asset performance	• Savings of 30-40% over reactive methods • Cost savings of 8-12% over preventive by avoiding unnecessary maintenance • Unpredicted failures reduced by more than 55% over preventive maintenance • Equipment availability increased by 30% over preventive maintenance • Mean time between failures increased by 30% over preventive maintenance

Det krever en investering



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Implementation Curve



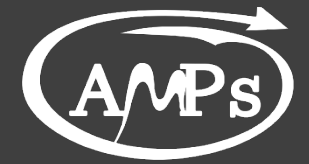
De færreste utnytter fullt potensiale av PdM.

Store besparelser på å optimalisere vedlikeholdet

Pluss; potensielt enorme besparelser i forhold til å unngå havari og nedetid.

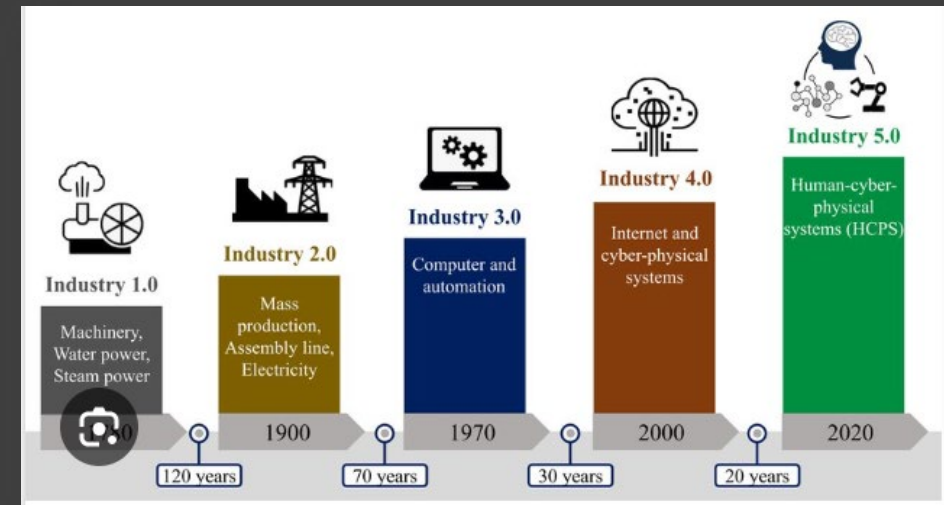
Ja takk – begge deler!

Hvorfor Tilstandsbasert vedlikehold



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- Kostnyttig
- Bærekraftig
- «Supply chain issues» er den nye normalen
- Generasjon Z, synkende arbeidskraft
- Konkurransedyktig / Industri 5.0 / prescriptive / Reliability



Hvordan lykkes med Prediktivt vedlikehold

Hvordan starte et CBM / Vibrasjonsprogram

ISO 17359 - Condition monitoring and diagnostics of machines — General guidelines

This international standard sets out guidelines for the general procedures to be considered when **setting up a condition monitoring programme** for machines and includes references to associated standards required in this process. This standard is applicable to all machines.

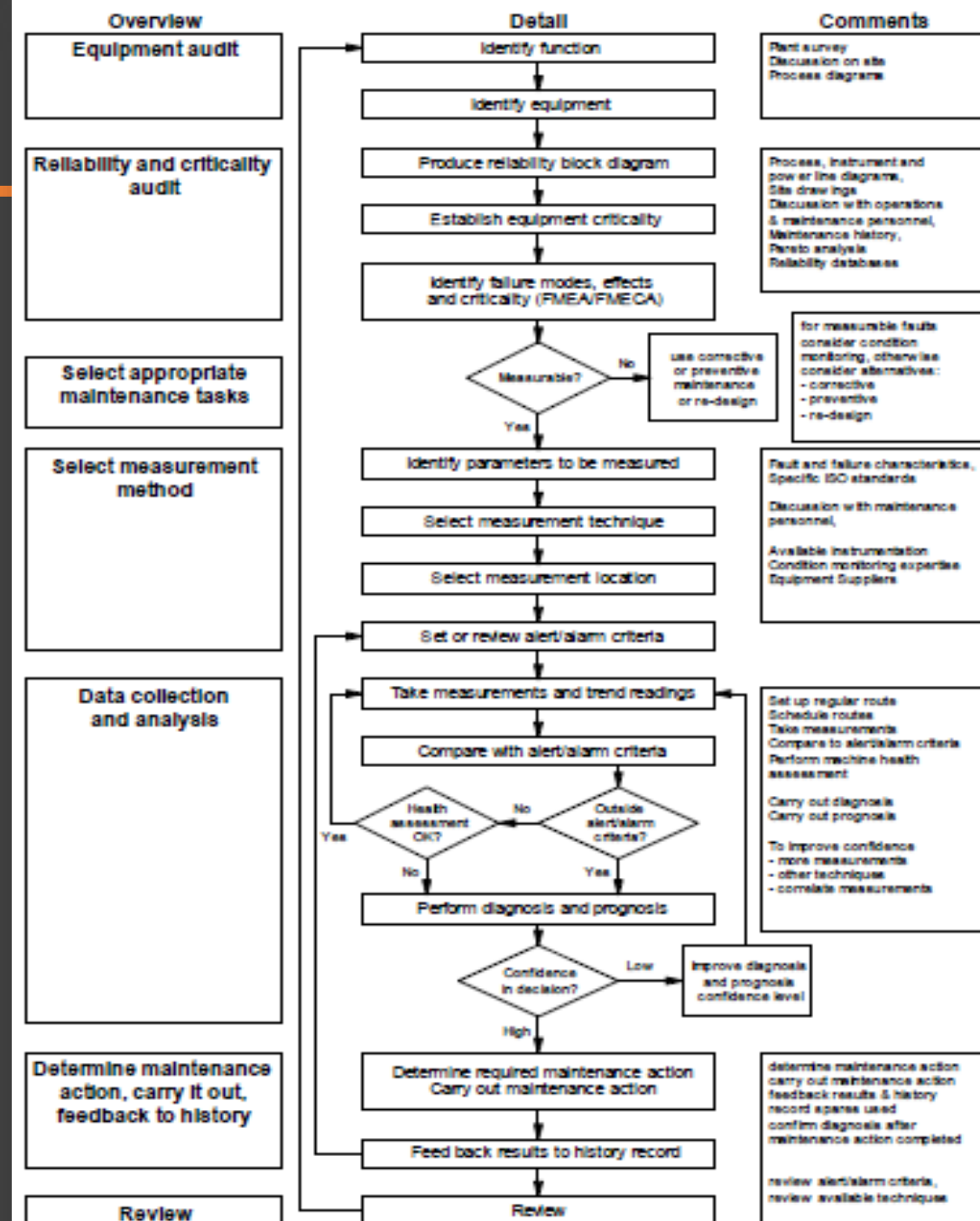
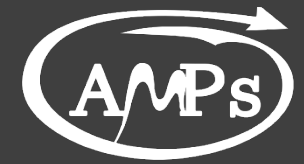


Figure 1 — Condition monitoring procedure flowchart

Overordnet for å starte et PdM program



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Mål & forståelse

- Tydelig målsetning med Tilstandsbasert vedlikehold. Sette mål og KPI'er
- Outsorce eller bygge opp egen kompetanse?

Ledelse & Personell

- Roller og ansvar / Implementere og følge opp / opplæring eget personell

Instrument / verktøy

- Håndholdt, trådløst full online. Fordeler og bakdeler

ISO 17359

- Valg av maskiner, Maskin ID, Tekniske data, målepunkt, måleoppsett, utføre målinger, analyse og rapportering

Analyse & Rapportering

Er rapporten forståelig? hvordan blir den fulgt opp?

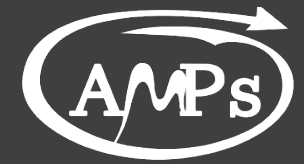
Oppfølging & Feedback

- Fungerer programmet? Hvilke maskiner har vi «feil» på? Har vi hatt noen havari som ikke er oppdaget? Kontinuerlig forbedring

Integrering & Prosedyrer

- Implementer i CMMS, lag prosedyrer. (Ikke la det være et eget program som lever på utsiden av vedlikeholdsprogrammet)

Overordnet for å starte et PdM program



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Mål, Ledelse,
Personell, Integrering
og prosedyrer

- Tydelig målsetning med Tilstandsbasert vedlikehold. Sette mål og KPI'er
- Outsorce eller bygge opp egen kompetanse?
- Roller og ansvar, opplæring eget personell, implementere i CMMS.

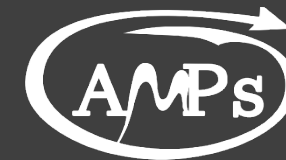
ISO 17359

- Valg av maskiner, Maskin ID, Tekniske data, målepunkt, måleoppsett, utføre målinger, analyse og rapportering.
- Valg av instrumentering

Analyse, Rapportering,
oppfølging og feedback

- Er rapporten forståelig / blir avvik fulgt opp / Blir vedlikehold planlagt optimalt i forhold til produksjon / blir det gitt feedback til de som analyserer?

Our monitoring concept!



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Wireless sensor solutions



Full online – Realtime online



Portable data collection



AMPs Diagnostic center:

1. AI powered diagnostic tool
2. Certified Vibration & Reliability experts

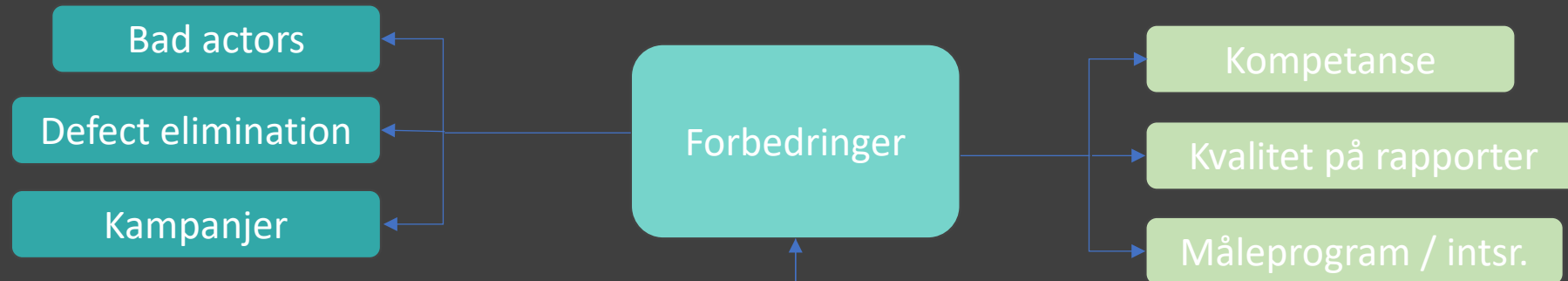
Machine status
Maintenance recommendations
Bad actors / KPI's
Technical support:

- Lubrication
- Trouble shooting
- System support
- Regular meetings



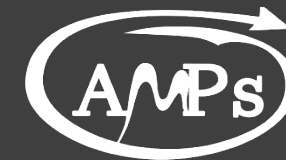
Reliability services:

- Onsite balancing
- Shaft alignment
- Motion Amplification
- EDM trouble shooting (VSD related problems)
- Machine and structural trouble shooting

[illegible]



Vårt nye TBV program



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Wireless sensor solutions



Full online – Realtime online



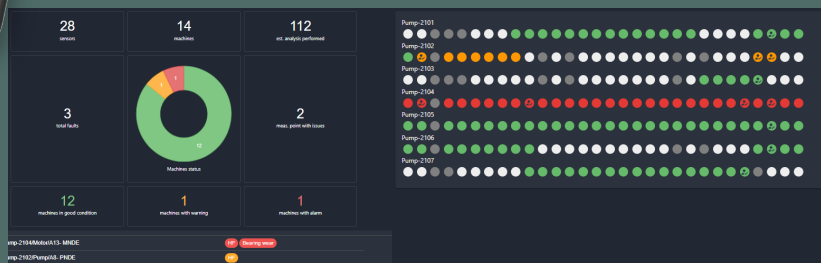
Portable data collection



Hvilket som helst
Vib- sensor data



VibSim



Korrektivt utsatt

- Lagerskade S1 & S2
- Moderat ubalanse



Analyse &
rapportering

Gjennomgang
og planlegging

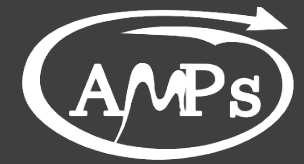
CMMS - Work order

**Forebyggende
Vedlikehold**

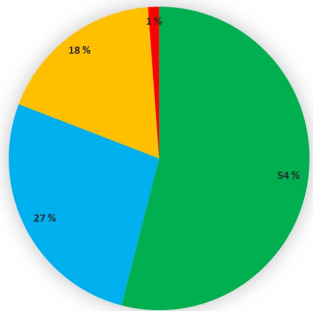
- Smørning
- Inspiser
(looseness?)
- Balansering
- Oppretting

Korrektivt Akutt
- Bytt lager

Work order closed



Report Severity Status 2018-2025

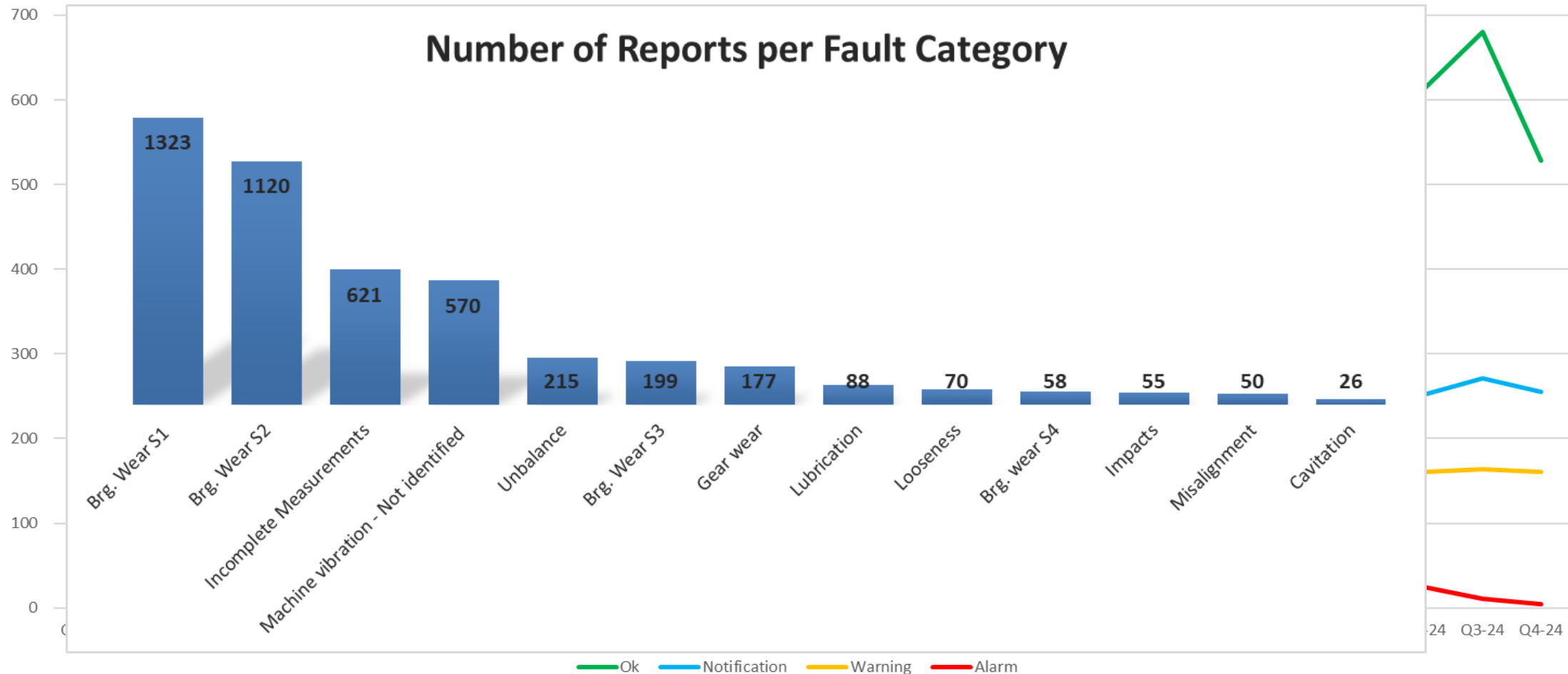


OK (8173) Notification (4071) Warning (2736) Alarm (179)

Ca. 1100 rapporter, pr kvartal

Quarterly Number of Reports by Severity Status 2018-2024

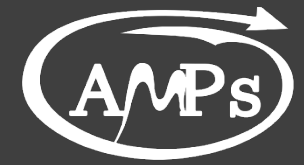
Number of Reports per Fault Category



- 7.1 PdM som vedlikeholdskonsept

Eksempler på kostnadsbesparelser

um Cond CSW	Engine-Room	Ok	Ok	Ok	1X	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok
CSW Pump A	Engine-Room	Brg	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok
CSW Pump B	Engine-Room	Ok	Ok	Ok	Ok	Ok	Ok	1X	Ok	Ok	1X	1X	1X
y Pump E-house A	Engine-Room	Brg	Brg	Brg	Brg	Brg !	Brg !	Brg !	Brg !	Brg !	Brg !	Brg !	Brg
y Pump E-house B	Engine-Room	Brg	Brg	Brg	Brg	Brg	Brg !	Brg !	Brg !	Brg !	Brg !	Brg !	Brg !
ater Transfer Pump A	MP1	Brg !	Brg !	Brg !	Brg !	Brg !	Brg !	Brg !	Brg !	Brg !	Brg !	Brg !	Brg !
jector Pump A	Engine-Room	Brg	Brg	Brg	Brg	1Xn	S1	S1	S1	S1	S1	S1	S1
jector Pump B	Engine-Room	Brg	Brg	Brg	S3	Ok	Brg	Brg	Ok	Ok	Ok	Ok	Ok
ling FW Pump A	Engine-Room	Ok	Ok	Ok	Brg	Brg	Brg	Brg	Ok	Ok	Ok	Ok	Ok
ling FW Pump B	Engine-Room	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok	Ok
l Draft Blower A	Engine-Room	Ok	Brg	Brg	Brg	Brg	Brg	Ok	Ok	Ok	Ok	Ok	Ok
l Draft Blower B	Engine-Room	Ok	Ok	Ok	Ok	Brg	Brg	Brg	Ok	Ok	Ok	Ok	Ok



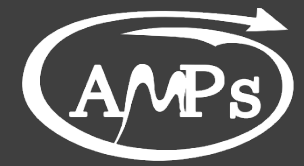
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[Demo](https://cm-vibsim.web.app/)

<https://cm-vibsim.web.app/>

The VibSim logo consists of a white waveform icon on the left, followed by the text 'VibSim' in a large, white, sans-serif font. The waveform is a stylized representation of a vibration signal, with a horizontal line at the top and bottom, and a central peak and trough.

VibSim



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Spørsmål?