# 2016資訊化船舶管理研討會
## – 船舶動力系統的健康監視與預保養

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敬邀　(2016, 05, 25)

# 船舶動力系統之健康監視與管理

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# Health monitoring and management for marine systems

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**(2016, 05, 25)**

# Outline

- Introduction
- Health monitoring
- Health management
- Summary

# Introduction

System response changes include :

- Gradual change

  (performance degradation, or health degradation)

- Abrupt change

  (fault, malfunction, engine trouble or failure)

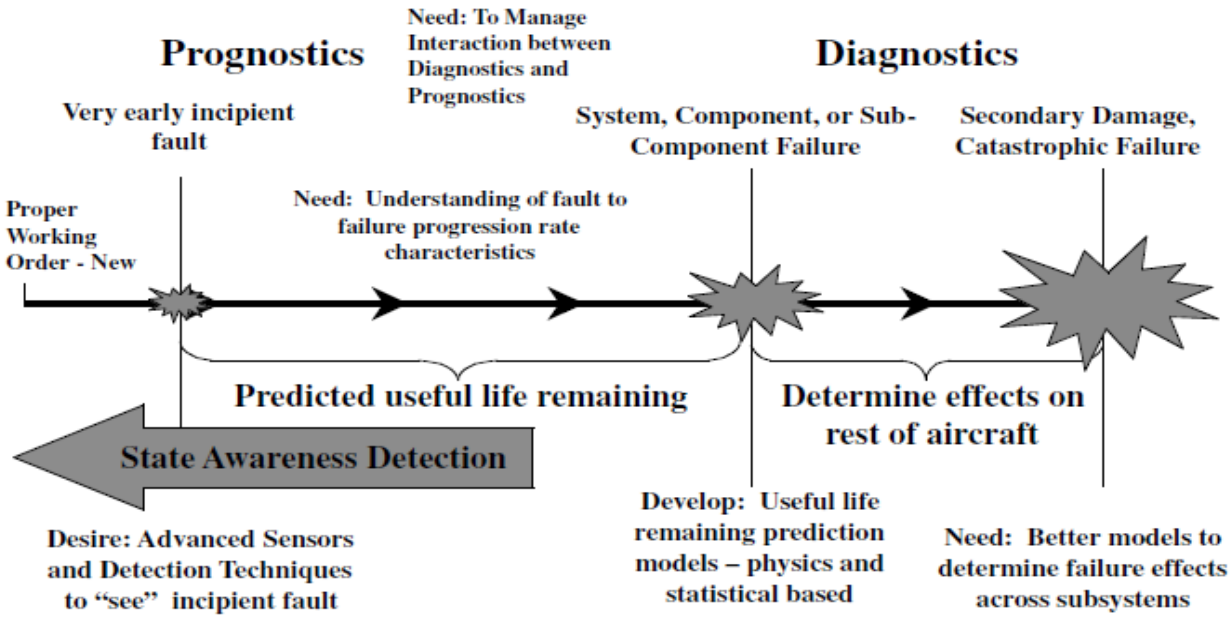
# Introduction (continue)

- Gradual change can be trapped by data mining from measured data, or by specific health monitoring scheme
- Abrupt change is usually trapped by alarming system
- Both of them may be missed by inadequate measurement

# Prognostics and health management

- It generally combines sensing and interpretation of environmental, operational, and performance-related parameters to assess the health of a system and predict remaining useful life
- Or at least we try to predict its trend to become failure

# Failure progression timeline




Failure progression timeline.

# Examples of degradation

- Wear
- Slackness
- Leakage
- Dust
- Dirt
- Corrosion
- Deformation

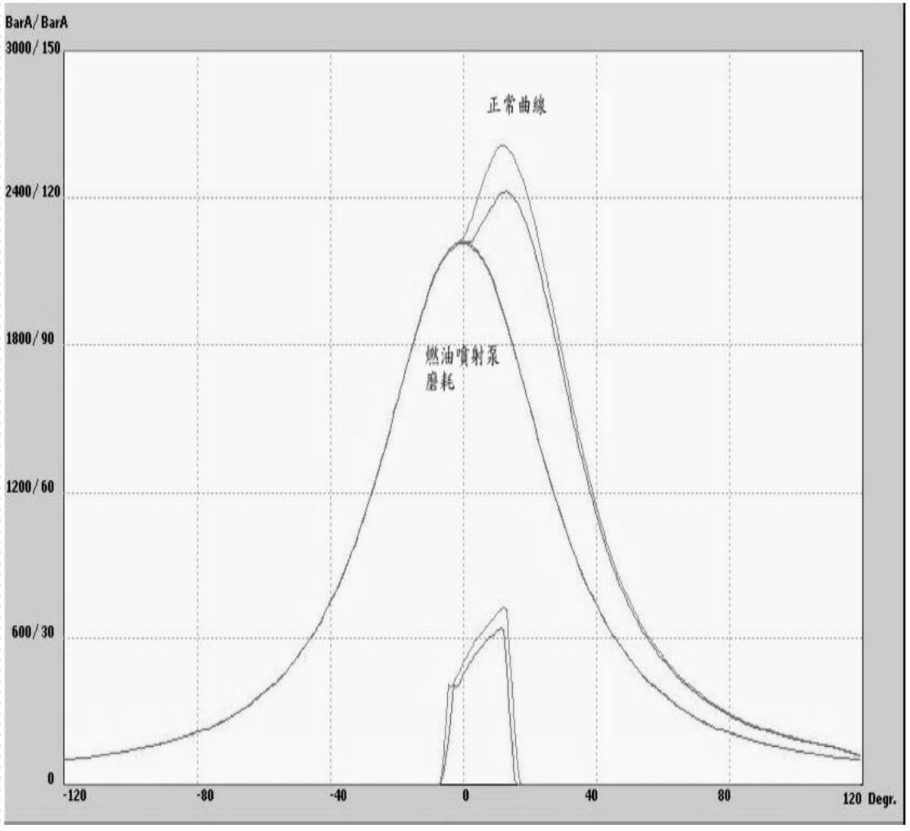
# Examples of degradation

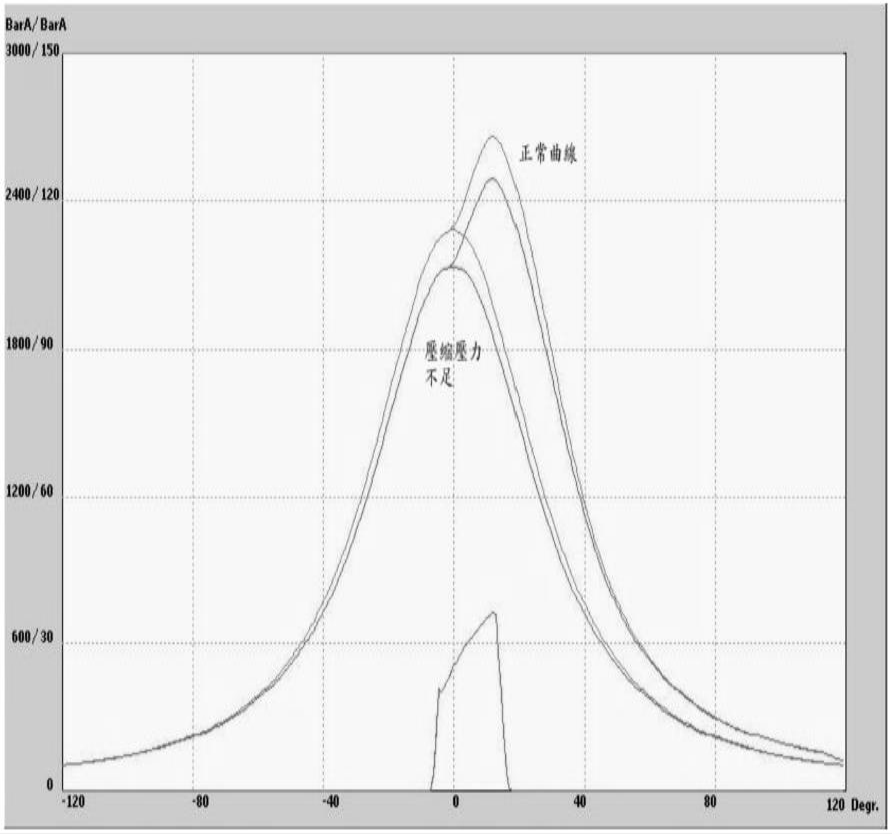
- Increased friction
- Surface damage
- Cracking
- Overheating
- Vibration
- Noise
- Poor combustion

# Examples of KPIs for engine health monitoring

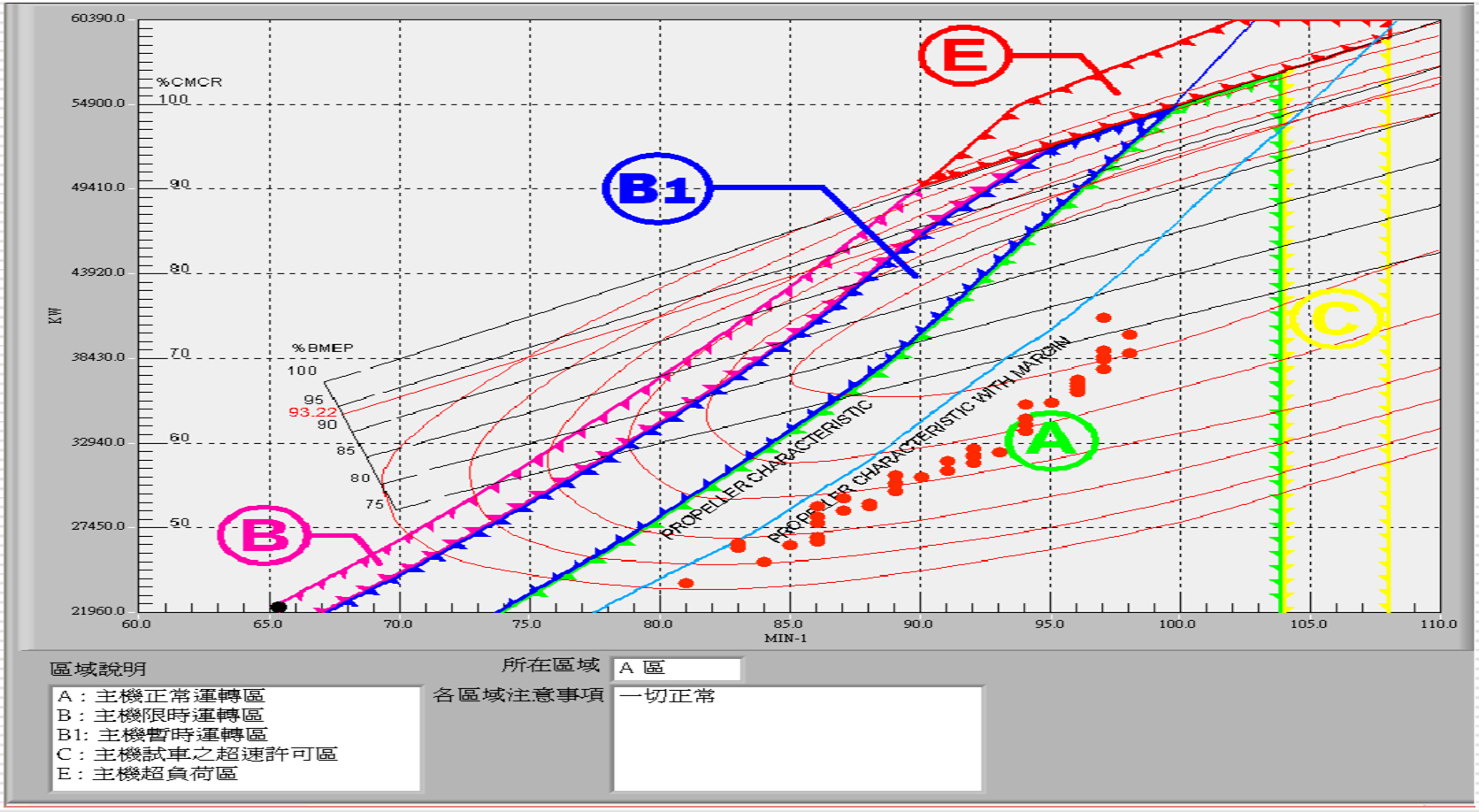
- Combustion efficiency (P-theta diagram)
- Load (torque meter)
- Turbocharger efficiency
- Flow resistance(e.g. pressure difference between inlet/outlet of the air cooler, or boiler furnace)
- Condition of piston ring sealing and rotation (piston ring monitor)

# Combustion monitoring example

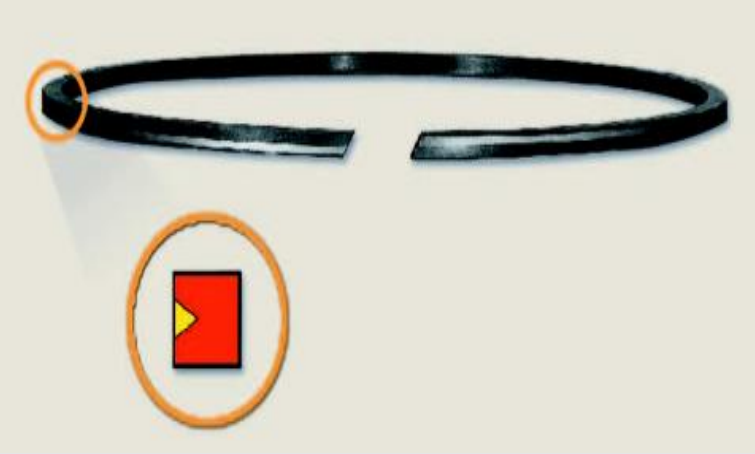


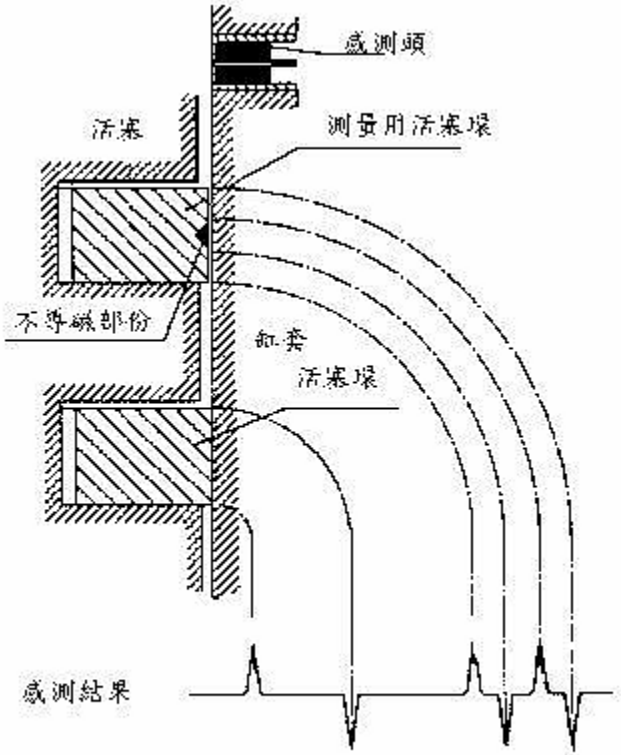



# Monitoring for torque rich (power /Speed diagram)

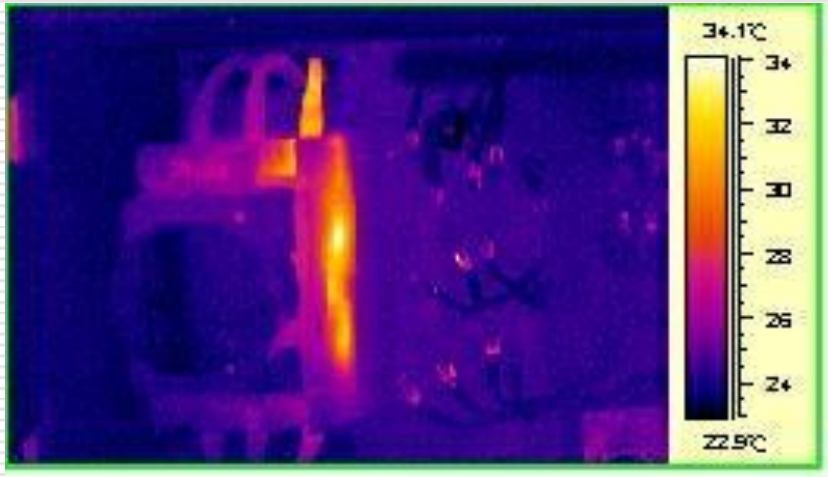


# Piston ring monitor





# Monitoring for high temperature site (thermographic image)

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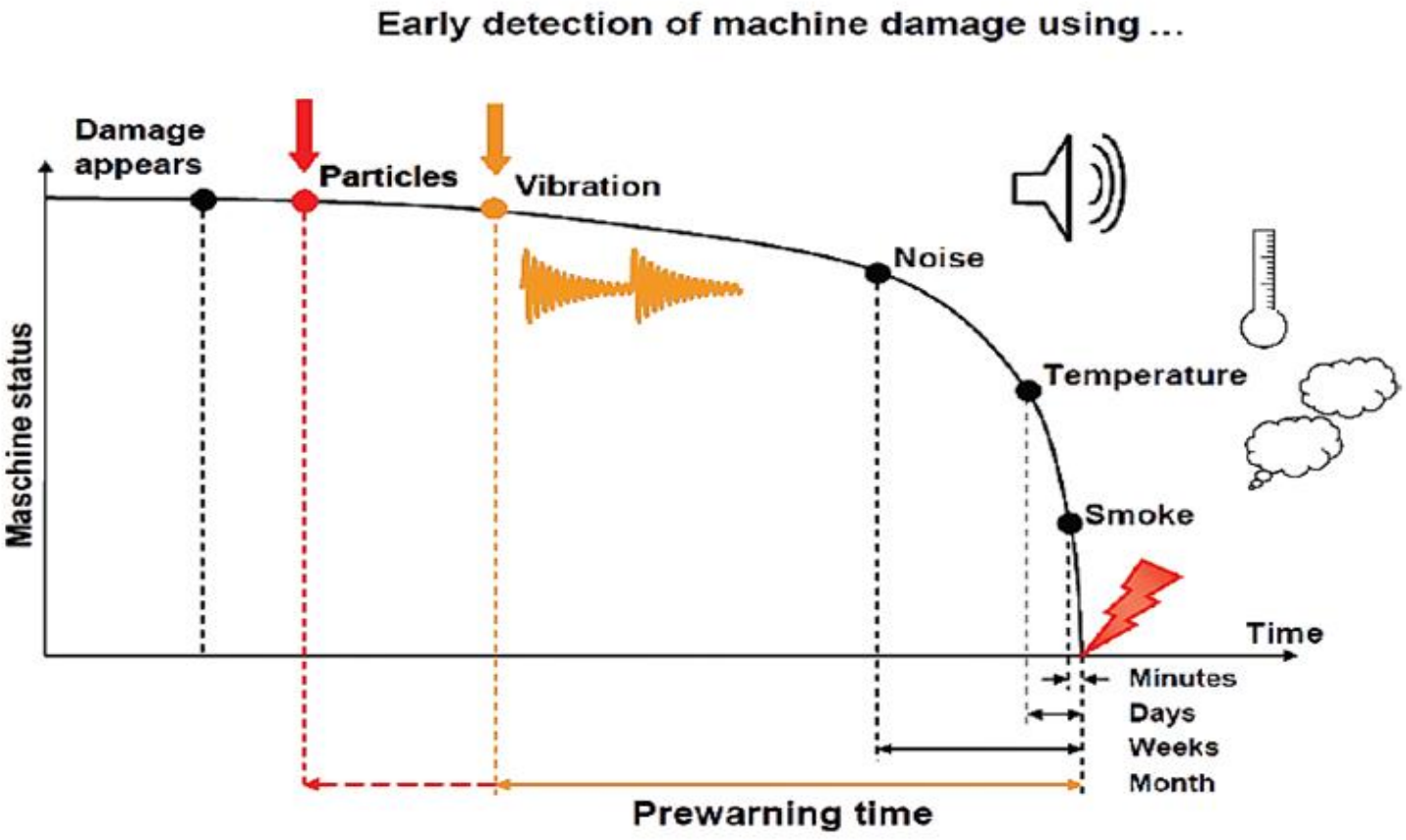
# Some remarks for health monitoring indexes

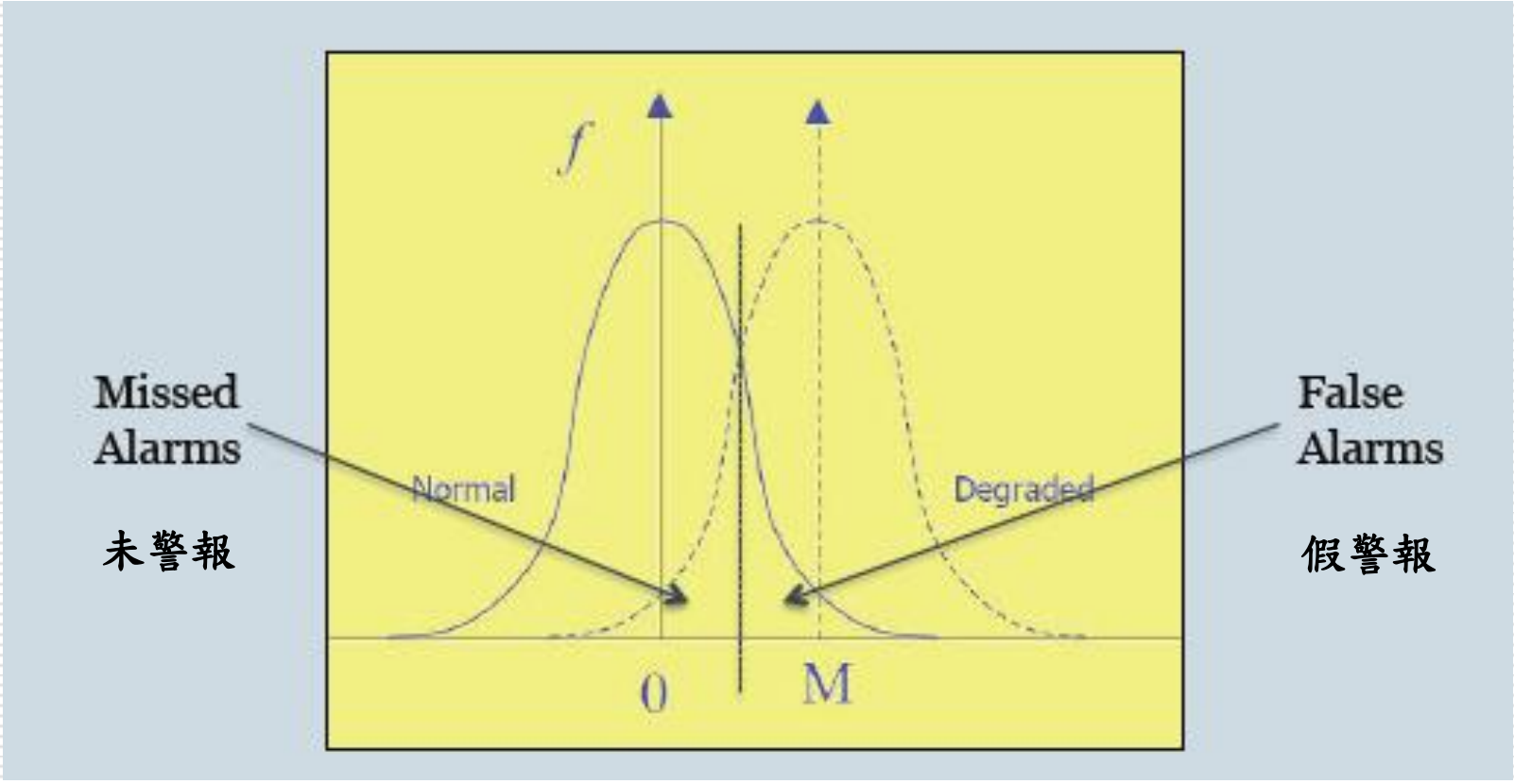
- Health indexes are usually changed with operating point
- Beware of bias, noise in the measurement, which may deteriorate health indication

# Pre-warning time for different condition monitoring methods




Kuhl, A.: Condition Monitoring – many options, one goal, Proceedings of OilDoc 2011, Rosenheim, Germany, February 2011

# Tradeoff between False alarm and Miss fault detection



# Health management

- Select proper health monitoring indexes
- Health management procedure
- Link with safety management (error management)

# Health monitoring index may be classified into 3 levels

- Green level (health is in good condition)

  Controller tuning can be considered to optimize system's performance

- Yellow level (health is degraded)

  The monitoring scheme try to indicate actual cause which is responsible for degraded health, so that useful improvement (e.g. maintenance scheduling) can thus be made to restore system's health（預處理）

# (continued)

- **Red level (Poor health)**

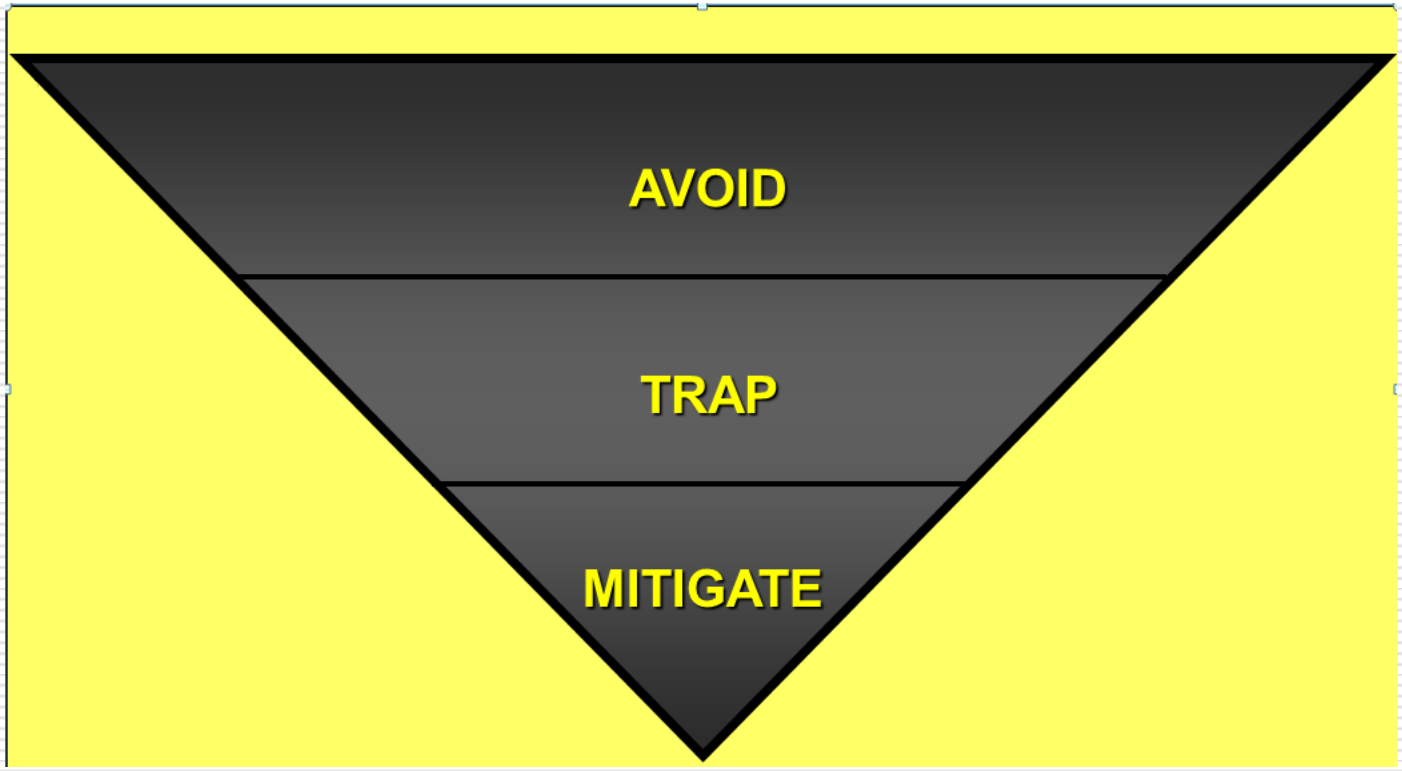
  **Actually, it is in fault diagnostic mode, fault accommodation(such as auto-change, auto-trip…) is required to avoid system breakdown**

  **(系統故障已經出現，必須藉助安全防護機制以避免系統損毀，而後透過故障診斷分析以找出故障源，從而對症下藥，讓系統恢復健康，屬於後處理)**

# Health management procedure

- Health monitoring is used to find the sign of degrading health (by examining health indicators)
- Using health indicator analysis to find root cause for degraded health (fault isolation)
- Suggest proper actions to restore health

# Helmreich's error management model



# Health management should link with error management

- Avoid (Be cautious with hazard analysis first and maintain situation awareness)
- Trap (Use health monitoring indexes to trap degraded health, find out its true cause, so that remedy can be made to restore health)
- Mitigate (Using failed-safe design and SOPs to reduce possible human error)

# Summary

- Safety is not something we have, but we create it in every day, every moment

  安全並非我們天生能夠擁有，其必須倚靠監視環境以及管理人員的警覺，並加上無時無刻的努力與關注才能營造出來

# Summary

- The earlier the degradation we trapped, the less hazard to the system's health can be achieved

  越早發現健康下滑的狀況而予以處理，能越早阻斷其對系統的危害

- Hardware(condition monitoring devices) is only an infrastructure, knowledge and management are required to maintain system's safety and efficiency

  監視系統只不過是基礎建設，還需要靠管理者足夠的專業跟敏銳的關注，才能維持系統的健康與安全，進而提升系統的效率

# 補充資訊

# 臺灣海洋大學輪機碩專招生資訊

- 本校輪機碩專目前正招生中，報名至105年6月3日(五)下午3:30截止。可聯結學校網站內的招生資訊：
  簡章下載 http://admission.ntou.edu.tw/files/info-20151209150809078 4.pdf
- 報名的程序如下
  1. 索取繳費帳號：即日起 ~ 105年6月3日(五)下午3:30止
  2. 報名日期：即日起 ~105年6月3日(五)下午5:00止
  3. 考試日期：105年6月17日(星期五)，(口試)
  4. 報名方式：一律採網路報名(報名網址：http://exam.ntou.edu.tw/)
  5. 考生請由海大網站的招生資訊內的輪機碩專的招生公告下載附件之電子簡章完整版，並請於報考前詳細閱讀招生簡章中相關規定，若有任何報考疑問，請於報名前洽本校進修推廣組或輪機系確認。

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Thank you very much for
your attention !