Total Life Cycle Equipment Management (TLCEM) Best Practices

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Consultant:

Eric Zhang, Senior engineer, Master degree of Dongnan University.

21 years of work experience, worked as engineering, quality, production logistics manager position, has nearly 10 years of management experience. He had been to Sweden head office and branch companies in the United States, Germany, Sweden, Malaysia, India and others to do industrial engineering (IE), logistics packaging design, lean manufacturing and six sigma technology exchange and training.

Training Style: Worked for 21 years, foreign enterprise (a state-owned enterprises, a foreign company, both are very large enterprises) engineering, quality, materials management departments work experience, has rich lean manufacturing, industrial engineering (IE) technology, transportation and packaging design, quality management, material and storage management working experience; Proficient in industrial engineering, lean production, lean value stream analysis, logistics packaging design, plant lean layout and logistics path design, warehouse management, 6 Sigma, etc.

His lecture advocate pragmatic. Training process mainly use curriculum system as the main line, through case study, role simulation exercises, group discussion, work practice and at the same time accompanied by consulting type training, guide the student to participate in, and focus on its rich enterprise practice to improve case sharing.

Typical clients: Abbott, Huayang - Kostal, Siemens, Shanghai Johnson, Harbin beer, Toshiba transformer company, Dongfeng motor, Cummins engine, Simon Electric, Continental Automotive Electronics, Midea Group, Geishite Pharmaceutical, Kraft Foods, Beijing Bowei Airport Support, Futian Automobile, Yongkang Pharmaceutical, Panhan Power Generation, Yibin Paper, Bohai NKK, Zhejiang Mobile, Jinbo Agrochemical, Nuokang medicine, Hankook Tires, United Automotive Electric System, Lafarge, Alfa Laval, Suntory etc.

Martin Linking Business Consulting

Who Should Attend?

Equipment designers, equipment engineers, production or process engineers, equipment maintenance personnel, production management, production manager, engineering manager, equipment manager, etc.

Seminar Objectives:

BM - > PM - > TPM - > TnPM, at present equipment management training mainly is TPM - Total Productive Management. Including Autonomous Maintenance, Preventive Maintenance, Equipment Improvement, etc. Focuses on how to improve the stability of the equipment after equipment putting-in-service proactively, reduce equipment failure and maintenance, but ignored the equipment design, manufacture, installation and other early stages, and the product disposal after the life cycle of the corresponding equipments, such as reuse, upgrade, scrap, etc.

This course brings together the consultant's more than 20 years of working experience in equipment design, manufacture and management, combining foreign EEM (Early Equipment Management- main content is equipment design, manufacture and installation to ensure the stability of the equipment after putting-in-service and reduce maintenance) concept, explain in detail from the equipment requirement research, equipment design, equipment manufacture and installation, equipment maintenance (i.e., equipment autonomous maintenance, planned maintenance, improve maintenance knowledge and so on of TPM), equipment asset management, spare parts management (spare parts inventory control, etc.), late equipment disposal (updating and disposal principle, equipment after treatment), such the lifecycle of the Equipment Management process. The teaching process combine with a lot of work or business consultation improvement cases, compared with TPM, this course improves what mentioned but not explained about how to through the equipment design, improve the robustness of equipment, so as to reduce the risk of equipment failure, reduce improvement maintenance, and discuss cost control method of the lifecycle of the equipment.

Tis course can help enterprises to establish equipment design process, equipment management process, late disposal process and cost control within the whole life cycle of equipments.

In-House Training Solutions

If you have a number of delegates with similar training needs, then you may wish to consider having an In-House Training solution delivered locally on-site. Course can be tailored to specific requirements.
Please contact **Whitney Shen** on **+86 28 8532 7678** or email **whitney.shen@martinlinking.net** to discuss further possibilities.

Seminar

Total Life Cycle Equipment Management (TLCEM) Best Practices

Section 1: Equipment design process

- EEM introduction
  - Introduction to **E**arly **E**quipment **M**anagement
  - The role of EEM
  - Main steps of EEM
  - The relationship between EEM and equipment design
- Equipment design research
  - Equipment requirements, equipment capacity analysis
  - Similar equipment information collection
  - Equipment budget
- Equipment design criteria (general requirements)
  - Structure/function/accuracy/material/ key components
  - Maneuverability/maintainability/ ergonomics/safety
- Design detailed requirements
  - Functions/work environment/EHS requirements
  - Operation/maintenance requirements
  - Equipment profile/documents

Case: design detailed requirements of a device

- Production process instructions
  - Product parameters/production process/process requirement
- Equipment design steps
  - Design draft
  - Detailed design
  - Design failure mode analysis - DFMEA
  - Equipment manufacturing
- Key components requirements
  - Standard parts selection/ standardization of non-standard parts
- Documents requirement
  - Whole machine assembly drawings/non-standard parts drawings/parts list
- Detailed requirements of quotation

Case: specification for quotation of a device

- Confidentiality agreement requirements

Case: equipment design document example

Section 2: Equipment reliability and products manufacturing quality

Our expectation is to consider upgrading equipment robustness from the design phase, become free maintenance or less maintenance equipment. So after delivery of the equipment, should do reliability evaluation before using. Evaluation results is as part of the delivery process

- Use stability - MTBF
- Performance stability
- Product quality stability - Cpk analysis
- Equipment Poka-Yoke design
- Equipment improvement design

Case: equipment Poka-yoke design, improve product quality

Case: equipment improvement design, improve product quality

Section 3: Equipment cost control

- Equipment cost structure
  - The cost of materials
    - Standard/non-standard parts/assembly materials
  - Processing cost
    - Surface treatment/machining/assembly
  - Design cost
  - Tax management
- Equipment cost control method
  - Cost analysis method
  - Value engineering
    - Value engineering introduction
    - factors of value engineering - function/cost/value
    - Methods for improvement of the value
    - Value engineering work order
  - Bidding and negotiation

Case: value engineering analysis examples

Section 4: Receiving and installation of equipment

- Appearance validation
- Installation and debugging
- Functional verification
- Performance verification
- Attachment verification
- To receive equipment
- The installation of the equipment
  - Site selection and layout design
  - Installation related issues

Section 5: Introduction of TPM (short)

- The origins and evolution of TPM
- The theoretical basis of TPM - Heinrich triangle
- The main connotation of TPM

- TPM eight pillar activity
- Four importing stage of TPM
- Ten key success factors of TPM
- TPM implementation effects

Section 6: Autonomous management of TPM

- TPM Autonomous Management introduction
- Seven steps of TPM Autonomous Management introduction
  - AM0-Preparation
  - AM1-Initial cleaning
    - Bad point label
    - Temporary standard of cleaning
    - AM implementation process
  - AM2-sources of pollution and difficult position countermeasure
    - Sources of pollution and difficult part finding
    - Pollution source analysis method
    - AM2 target
  - AM3-develope provisional benchmark
    - Provisional benchmark book
    - Visual management
  - AM4-total point check
    - Understand the equipment structure, familiar with equipment
    - Find and repair the minor defects
    - Personnel training and ability improvement
  - AM5- autonomous point check
    - Point check classification
    - Point check working table
    - Point check preparation
    - Personnel training and the ability improvement
  - AM6-Standardization
    - Standardization of the above activities
    - Expand autonomous activities to the surrounding equipment
  - AM7-completely autonomous activity
    - PDCA of autonomous activities
- TPM autonomous management and the main points of the organization

Case: introduction autonomous maintenance activities of an enterprise

Discussion: know the present situation of TPM of our plant

Material: autonomous activity forms

Section 7: Scheduled maintenance of TPM

- Types of scheduled maintenance introduction
  - Time based maintenance - TBM
  - Condition Based Maintenance - CBM, IR
  - Breakdown Maintenance - BM
  - Corrective maintenance - CM
  - Emergency maintenance
- Autonomous maintenance & scheduled maintenance and skill sharing
- Natural degradation and forced degradation studies
- Scheduled maintenance steps
  - Equipment status evaluation - maintenance infrastructure
  - Degradation recovery and weak position improvement - fault lower activity period
  - Establish a scheduled maintenance system (organization/plan/budget) - scheduled maintenance system construction period
  - Improve maintenance activities - trustable maintenance activity
  - Prevention Maintenance activities - trustable maintenance activity
  - Predictive maintenance research - trustable maintenance activity
  - Device status and product quality - the highest productivity and quality
- Scheduled maintenance activities management
  - Scheduled maintenance management process
  - maintenance plan and management- maintenance cycle, what equipments
  - Maintenance information management- maintenance records and improvement measures
  - Spare parts management - forecast and inventory study
  - Maintain records of the cost management system
- Spare parts inventory management
  - 3A calculation model of stock and spare parts
  - Spare part inventory strategy
  - Spare parts planning and management
  - Fault record, degradation judgment, spare parts inventory basis
  - In accordance with the line rate, find out the slow moving spare parts, formulate measures
  - Statistical information source of spare parts and ordering cycle, for high value , and long ordering cycle imported spare parts, considering localization or part localization (and usually use homemade parts, but keep very little imported spare parts, and do statistical analysis of local parts use cycle)
  - Based on the above analysis, formulate a reasonable inventory level.

- Scheduled maintenance implementation steps
- Equipment importance evaluation
- Two key indicators of TPM
  - MTBF - Mean Time Between Fault
  - MTTR - Mean Time To Repair

Section 8: Equipment OEE analysis and improvement

- Equipment six big losses introduction
  - Equipment failure
  - Switch/adjustment
  - Power on/shutdown
  - Loss of speed
  - Small stop/idling
  - Quality defects rework
- Learn overall equipment efficiency (OEE)

Case study: why efficiency of equipment is so low?

- Equipment OEE introduction
  - Where equipment efficiency loss in?
  - The origin and development of OEE
  - Why to use the OEE?
  - Equipment time loss waterfalls flow
  - How to calculate efficiency of equipment OEE
- Equipment importance evaluation
  - Influence degree to production
  - Influence degree to quality
  - Influence degree to maintenance
  - No backup machine
  - Influence degree to the quality of product, etc
- Definition of key equipment and the meaning of OEE calculation
  - OEE calculation of a single equipment
  - OEE calculation of production line
  - OEE calculation exercises combined with the actual plant situation
- Analysis of OEE
  - How much is the industry's advanced level of OEE
  - Relationship between equipment utilization rate and OEE
  - How much is the loss of speed?
  - How much is the idling and instantaneous stop loss?
- On-site often occurred OEE related problems
  - How to improve OEE
  - On-site OEE data collection and statistics (common methods and computer methods)
  - Specific measures to improve OEE
  - Reduce the outage loss analysis and improvement
  - TPM-AM/PM
  - Quick analysis and judgment of failure - PM, FTA
  - Quick maintenance (QM) /preventive maintenance (PM)
  - Shorten production preparation time analysis and improvement
  - Human-machine collaborative analysis - digging machine idle capacity, improve equipment utilization
  - SMED (watch video)
  - Shorten the warm-up time
  - Equipment maintenance and modification
  - Product failure analysis and improvement
  - The reasons of defects
  - Count measure to prevent defects
  - Poka Yoke
- OEE ascension method and step

Case: OEE improvement example: efficiency increases cases, from 35% to 70% (three years)

Practice: OEE improvement classroom practice

Practice: OEE calculation

- **Key (individual) improvement**
- Steps of key (individual) improvement activities
- Tools for key (individual) improvement activities
  - OPL-One Point Lesson
  - SGA-Small Group Activity
  - AB-Activity Boards
- **Education and training of TPM**
  - TPM staff levels
  - Training methods
  - Skills matrix
- Six steps system of TPM education and training
- Main content of TPM training education and training
- TPM related templates

Case: TPM activities improve the SMT line OEE case

Section 9: Equipment daily management and late disposal

- Equipment profile and records
- Equipment maintenance book
- Equipment asset management
- Equipment total life cycle cost management - LCC
- Equipment weeding out rules
  - Equipment maintenance cost and residual value – 3 principles
  - Production lost caused by equipment maintenance
  - Quality loss caused by equipment instability
  - Equipment production efficiency loss and equipment changing costs
- Late equipment disposal
  - Equipment modification
    - Modification time
    - Equipment modification cost calculation - maintenance & quality cost vs. renovation costs
    - Equipment modification factor
    - Equipment modification methods
  - equipment reuse, use in similar new equipment
  - Equipment disposal as second-hand equipment in the open market
  - Equipment core modules dismantling of and reuse
  - Scrapping process

TPM: everyone is familiar with it, which mentioned the MP (preventive maintenance), DM (design maintenance), equipment maintenance should begin from the design phase. But TPM does not guide how to do MP, DM.

Cost: the design of the device determines the reliability of the equipment, TPM emphasizes the lifecycle of the equipment cost, inevitably contains equipment design, installation, use, maintenance, renovation, reuse and scrap etc.

Status: the current domestic about equipment management more focused on maintenance after equipment put into use, to ensure equipment life, performance and processing quality.

Goal: equipment management should be from design stage, meet the functional requirements, stable and reliable and reasonable price of equipment is the goal of the design.

设备全生命周期管理最佳实践-TLCEM

上海，中国

2015 年 5 月 21 日至 22 日

咨询师:

Eric Zhang， 高级工程师，东南大学硕士研究生学历。

21年的工作经验，期间担任工程部、质量部、生产物流部经理等职务，有近10年的管理工作经验。曾赴瑞典总公司及公司在美国，德国，瑞典，马来西亚，印度等分公司进行工业工程（IE），物流包装设计，精益生产及6Sigma等方面的技术交流及培训。

培训特点：工作二十一年来、外资企业（一家国企，一家外资，均为特大型企业）工程技术，质量，物料管理等部门工作经历，有丰富的精益生产、工业工程（IE）技术、运输包装设计、质量管理、物料及仓储管理等方面的工作经验；精通工业工程，精益生产，精益价值流分析，物流包装设计，工厂精益布局与物流路径设计， 仓储管理，6 Sigma等。

授课推崇务实、讲求实效；培训过程主要以课程体系为主线，全程案例研习、角色演练、小组讨论、工作实务模拟并同时伴以咨询式培训等形式，引导学员参与，并注重其丰富的企业实践改进案例的分享。

服务案例：雅培、华阳-科斯达、西门子、上海庄臣、哈尔滨啤酒、东芝变压器公司、东风汽车、康明斯发动机、西蒙电器、升德升电子、美的集团、吉斯特药业、卡夫食品、北京博维航空设施、福田汽车、永康制药、盘山发电、宜宾纸业、渤海能克、浙江移动、京博农化、诺康医药等、韩泰轮胎、联合汽车电子、拉法基、阿法拉伐、三得利……等。

研讨会参加对象：

设备设计人员、设备工程师、生产或工艺工程师、设备维护人员、生产管理人员、生产经理、工程经理、设备经理等。

研讨会目标：

BM->PM->TPM->TnPM， 目前关于设备管理类培训主要为 TPM-全员生产力管理。包括自主维护、预防维护、设备改善等。主要集中在设备投用后如何提高设备稳定性，减少设备故障及维修，但忽视了设备设计，制造、安装等前期环节，及产品到达生命周期后相应设备的处置，如再利用、升级改造、报废等。

本课程汇集了讲师二十多年的设备设计、制造及管理工作经验，结合国外 EEM（Early Equipment Management-设备早期管理，主要内容为设备设计，制造及安装来保证设备投用后的稳定性及维护的减少）理念，详细讲解了从设备需求调研、设备设计、设备制造及安装、设备维护（即 TPM 中的设备自主维护、计划维护、改善性维护等知识），设备资产管理、备品备件管理（备件库存控制等）、设备后期处置（更新淘汰原则，设备淘汰后的处理方法）等设备全生命周期的管理过程，讲授过程结合大量工作或企业咨询改善案例，相比 TPM， 本课程完善了其中提及但未讲述的如何通过设备设计，提高设备健壮性，从而降低设备出现故障的风险，减少改善性维护，并且系统讲述了设备全生命周期的成本控制方法。
通过本课程讲解，可以帮助企业建立设备设计流程，设备管理流程、设备后期处置流程及设备整个使用周期内的成本控制。

内训方案

如果公司有许多人有类似的培训需要，那么你不妨考虑内部培训的解决方案。培训将在贵公司现场举行。并且培训可以根据您具体的要求来进行。

请联系 **Whitney Shen** 来讨论合作的可能:
电话：**+86 28 8532 7678**
电邮：**whitney.shen@martinlinking.net**

设备全生命周期管理最佳实践-TLCEM

第一单元：设备设计流程

- EEM 介绍
  - Early Equipment Management 简介
  - EEM 的作用
  - EEM 的主要步骤
  - EEM 与设备设计的关系
- 设备设计调研
  - 设备需求，设备能力分析
  - 同行同类设备资料收集
  - 设备预算
- 设备设计准则（总体要求）
  - 结构/功能/精度/材质/关键部件
  - 可操作性/可维护性/人因工程/安全性
- 设计详细要求
  - 功能实现/工作环境/EHS 要求
  - 操作要求/维护要求
  - 设备履历/相关文件

案例：某设备设计详细要求

- 生产工艺说明
  - 产品参数/生产流程/工艺要求
- 设备设计步骤
  - 设计草案
  - 详细设计
  - 设计失效模式分析-DFMEA
  - 设备制造
- 关键部件要求
  - 标准件选择/非标件的标准化
- 文件资料要求
  - 整机装配图/非标件图纸/部件明细清单
- 报价明细要求

案例：某设备报价明细单

- 保密协议要求

案例：设备设计书实例

第二单元：设备可靠性与产品制造质量

我们的期望是从设计阶段就考虑提升设备的健壮性，成为免维护或少维护的设备。所以设备在交付后，使用前应该做可靠性评估。评估结果作为交付流程的一部分

- 使用稳定性-MTBF
- 性能稳定性
- 产品质量稳定性-Cpk 分析
- 设备 Poka-Yoke 设计
- 设备改善性设计

案例：设备 Poka-yoke 设计，提高产品质量

案例：设备改善性设计，提高产品质量

第三单元：设备成本控制

- 设备成本构成
  - 材料成本
    - 标准件/非标件/装配材料
  - 加工成本
    - 表面处理/机加工/装配
  - 设计成本
  - 管理税收
- 设备成本控制方法
  - 成本分析方法
  - 价值工程
    - 价值工程介绍
    - 价值工程要素-功能/成本/价值
    - 提高价值的途径
    - 价值工程的工作顺序
  - 招标议价

案例：价值工程分析实例

第四单元：设备的接收与安装

- 外观验证
- 安装调试
- 功能验证
- 性能验证
- 附属验证
- 设备接收
- 设备的安装
  - 选址与布局设计
  - 安装相关事项

第五单元：TPM 简介（简略）

- TPM 的起源及演进过程
- TPM 的理论基础-海因里奇三角
- TPM 的主要内涵

设备全生命周期管理最佳实践-TLCEM

- TPM 的八大支柱活动
- TPM 的四个导入阶段
- TPM 的十个关键成功因素

✧ TPM 实施带来的效果

第六单元：TPM 之自主管理

✧ TPM 自主管理介绍

✧ TPM 自主管理七步法介绍

- AM0-准备阶段
- AM1-初期清扫
  - 不良点标签
  - 清扫临时标准
  - AM 实施流程
- AM2-污染源和困难部位对策
  - 污染源和困难部位寻找
  - 污染源分析方法
  - AM2 目标
- AM3-制定暂行基准
  - 暂行基准书
  - 视觉管理
- AM4-总点检
  - 了解设备结构，熟悉设备
  - 发现和修复轻度缺陷
  - 人员培训和能力提高
- AM5-自主点检
  - 点检分类
  - 点检作业表
  - 点检准备
  - 人员培训和能力提高
- AM6-标准化
  - 上述活动的标准化
  - 自主活动拓展到设备周边
- AM7-完全自主活动
  - 自主活动的 PDCA

✧ TPM 自主管理的要点及组织方式

案例: 某企业自主维护活动介绍

讨论: 认识我们工厂 TPM 的现状

资料: 自主活动相关表格

第七单元：TPM 之计划维护

✧ 计划维护种类介绍

- 预防性维护-TBM
- 预测性维护-CBM，IR
- 故障维护-BM
- 纠正维护-CM
- 紧急维护

✧ 自主维护&计划维护及技能分担

✧ 自然劣化与强制劣化研究

✧ 计划维护步骤

- 设备现状评估-维护基础构造
- 劣化复原及薄弱部位改善-故障降低活动期
- 建立计划维护体制（组织/计划/预算）-计划维护系统构造期
- 改善维护活动-信赖为中心保全活动
- 维护预防活动-信赖为中心保全活动
- 预测维护研究-信赖为中心保全活动
- 设备状态与产品质量-最高生产性与品质

✧ 计划维护活动管理

- 计划维护管理流程
- 维护计划与管理-维护周期，何设备
- 维护信息管理-维护记录及改进措施
- 备品备件管理-预测及库存研究
- 维护成本管理-系统记录

✧ 备件库存管理

- 备品备件库存计算 3A 模型
- 备品备件库存策略
- 备品备件计划与管理
- 故障记录，判断劣化，备件库存依据
- 依动线率，找出缓动备件，制定措施。
- 统计备件来源信息及订货周期，对于值大的进口备件，且订货周期长的，考虑国产化或部分国产化（及平时用国产，但保留极少量进口备件，并且统计分析国产件的使用周期）
- 基于上述分析，制定合理库存水平。

设备全生命周期管理最佳实践-TLCEM

- ✧ 计划维护推行步骤
- ✧ 设备重要度评估
- ✧ TPM 的两大重点指标
  - ◆ MTBF-故障平均间隔时间
  - ◆ MTTR-故障平均处理时间

第八单元：设备 OEE 分析及改善

- ✧ 设备六大损失介绍
  - ◆ 设备故障
  - ◆ 切换/调整
  - ◆ 开/停机
  - ◆ 速度损失
  - ◆ 小停机/空转
  - ◆ 质量缺陷返工
- ✧ 认识设备综合效率 OEE

案例分析：设备的效率为什么这么低？

- ✧ 设备 OEE 介绍
  - ◆ 设备的效率损失在哪里？
  - ◆ OEE 的由来与产生
  - ◆ 为什么要使用 OEE？
  - ◆ 设备损失时间瀑布流
  - ◆ 如何计算设备的效率 OEE
- ✧ 设备重要度评价
  - ◆ 生产影响度
  - ◆ 质量影响度
  - ◆ 维护影响度价值
  - ◆ 无备机
  - ◆ 产品质量影响度等
- ✧ 关键设备的定义及计算 OEE 的意义
  - ◆ 单台设备的 OEE 计算
  - ◆ 生产线的 OEE 计算
  - ◆ 结合实际的工厂 OEE 计算练习
- ✧ 设备综合效率 OEE 的分析
  - ◆ OEE 的行业先进水平是多少
  - ◆ 设备利用率与设备综合效率的关系
  - ◆ 速度损失是多少？
  - ◆ 空转及瞬间停止损失是多少？
- ✧ 现场常常出现的与 OEE 相关的问题
  - ◆ 怎样提高设备综合的效率 OEE
  - ◆ 现场 OEE 的数据收集和统计（普通方法和电算方法）
  - ◆ 提升 OEE 的具体措施
  - ◆ 降低停机损失的分析和改善
  - ◆ TPM-AM/PM
  - ◆ 故障的快速分析与判断-PM、FTA
  - ◆ 快速维修 QM/预防维修 PM
  - ◆ 缩短生产准备时间的分析和改善
  - ◆ 人机协作分析-挖掘机器闲余能力，提高设备利用率
  - ◆ 快速换型 SMED (观看录像)
  - ◆ 缩短暖机时间
  - ◆ 设备的维修与改装
  - ◆ 产品不良的分析与改善
  - ◆ 产生不良的原因
  - ◆ 消除不良的对策
  - ◆ 设备防呆法-Poka-Yoke
- ✧ OEE 提升的方法与步骤

案例：OEE 改善事例 效率提升案例 35%提升到 70%（三年时间）

练习：OEE 改善课堂实习

练习：设备综合效率计算

- ✧ **重点（个别）改善**
- ✧ 重点（个别）改善活动的步骤
- ✧ 重点（个别）改善活动的工具
  - ◆ OPL-One Point Lesson
  - ◆ SGA-Small Group Activity
  - ◆ AB-Activity Boards
- ✧ **TPM 之教育训练**
  - ◆ TPM 员工的级次
  - ◆ 培训方式
  - ◆ 技能矩阵
- ✧ TPM 教育训练六步体系
- ✧ TPM 教育训练主要内容
- ✧ TPM 相关模板

案例：TPM 活动提高 SMT 线 OEE 案例

设备全生命周期管理最佳实践-TLCEM

第九单元：设备日常管理及后期处置

- ✧ 设备履历及档案建立
- ✧ 设备维修台账
- ✧ 设备资产管理
- ✧ 设备全生命周期成本管理-LCC
- ✧ 设备淘汰规则
  - ◆ 设备维护成本与设备残值-一三原则
  - ◆ 设备维护造成的生产损失
  - ◆ 设备不稳定性造成的质量损失
  - ◆ 设备生产效率损失与设备更新成本
- ✧ 设备后期处置
  - ◆ 设备改造
    - ➢ 改造时机
    - ➢ 设备改造成本核算-维护&质量成本 VS.改造成本
    - ➢ 设备改造考虑因素
    - ➢ 设备改造方法
  - ◆ 设备的重利用，用于同类新产品
  - ◆ 设备作二手设备在公开市场处理
  - ◆ 设备核心模块的拆解重利用
  - ◆ 设备报废流程

TPM :大家都熟悉，其中提到了 MP（维护预防），DM（设计维护），设备的维护应从设计阶段开始。但 TPM 并未指导如何去做 MP、DM。

成本: 设备的设计决定了设备的可靠性，TPM 强调设备全生命周期的成本，必然包含设备设计，安装，使用，维护，改造，重利用及报废等各项成本。

现状: 目前国内关于设备管理更多集中在设备投入使用后的维护，以保障设备使用寿命、性能及加工质量。

目标: 设备的管理应从设计阶段开始，满足功能需求，可靠稳定且价格合理的设备是设计的目标。

Total Life Cycle Equipment Management (TLCEM) Best Practices

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