ASQ0701 Dinner Mtg Clinic 5/8/18
Lean
Single Minute Exchange of Die (SMED) / Quick Change Over
Total Productive Maintenance (TPM)
Overall Equipment Effectiveness (OEE)

Based on the BoK topics in numerous ASQ Certifications

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Lean – SMED – Quick Changeover

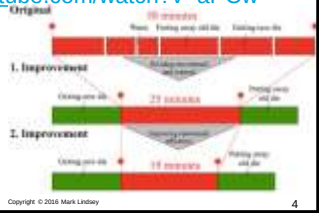
- Single Minute Exchange of Die (SMED) concept is to take a long setup change of perhaps 4 hours in length and reduce it to 3 minutes.
- Shigeo Shingo, developer of the SMED system used it very effectively in the Toyota Production System for Just-In-Time production.

Lean – SMED – Quick Changeover

- Single Minute Exchange of Die does not literally require die changes to be performed in only one minute.
- It implies that die changes are to be accomplished under a single digit of time (nine minutes or less).
- https://www.youtube.com/watch?v=UlIGI3l

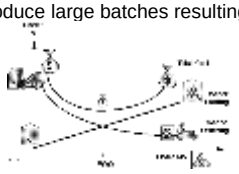
Lean – SMED – Quick Changeover

- Is a system that reduces the dependence on the long term experience of operators to perform an effective changeover.
- Reduces the skill level needed for setup changes.
- https://www.youtube.com/watch?v=aPCwTIFvXfs

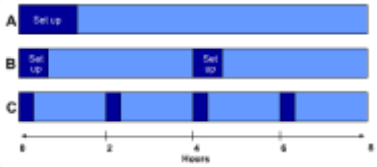


Lean – SMED – Quick Changeover

- Quick changeover methods can remove constraints with the Economic Order Quantity (EOQ) method (price quantity discount).
  - The EOQ tries to balance the cost of inventory to the cost of setup.
  - The value of long production runs through EOQ theory is no longer valid as there is no longer the need to produce large batches resulting in excess inventory.



Lean – SMED – Quick Changeover



A. Requires 1 set up of 1 hour, and a run of 7 hours, to produce a months worth of single product.
B. If set up is reduced by a half, two products can be produced in the same time period at **No additional cost**.
C. If set up is further reduced by a half, four products can be produced in the same time period at **No additional cost**.

Lean – SMED – Quick Changeover

Setup Improvement Steps

- The beginning of a SMED project is to recognize that setups can be improved by distinguishing between internal and external setup conditions**.**
  - Identify what can be performed before shutting down the machine (external setup times),
  - Identify what has to be done when the machine is shut down (internal setup time).
- In planning a SMED project, the actual conditions and steps of the changeover must be detailed.

Lean – SMED – Quick Changeover

Setup Improvement Steps (cont).

- Every step in the setup process from start to finish is broken down and classified.
- External setup operations should include:
  - Preparation of parts
  - Finding parts
  - Measuring parts
  - Maintenance
  - Cleaning of spares, etc.
- A second look must be made to re-examine the existing internal setup elements and to convert more of those elements into external setup.

Lean – SMED – Quick Changeover

Setup Improvement Steps (cont).

- The setup team will need to generate some creative options to what is currently being done.
  - Brainstorming sessions and use of other problem solving tools can be used to continuously improve the setup process.

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Lean – SMED – Quick Changeover

Setup Improvement Steps (cont).

- All elements of internal and external setup must be reviewed in detail and streamlined in order to move to the 1 digit goal.
  - Perhaps the goal is unattainable, but efforts are made to go as low as possible.
- Once a SMED procedure is agreed upon, the setup team should practice the process and critique itself for improvements.
- https://www.youtube.com/watch?v=wDkPQlIx4rE

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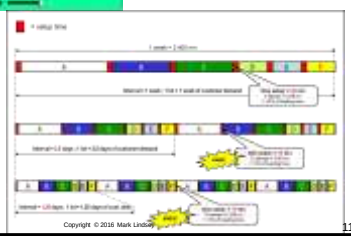
Lean – SMED – Quick Changeover



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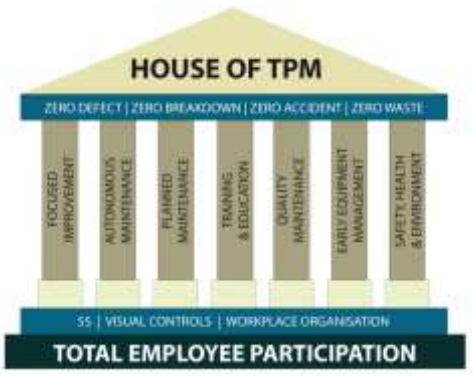
Lean – Total Productive Maintenance



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Lean – Total Productive Maintenance

Total Productive Maintenance (TPM)

- The goal of maximizing equipment effectiveness requires the complete elimination of failures, defects, waste and loss due to equipment related operations.
- The objectives of TPM are zero breakdowns, zero defects, and zero waste.

Lean – Total Productive Maintenance

- The "Total" in Total Productive Maintenance has the following meanings:
  - Total effectiveness in the pursuit of economic efficiency and profitability.
  - Total maintenance system includes maintenance prevention, maintainability, and preventive maintenance.
  - Total participation of all employees includes autonomous maintenance by operators and small group activities.

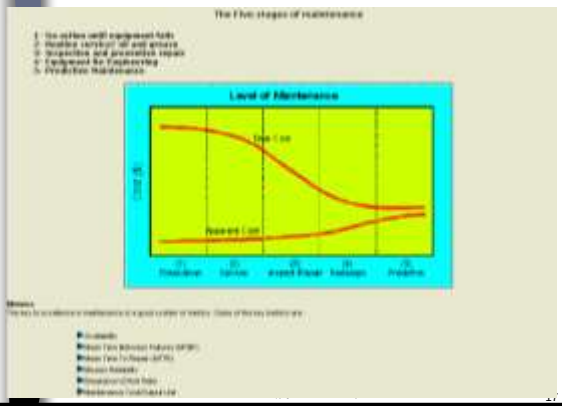
Lean – Total Productive Maintenance

- Important Features of TPM (TPM) are:
  - Efforts to Increase Overall Equipment Effectiveness (OEE)
  - A system of productive maintenance for a machine's life span
  - Implementation by engineering, operations, and maintenance
  - Involvement of every employee, from top management to the floor employees
  - Autonomous maintenance by operators
  - Company led small group activities
  - https://www.youtube.com/watch?v=JgxN6DGbjUO

Lean – Total Productive Maintenance

- The "Six Big Losses" that contribute negatively to equipment effectiveness are:
  1. Equipment failure
  2. Setup and adjustment
  3. Idling and minor stoppages
  4. Reduced speed
  5. Process defects
  6. Reduced yield

Lean – Total Productive Maintenance



Lean – Total Productive Maintenance

Designing for Maintainability and Availability

- In many situations involving corrective or preventive maintenance, ease of maintenance concerns time, material and money.
- Ease of maintainability is a design feature that affects these factors.

Lean – Total Productive Maintenance

Designing for Maintainability and Availability

- Design Guidelines which would increase maintainability and availability are:
  - Standardization
  - Modularization
  - Functional packaging
  - Interchangeability
  - Accessibility
  - Malfunction annunciation
  - Fault isolation
  - Identification

Lean – Total Productive Maintenance

- The Japan Institute of Plant Maintenance (JIPM)
  - Awards an annual Preventative Maintenance (PM) prize.
  - Factors include the following:
    - Reduced costs
    - Reduced inventory
    - Accident reduction/ elimination
    - Pollution control
    - Work environment

Lean – Overall Equipment Effectiveness

Overall Equipment Effectiveness (OEE)

- Measuring the efficiency and effectiveness of a process by measuring it as the product of three Factors (Availability, Performance, Quality)

Lean – Overall Equipment Effectiveness

- Availability

Availability = Run Time / Planned Production Time

Run Time = Planned Production Time − Stop Time

Takes into account Unplanned and Planned Stops

Lean – Overall Equipment Effectiveness

- Performance
  - Performance = (Ideal Cycle Time x Total Count / Run Time
  - Is the ratio of Net Run Time to Run Time.
  - Since rate is the reciprocal of time, Performance can also be calculated as:
  - Performance = (Total Count / Run Time) / Ideal Run Rate
  - Takes into account Slow Cycles and Small Stops

Lean – Overall Equipment Effectiveness

- Quality
  - Quality = Good Count / Total Count
  - Takes into account Defects (including parts that need rework)
  - OEE Quality is similar to First Pass Yield, in that it defines Good Parts as parts that successfully pass through the manufacturing process the first time without needing any rework.

Lean – Overall Equipment Effectiveness

- OEE takes into account all losses, resulting in a measure of truly productive manufacturing time. It is calculated as:
  - OEE = Availability × Performance × Quality
  - If the equations for Availability, Performance, and Quality are substituted in the above and reduced to their simplest terms the result is:
  - OEE = (Good Count × Ideal Cycle Time) / Planned Production Time
  - https://www.youtube.com/watch?v=u4U19l-uXi8

Lean – Overall Equipment Effectiveness

- OEE and the Six Big Losses