Reliability and Maintenance

By: Andy Inman

Safety Slogan: “Lock out or clock out!”

TOYOTA NORTH AMERICA FACTORY LOCATIONS

SOURCE: TOYOTA MOTOR CO.

Corolla

TUNDRA

Highlander

Re-Dedication to Customer First

Personal Commitment to the Customer

"My name is on every car. You have my personal commitment that Toyota will work vigorously and unceasingly to restore the trust of our customers."

House Committee on Oversight and Government Reform
February 24th, 2010

Akio Toyoda
TMC President & CEO

Toyota Reliability Group

Principle of Machine Maintenance

Toyota Production System

Direction is clear and simple

- "Take care of old equipment." (Taiichi Ohno Toyota Production System) because…
  - "Preventing machine failure prevents the need for storing extra raw materials and finished goods."
  - "Increase production with fewer workers."

The basis of lean manufacturing is absolute elimination of waste and the supporting pillars are "Just-In-Time". "Jidoka".

<u>How does engineering and maintenance support these principles of the Toyota Production System?</u>

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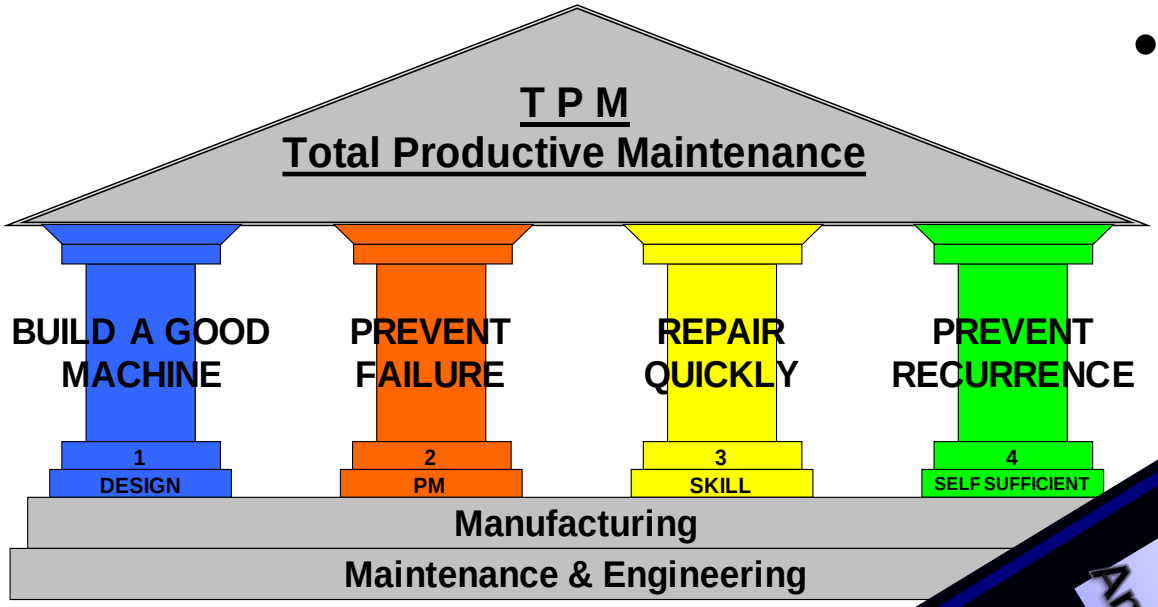
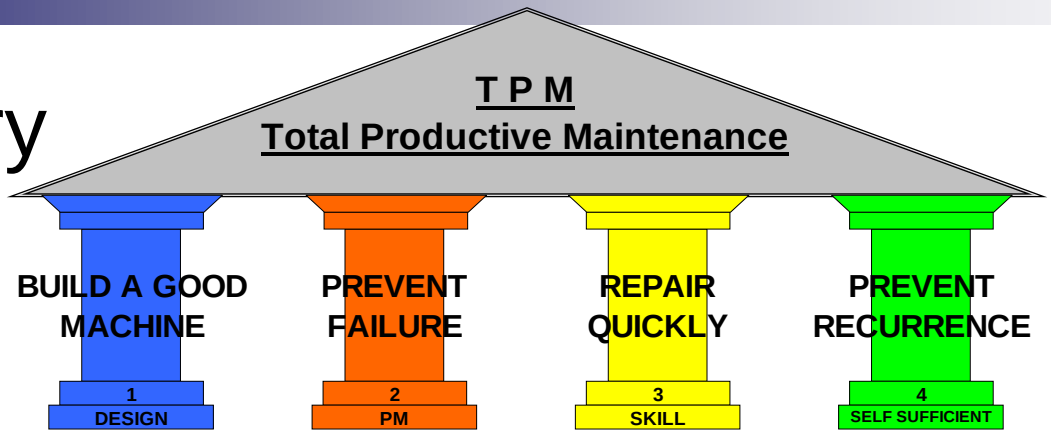
Fundamental Image



- **The beauty is its simplicity**

- **The key is it's execution**

Summary



Build a Good Machine

CMMS

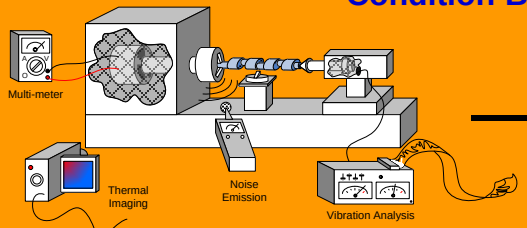
Feedback to PE

M/C Spec.

TMR / TMS

Prevent Failure

Condition Based & Daily Checks



CMMS

Daily Check W.O.

PM PdM W.O.

MTBF

Prevent Recurrence

CMMS

Major Breakdown
- Failure Mode Effect Analysis
- Root Cause Analysis
- Countermeasure

PDCA

Yokoten Work Order

RCM

Repair Quickly

CMMS

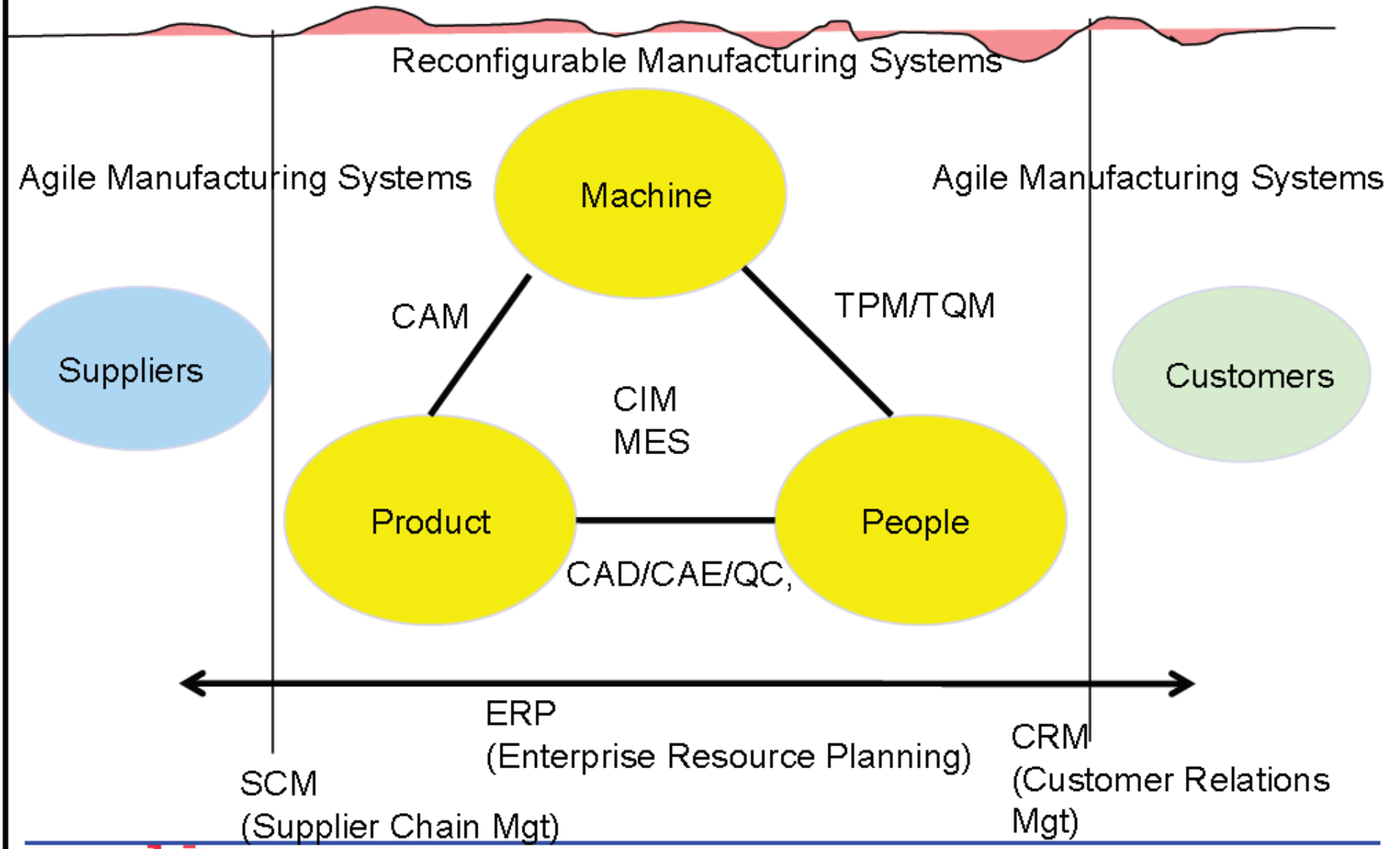
MQS → Assure Skill Have = Skill Need

Spare Part → Tie to Machine

Work Instruction Sheet → Standardize Work

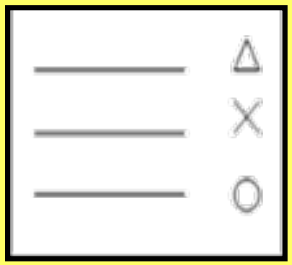
History → Similar Failure & Repairs

Data's Role in Manufacturing

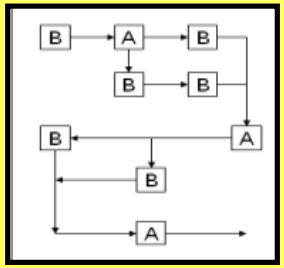


Reliability Improvement Cycle

1 Shop Audit



2 Equipment Risk Map



3 Evaluate

RCM
MNET
MTA

Maint. Improve. Plan

4 Implement

Maint. Improve. Plan

- Failure Mode-based Tasks
- Task Improvements
- Contingency Plans
- CMMS/ LDC
- Process Imp Kaizens
- TPM

5 Track

- CMMS/ LDC
- Operational Availability
- MTTR/ MTBF
- Maintenance Cost
- Reactivity
- Reliability Progress Report

6 Reflect

- 3 Function Criteria
- MCAP Audit
- MTA
- Maintenance SSR Reflection
- NAMC Reflection
- Reliability Progress Report

P	1 Audit
	2 Prioritize
	3 Evaluate
D	4 Implement
C	5 Track
A	6 Reflect

Reliability Improvement Cycle

P	1 Audit
	2 Prioritize
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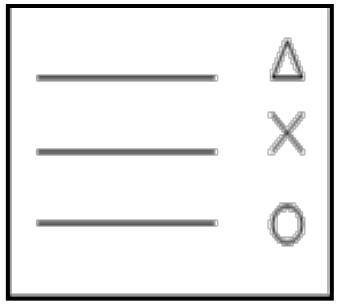
A	6 Reflect

1 Audit

Objective: Compare to good. Show shop *PROCESS* deficiencies and improve.

Tool Useds:
Maintenance Capability (MCAP)
3 Function Criteria



Certification Levels: Bronze (Good), Silver (Better), Gold (Best)

★ TPM Concepts Used Here

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Reliability Improvement Cycle

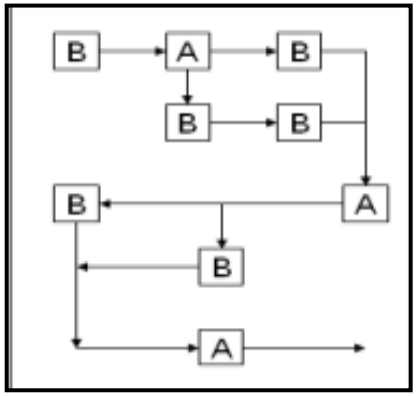
P	1 Audit
	2 Prioritize
	3 Evaluate
D	4 Implement
C	5 Track
A	6 Reflect

2 Prioritize Equipment

Objective: Determine what equipment to improve that will give you the largest *ROI*.

Tool Used: Risk Management

Methodology: Risk = Severity x *Probability of Failure*



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Reliability Improvement Cycle

P	1 Audit
	2 Prioritize
	3 Evaluate
D	4 Implement
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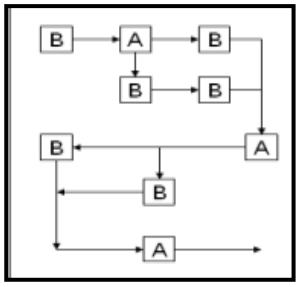
2 Prioritize Equipment

Risk = Severity x *Probability of Failure*

Severity \ Probability of Failure	Not in many years (0)	Once or twice in a year (1)	Once in 3 months or more (2)	Once a month or more (3)	Daily or weekly (4)
A					
B					
C					
D					
E					

Rank	Safety	Line Stop	Cost	Quality
A	Possibility of Severe Injury; Death	> 2 hrs Line Stop; No back-up/ redundancy	Capital >20% of Asset	Continuous Defects
B	Possibility of Lost Time / Minor Injury	<2 Hr Line Stop All Shops; minimal/ no back-up	>5% of Asset	>20% of Parts Defective
C	OSHA Recordable No Lost Time	Major shop line stop; periodic/ no consistent redund./ back-up	Capital < 5% of Asset	>10% of Parts Defective
D	Non OSHA Recordable; First Aid only	Minor Line Stop; consistent redundancy/ back-up	Increased Operating Cost	<10% of Parts Defective
E	None	None	None	None



H Contingency Plan must be in place immediately without condition.

M C/Ms must be taken at an appropriate time determined by top management.

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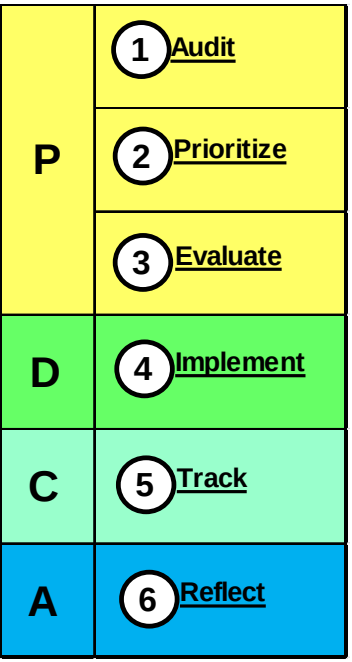
Reliability Improvement Cycle



3 Evaluate

Objective: Evaluate, for improvement, ALL High and Medium Risk Equipment from Prioritization.

Tools:

- RCM (Reliability-Centered Maintenance)
- MNET (Maintenance Network)
- FMEA (Failure Modes Effects Analysis)
- MTA (Maintenance Task Analysis)
- PMO (PM Optimization)

Maint. Improve. Plan

Output: FM-based Tasks, MTTR Kaizens, Spare Parts, Back-up Improvement, etc.

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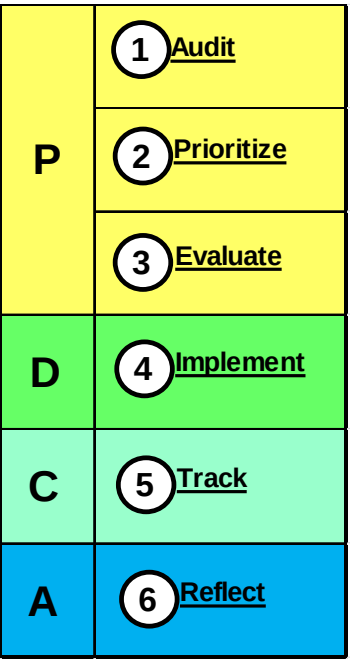
Reliability Improvement Cycle



4 Implement

Objective: Improve focus areas from Steps 1-3.
- *Audit (1)*: Improve 3 Function Level to 90%
- *Machine (2-3)*: Improve Risk Level

Tools:- TPM (Total Productive Maintenance)
- PdM (Predictive Maintenance)
- Autonomous PdM (Data Analytics, LDC)
- Training (PdM, TPM, Proactive Maint.)
- Mobile Machine Health Monitoring
- New CMMS
- NAMC Shareable Kaizens

Maint. Improve. Plan

★ TPM Concepts Used Here

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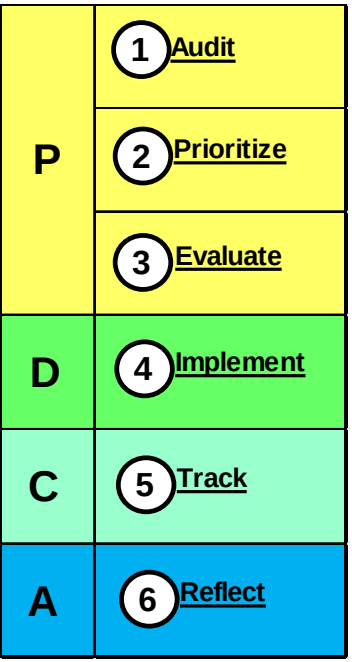
Reliability Improvement Cycle



5 Track

Objective: Show that Improvement Activities had an impact on Managing KPIs

Tools: - OA% (Operation Availability),
- MTBF (Mean Time Between Failure)
- MTTR (Mean Time To Repair)
- OR% (Operation Rate)
- MCCAV (Maintenance Costs)
- OEE% (Overall Equipment Effectiveness)
- Safety Incidents
- Quality Defects

Maint. Improve. Plan

★ TPM Concepts Used Here

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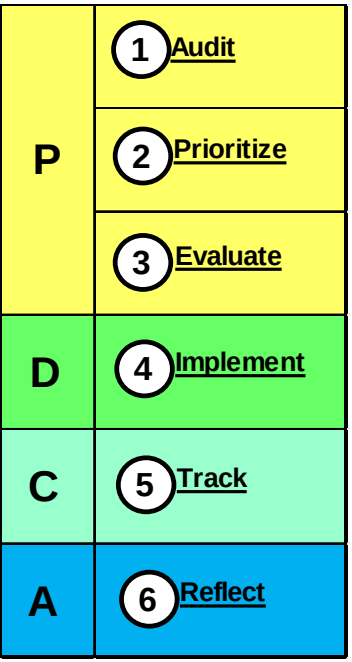
Reliability Improvement Cycle



6 Reflect

Objective: Show how the Improvement Activities for the FY Improved KPIs. Also, show how activities could have been improved.

Tools:
MCAP Re-Audit
3 Function Re-Audit

Next Step: START ALL OVER for FY-X !!!

Maint. Improve. Plan

★ TPM Concepts Used Here

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Questions?