ZenPower International
Industry TPM Consultants

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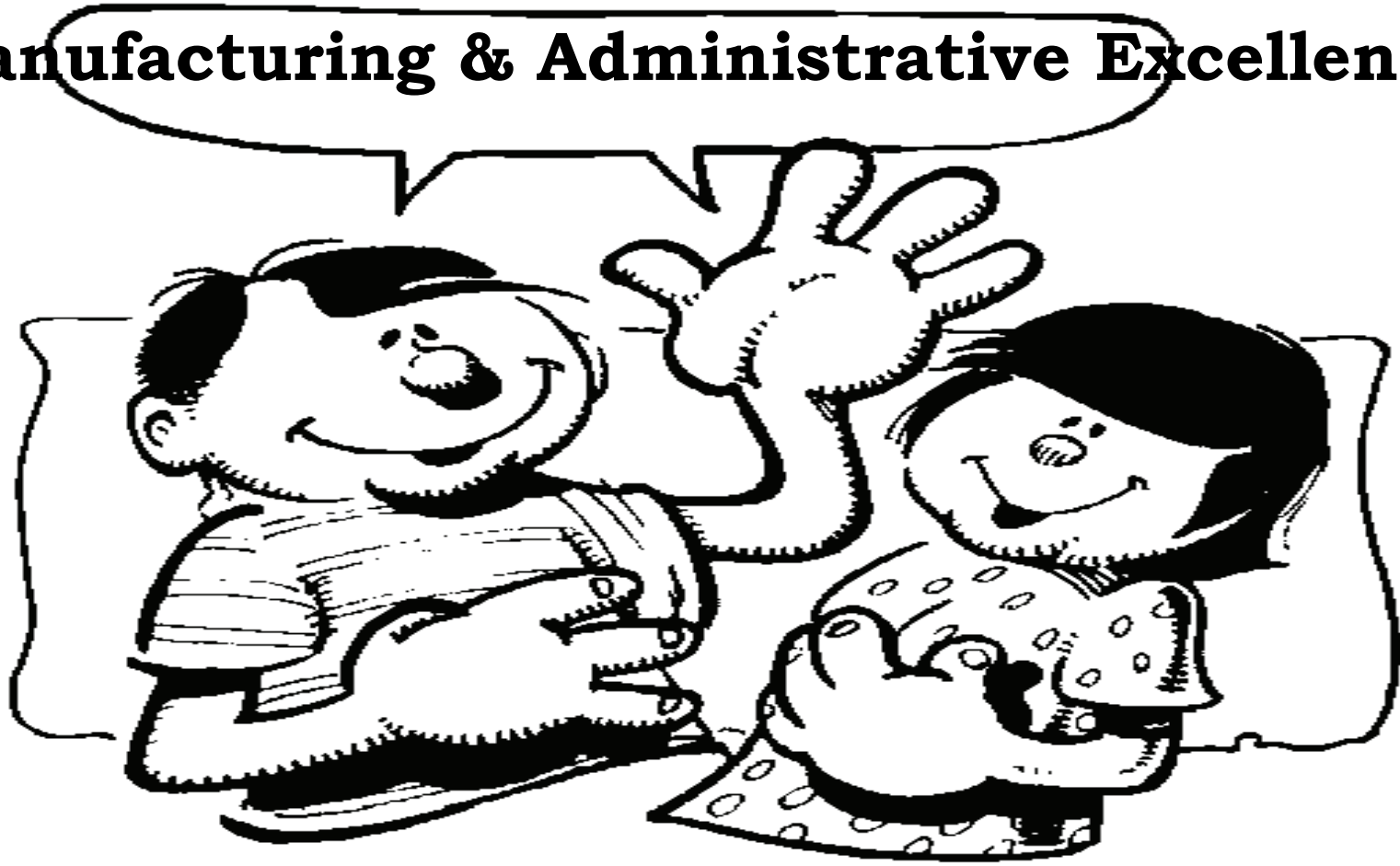
Website: www.tpmquality.com

TPM OVERVIEW

Manufacturing & Administrative Excellence.



Background of TPM

- **Main manufacturing excellence approach of Toyota and other excellent Japanese companies since the 70's.**
- **TPM is foundation for JIT, FA, Poka Yoke, Lean Manufacturing, Zero Defects.**
- **TPM Reference Standard - JIPM (Japan Institute of Plant Maintenance)**
- **Comes from the best of Japanese Industrial Excellence and evolved from the heat of the continuing Energy Crisis and Globalization challenges to achieve More with Less.**

TPM GOALS

1. Increase asset Utilization and Equipment OEE
2. Foster Production Equipment Ownership
3. Equipment breakdown prevention (Planned Maintenance through CM, TBM, CBM)
4. Defect Prevention (QM Process & Poka Yoke)
5. Evolving into Self Directed Work Teams (SDWTs) and Lean Manufacturing.

JIPM STANDARDS

1. TPM Structure & Organization
2. Equipment Improvement activities
3. Production Autonomous Maintenance
4. Planned Maintenance
5. Quality Maintenance
6. Product & Equipment Initial Control
7. Education & Training
8. Office TPM
9. Safety, Hygiene & Environment
10. Quantifiable TPM Measurement

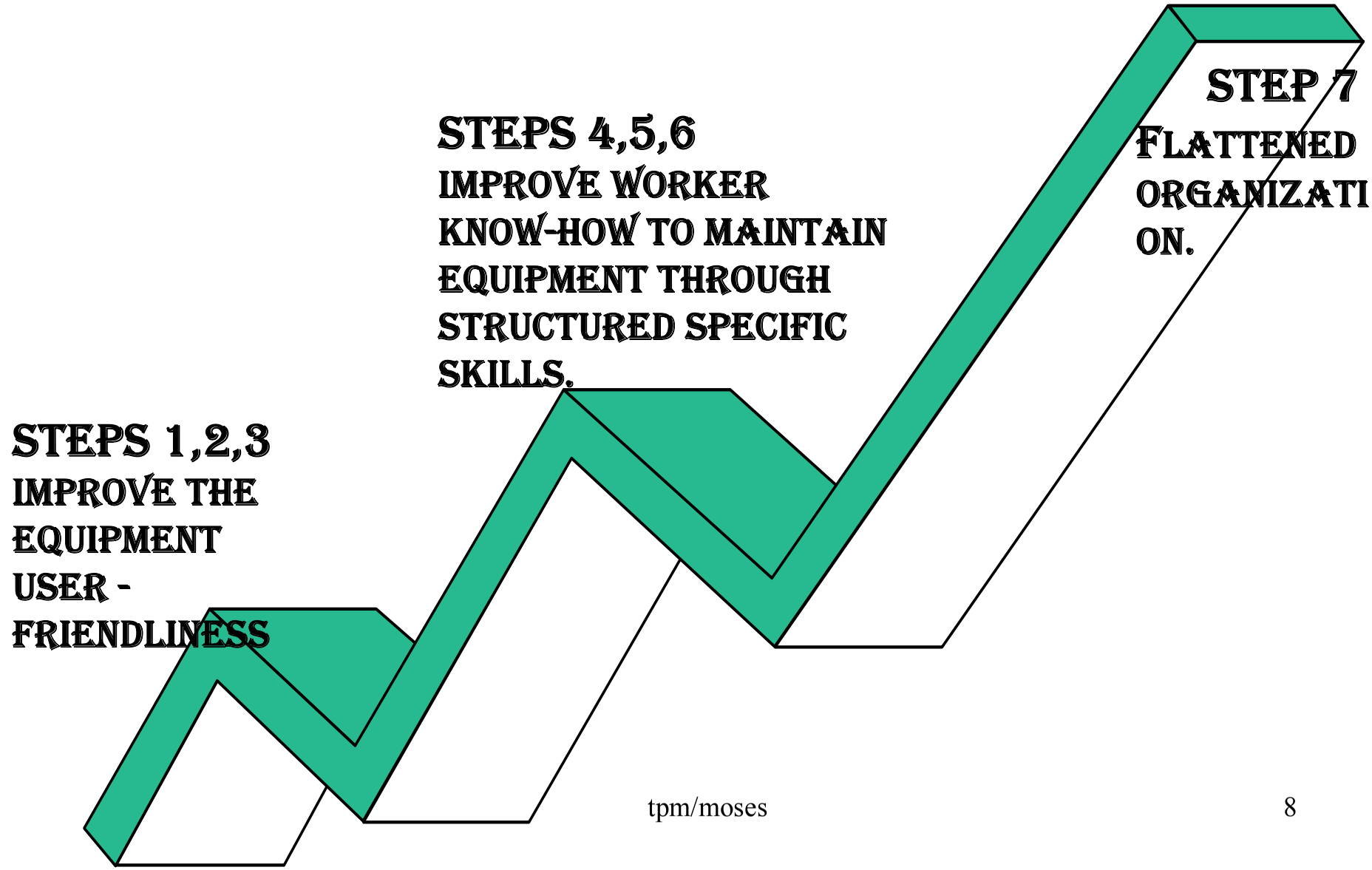
Executive Overview Of

1. Autonomous Maintenance
2. Equipment Improvement
3. Planned Maintenance
4. Quality Maintenance
5. Office TPM

QUICK LOOK AT

Production Autonomous Maintenance

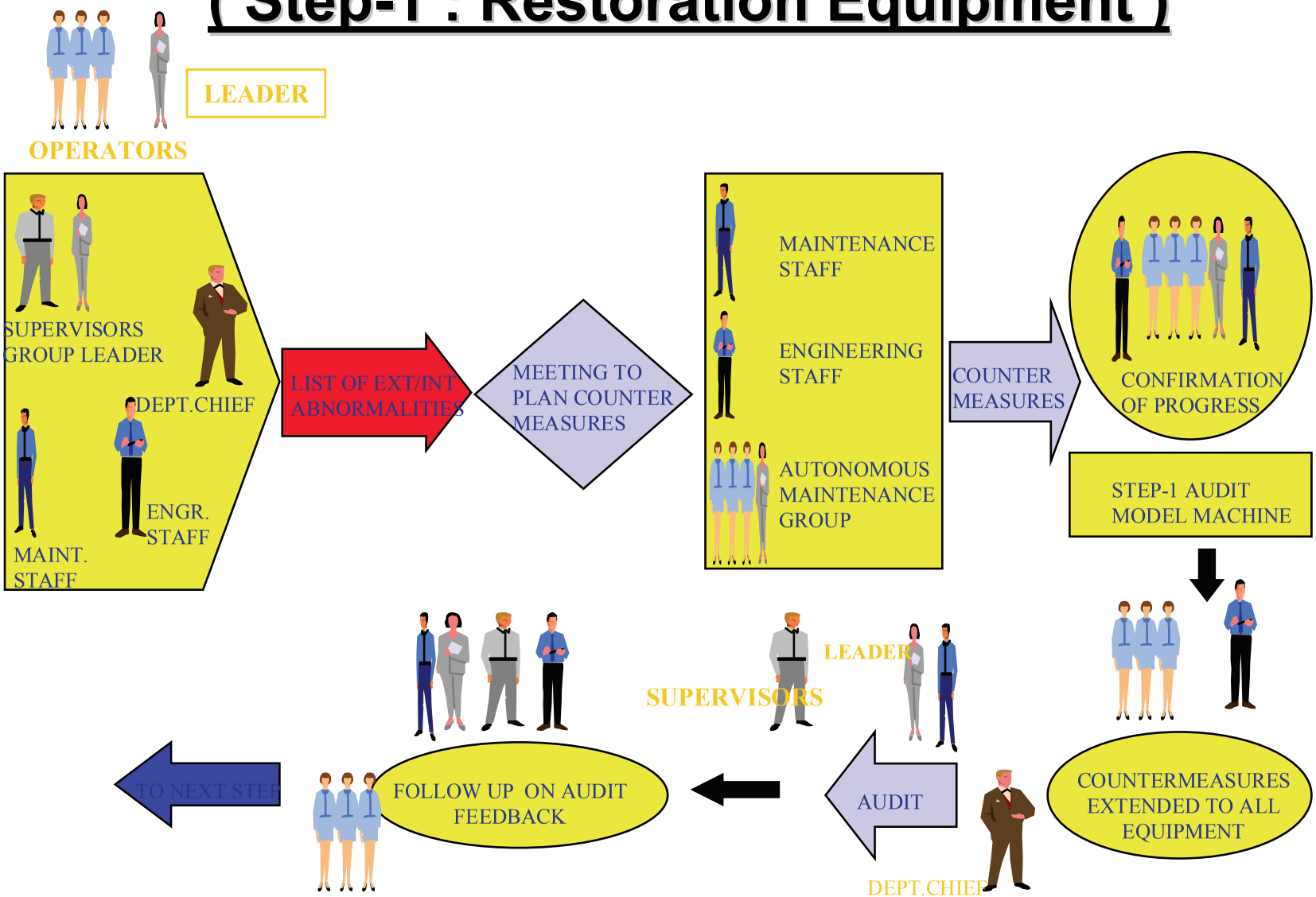
LOGIC OF AM STEPS



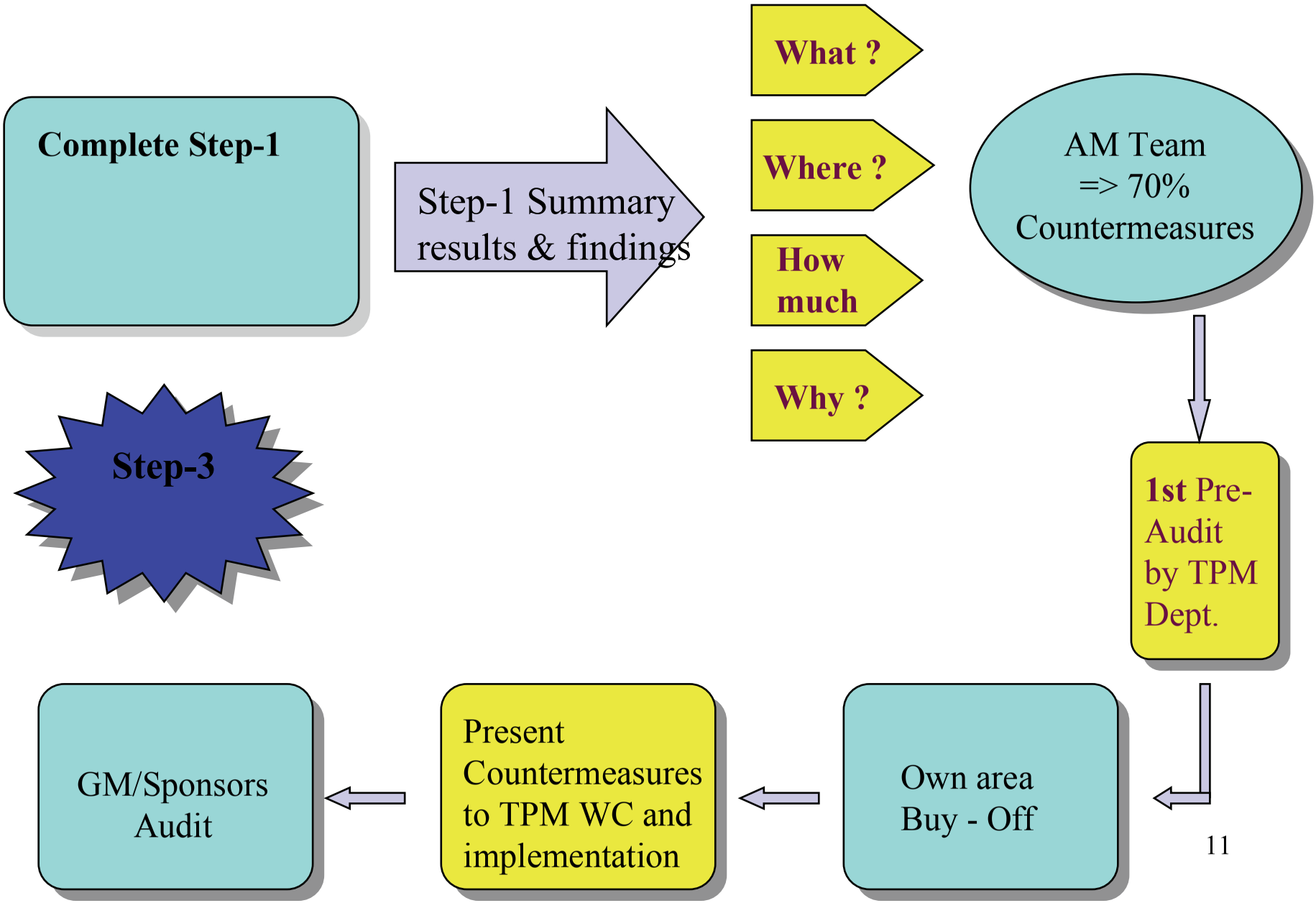
AM STANDARDS

Step #	Step Goal	Standards
Step 1	Restoration	**=> 85% repair rate**
Step 2	Eliminate Sources of Contamination	**=>70% successful effort**
Step 3	Improve Equipment Accessibility	**=>70% successful effort**
Step 4	Initial Maintenance Standards	**> 50% sudden b/d reduction**
Step 5	General Inspection Skills	**> 90% sudden b/d reduction**
Step 6	Autonomous Inspection	**> 95% sudden b/d reduction**
Step 7	Organise and manage workplace	**TBD by management**

(Step-1 : Restoration Equipment)



(Step-2 : Eliminate Contamination & Stains on Area & Parts)



(STEP 3 : IMPROVE EQUIPMENT ACCESSIBILITY).

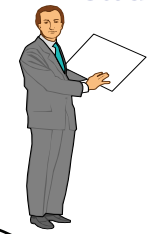
Model m/c Passed Step 2

Areas difficult or inaccessible for cleaning checking & lubricating

- Inaccessible
- No Place To Stand
- Wiring or piping obstruct
- Cannot see easily
- Time Consuming to clean

Product Manager

AM Leader



Operator Leader/ Operators

Supervisor

Model Machine Goes To Step 4

Pre-Audit by TPM Dept.

Own Area Buy Off

W/C Buy Off

GM Audit

(Step 4 : Initial Maintenance Standards)

Model m/c passed Step 3

Initial maintenance standard

Hard to lubricate

Hard to check oil level

Abnormality in lubrication equipment

Abnormality in circulation of lubrication

Equipment gets dirty during oiling

Product Manager

AM Leader

Operator

Leader/operator

Counter measure for cleaning and checking

Supervisor

Draft standards for cleaning, inspection & lubrication

Engineer & Maintenance

Trial Period

Attach identification label

Confirm standard for cleaning, inspect & lubrication

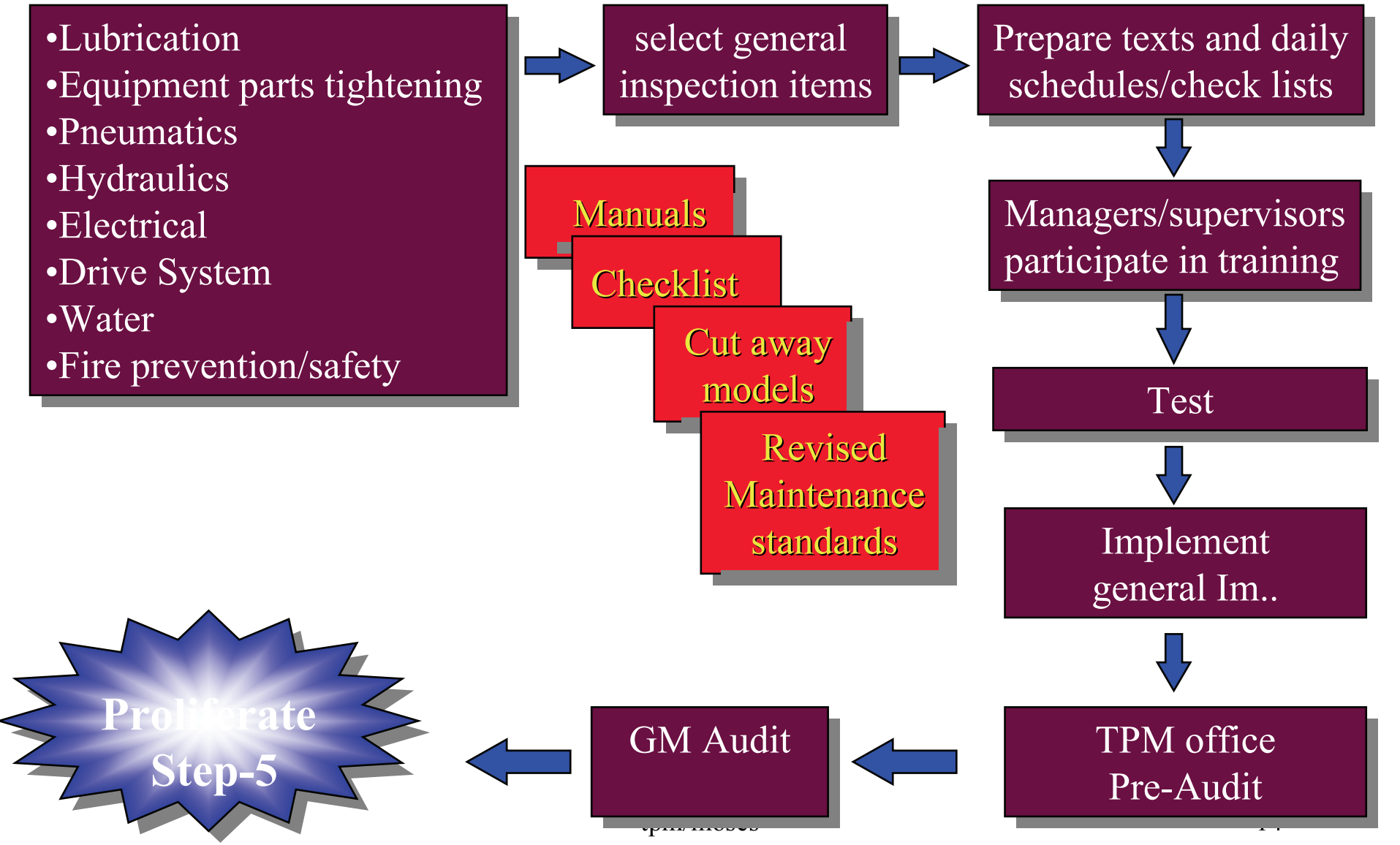
TPM dept. Pre-audit

GM audit

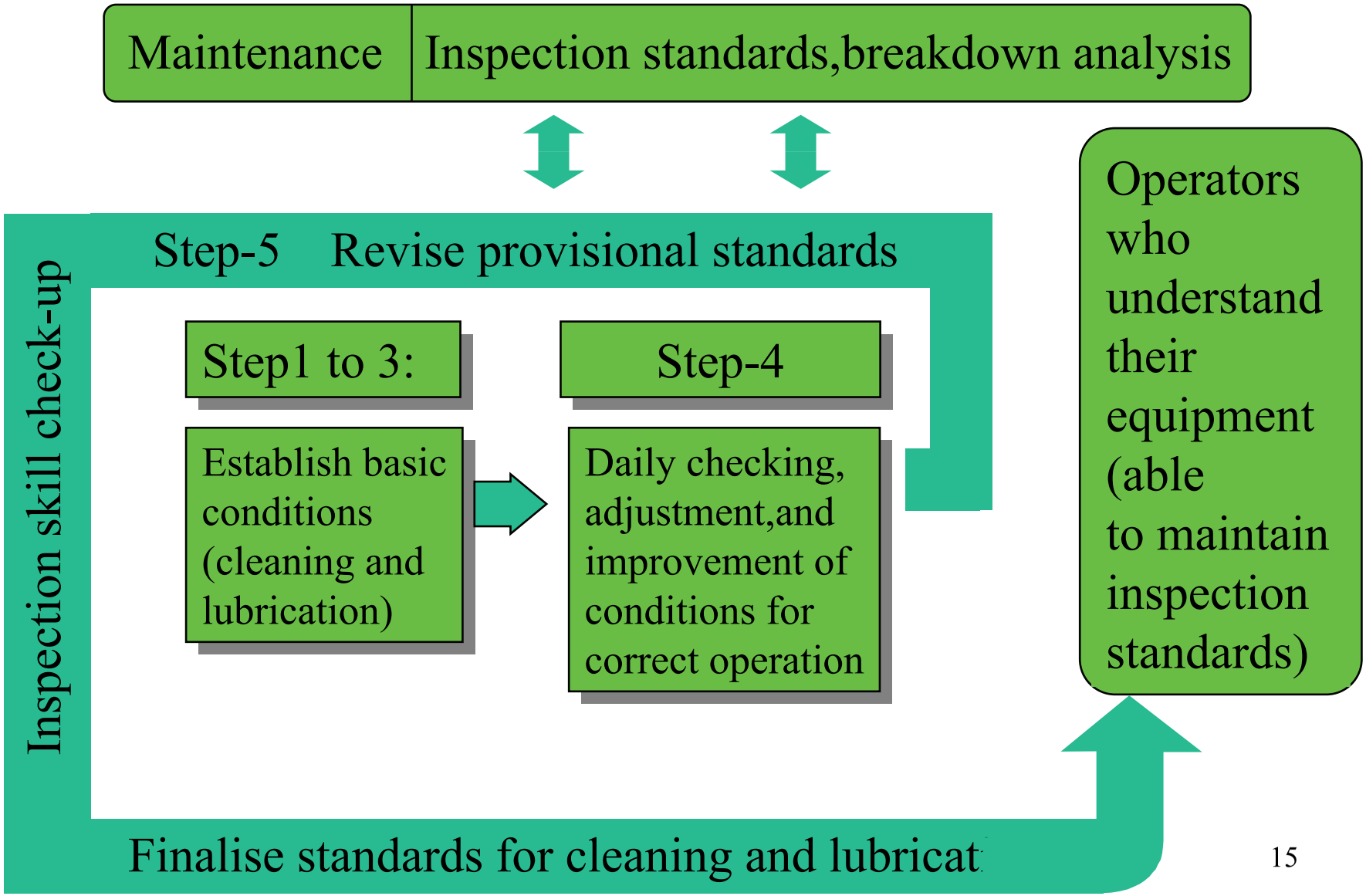
es

Proliferation of Step 4

(Step 5 : General Inspection skills)



(Step-6 : Autonomous Inspection)



Step-7 : Organise and Manage Workplace

Organise and set standards for :

EQUIPMENT PRECISION INSPECTION ITEMS

TOOLS AND MATERIALS FLOW AND STORAGE

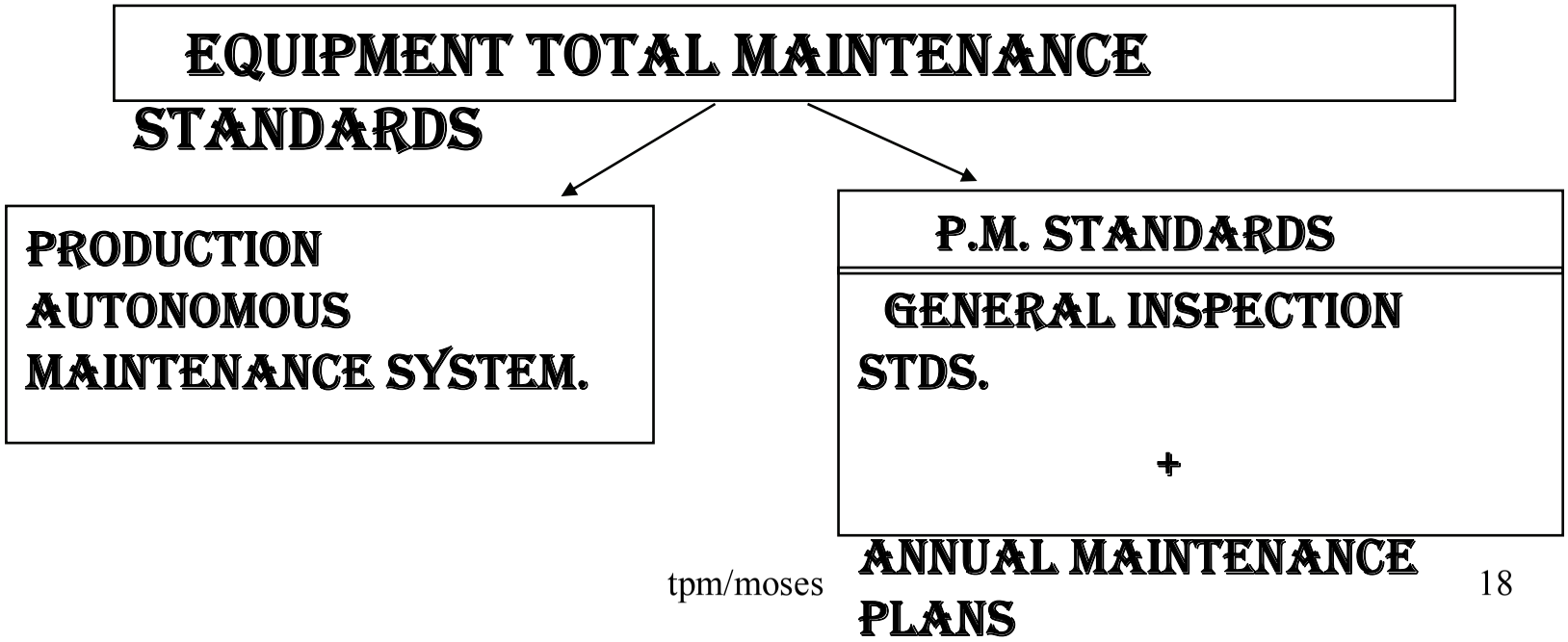
STANDARDS FOR INDIVIDUAL WORK RESPONSIBILITIES

QUICK LOOK AT

Planned Maintenance Pillar

GOAL OF PLANNED MAINTENANCE

Achieve "ZERO EQUIPMENT BREAKDOWNS" by implementing systems of "parts replacement before failure" through TBM and CBM.



PLANNED MAINTENANCE ACTIVITIES:

- SUPPORT AUTONOMOUS MAINTENANCE ACTIVITIES BY TECHNICAL SUPPORT, BREAKDOWN ANALYSIS AND DEMARCATION BETWEEN PRODUCTION & P.M. SYSTEMS.
- P-M ANALYSIS FOR CHRONIC BREAKDOWNS.
- TIME BASED MAINTENANCE ITEMS
- CONDITION BASED MAINTENANCE ITEMS.
- SPARES MGTM & MAINTENANCE DAY PRACTICE.

QUICK LOOK AT

Equipment Improvement Pillar

ROLE OF PLANT EI TEAM

Achieve systematic breakthroughs in equipments' 6 BIG LOSSES and establish Standards for Basic Machine Conditions.

The Basic Machine Conditions are:

1. **Cleaning Standards.**
2. **Lubrication Standards.**
3. **Bolt-tightening Standards.**

EQUIPMENT 6 BIG LOSSES

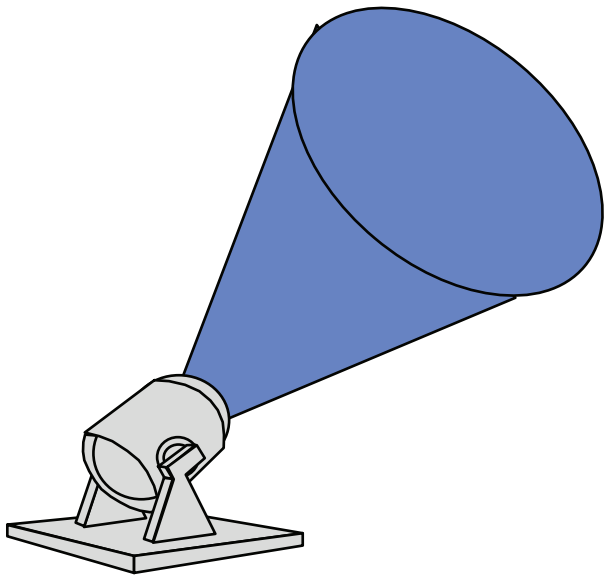
(FOCUS IS AT THE BOTTLENECK PROCESSES.)

1. BREAKDOWN LOSSES
2. SPEED LOSSES.
3. SETUP LOSSES.
4. DEFECT LOSSES.
5. START-UP OR YIELD LOSSES
6. MINOR STOPPAGES LOSSES

LOSSES / Maint LEVEL	LEVEL 1	LEVEL 2	LEVEL 3	LEVEL 4
1.Breakdown losses	• Have chronic B/Ds • B/d Repair time PM time. • >20% deviation of service life range. • Root-cause s of breakdown not clear.	• Only spontaneous breakdowns. • B/d Repair time = PM time. • Within parts service life span. • Root-causes of B/Ds are clear and addressed.	• Time-based component maint. system. • D/Trepair time < PM time • B/d downtime < 1% • Service life of components => upper range of specs.	• Condition-based maint system • Maint staff do only PM. • AM do D/T repairs < at 0.1% of DT level. • Clear improvement in MTBF
2.Setup Losses	• Incomplete setup documentation. • Setup times variation >30%.	• Complete set-up documentation • On-line and off-line setups are defined. • SetupTime variation < 15%	• Successful efforts to convert on-line to off-line setups • All adjustments are fully clarified and standardized.	• Optimal set-ups under 10 mins. • 1st time set-up produce good parts. No need to adjust any further.
3.Minor Stoppages	• No awareness/data.	• Data on frequency, location of minor stoppages.	REDUCED 1/20TH OF CURRENT LEVEL • Root-causes of minor stoppages are clear and countermeasures in place.	• Zero minor stoppages.
4.Speed Losses	• Equipment specs not clear. • No settings documented by different packages/ machine models & types.	• Root-causes are clear • Settings documented by package / machine type. • < 5% variation between same type machines	• Countermeasures for root-causes of speed losses implemented. • Revised settings with notes on quality and accuracy impact. • < 2% speed loss.	• Operates at designed speed or above. • Zero Speed losses
5. Defect & Startup Losses	• Nothing done about chronic losses. • No results from previous actions	• Chronic defects are quantified by type, frequency and volume. • Root causes for problems are identified and understood.	• Countermeasures implemented effective for early in-process detection of defects. • Q-components identified and effects on quality are clear.	• M-Q relationship established. • Regular audit of Q-components • Loss due to quality defects is < 0.1%

OVERALL EQUIPMENT EFFICIENCY

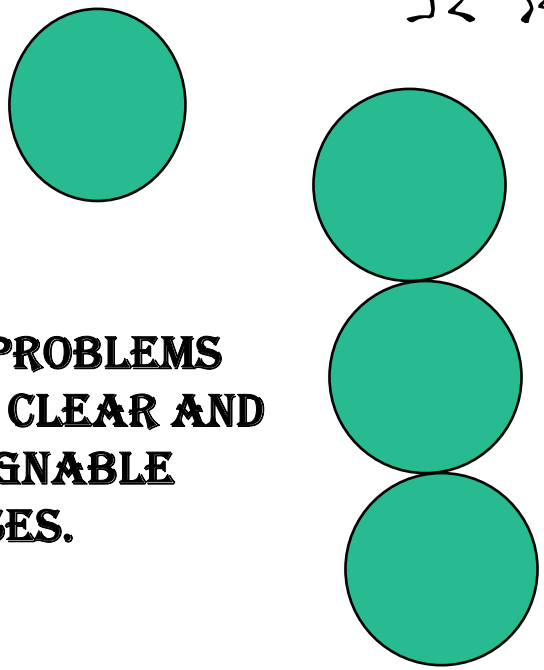
OEE => 85% target



NOTE: OEE IS NOT THE SAME AS UTILIZATION. UTILIZATION MEASURES THE UP-TIME OF THE EQUIPMENT. OEE MEASURES THE 'ABILITY' OF THE EQUIPMENT TO PRODUCE. LIKE THE HORSE-POWER RATING OF AN ENGINE, OEE DESCRIBES THE EQUIPMENT'S HEALTH.

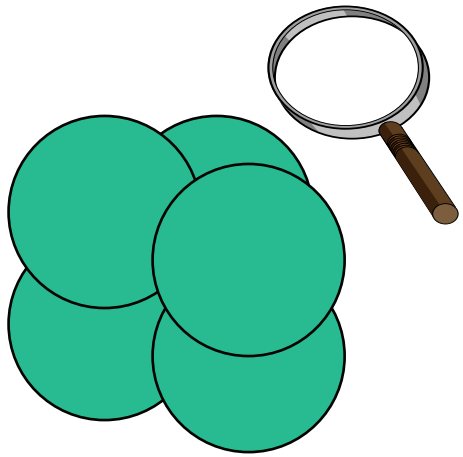
Sporadic & Chronic Problems

Why-Why Analysis.



FOR PROBLEMS WITH CLEAR AND ASSIGNABLE CAUSES.

P-M Analysis.



FOR PROBLEMS WITH CLEAR CAUSES & NO EFFECTIVE COUNTER-MEASURES

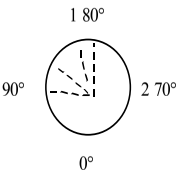
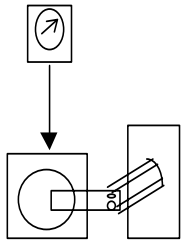
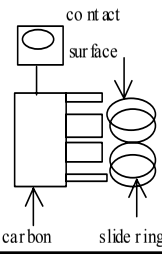
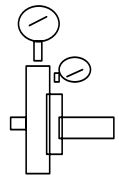
Why-Why Analysis & P-M Analysis

- Used with other data analysis or data collection tools.
- Emphasize on logical reasoning to fully understand the whole chain of cause-effects so as to devise holistic multiple solutions.
- All defects, breakdowns, accidents and work – problems are result of an error by Man which is the Root Cause.
- Problems are traced to all the 4Ms
- Solution Sustained by linked to the TPM systems.

PM Analysis Chart

No1/3

Checked by	Prepared by	Phenomenon	Physical view (Logical reasoning)
		Hooking errors occasionally occur during continuous winding	Distance between the roller at the tip of the flyer and hook needle cha during hooking

Contributing Condition	Investigation Result			4M Correlation, First Item	Investigation Result			4M Correlation, Second Item (3rd, 4th, 5th and 6th Items	Investigation/ Measuring Method	Investigation Result			If NG, why NG?	Countermeasure	Res
Investigation Measuring Method	Temporary Decision Criterion	Measure-ment Value	Decision	Investigation/ Measuring Method	Temporary Decision Criterion	Measure-ment Value	Decision			Temporary Decision Criterion	Measure-ment Value	Decision		Restoration, Replace-ment, Improvement, Remodeling	Measurement Value
1. Position at which roller a tip of flyer stops changes. 	170° to 180°	106° to 180°	NG	1-1 Flyer rotation is not smooth when load is not applied. 	1to 15kg/cm²	20 kg/cm²	NG	1-1-1. Carbon contact pressure of the slide ring is high.	Tension Gauge 	120g to 150g	170g to 300g	NG	Carbon powders from a deposit inside brush box.	Clean	120g to 150
													·Spring different from those in other places was used.	Replace with the same spring	140g
													(1/8 place)		
								1-1-2 Galling of spindle bearing.	Touch by hand	Smooth with no roughness	Smooth	OK			
								1-1-3. V-belt tension is high.	Push-pull gauge	Amount of deflection 10mm/1kgcm²	2 to 3 mm/ 1 kgcm²	NG	Adjustment was made by turning the belt and touching t by hand.	·Adjust amount of belt deflection.	10mm/1kg cm
								1-1-4. Motor brake pad clearance	Thickness gauge	0.1 to 0.3mm	0.1 to 0.6mm	NG	Plate spring of brale disc damaged	·Replace	0.25mm
								1-1-5 Motor clutch plate clearan cing of brake disc damaged.	Thickness gauge	0.1 to 0.3mm	1. 0.25mm	OK			
											2. 0.3mm	OK			
											3. 0.3 mm	OK			
								1-1-6. Spindle shaft deflection	Dial gauge 	Below 0.05	0.03mm	OK			

QUICK LOOK AT

Quality Maintenance Pillar

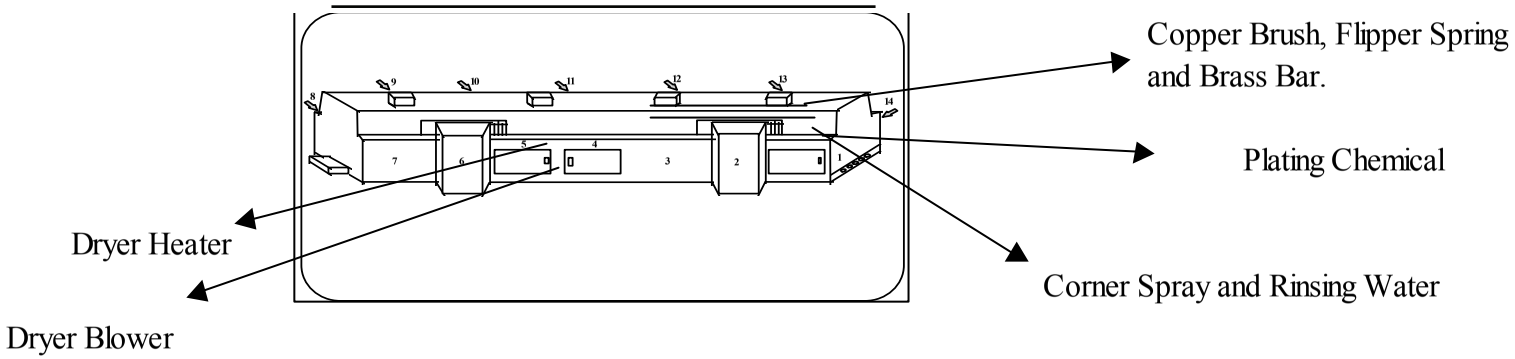
QUALITY MAINTENANCE:

IS ACTIVITIES TO SET **EQUIPMENT CONDITIONS,** BASED ON THE BASIC CONCEPT OF MAINTAINING PERFECT EQUIPMENT TO MAINTAIN PERFECT QUALITY OF PROCESSED GOODS. THE MACHINE CONDITIONS **(Q-COMPONENTS)** ARE CHECKED AND MEASURED IN TIME-SERIES TO VERIFY THAT MEASURED VALUES ARE WITHIN STANDARD VALUES TO PREVENT DEFECTS. THE TRANSITION OF MEASURED VALUES IS WATCHED TO **PREDICT POSSIBILITIES OF DEFECTS** OCCURRING AND TO

ROLE OF PLANT TPM-QM

Achieve "ZERO DEFECT" by identifying all the upstream factors of Equipment causes of defects and implementing fool-proofing techniques to eliminate man and materials-caused defects.

1. **Identify all the Q-components**
2. **Implement fool-proofing techniques to prevent man and materials-caused defects.**
3. **Eliminate all Chronic defects.**



Part of Machine	Plating Chemical	Flipper	B. Bar / C. Brush	Dryer Heater
Measurement	Chemical Content	Tension	Contact Pressure	Hot Air Temperature
Std. Value	MSA: 37.5% +/- 5% TIN: 37.5 g/l +/- 5 g/l Additive: 2 g/l +/- 0.5 g/	Upper <= 250 g Nominal = 120g Lower => 60g	Upper = 6 kg/cm Nominal = 5.5 kg/cm Lower = 5 kg/cm	Upper = 130 deg. C Nominal = 125 deg C Lower => 120 deg C
Interval	Daily	Weekly	Forthnightly	Daily
Quality Defect / Quality of M/c Part	Thickness Fail	Thickness Fail	Thickness Fail	Thickness Fail
Circularity				
Content				
Deterioration				
Smoothness				
Q-Tag number & Revision	Q-tag # 60-001 Rev A	Q-tag # 60-002 Rev A	Q-tag # 60-003 Rev A	Q-tag # 60-004 Rev A

EXAMPLE OF AN M-Q (MACHINE-QUALITY) MATRIX

ABOUT OFFICE TPM

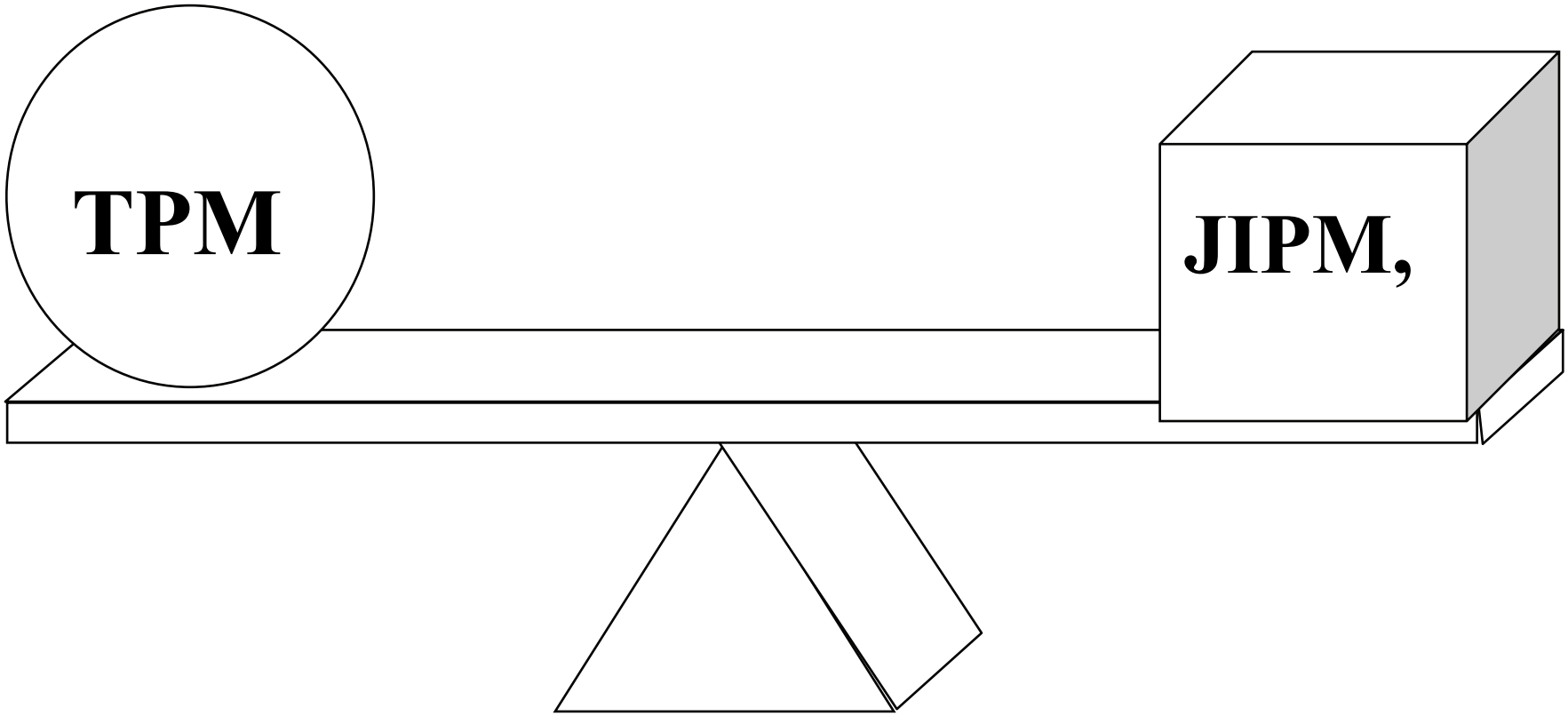
- **Is a structured 5S program using Why-Why Analysis as a problem-solving tool.**
- **Has similar Autonomous Maintenance 5 Steps**
- **Improves "CRITICAL FUNCTIONS" of Ware-house, Storage Place, administrative areas' through work-flow studies.**
- **Areas contributing to OEE losses are selected for Kai'zen activities.**

The 5S step-by-step program.

1 - Cleaning & Restoration.	THOROUGHLY RESTORE & CLEAN. MOTIVATION THROUGH PARTICIPATION.
2 - Eliminate Stains, Mixed, Contamination.	STUDY ROOT CAUSES OF DIRT, MIXING, LOSS, DAMAGE AND TAKE ACTIONS.
3 - Improve Accessibility.	ACHIEVE 1 MINUTE ACCESSIBILITY TIME FOR DOCUMENTS + PARTS. IMPLEMENT STOCK-MANAGEMENT-AT 1 GLANCE.
4 – Standardization & Control of Work.	ACHIEVE A PROBLEM-FREE WORK FLOW IN STOCK INVENTORY, DATA AVAILABILITY.
5 - Self Management	SELF MANAGING WORK TEAMS.

TOGETHER.....

Towards World-Class Manufacturing Excellence



TPM MASTERPLAN 2001 - 2003

DEVELOPMENT PROGRAM	DESCRIPTION	INTRODUCTORY STAGE 2001	PRACTICE STAGE 2002	CONSOLIDATION STAGE 2003 2004	FINAL STAGE JIPM AWARD
Policy	Basic Objective	Proliferation and total involvement	Defects and breakdowns prevention	Zero defects and zero breakdowns through every employees' involvement	Challenge the standards
Basic TPM Organisation & Main Committees	Weekly WC mtgs Regular EI mtgs Regular PM mtgs				
Basic Strategy	Select Model machine, form Teams,	Implement improvements on Model M/Cs &	then proliferate to all similiar equipments	to achieve a skilled workforce and equipment that do not breakdown.	
Employee Suggestion Scheme for Continous Imporvement	Policy Pilot Area Proliferate				
TPM Measurements	OEE/ Breakdowns/ Quality				
Autonomous Maintenance (5 Pilot Lines then 85% of rest of types of equipment)	Step 1: Restoration Step 2: Eliminate Contamination Step 3 : Improve Accessibility Step 4 : Initial Standards -Prepare Inspection manuals Step 5 : General Inspection Step 6 : Autonomous Inspection Step 7 : Manage quality of work	Step 1 1 Rest of M/cs Pilot M/cs Step 2 Step 3 manuals	2 3 Step 4 4 Step 5 Step 6 manuals	{Tech. Opr Standards} Step 5 : General Inspection Skills 5.1 Bolts, Nuts, Lubrication 5.2 Pnuematics 5.3 Electricity & Motors 5.4 Oil Hydraulics 5.5 Participate in in-line repairs 5 6 Step 7 7	• Technical Operators • OEE => 85%
Eqipment Improvements on 6 losses	Technical support for AM Baseline current m/c losses Model m/c basic conditions Model m/c losses improvements	(Lubrication & bolting)			
PM & QM Systems	Planned maintenance schedules (Time & condition based) Machine/Prodcut Quality matrix		Establish systems & schedules Implement Analysis Control Standards	Quality matrixes Implement	
TPM Training and Skills Development	AM Skills workshops PM Analysis workshops Advanced workshops	Establish	Implement		
Early Equipment & Product Control	Develop trouble prevention checklists on			Develop Implement on test run	
Office TPM	5S Program for office			Review Enhance	
Safety, Hygiene & Environment	Equipment Safety Workplace environment & waste treatment		tpm/moses	Review Enhance	35

THANK YOU