Reliability Process

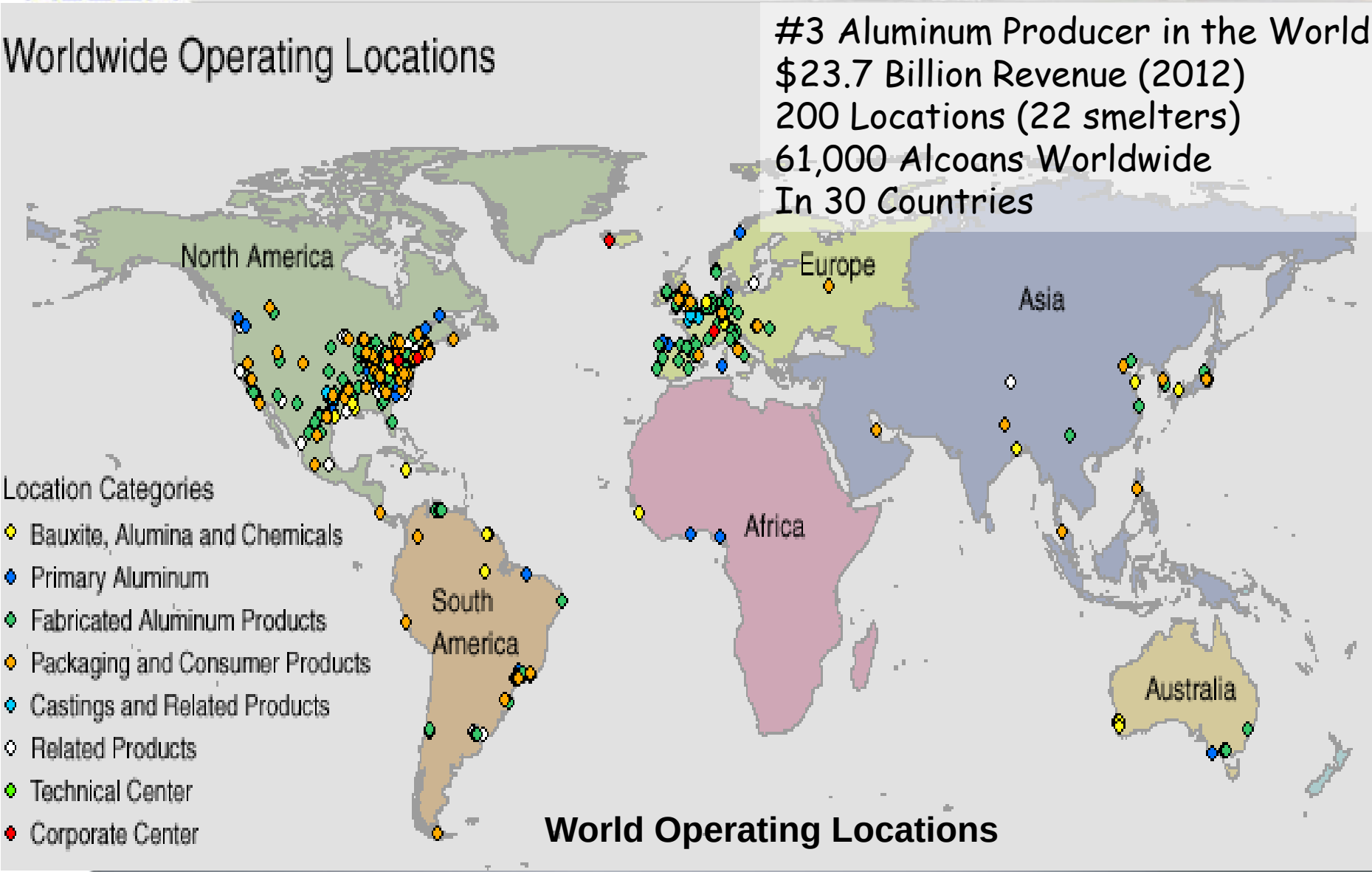
at Mt. Holly

Gérald Bouchard – Engineering Services Supervisor

November 5-7, 2013

Alcoa Industry Leader

#3 Aluminum Producer in the World
$23.7 Billion Revenue (2012)
200 Locations (22 smelters)
61,000 Alcoans Worldwide
In 30 Countries



World Operating Locations

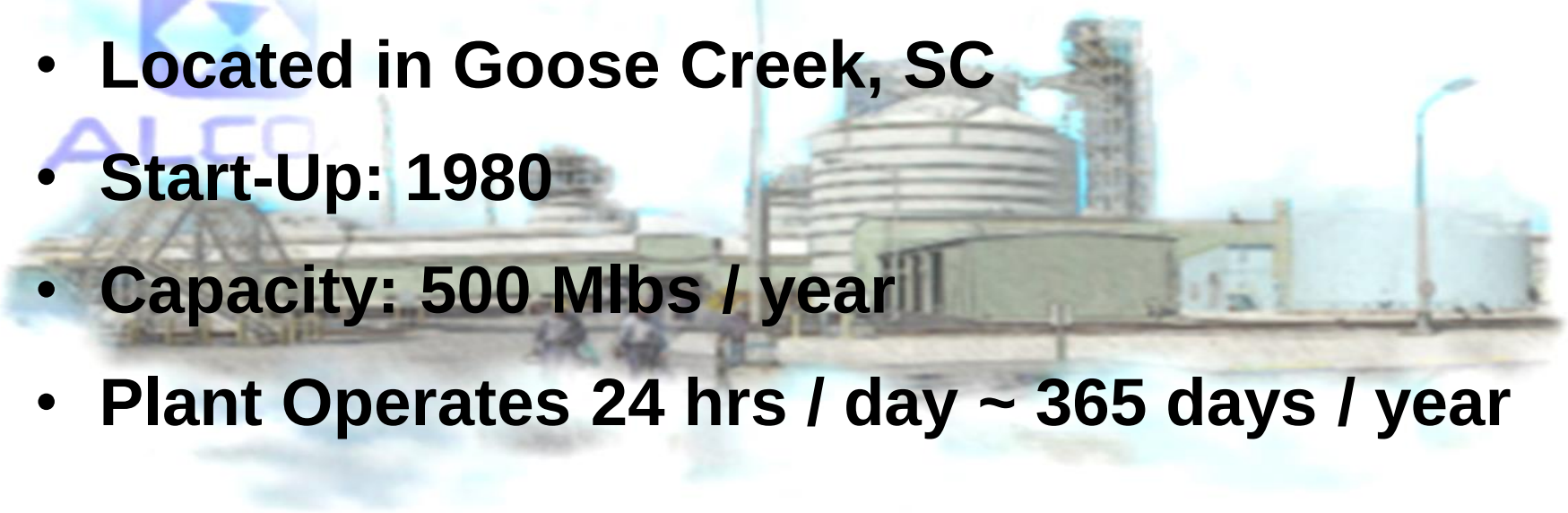
Alcoa Named "Most Admired"

- **Ranked Number One in Metals Industry**
  - 2005 and 2009
  - Innovation
  - Use of Assets
  - Employee Talent
  - Management Investment Value
  - Social Responsibility
  - Financial Soundness
  - Products / Services

Alcoa Mt. Holly

Mt. Holly Facility

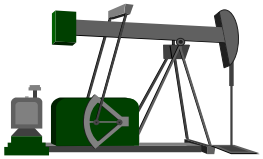
- Primary Aluminum Reduction Plant (Smelter)
- Located in Goose Creek, SC
- Start-Up: 1980
- Capacity: 500 Mlbs / year
- Plant Operates 24 hrs / day ~ 365 days / year



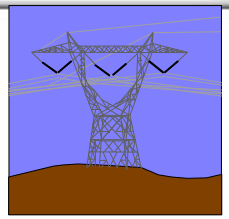
Mt. Holly Employees

- **Total** **586**
- **Salaried** **195**
- **Production** **290**
- **Maintenance Craft** **101**

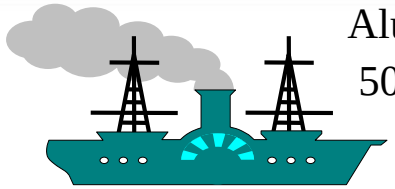
Mt. Holly Resources



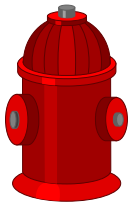
Natural Gas
6.5 M Therms



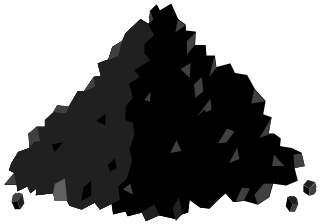
Electricity 3 M MWH



Alumina Ore
500,000 Tons

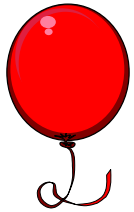


Water 66 M Gals.

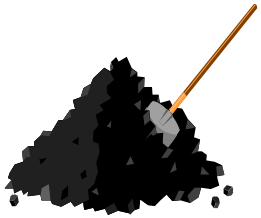


Coke 115,000 Tons

250,000 Tons of Aluminum Produced Annually

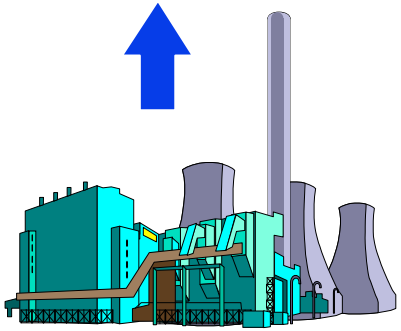


Compressed Air
4,000 M Cu. Ft.

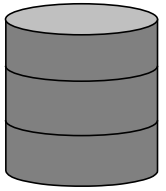


Pitch 26,000 Tons

586 Employees



Building Space 1.5 M Sq. Ft.



Al Fluoride 4,000 Tons

g – Major Inputs

Inputs

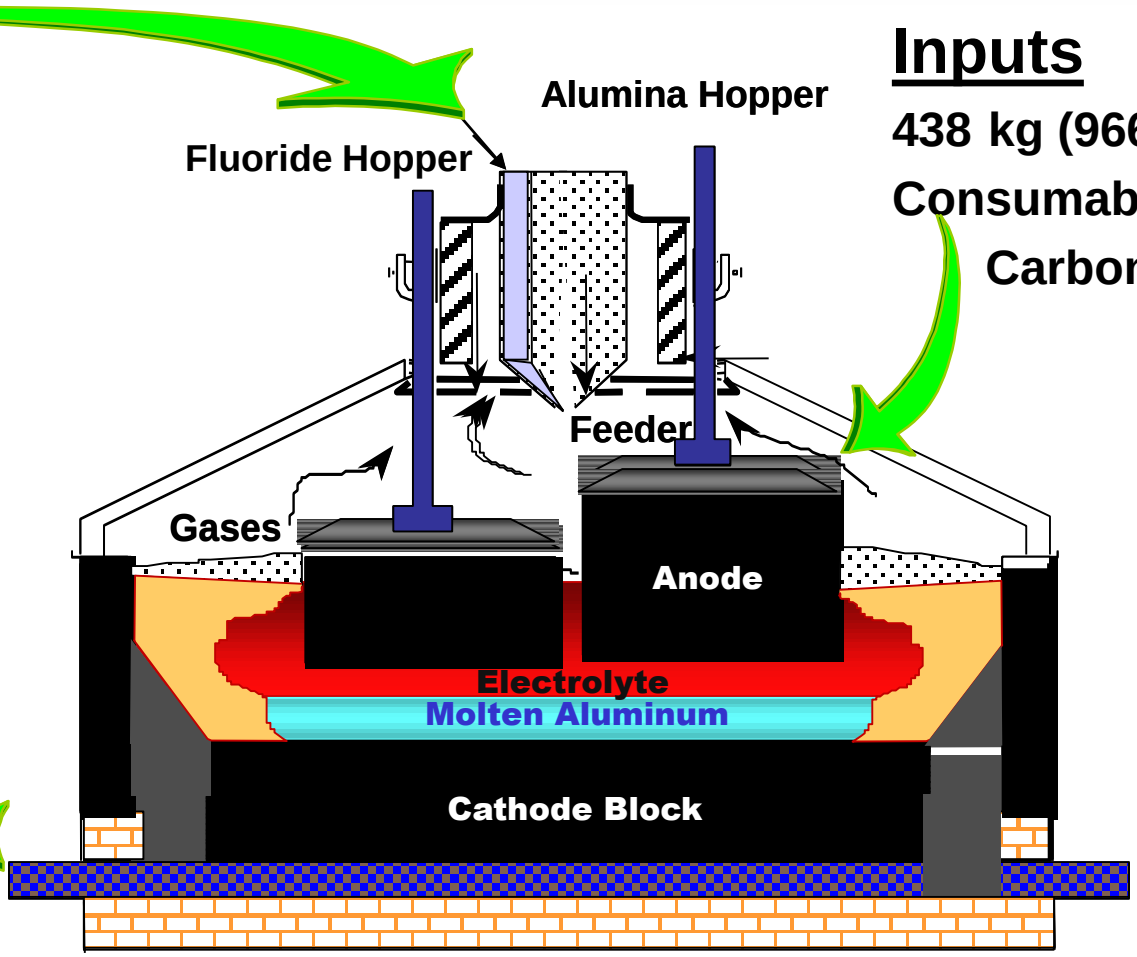
1927Kg (4248 lb) of Alumina (Al2O3)

16 kg (35 lb) of AlF3

14.5 MWH Electricity

11,600 MW/Day

Typical usage for Household is 11 MW/Yr



Center Point Break Pre-bake Anode Cell

Inputs

438 kg (966 lb) of Consumable Carbon Anodes

Per 1000 kg of metal production (a metric ton)

Produce 800 mt/day

Presentation Agenda

- APS House – Why reliability is important
- Goals
- Principles
- Elements
- Teams
- Key Tools – FAT, ERT, PRT
- Dashboard Metrics
- Process Review

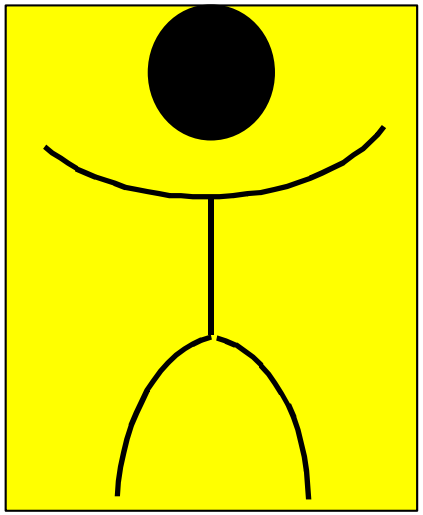
The Alcoa Production System

GOALS: Best Quality ⬭ Lowest Cost ⬭ Shortest Lead Time

KEY: *Thorough Elimination of Waste*

JUST-IN-TIME

- Continuous Flow
- Pull System
- Takt Time



AUTONOMATION

- "Automation with a Human Touch"
- Machines stop for Abnormalities
- Separate Man & Machine
- Error Proofing

Leveling | Standardized | Continuous Improvement

TPM | Work | 5 S

Stability

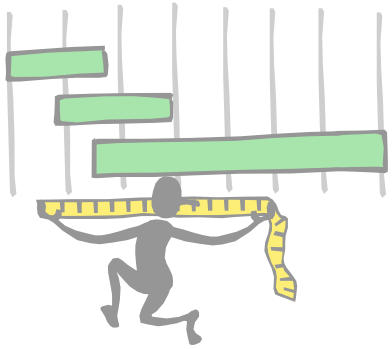
(e.g. Equipment reliability, Stable Processes, Quality, Suppliers)

PEOPLE

Goals of the Reliability Process

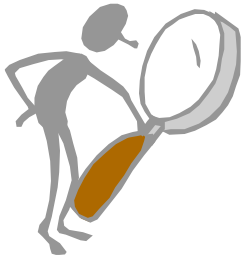
- Save $$$
  - Reduce downtimes and costs by solving problems to their root causes
  - Use non-capital solutions to eliminate problems
- Reduce Process variations
- Grow partnership between Production, Environmental and Maintenance

Principles of the Reliability Process



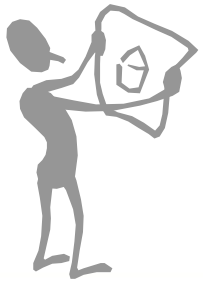
MEASURE:
Review Failure Data since last meeting

ANALYZE:
Research the Root Causes of failures



CORRECT:
Initiate Action Items to Prevent Recurrence

FOLLOW UP:
Review the Action Items



Reliability Elements

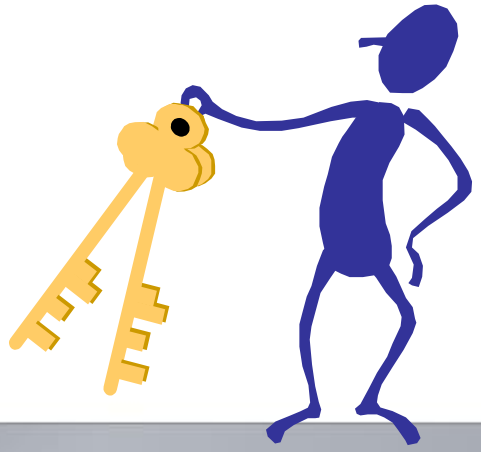
- Involve People on the Floor
- Simple (Look at Information Since Previous Meeting)
- Use Apollo Root Cause Analysis Method
- Cross-Functional Team of 4 - 5 People
- Reliability Engineer Leads Analysis
- Reliability designee Develops Pareto Prior to Meeting
- Team Decides - “What to Work on”
- Strong Support from Maintenance Management
- Track Reliability Cost Savings
- Dashboard Metrics

Reliability Teams

- Failure Analysis Team (FAT)
  - Cross-functional Standing Team Meeting Regularly
  - Led by Maintenance/Reliability Engineers
  - Review Equipment with Highest # Unplanned Work Orders, Hours and Cost
  - Take Actions to Prevent Recurrence of Failures
- Equipment Reliability Team (ERT)
  - Cross-functional Ad Hoc Team Meeting as Necessary
  - Led by Reliability designee
  - Focus Only on One Equipment/System
  - Use RCA to Identify Root Causes
- Process Reliability Team (PRT)
  - Cross-functional Team Meeting Regularly
  - Co-led by Maintenance/Reliability Engineer and Production designee
  - Focus on reducing Process Functional Failures
  - Use RCA to Identify Root Causes

Key Tools of the FAT

1. Pareto Chart for number of failures
2. Who - Does What - When list

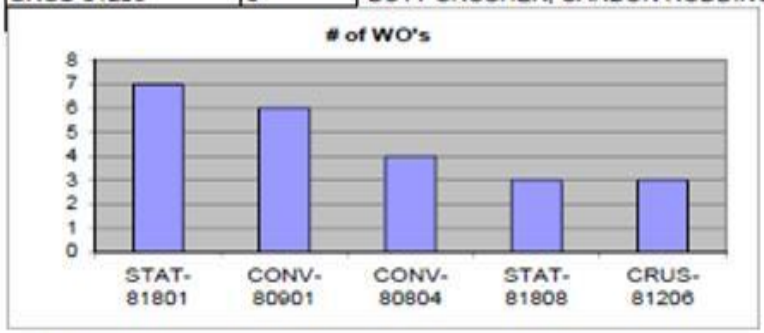


FAT data

Rod Shop FAT Report - March 2013

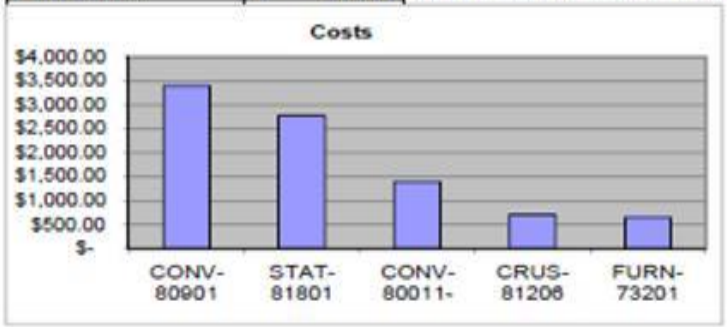
of WO's

Asset Number	Total	
STAT-81801	7	BUTT BATH CLEANING AND BLOW OFF STA
CONV-80901	6	POWER AND FREE CONVEYOR,CARBON RODD
CONV-80804	4	ROLL CONVEYOR, EXIT FROM BLOCK STOR
STAT-81808	3	ANODE ASSEMBLY MACHINE,CARBON RODDI
CRUS-81206	3	BUTT CRUSHER, CARBON RODDING



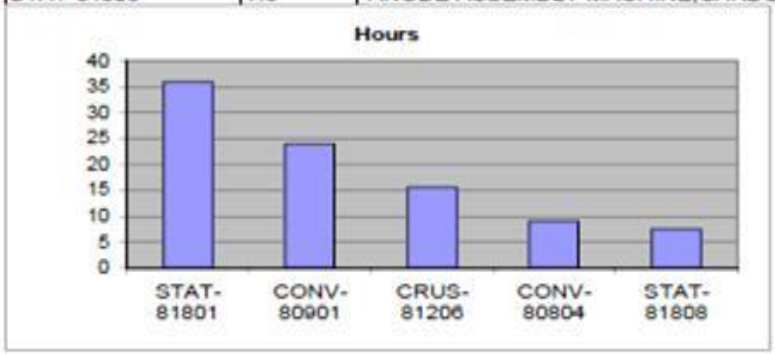
Costs

Asset Number	Total	
CONV-80901	$ 3,396.49	POWER AND FREE CONVEYOR,CARBON RODD
STAT-81801	$ 2,771.21	BUTT BATH CLEANING AND BLOW OFF STA
CONV-80011-	$ 1,393.54	BELT CONVEYOR,BATH,BUTT BATH CLEANI
CRUS-81206	$ 705.10	BUTT CRUSHER, CARBON RODDING
FURN-73201	$ 645.72	CAST IRON INDUCTION FURNACE, WEST.



Hours

Asset Number	Total	
STAT-81801	36	BUTT BATH CLEANING AND BLOW OFF STA
CONV-80901	24	POWER AND FREE CONVEYOR,CARBON RODD
CRUS-81206	15.5	BUTT CRUSHER, CARBON RODDING
CONV-80804	9	ROLL CONVEYOR, EXIT FROM BLOCK STOR
STAT-81808	7.5	ANODE ASSEMBLY MACHINE,CARBON RODD

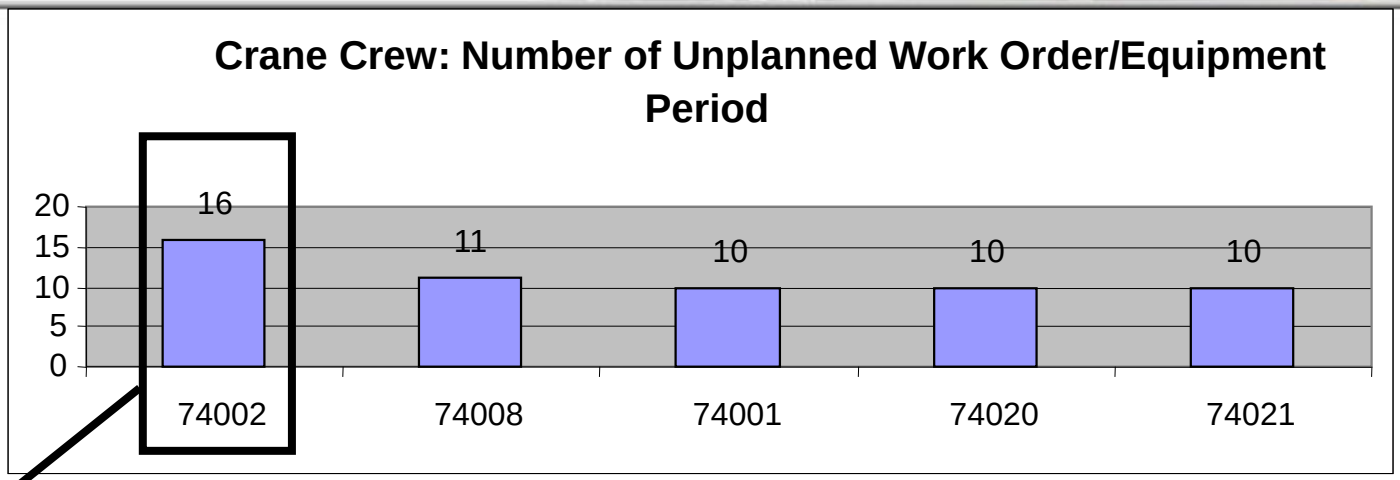


Top 5 Bad Actors

CONV-80011- BELT CONVEYOR,BATH,BUTT BATH CLEANI
CONV-80804 ROLL CONVEYOR, EXIT FROM BLOCK STOR
CONV-80901 POWER AND FREE CONVEYOR,CARBON RODD
CRUS-81206 BUTT CRUSHER, CARBON RODDING
STAT-81801 BUTT BATH CLEANING AND BLOW OFF STA

FAT data

Count of WO	
EOP #	Total
74002	**16**
74008	11
74001	10
74020	10
74021	10
74007	9
74003	8
74006	8
74004	6
74005	5
74705	5
74104	4
Grand T	102



74002 ECL POTLINE CRANE,WEST,BLDG 101,POTLINE 1

	WO	Work Order DESCRIPTION	CREW	CLOCK	HOURS x 10	DOWN TIME	MAT. COST
1	20657400	CALLED FOR NO TRANSFER OUT. C.B. RAN FROM PANEL TURNED OVER TO 39	215	1223	5	0.5	0
2	20657700	JACKHAMMER WOULD NOT TRANSFER OUT.	226	1327	10	0.5	0
3	20666600	REPLACE LEAKING HYd hose	203	1078	20	1.5	0
4	20788300	BIT RETAINING PIN FOR JACKHAMMER JAMMED DUE TO ROLLED METAL REPAIRED	215	1223	5	0.5	0
5	20788100	MAIN HYD. PUMP MOTOR M5 WOULD NOT START O/L TIRPP- ED.	226	1327	10	0.3	0
6	20790600	DISCONNECT WAS CUT OFF AT 101-W-CRANE BAY AREA. CHECKED CRANE TO MAKE EVERYTHING	215	1224	5	0.5	0
7	20790900	JACKHAMMER DELAYS TO LONG BEFORE IT VIBRATES ADJUST TIMER ON J22. CHECK OPERATION.	226	1563	10	0.3	0
8	20793400	PUT WINDOWS BACK IN CRANE CAB.WINDOWS APPEARED TO HAVE BEEN KICKED OUT.(ED)	215	1224	15	1.5	0
9	20797900	REPLACE ANODE WRENCH SOCKET BOLT ON 101-W-ECL. (GREEN)	215	1224	5	0.5	0
10	20890200	REPLACE JACKHAMMER DUE TO OFF AND ON STICKING PROBLEMS.CHECKED THE FOLLOWING AIR	230	1972	20	2	0
11	20896900	REPLACE HOSE TO TOP OF C.B. LIFT CYLINDER. HOSE RUBBED HOLE NEAR SLIP RING BOX.	215	1139	10	1	0
12	20901300	MAIN HYDRAULICS SHUT OFF... OPENED N8 PANEL AND CHECKED O.L., THEY WERE CLOSED. TRIED HYDRAULICS AND IT STARTED UP OK. GAVE CRANE BACK TO PRODUCTION. GOT CALLED BACK AN HOUR LATER FOR THE SAME THING. CHECKED O.L. AND THEY WERE CLOSED...HYD ST	226	1431	15	1	0
13	20902300	MAIN PUMP MOTOR TRIPPED OUT. STUCK ON CARBON. GET LOOSE. TRIPPED SEVERAL TIMES T.O.	215	1139	10	1	0
14	20997400	TROLLEY WOULD NOT OPERATE FOUND TWO BLOWN FUSES IN TROLLEY DRIVE MOTOR CIRCUITRY. REPLACED FUSES. CHECKED OPERATION. OK NOW. UNKNOWN REASON FOR BLOWN	226	1432	10	0.5	39.16
15	20997300	REPLACED BOTH J-HAMMER D/C VALVES; ONE STICKING, ONE LEAKING.	215	1749	10	1	624.53
16	21020500	CALLED TO CHECK FOR SLOW TRANSFER OF JACKHAMMER RAN CRANE COULD FIND NO PROBLEMS	215	1223	5	0.5	0

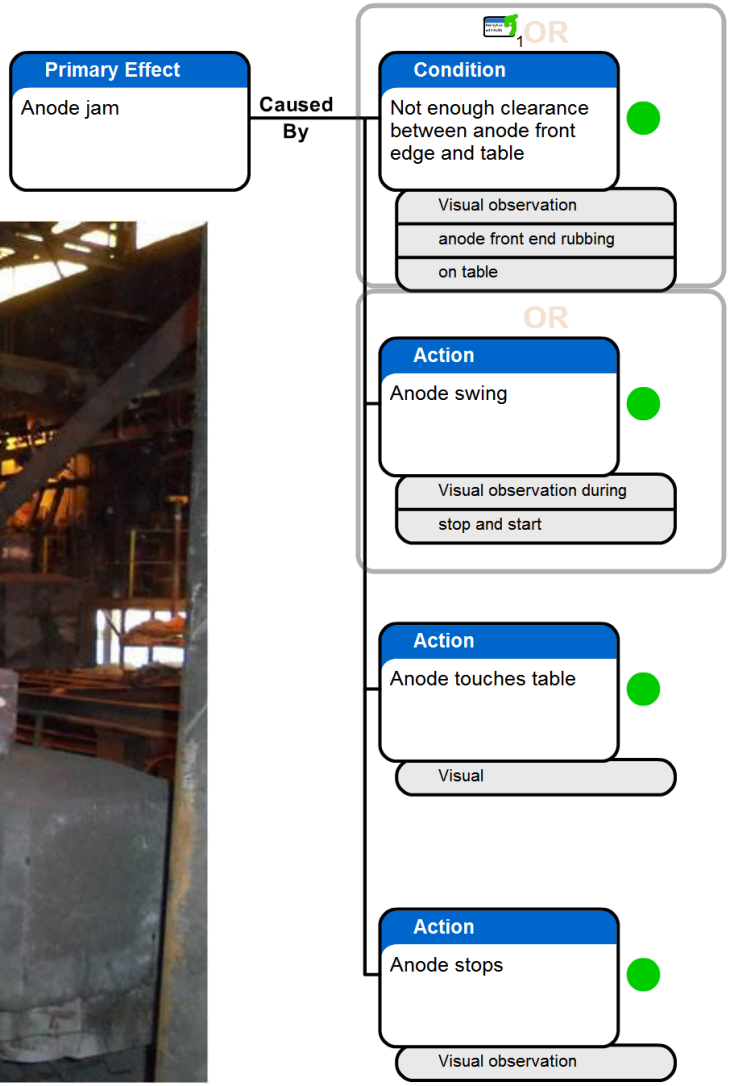
Who - Does What - When List

Equipment	Who	Does What	When	Action Type
ECL cranes	Don Olwig	Will create a single point lesson to improve the operation of the crimping machine.	7-Mar	Communication
ECL cranes	Don Olwig	Communication to make sure the hoses that are found to be leaking will be sent to the Crane Crew shop with the WO number tagged on it.	10-Apr	Communication
ECL cranes	Norman Cross	Replace the air lines that contains rust.	7-Jul	Corrective
Bake Oven Crane	Valerie Kahrs	Follow-up the blitz and project to improve suction on BOC	7-Jul	Follow-up
Bake Oven Crane	Andrew Estaver	Update the weekly PM on BOC to reflect reality of cleaning the hole of dust for the slack cable switch	7-Jul	Corrective
Bake Oven Cranes	Valerie Kahrs	Have a new block separator fabricated to be used with the 20T hoist.	1-May	Corrective
Bake Oven Cranes	David Moultrie	Try the new bags (yellow) and compare them to the present ones (white). They should be able to sustain more heat.	21-Jun	Analysis
ECL cranes	Pierre Leblanc	Design a basic lube station for every 8 Potline rooms to address the problem of lubrication of the jackhammers.	6-Jun	Corrective
ECL cranes	Norman Cross	Install a hydraulic hose (451TC with 43 fitting) for the air on the jackhammer of all ECL Cranes.	9-May	Corrective
ECL 103W	Charles Rider	Investigate what is causing the hole in the hose on top of C.B. lift cylinder.	6-Jun	Analysis
ECL 103W	Gerald Bouchard	Find out what are the causes for the material not coming out of the hopper .	6-Jun	Analysis

Key Tools of the ERT

1. Root Cause Analysis
2. Who - Does What - When list

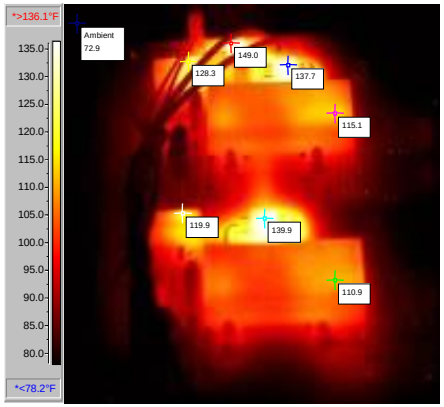
Root Cause Analysis (RCA)



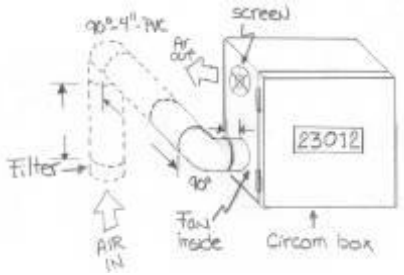
Success Story: Circom Modules

1. Problem

2. Root Cause



3. Solutions



Success Story: Ore Bucket Cable

1. Problem

2. Root Cause

3. Solutions

Success Story: Hopper build-up

1. Problem

3. Solution

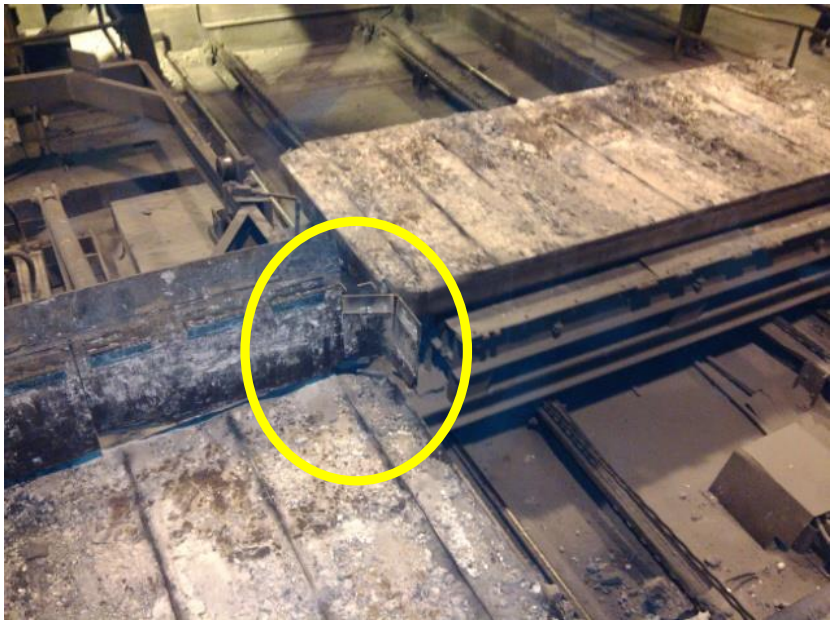
2. Root Cause

Success Story Butt Pusher at Hanging Station

1. Problem

2. Root Cause

3. Solution



Success Story: Scrap Grabber

1. Problem

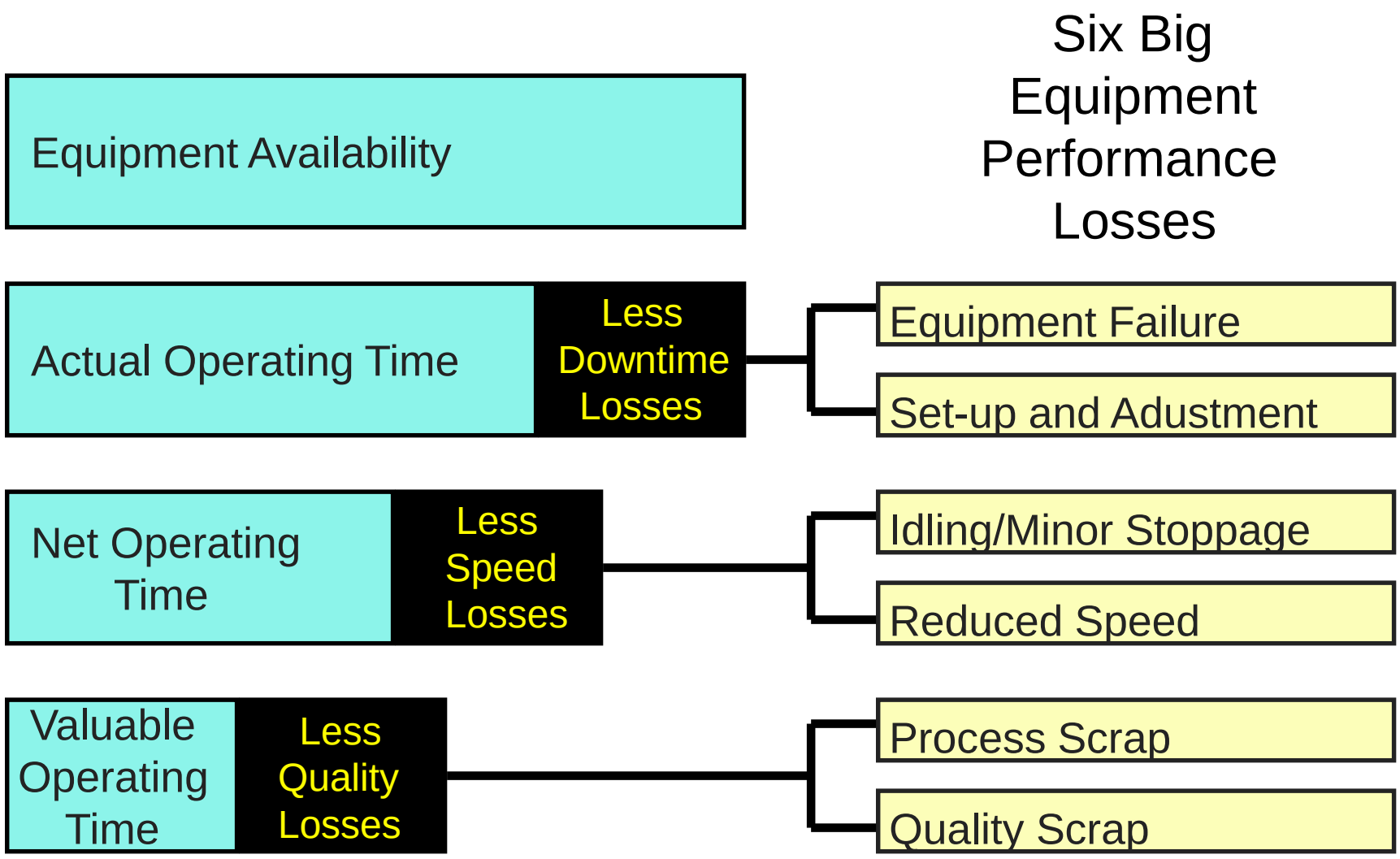
2. Causes

3. Solution

Key Tools of the PRT

1. Tracking data to improve
   - Overall Equipment Effectiveness
     - Availability
     - Performance
     - Quality
   - Overtime
   - …
2. Who - Does What - When list
3. Operator care

OEE (OVERALL EQUIPMENT EFFECTIVENESS)



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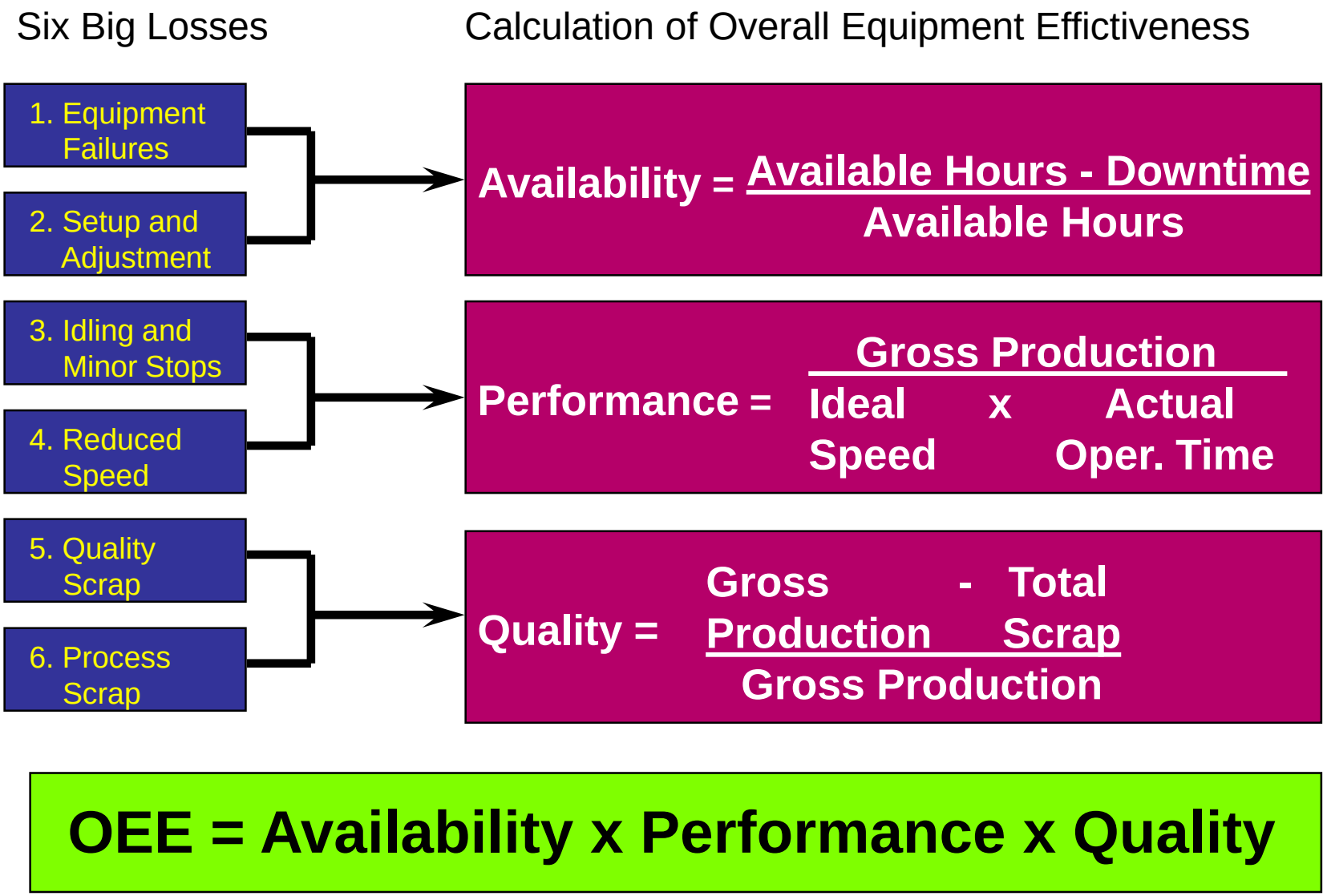


Operator Care

OVERALL EQUIPMENT EFFECTIVENESS - CLI STANDARDS

DEPT:	CASTHOUSE	EQUIPMENT:	HDC	LOCK, TAG, VARIFY (LTV)!

Machine Down Activity

PIC	AREA	LTV	METHOD	TOOL	INTERVAL	CLI STANDARD	TIME
1	FCE 3 HYD. ASSEMBLY	Y	BLOW OFF / WIPE	AIR / RAG / SOL	DOWN	CLEAN / INSPECT	15min

USE A DEGREASER WISELY ON MACHINE PARTS THAT ARE CONTAMINATED WITH OILY RESIDUE

Machine Running Activity

PIC	AREA	LTV	METHOD	TOOL	INTERVAL	CLI STANDARD	TIME
2	FCE 3 HYD. ASSEMBLY	N	BLOW OFF	AIR	BI-WEEKLY	CLEAN / INSPECT	5min
3	CASTER CONSOLE	N	BLOW OFF / WIPE	AIR / RAG	WEEKLY	CLEAN	6min
4	STACKER PLC CABINET	N	WIPE	RAG / CLNR	WEEKLY	CLEAN	10min

SUNDAY **D**

Success Story PRT Rod Shop

Safety:

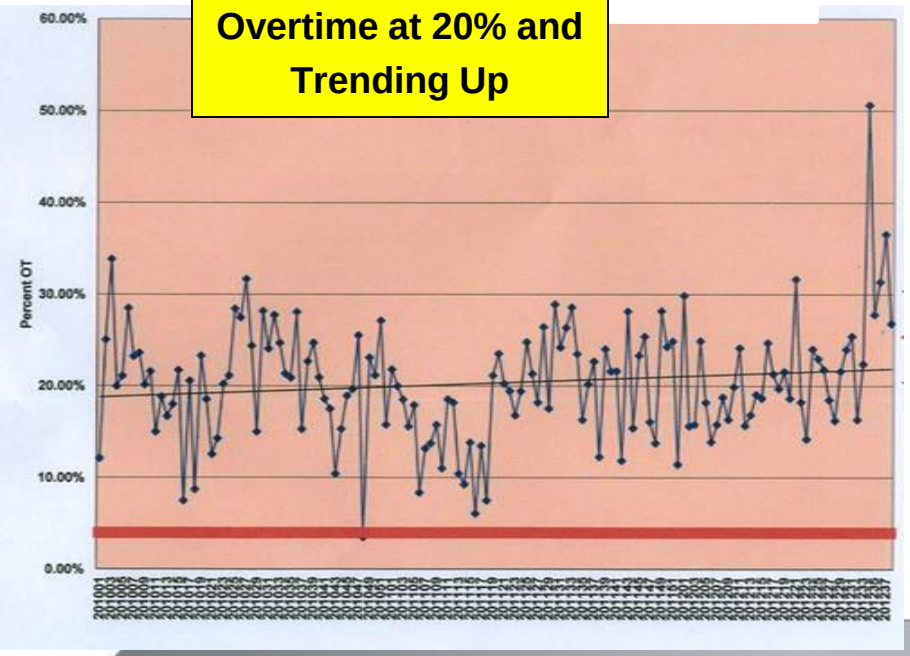
2010, 2011, 2012 Count

- OSHA = 4
- RWD = 2
- LWD = 1

2012 LWD Incident

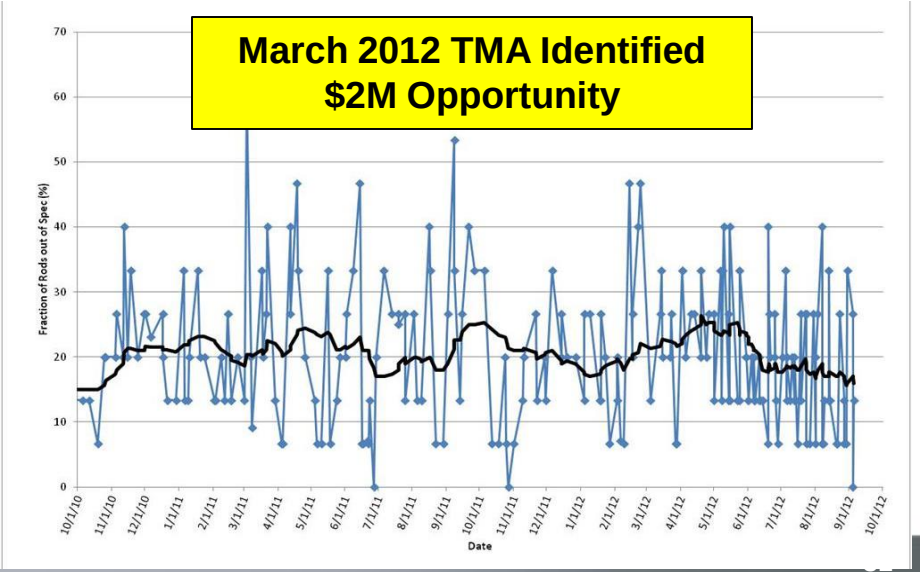
Overtime:

Overtime at 20% and Trending Up



Rod perpendicularity:

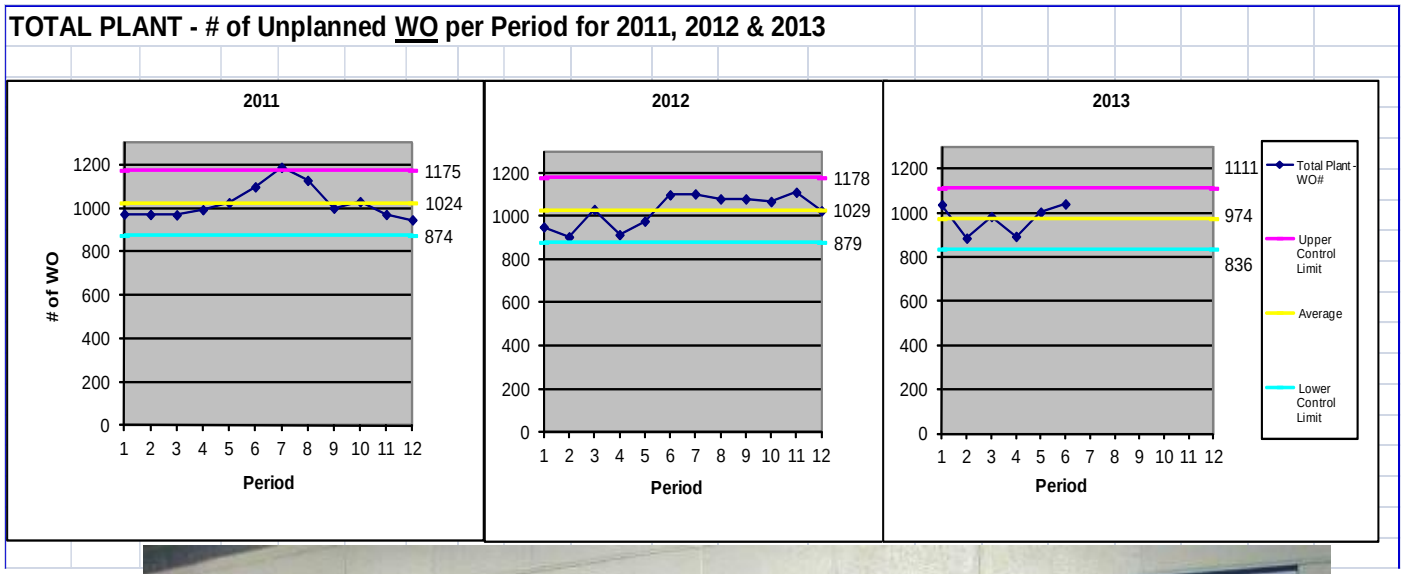
March 2012 TMA Identified $2M Opportunity

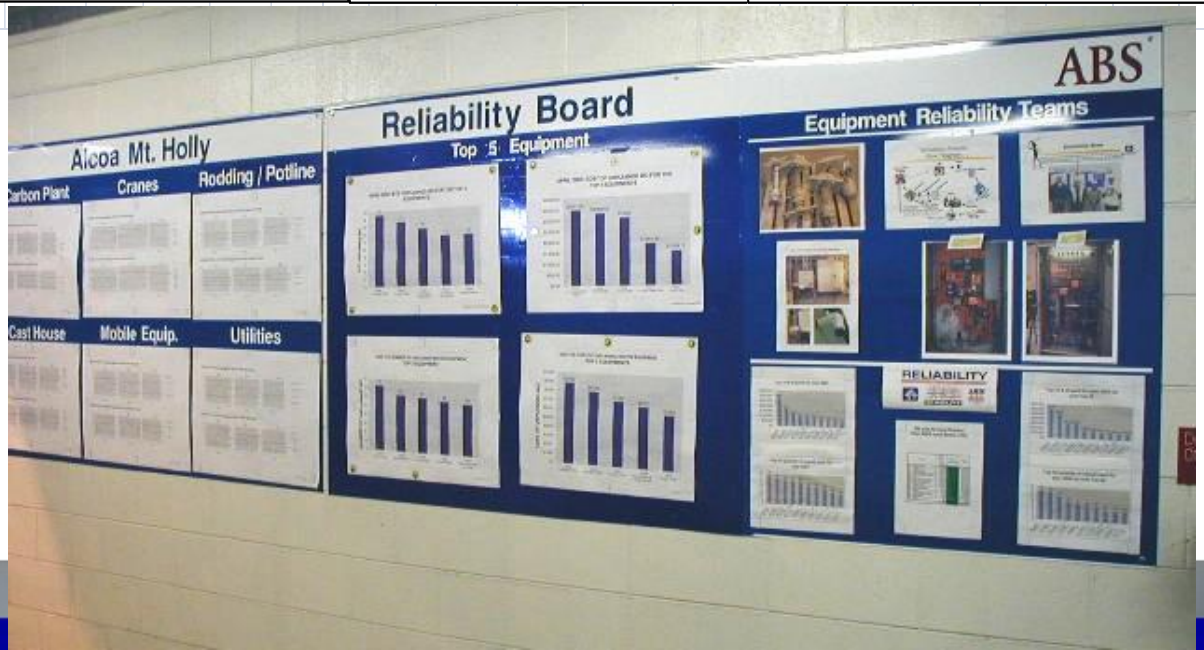


Success Story PRT Rod Shop

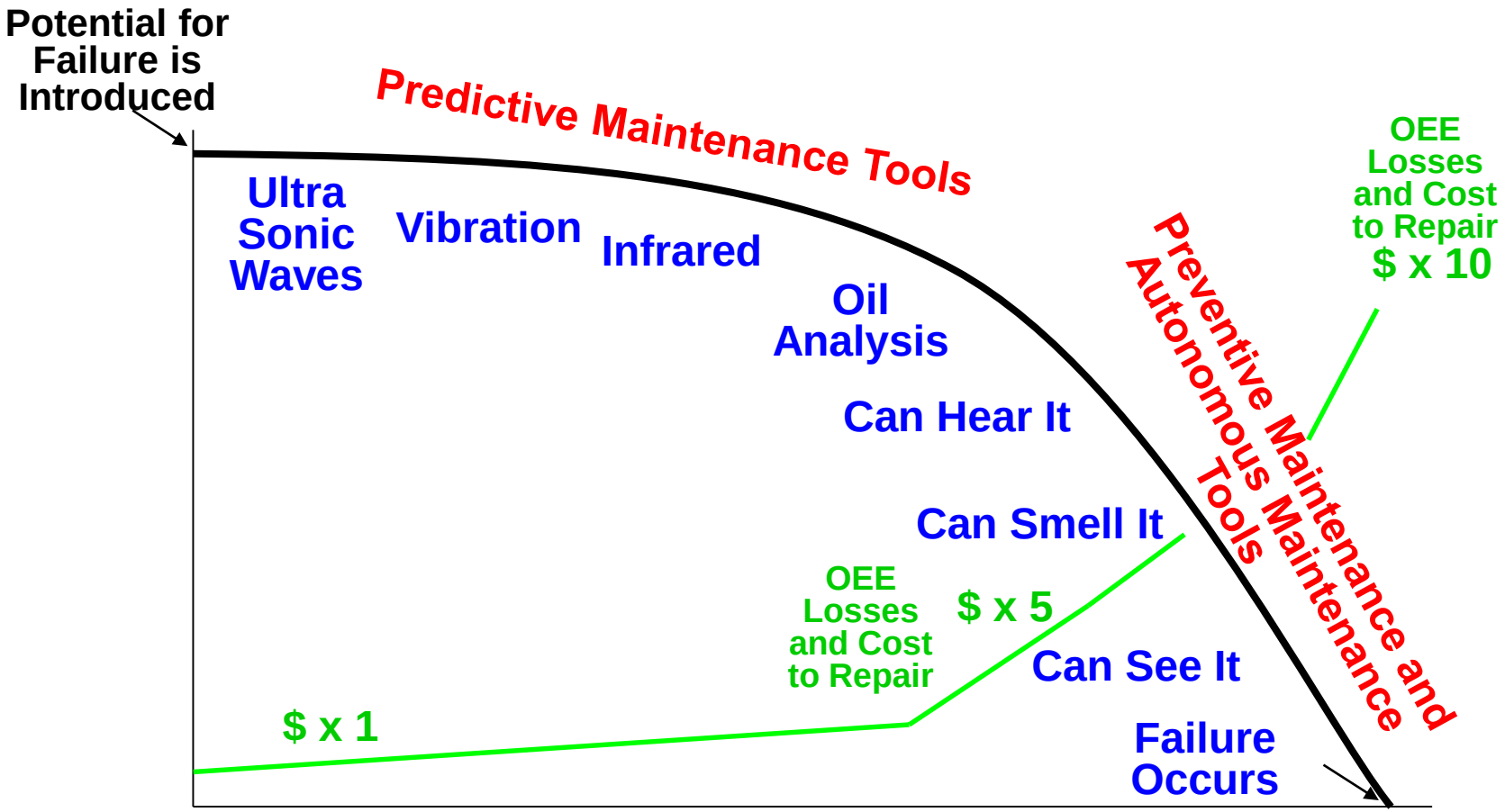
- In less than 12 months:
  - No major safety incident
  - Rate of production increase 13%
  - Production OT went down by 10%
  - Availability and performance trending up

Dashboard Metrics





PF Curve – PRT vs. FAT/ERT



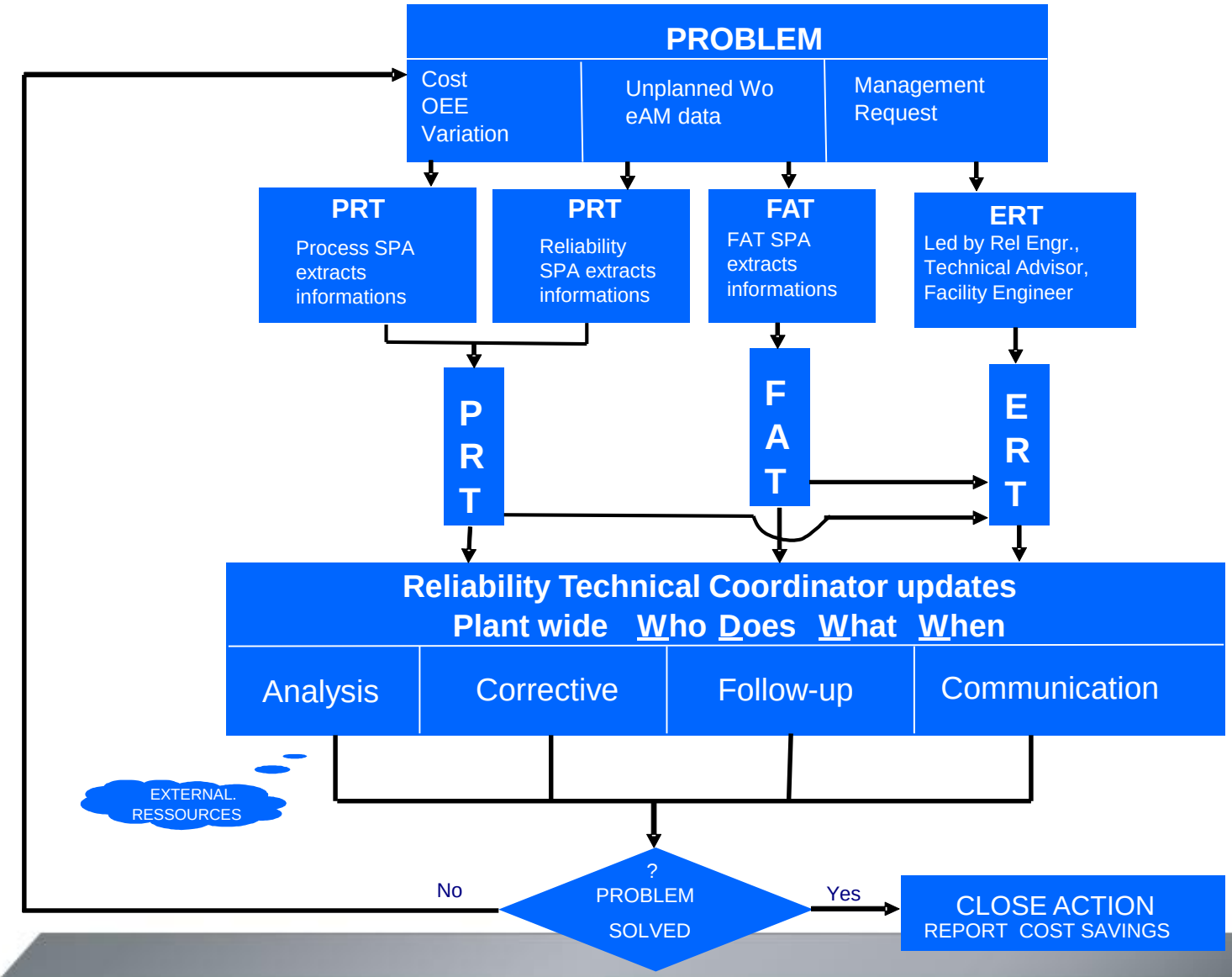
"Time from P to F" can be Weeks, Days, Hours, or Minutes

Plenty of Time for Excellent Planning & Scheduling

Unplanned-Unscheduled R&M work is 7 times more expensive than planned-scheduled work!

Little to No Time for Proper Planning & Scheduling

Reliability Process (PRT, FAT, ERT)



Question?