Reliability and Assets Management

LIFE CYCLE MANAGEMENT

Life Cycle Cost refers to the total cost of equipment throughout its life. The US Management and Budget defines LCC as the sum of the direct, indirect, recurring, non-recurring, and other related costs of a large-scale system during its period of effectiveness.

In terms of production equipment, LCC can be described more simply as design and fabrication cost, which is the initial or acquisition cost, plus the operation and maintenance cost which is the running costs.

The initial cost will always be easy to see, but the running cost is not. Failure to consider the running cost can lead to many problems. At least 80% of an equipment's LCC can be conceptualized at the design stage. Hence,

LCC = INITIAL COST + RUNNING COST

LIFE CYCLE MANAGEMENT

DESIGN

- Evaluation
- Design Cost
- Quality Test
- Revisions
- Labor Cost
- Engineering

FABRICATION COST

- Quality Test
- Procurement Cost
- Modification Cost

COMMISSIONING COST

- Installation Cost
- Transportation Cost
- Warranty Cost
- Debugging Cost
- Contractor's Cost

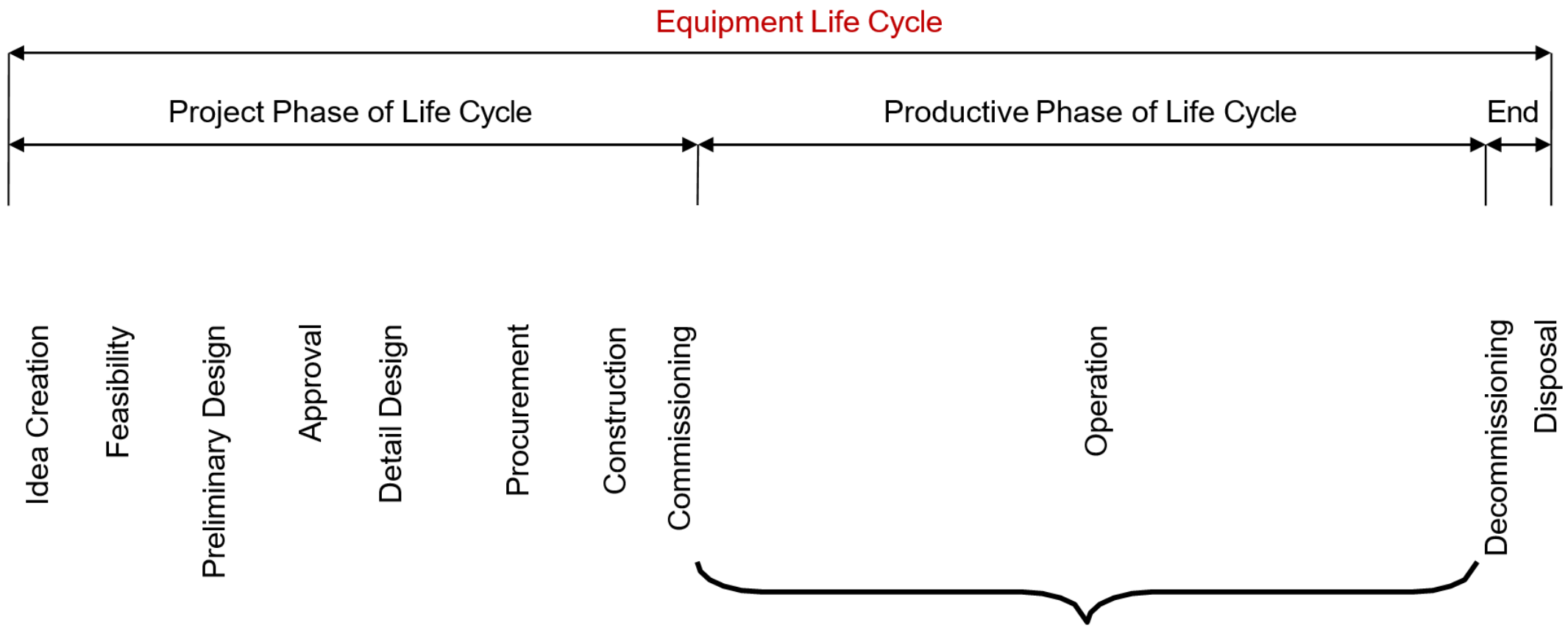
OPERATION COST

- Maintenance Cost
- Spare Parts Cost
- Downtime Cost
- Energy Cost
- Facilities Cost
- Modification Cost
- Training Cost
- Labor Cost

DECOMMISIONING

- Disposal Cost
- Transportation Cost
- Labor Cost
- Spare Inventory

The Life Cycle of Plant and Equipment

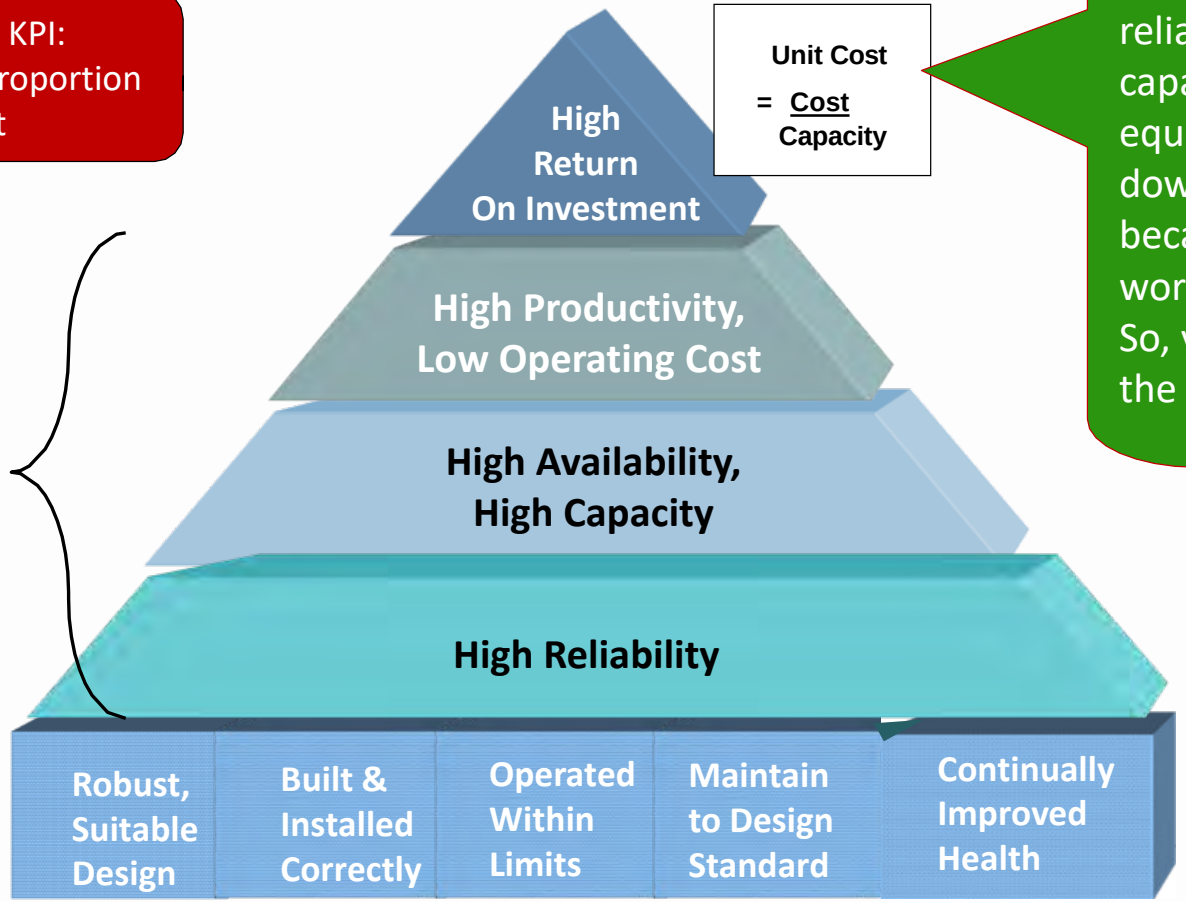


UNDERSTANDING LIFE CYCLE COST

What Makes a Productive Equipment Life?

MAINTENANCE KPI:
Maintenance proportion of the Unit Cost

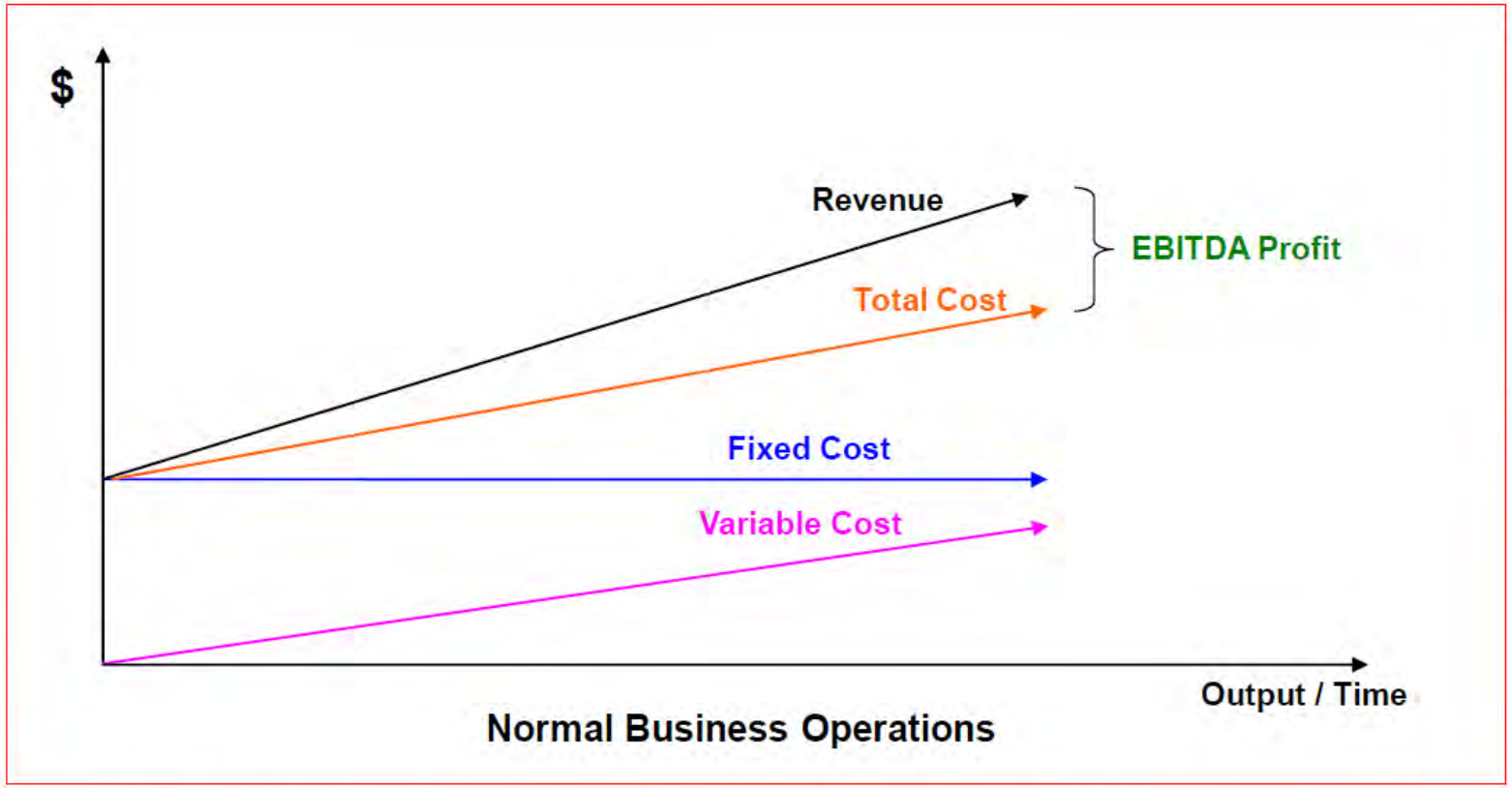
Maintenance Reliability Management add value here



Unit Cost = Cost / Capacity

When you make the plant more reliable, you work on the capacity part of the Unit Cost equation. As a result, you drive down the cost of your product because the plant is available to work at full capacity for longer. So, you make more products at the same time for less cost.

The Purpose of Business



Profit ($) =
Revenue ($) - Total Costs ($)

Total Costs ($) =
Fixed Costs ($) + Variable Costs ($)

EBITDA = Earnings before Interest, Tax, Depreciation, and Amortization – it represents the operating profit.

RELIABILITY DEFINED

- FAILURE simply means the inability of an equipment to perform its required function. The failure of a component is viewed as terminating its life.

- RELIABILITY is the probability that no failure will occur throughout a prescribed operating period.

Maintenance is not about eliminating failures but understanding that it is more important to preserve the functions and understand each of the consequences of failure, and in order to address these failures, we must thoroughly understand its diversity . . . . .

UNDERSTANDING EQUIPMENT FAILURE

We need to understand the diversity of failures?

1 Patterns of Failure

- Infant Mortality Failure
- Random Failures
- Age-Related Failures

2 Types of Failures

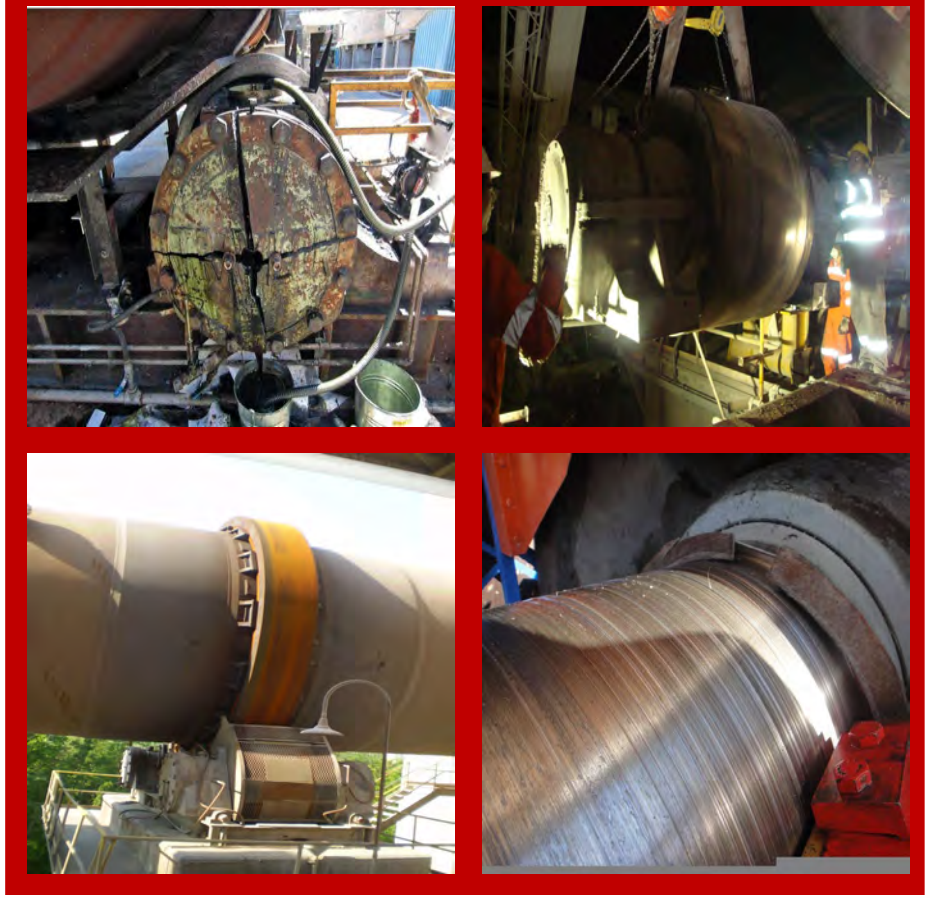
- Function Loss Failures
- Function Reduction Failures

3 Classification of Failures

- Hidden Failures
- Evident Failures

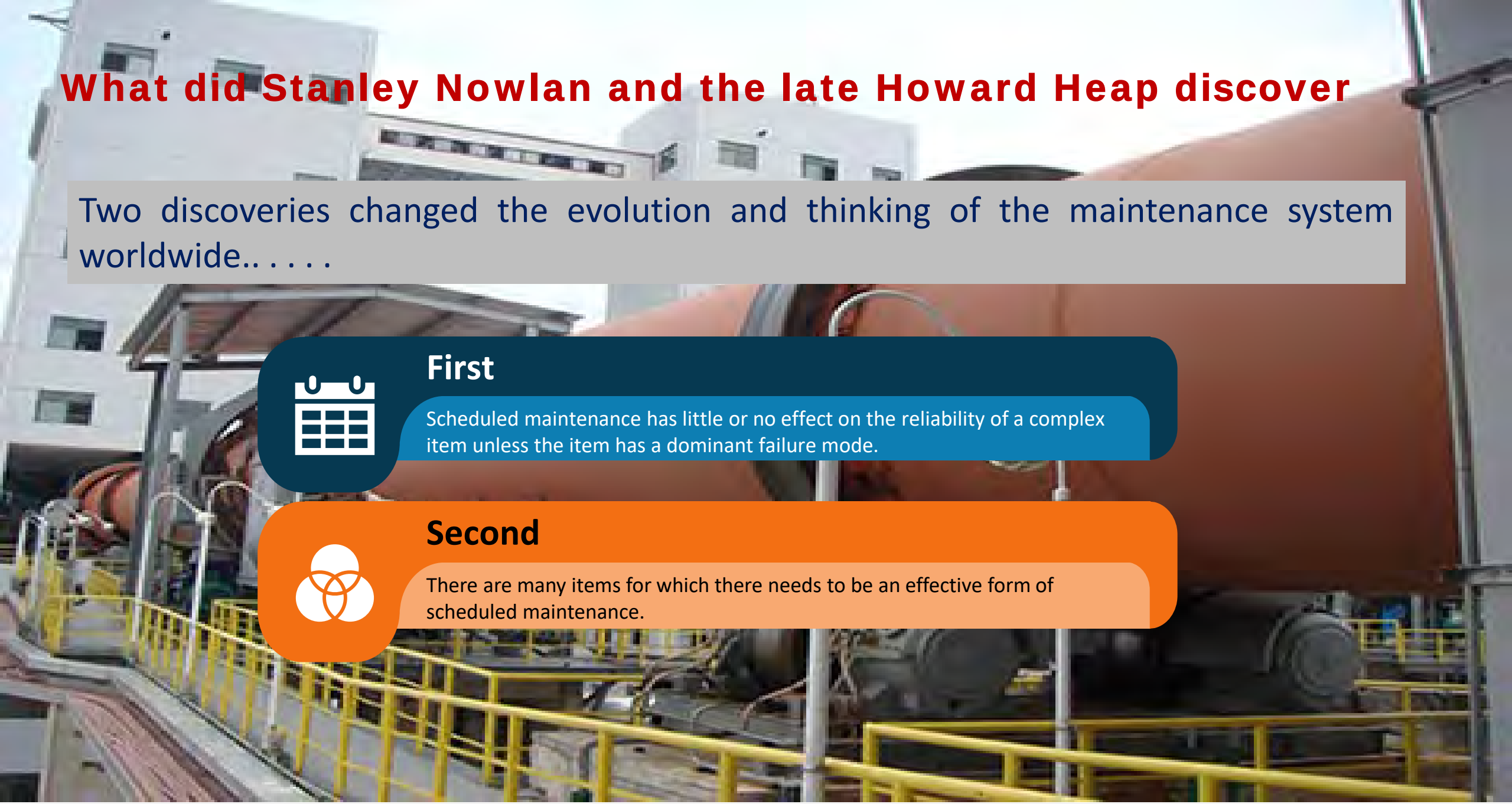
4 Occurrences of Failures

- Sporadic Failures
- Chronic Failures



What did Stanley Nowlan and the late Howard Heap discover

Two discoveries changed the evolution and thinking of the maintenance system worldwide.. . . . .



First

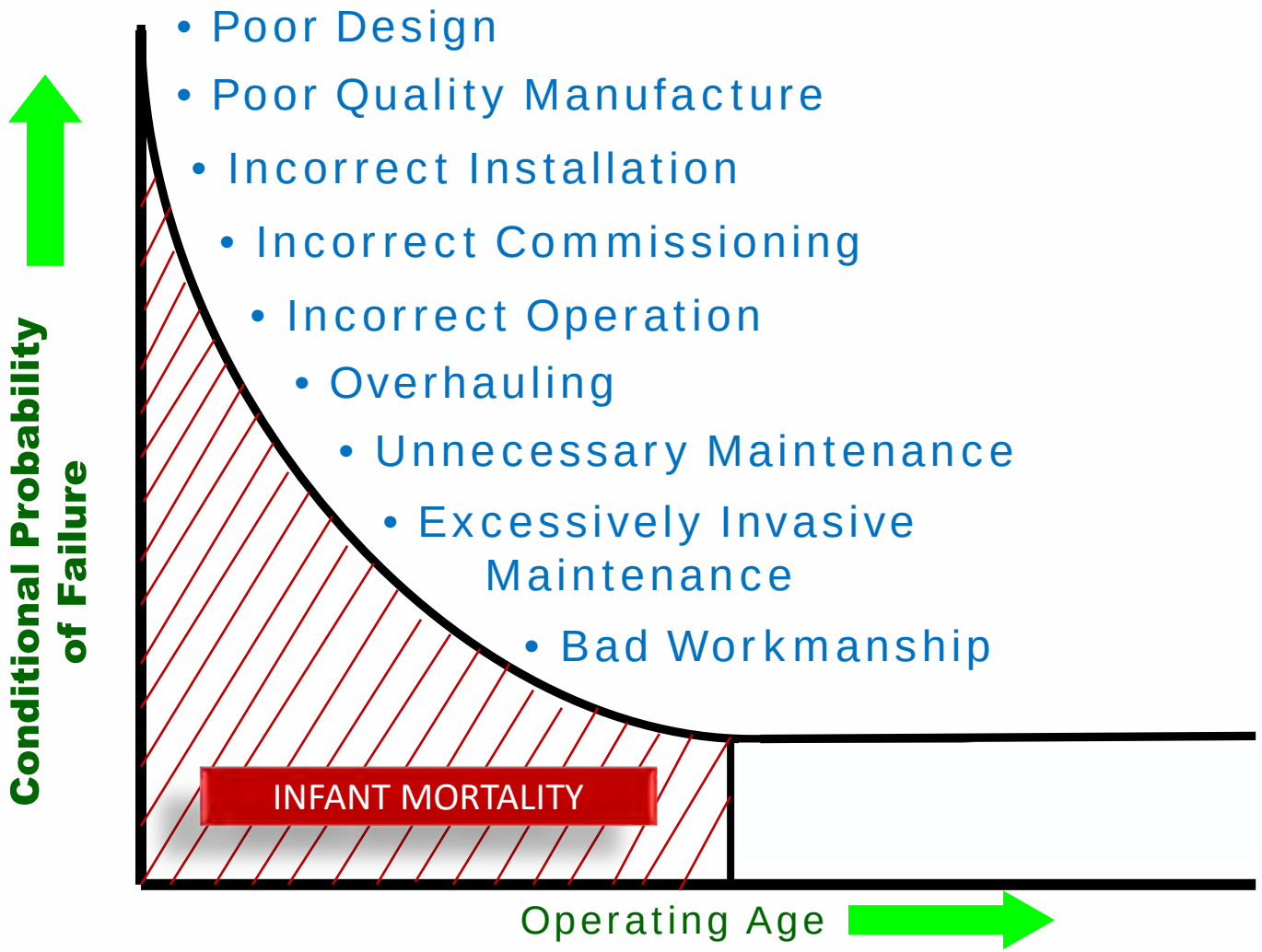
Scheduled maintenance has little or no effect on the reliability of a complex item unless the item has a dominant failure mode.

Second

There are many items for which there needs to be an effective form of scheduled maintenance.

UNDERSTANDING EQUIPMENT FAILURE

INFANT FAILURES ARE CAUSED BY HUMAN



UNDERSTANDING EQUIPMENT FAILURE

UNDERSTANDING RANDOM FAILURES

It simply means that the probability that an item will fail in any one period is the same as it is in any other period. One characteristic of random failure is that a wear-out age is not identifiable, and that the failure can occur at any given time or period.

Random Failures are failures that occur during any given period.

Samples of random failures are electronic boards, bulbs, ball bearings, seals, and hydraulics.

When failures that are occurring is random in nature, **this is when Preventive Maintenance is at its weakest point**. In simple terms, this is not a recommended option & other tasks to use will be to Run To Fail only when the consequences of failure are low, Condition-Based Maintenance, or Modification.

CHANGING THE WAY WE THINK ABOUT FAILURES

UNDERSTANDING AGE-RELATED FAILURES

- Age-related failures mean that the failure is directly related to age, and there is a clear wear-out zone.
- Age specified may be in the form of running hours, time, number of strokes, revolutions, number of stress applied, or any other form. The best maintenance strategy for this type of failure will be to identify when most of the parts will fail and apply Preventive Maintenance.

A tire in a vertical mill that is not properly aligned can fail randomly or prematurely but a tire that is properly aligned will most probably wear out after running for several thousands of hours.

Therefore, before reaching its desired running hours we try to replace or weld the tire.

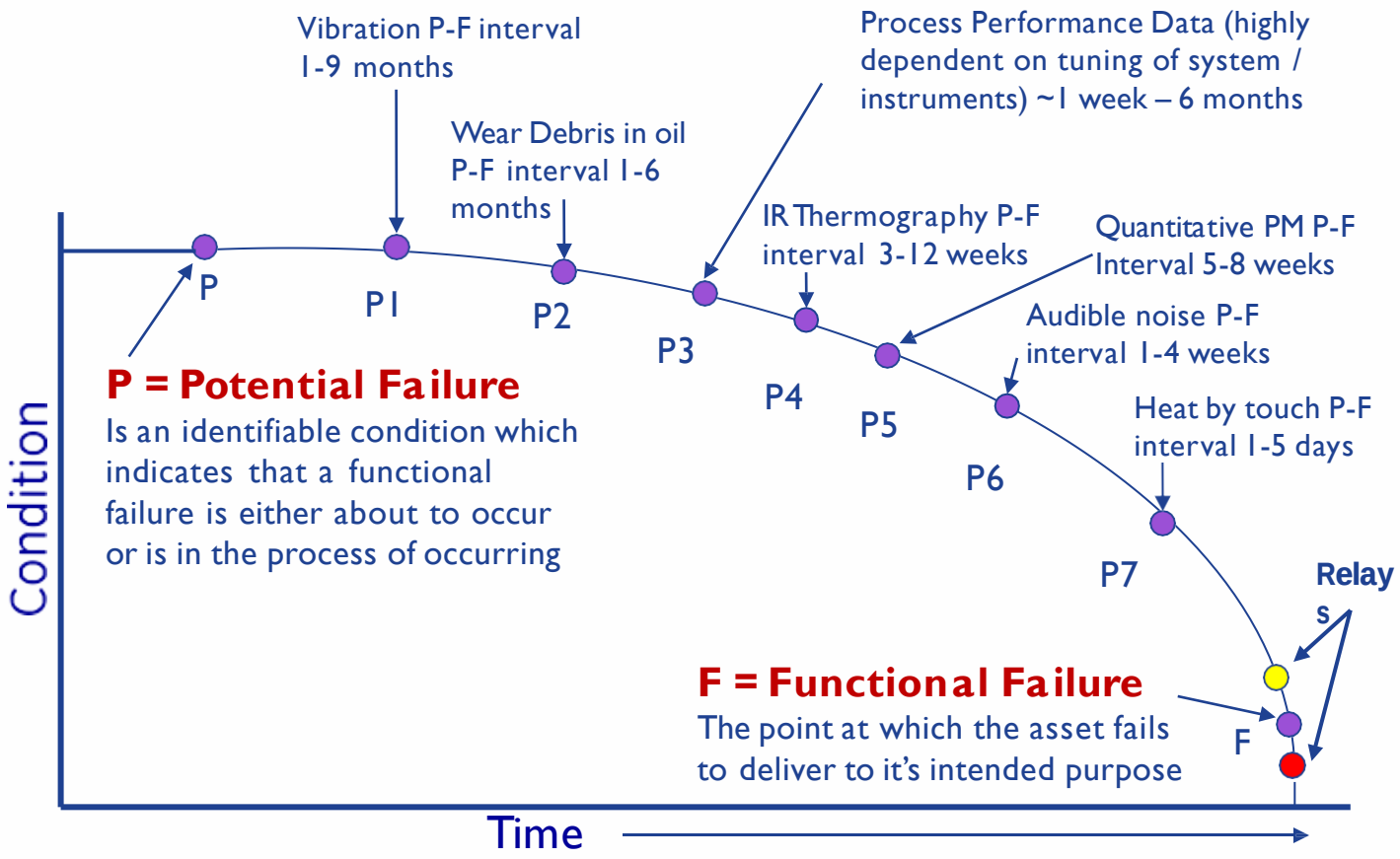
TYPICAL CAUSES OF FAILURES

Failure is just the tip of the iceberg, and when our people becomes good a fixing them, then something is definitely wrong . . . .

The P-F interval

Mechanical Asset Example (Centrifugal Pump)

- This is the time between an asset's potential failure and its functional predicted failure. Your inspection interval must be smaller than the P-F interval so you can catch a failure after it's detectable but before it actually occurs.
- Time can be measured in seconds, minutes, days, months, or years.
- P1-Px indicates detectability intervals by various techniques or technologies.



WHAT AFFECTS MAINTENANCE ?

Maintenance is often considered a “Cinderella” area of manufacturing industry, an area where funds disappear into the maintenance “black hole”, with little feel for the cost effectiveness of this expenditure or of the overall efficiency of the maintenance function. Total cost of maintenance can be around 25% of the cost of production or of the same order as the combined cost of fuel and power.

COST

- Spare parts cost
- Human Resources
- Manpower Overtime
- Commissioning Cost
- Repair & Maintenance Cost
- Investment & Modification

→ Goal is to reduce the cost of maintenance

- Spare Parts Management
- Study of Life Cycle Cost
- Modification and Redesign
- Proactive Maintenance
- Analysis on Top Spare Contributors

WHAT AFFECTS MAINTENANCE ?

UNRELIABILITY AT WHAT COST?

DOWNTIME

- Breakdown or Failure
- Set-Up & Conversion
- Minor Stoppages & Assists
- Design Speed Loss
- Start-Up Loss
- Defects & Reworks

→ The goal is to reduce equipment downtime.

- Root Cause Failure Analysis
- Application of FMEA Techniques
- RCM/OER Application
- OEE/MTBF/MTBA Application
- Condition-Based Maintenance Techniques
- Monitor Equipment Indices & Metrics

WHAT AFFECTS MAINTENANCE ?

Technical Training Corporation has assessed the skill level of thousands of maintenance personnel in the U.S. and Canada and found 80% of the people assessed scored less than 50% of where they need to be in the basic technical skills to perform their jobs.

SKILLS

- Repair Skills
- Analytical Skills
- Multi-skills
- Technology Skills

→ Improve the skills of our human resources

- Conduct Training Needs Assessment
- Training & Education
- Coach & Educate Maintenance Personnel
- Improve procedures and MTTR Application

Proactive Maintenance

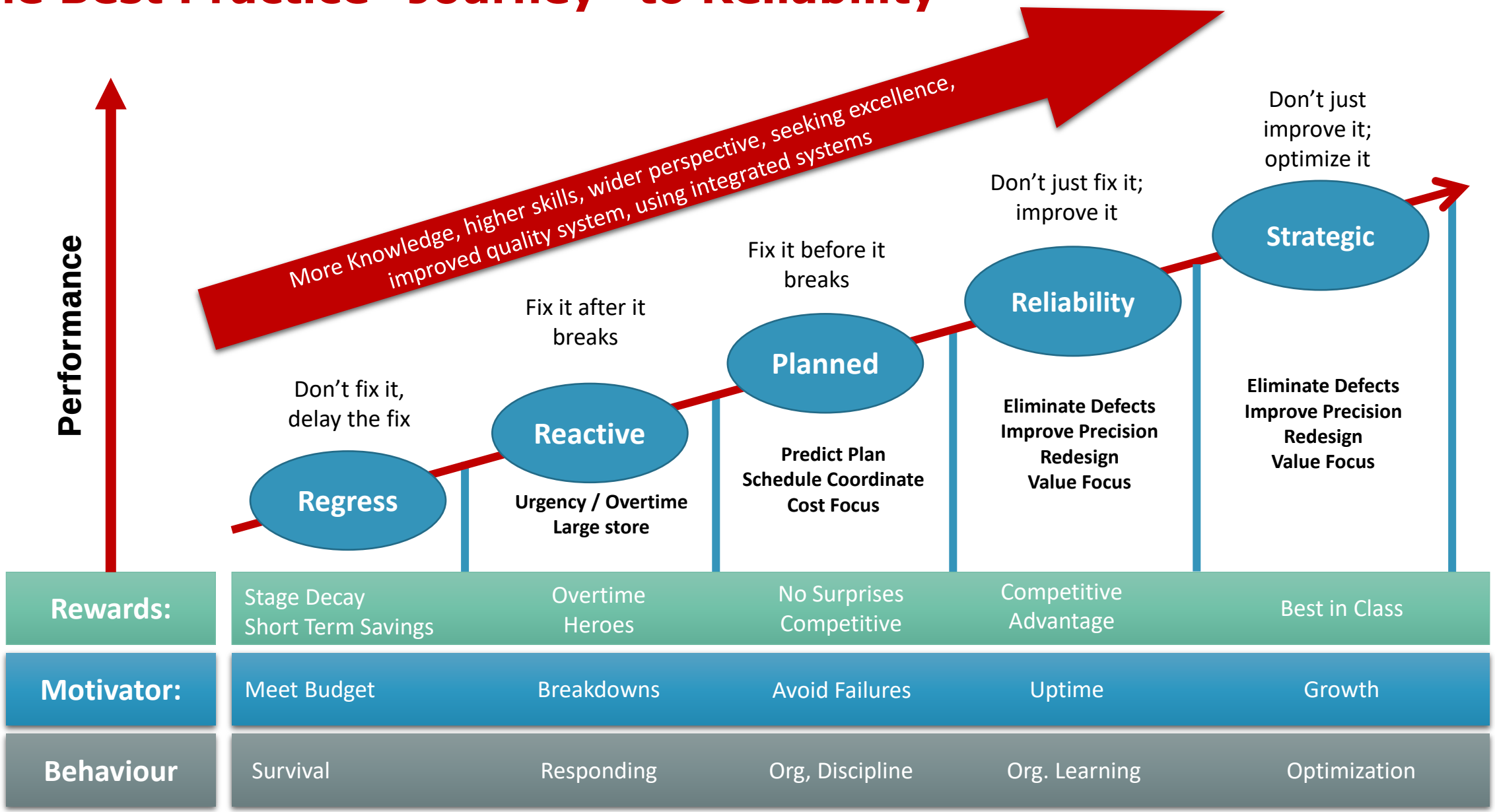
- While predictive maintenance uses online condition monitoring to help predict when a failure will occur, it doesn't always identify the root cause of the failure.
- That's where proactive maintenance comes in. Proactive maintenance relies on information provided by predictive methods to identify problems and isolate the source of the failure.

Proactive Maintenance

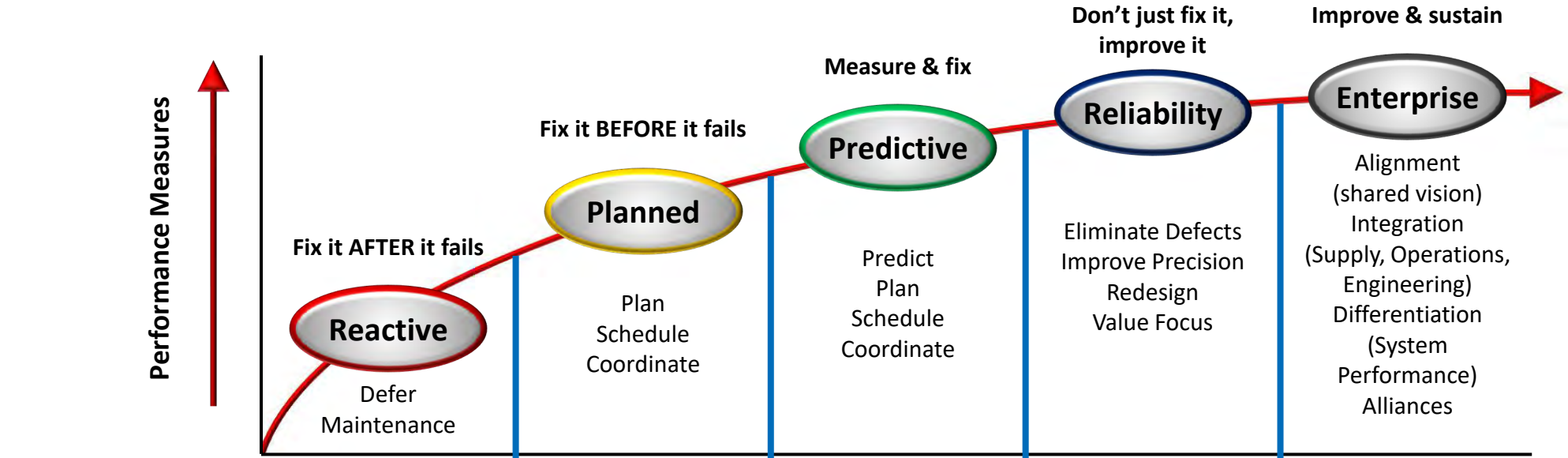
- Take the case of a pump that has periodic bearing failures. A condition-monitoring program may apply vibration sensors to the bearings, monitor the bearing temperature, and perform periodic lube oil analysis.

- These steps will tell when but not why the bearings are failing.

The Best Practice "Journey" to Reliability



Maintenance Maturity Continuum



People	"Fire Fighting" Heroes	Overlapping Responsibilities	Role Based Training	Defined Roles & Responsibilities	Cross Trained / Bench Strength
Processes	Limited Development	Planning Materials & Inventory Management	Kitting Materials & Scheduling Technicians	Monitoring Technician Work Execution	Total Productive Maintenance
Systems	CMMS PM Management	CMMS Planning & Inventory Management	CMMS Scheduling & Robust Reporting	CMMS Automated Work Generation	CMMS Lifecycle Cost Tracking
Technology	Limited Utilization	Electronic Document Management Systems	Predictive Technologies	Mobile Handheld Devices	Barcoding & RFID Utilization
Governance	Minimal Performance Tracking	Lagging Indicators	Leading & Lagging Indicators	Continuous Improvement Efforts	Organizational Metrics Aligned

12 AREAS OF MAINTENANCE MANAGEMENT DICIPLINE

- These 12 Areas for Maintenance Management Discipline will affect us how well we perform maintenance on our equipment and how reliable our equipment will be.

- These Maintenance Management Discipline can be categorized into three:

BASIC	INTERMEDIATE	ADVANCE
▪ Addressing Basic Equipment Condition ▪ Autonomous Maintenance ▪ Training and Skills Assessment ▪ Maintenance Indexes and KPIs ▪ Preventive Maintenance	▪ Spare Parts Management ▪ Lubrication Management ▪ Life Cycle Management ▪ Root Cause Failure Analysis ▪ Reliability & Continuous Improvement	▪ Condition-Based Maintenance ▪ CMMS & Automation 

MAINTENANCE MANAGEMENT BASIC DISCIPLINE

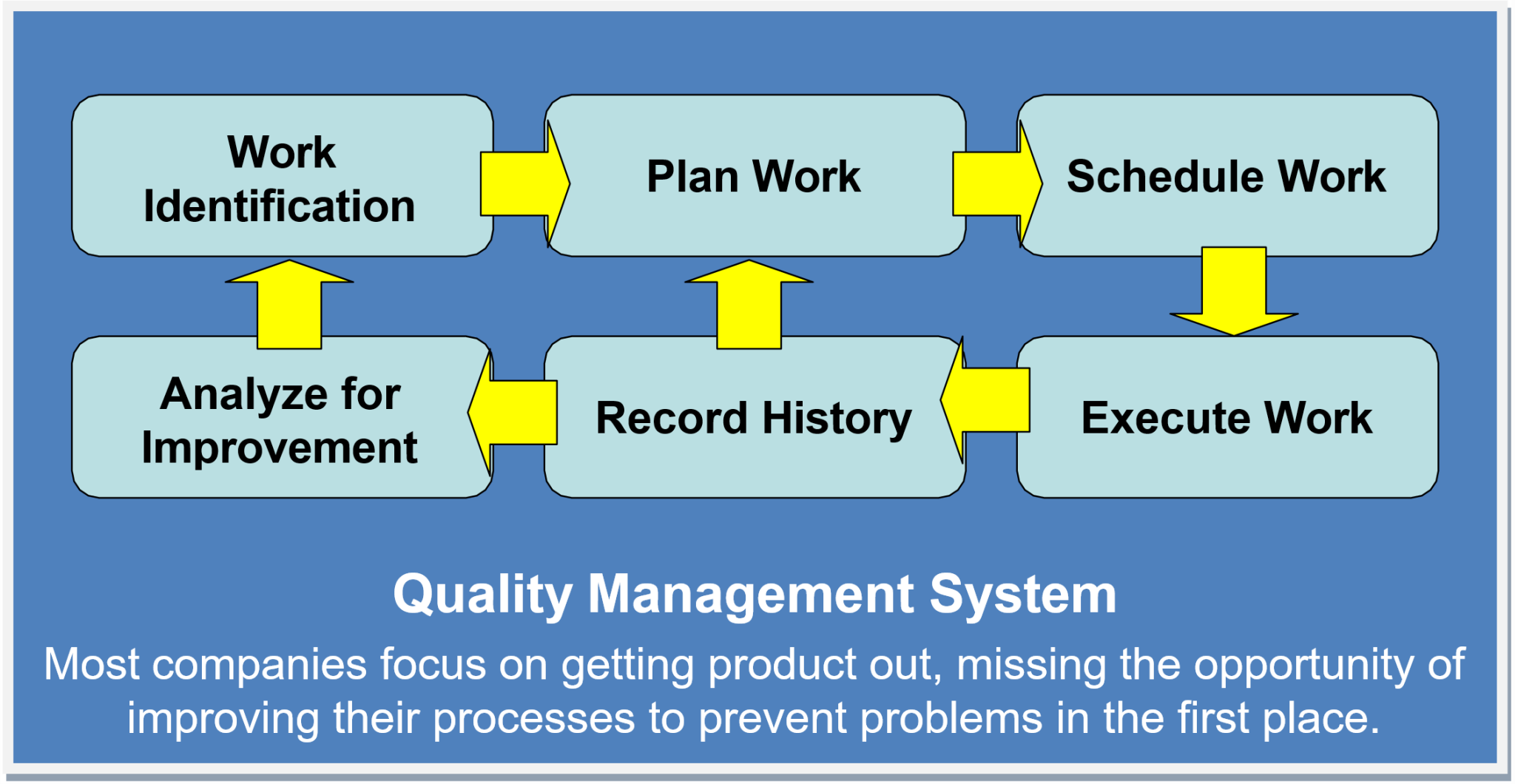
So, what does a maintenance manager have to do to enter the maintenance management process with many options available at hand . . . . .

ANSWER : GO BACK TO THE BASICS

Big failures always start from small things, and yet no one seems to take responsibility for them or take action. We must recognize the importance of returning to the basics and make it our collective responsibility to do so.

Often, things become complicated because people overlook simple tasks, and the most obvious reason is that they are too busy to perform them. Yet, they always seem to find the time to fix equipment, even when they complain about a lack of resources and workforce.

Basic Maintenance Management Process



ESTABLISHING BASIC EQUIPMENT CONDITION

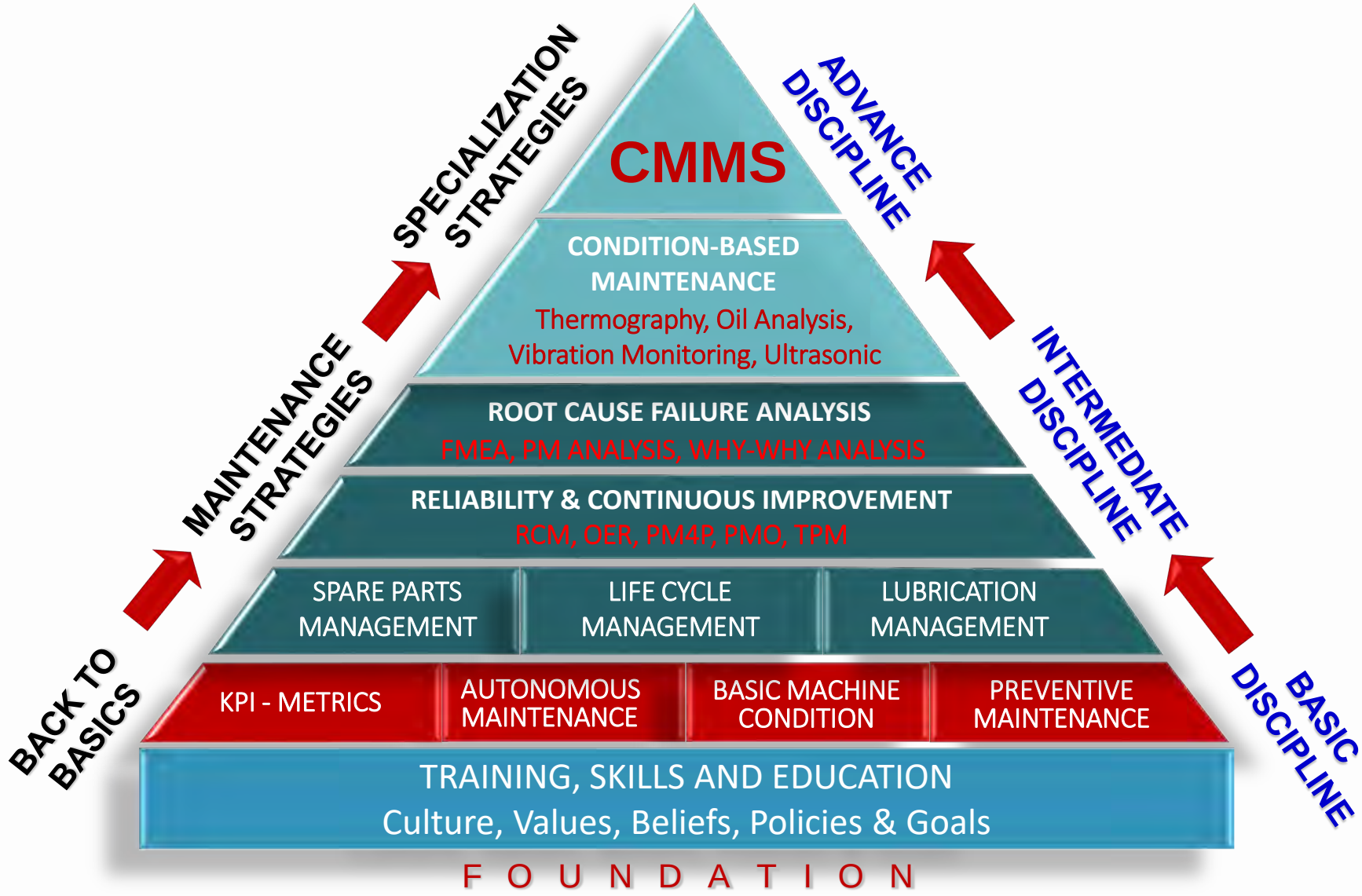
Best In Class performers understand the essence of establishing Basic Equipment Conditions in their equipment, while others often overlooked them yet almost all understand its importance.

BASIC EQUIPMENT CONDITION INCLUDES

- CLEANING
- LUBRICATION
- TIGHTENING OF BOLT
- ALIGNMENT - BALANCING
- ADDRESSING LEAKS
- ABILITY TO USE SENSES TO DETECT PROBLEMS

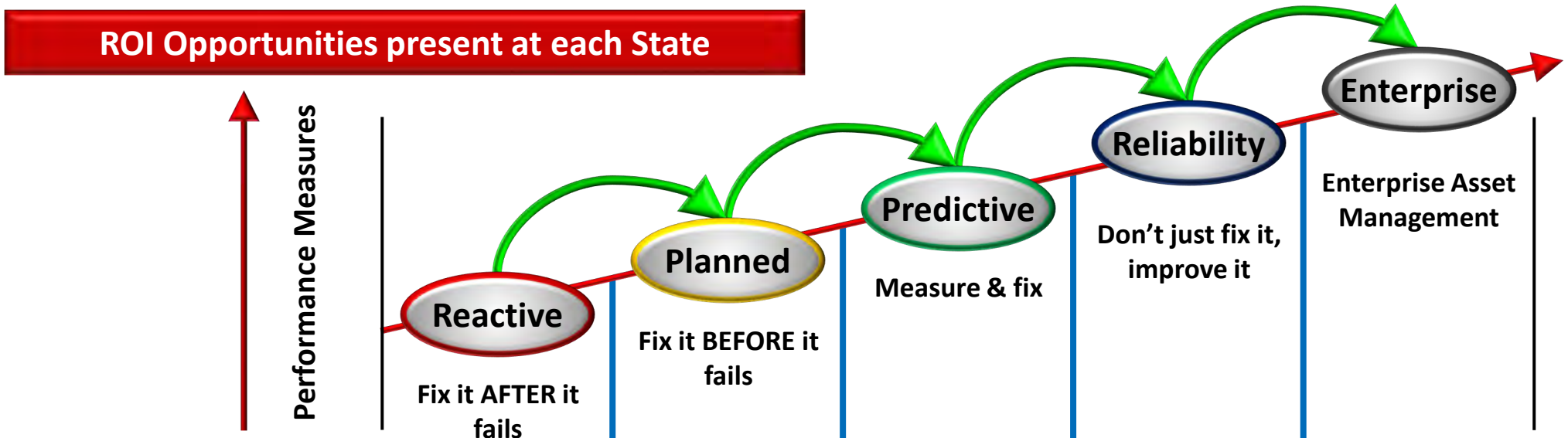
The major difference between the best performers & others is that the best performers implement what others only talk about . . . . .

MAINTENANCE MANAGEMENT RELIABILITY STRATEGY



Return on Investment

ROI Opportunities present at each State



	Reactive	Planned	Predictive	Reliability	Enterprise
Wrench Time	25%	35%	50%	60%	70%
OEE - Availability Factor	80%	84%	90%	95%	98%
Labor Cost Savings	35%	30%	20%	10%	0%
Contractor Cost Savings	35%	30%	20%	10%	0%
Material Cost Savings	20%	15%	10%	5%	0%
Inventory Carrying Cost Savings	20%	15%	10%	5%	0%
Safety Improvement					
Quality Improvement					

Thank you