



Elements of a Successful Plant Maintenance Program

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Introduction

- Our subject is maintenance management
- We will discuss
 - Maintenance paradigms and perceptions
 - Maintenance brutal facts
 - The requirements for a successful plant maintenance improvement program
- At the end you will have a roadmap for achieving a world class maintenance program



Maintenance Paradigm No. 1

“Seeking technological solutions, operations and maintenance have tried many approaches to reliability improvement. These often cost an organization significantly more than anticipated and return far less than expected”

Source: Gail Peterson, in *Solutions!*, April 2003



Maintenance Paradigm No. 2

“While most maintenance professionals understand the untapped value hidden in plant assets, making the case to corporate leadership for maximizing these assets is an ongoing battle”

Source: Mike Laszkiewicz, in *Maintenance Technology*, December 2003



Maintenance Perception No. 1

“Maintenance personnel view new initiatives as a flavor-of-the-month project dreamed up by some manager and, through experience, they have learned that after everybody gets tired of this one, it will be abandoned, and another one will soon follow.”

Source: Bob Call, in *Plant Engineering* , November 2002



Maintenance Perception No. 2

“Most managers view the maintenance person as stubborn and hard-headed, bucking every attempt to improve reliability through a change of normal work processes.”

Source: Bob Call, in *Plant Engineering* , November 2002



Maintenance Perception No. 3

“In almost all organizations, the maintenance function is viewed as:

- a necessary evil,
- a cost,
- insurance,
- a disaster repairing function,
- prima donnas”

Source: Terry Wireman, Benchmarking Best Practices in Maintenance, 2004



Maintenance Brutal Fact No. 1

“The economic realities of today are forcing increased demands on the operation and maintenance of industrial facilities. Managers must continually seek out new ways to optimize their processes.”

Source: Jerry Kahn, in *Sensors in Intelligent Buildings*, 2001



Maintenance Brutal Fact No. 2

“Formal maintenance skills and knowledge training will be the weakest link in industrial competition for the next two decades.”

Source: Bob Williamson, in *Maintenance Technology*, June 2006

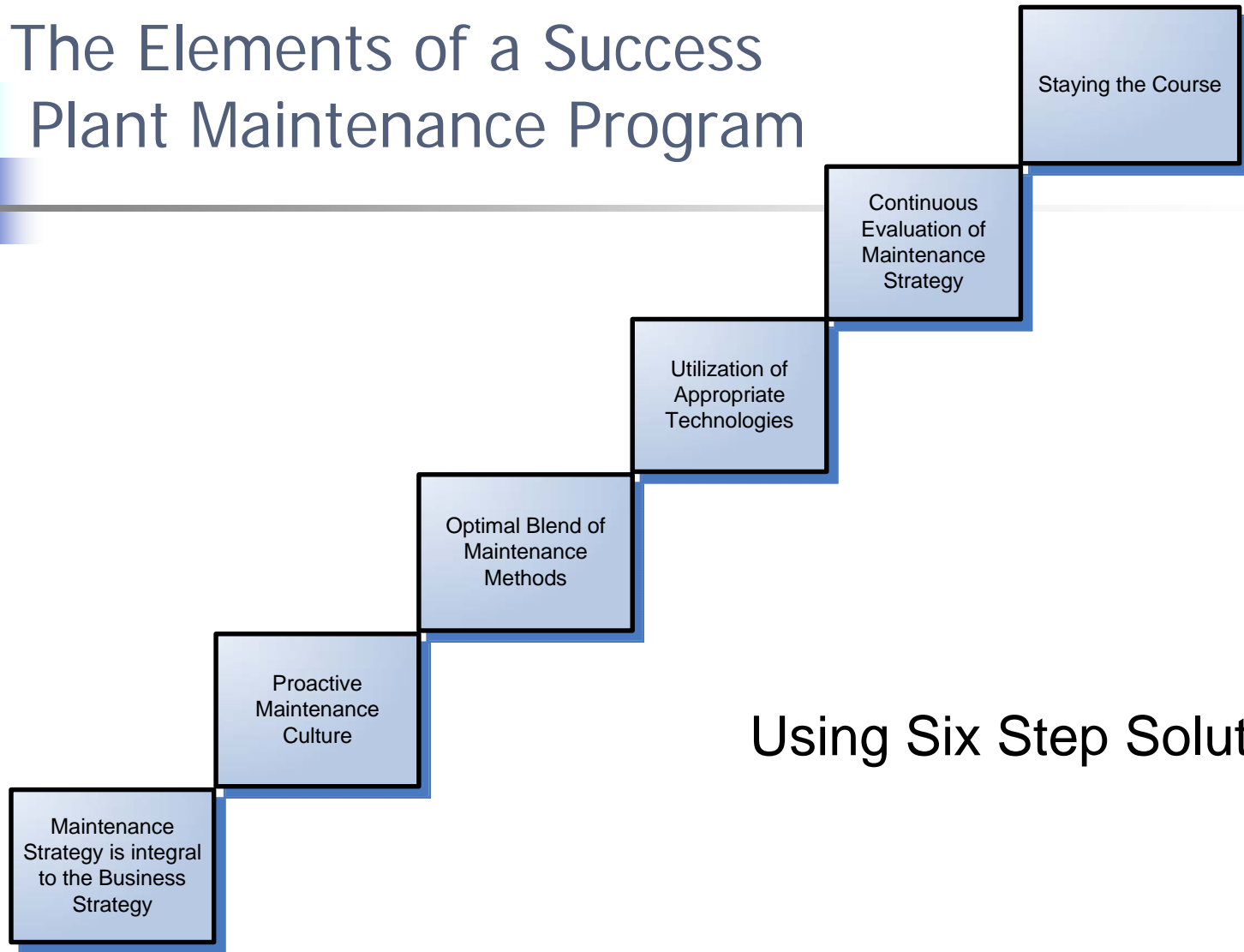


Maintenance Brutal Fact No. 3

“Maintenance is forever. To meet maintenance requirements of success, the Future Capable Company must recognize that maintenance is a key contributor to total supply chain success.”

Source: James A. Tompkins, Future Capable Company, 2001

The Elements of a Success Plant Maintenance Program



Using Six Step SolutionsSM

Maintenance Definitions

Asset

Any item of physical equipment





Maintenance Definitions

Asset Function

- What users expect from their assets (output, speed, safety, environmental integrity, quality ..)
- The level of performance which the users require when the asset performs its function

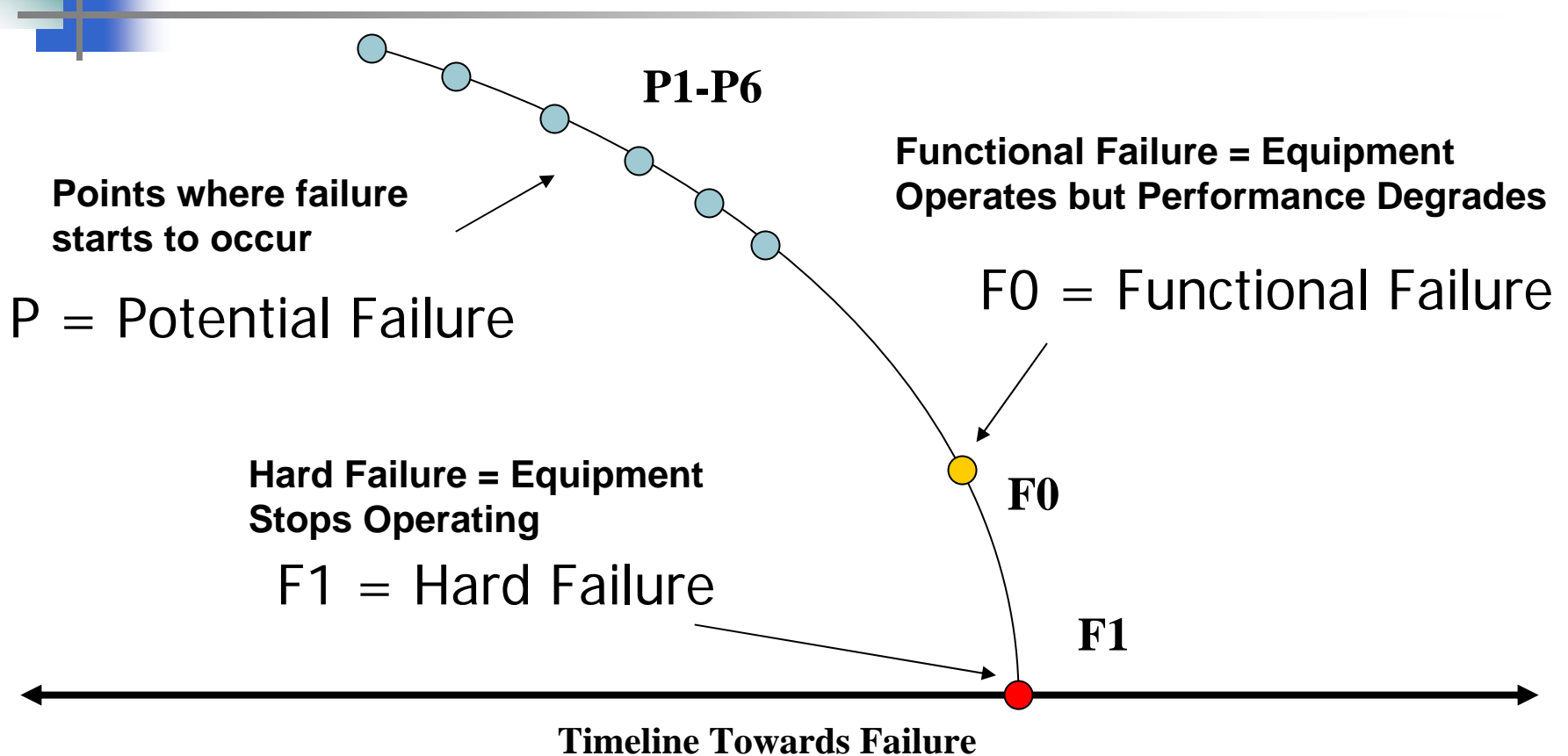


Maintenance Definitions

Asset Failure

Situation where the asset is no longer capable of fulfilling one or more of its intended functions

Understanding the Failure Modes





Maintenance Definitions

Maintenance

- Any activity carried out on an asset in order to
- ensure that the asset continues to perform its intended functions
 - repair the asset



Maintenance Definitions

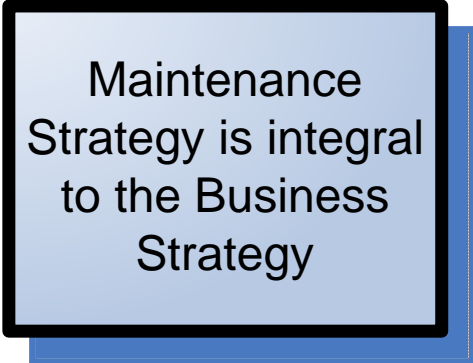
Maintenance Management

The coordination, control, planning, execution and monitoring of the right equipment maintenance activities of manufacturing and facilities operations



Make the Maintenance Strategy an Integral Part of the Business Strategy

- Recognize financial impact of maintenance
- Driven by senior management
- Vision of continuous improvement
- Know your starting point
 - Benchmarking, audits, consultants
- Know where you want to go
 - Gap analysis, goal setting
- Adequate resources allocated



Maintenance Strategy is integral to the Business Strategy

Financial Effects of Maintenance

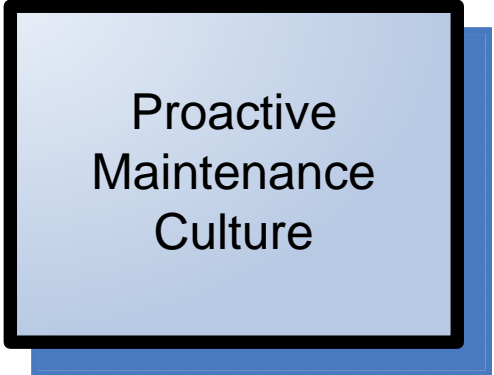


- Lost Revenues
 - fewer orders
 - price pressure
 - lower profit
- Indirect Maintenance Costs
 - rework
 - scrap
 - tied-up capital
- Direct maintenance costs
 - labor
 - spare parts
 - purchase services



Instill a Proactive Maintenance Culture

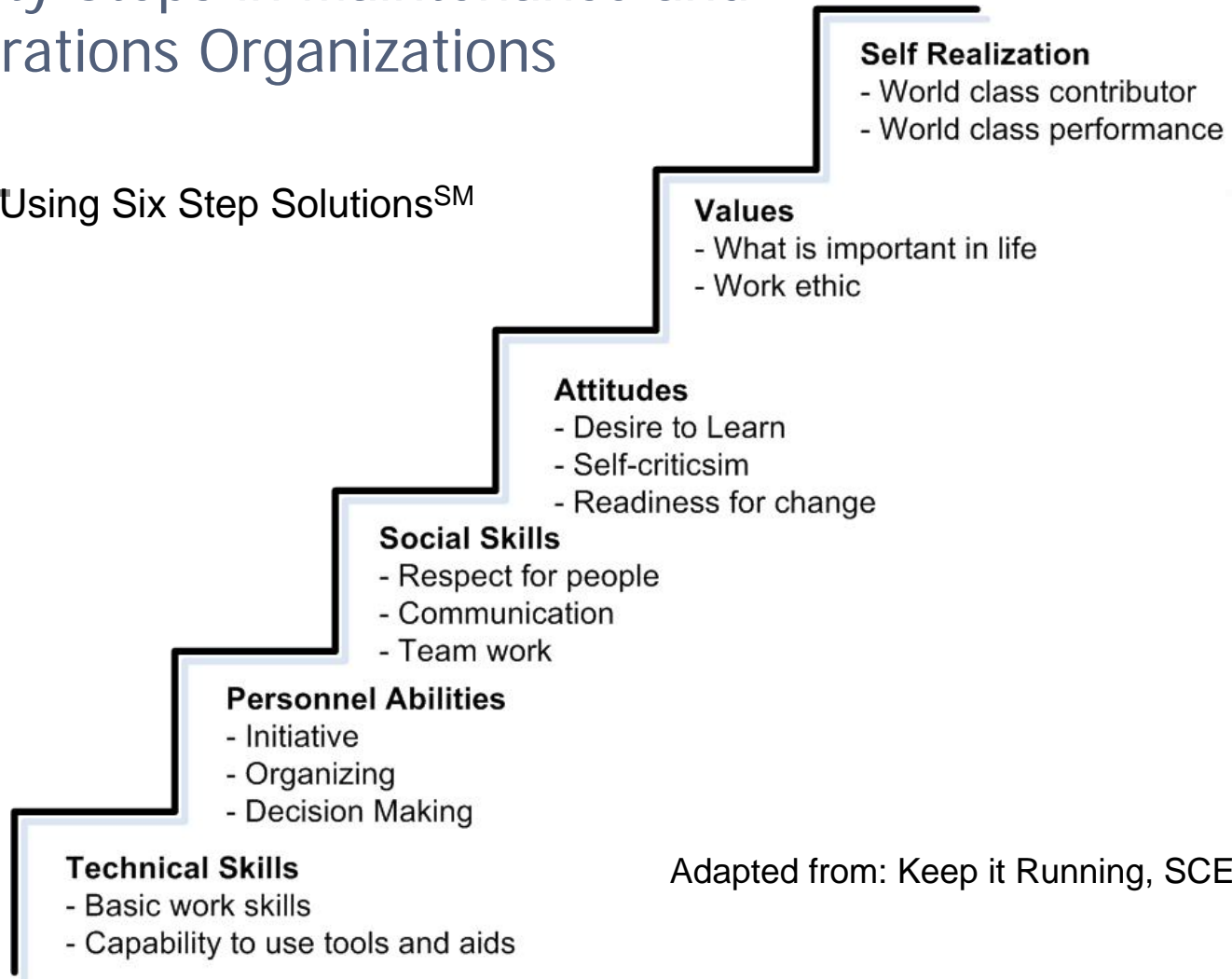
- Share a Common vision
- Have a World Class attitude
- Develop competence
 - Training
 - Hiring Practice
 - Apprenticeship
 - Certification
 - Outsourcing
- Instill Accountability
- Commit to Continuous Improvement



Proactive
Maintenance
Culture

Ability Steps in Maintenance and Operations Organizations

Using Six Step SolutionsSM

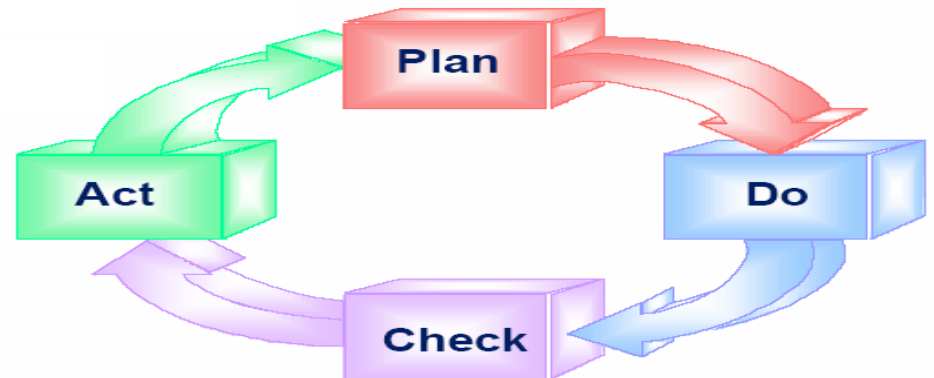


Adapted from: Keep it Running, SCEMM, 1998

Think Continuous Improvement

The Shewhart Cycle
also known as
The Deming Cycle

Part of ISO 9001:2000





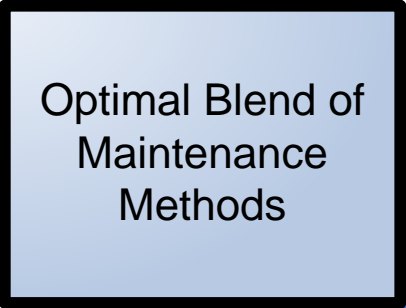
Building a Proactive Maintenance Culture

- Get the basics right
 - Planning
 - Scheduling
 - Housekeeping
 - Alignment
- Team with production and engineering
- Top Management support



Adopt an Appropriate Maintenance Strategy

- Basic Strategies
 - Corrective
 - Preventive
 - Predictive
 - Proactive (RCA, Design)
- Reliability Based MaintenanceSM
- Cost effective



Optimal Blend of
Maintenance
Methods



Evolution of Maintenance Management

Expectations of the Maintenance Function

1930 - 1950	1950 - 1980	1980 - 2000
Fix it when it breaks	Higher availability Lower costs Longer asset life	Higher availability Lower costs Longer asset life Higher reliability Better product quality Safety integrity Environment integrity Show results



Evolution of Maintenance Management

Maintenance Techniques

1930 - 1950	1950 - 1980	1980 - 2000
Fix it when it breaks	Scheduled maintenance Planning systems Computerization	Condition monitoring PM/PdM FMEA - RCFA CMMS RCM - TPM

Maintenance Management Today

Expectations	Techniques
<p>Higher availability Lower costs Longer asset life Higher reliability Better product quality Safety integrity Environment integrity Show results Life Cycle Costs Maintainability Sustainability</p>	<p>RCM TPM Condition Monitoring PM/PdM CMMS/EAM Integration FMEA/RCFA/HAZOP Six Sigma Expert Systems Wireless Systems E-Maintenance ISO/ANSI Standards</p>



Basic Maintenance Strategies Defined

Corrective

Run-to-failure or breakdown maintenance
- “Unplanned”

Preventive

Periodic and prescribed maintenance
- “Time-based”

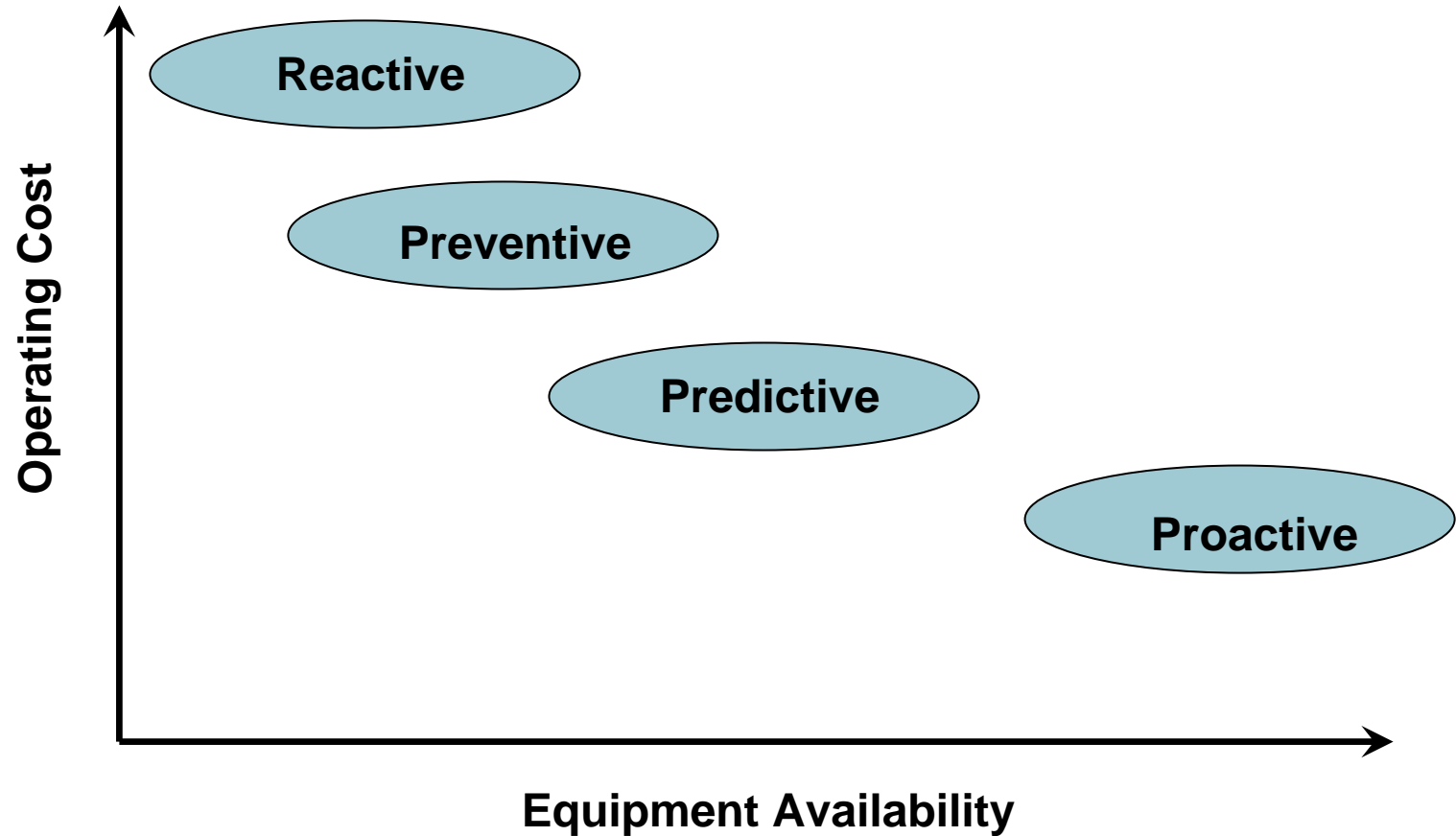
Predictive

Maintenance based on equipment condition
- “Condition-based”

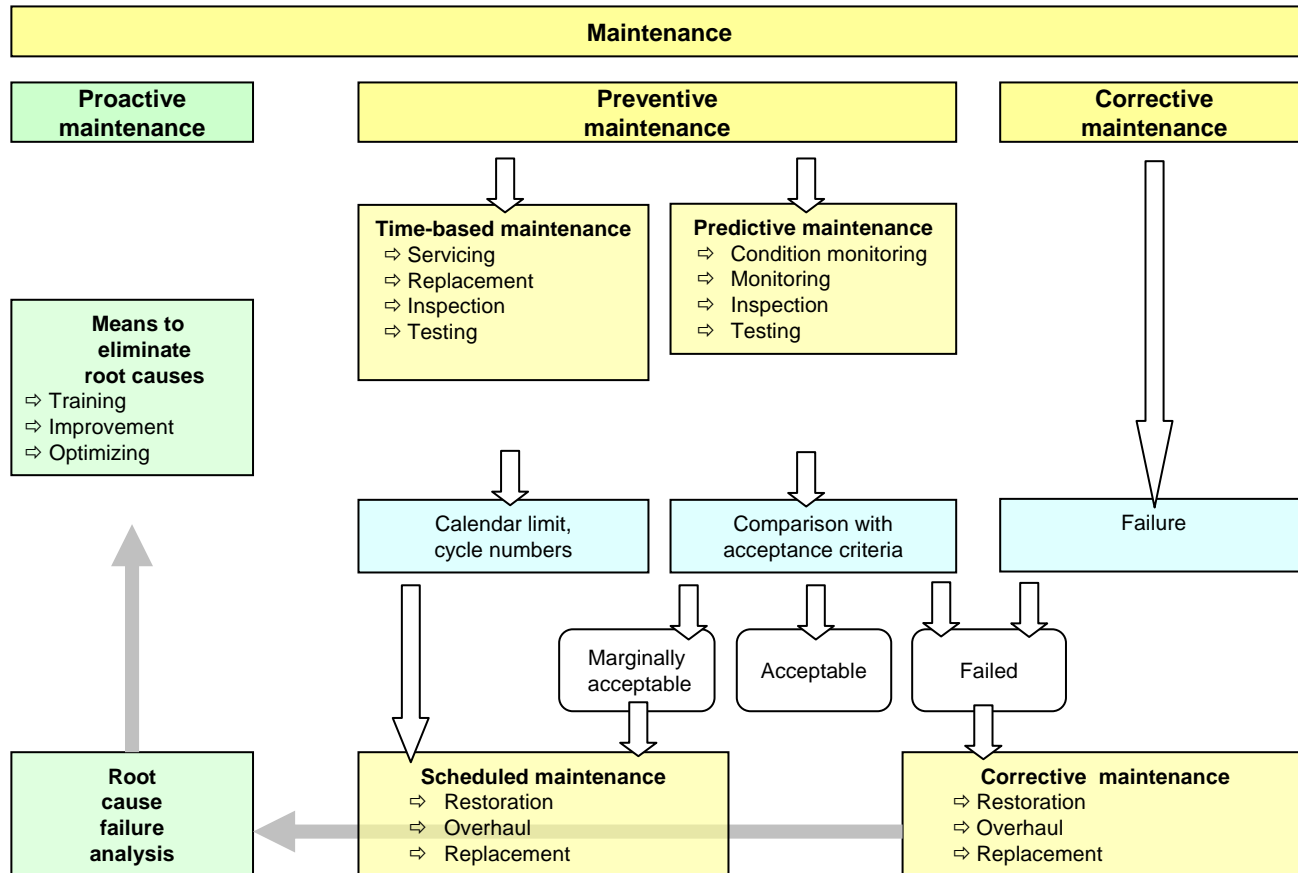
Proactive

Focus on mitigating the need for maintenance
- “Root cause-based”

Shift to Proactive Maintenance

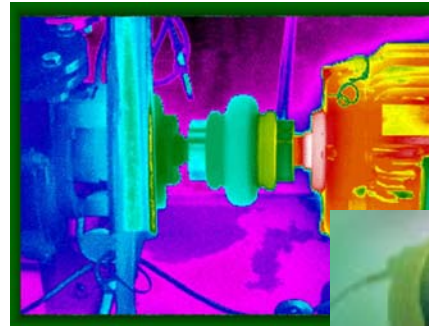


Reliability Based Maintenance Model



Use Appropriate Technologies

- Data collection & analysis
 - Thermography
 - Vibration
 - Ultrasonics
 - Tribology
 - Process parameters
 - Electrical testing
 - Sensory



Utilization of
Appropriate
Technologies

Use Appropriate Technologies

- CMMS
 - Work orders
 - Histories



“Unfortunately 90-95% of all CMMS implementations fail to deliver the desired results and are forsaken or underutilized.”

Source: Bob Long, in *Plant Engineering* , June 2000

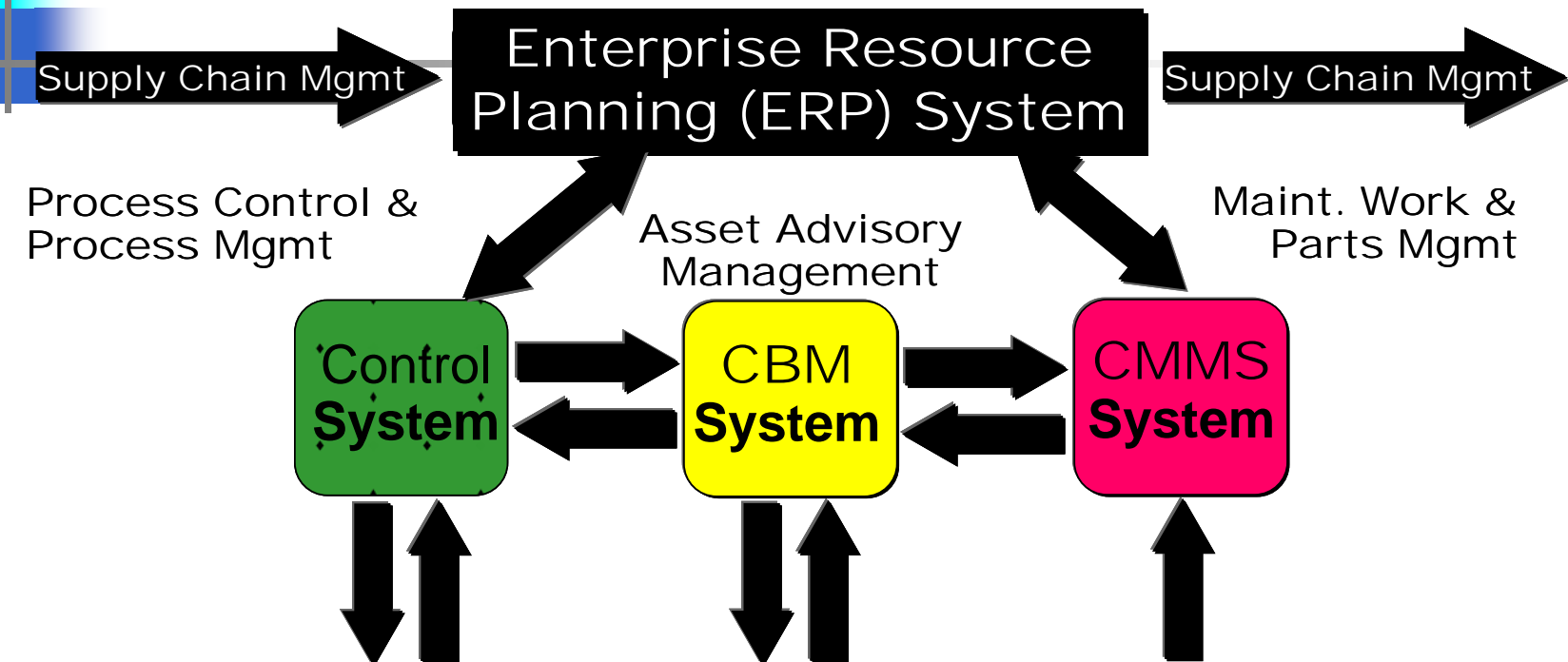


Use Advanced Technologies

- System Integration
- Expert Systems
- Wireless Sensors
- Smart Sensors
- E-maintenance



MRO Technology Integration

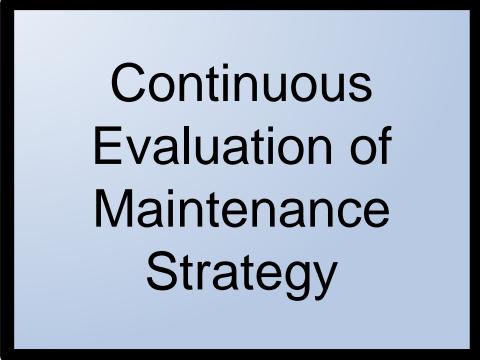


PLANT MEASUREMENTS / INSPECTIONS																						
Operation Field Input		Smart Machines & Xducers		Control Device Monitoring		Portable Device Monitoring		On-line Surveillance Monitors		On-Line Protection Monitors		On-line Transient Monitor		Sample Monitoring								
		Smart Valves & Field Devices	PLC	Vibration	Process	Oil Analysis	Thermography	Electrical	Shaft Displacement	Casing Vibration	Process	Electrical	Shaft Displacement	Shaft Position	Casing Vibration	Process	Shaft Displacement	Casing Vibration	Process	Oil Particle	Oil Chemical	Oil Properties



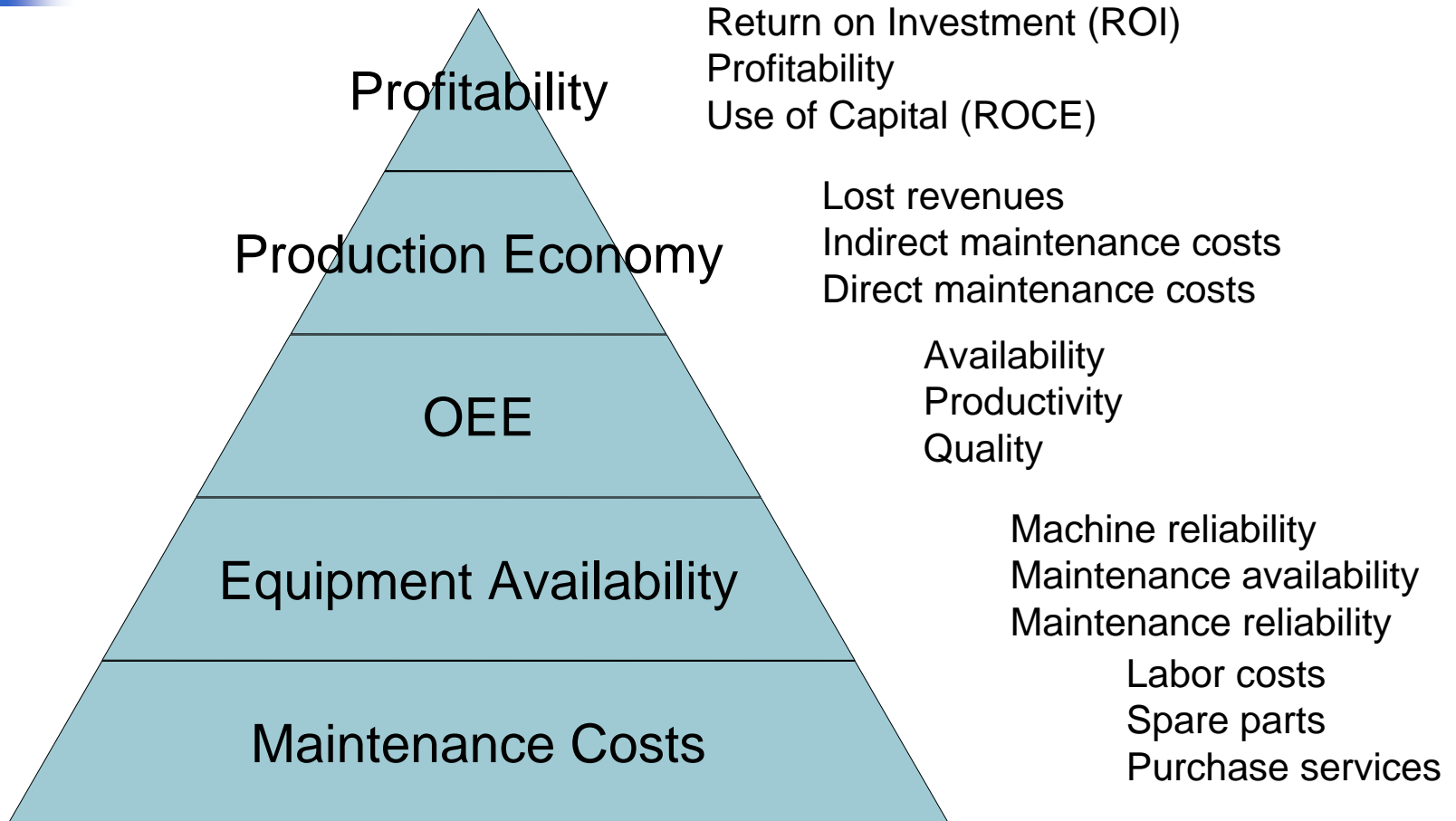
Continuously Monitor and Improve

- Monitor Effectiveness
 - Reporting
 - KPI's
 - OEE
 - Financial
 - ROI
 - ROCE
- Seek out Best Practices
- Update benchmarking
- Continuous Process Improvement (CPI)

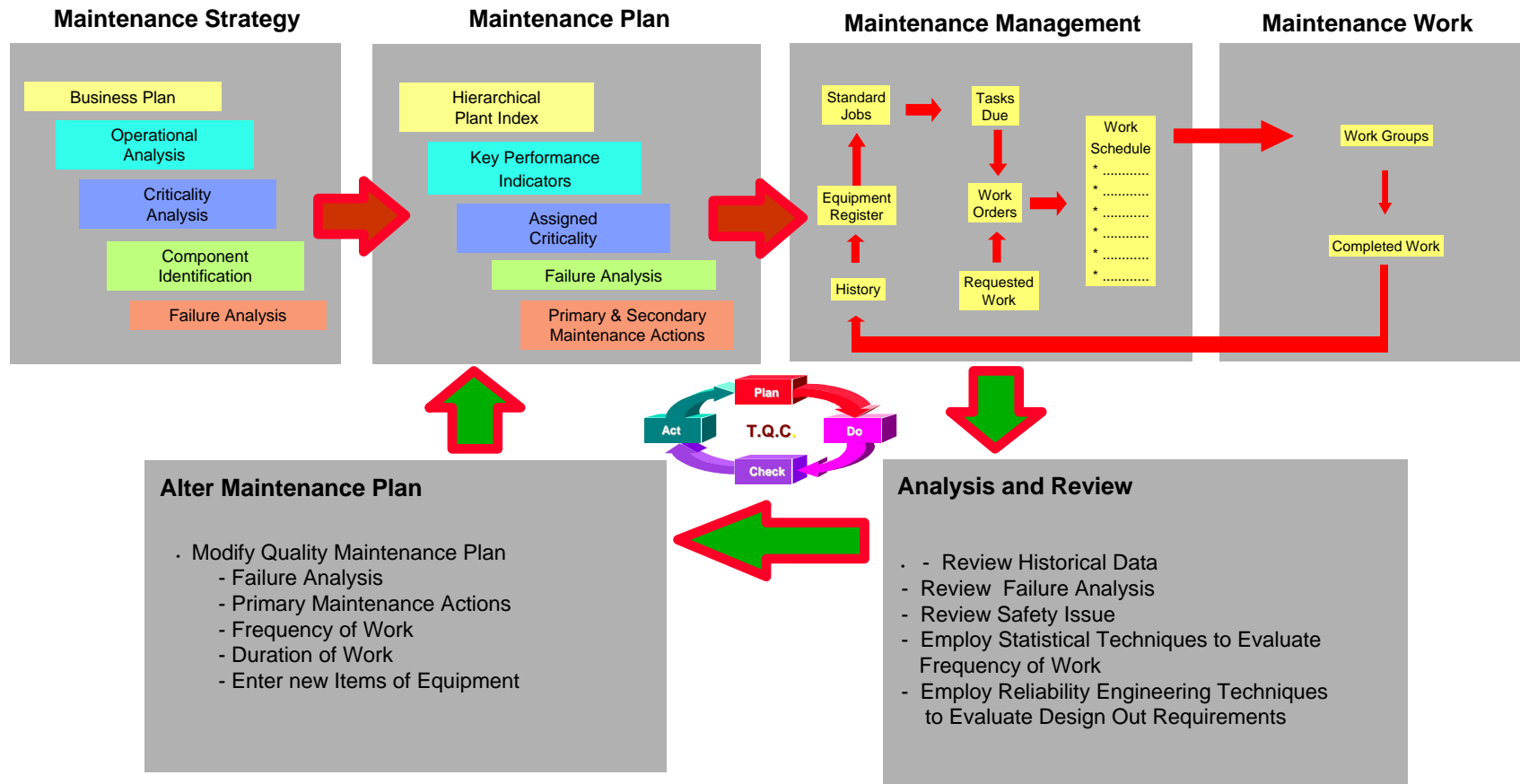


Continuous
Evaluation of
Maintenance
Strategy

Maintenance Effectiveness Measures at Different Organizational Levels



Quality Maintenance Work Cycle



Stay the Course

- Stick to the Plan
- Manage consistently
- Reinforce accountability
- Sustain the culture
- Long-term thinking
- Sisu



Staying the
Course



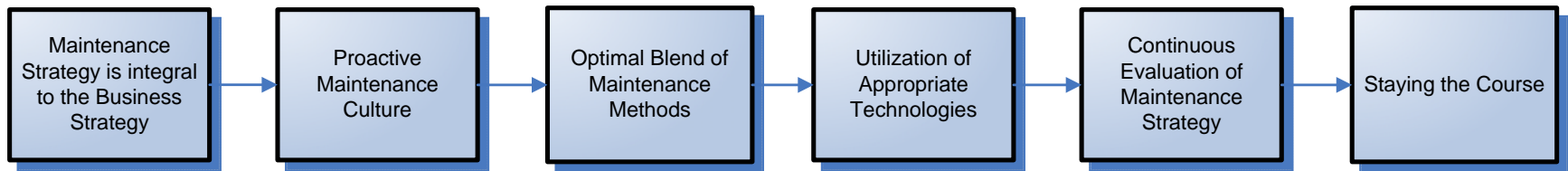
Business Results Expected

- Increased productivity 2-40%
- Reduced maintenance expense 7-60%
- Improved product quality
(rework & scrap rates reduced) 5-90%
- Extend equipment life
times 1-10
- Reduced spares inventory 10-60%
- Increased inventory turns
75% up to
- Reduced energy consumption 5-15%

Source: Emerson Process Management

Summary

The Elements for Success



Recognize financial impact of maintenance
 Driven by senior management
 Vision of continuous improvement
 Benchmark & audits
 Gap analysis
 Goal setting
 Adequate resources allocated

Common vision
 World class attitude
 Develop competence
 - Training
 - Hiring Practice
 - Apprenticeship
 - Certification
 - Outsourcing
 Instill Accountability
 Commit to CPI
 Get the basics right
 -Planning
 -Scheduling
 -Housekeeping
 -Alignment
 Team with production and engineering
 Top Management support

Basic strategies
 -Corrective
 -Preventive
 -Predictive
 -Proactive
 RCA
 TPM
 Cost Effective

Data collection
 -Thermography
 -Vibration
 -Ultrasonics
 -Tribology
 -Process parameters
 -Electrical testing
 -Sensory
 CMMS
 -Work orders
 -Histories
 System Integration
 Expert Systems
 Wireless Sensors
 Smart Sensors
 E-maintenance

Monitor Effectiveness
 -Reporting
 -KPI's
 -OEE
 -Financial
 >ROI
 >ROCE
 Best practices
 Update benchmarking
 CPI

Stick to the Plan
 Manage consistently
 Reinforce accountability
 Sustain the Culture
 Long-term thinking
 Sisu

Using Six Step SolutionsSM



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