

Pillar 2 - Manufacturing Process Reliability

2.2 Apply process improvement techniques

Lean Management

Lean (Meaning) : Free from unwanted substances

- Preserving value with less work (Doing more with less)
- To minimize the non-value adding activities

Principles :

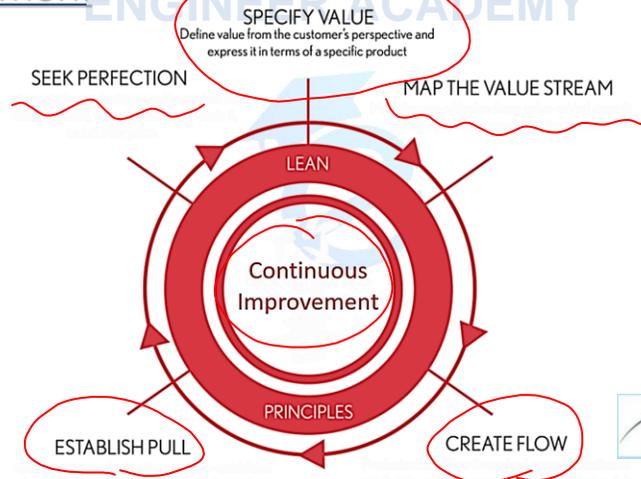
- Create Flow (one piece flow)
- Eliminate Waste
- Optimize resources
- Continuous Improvement
- Teaming



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Lean Management

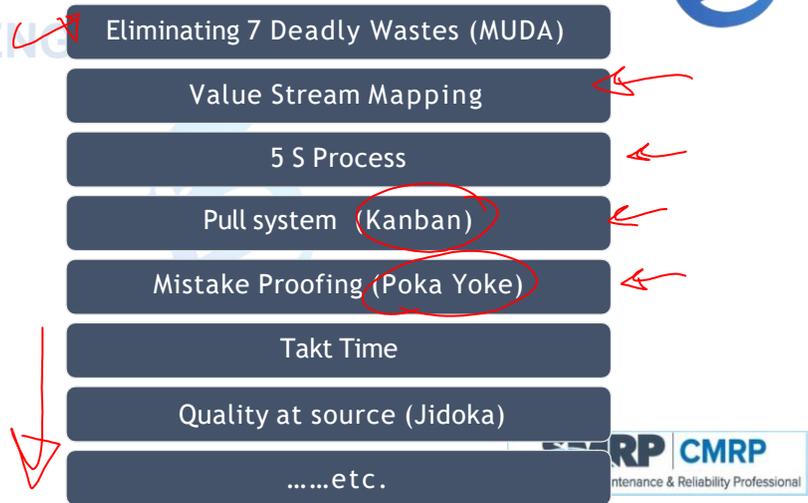


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2.2 Apply process improvement techniques

Lean Management

Lean Tools



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2.2 Apply process improvement techniques

Lean Management (Two points of view : Workplace & Maintenance Activities)

5 S Process

- Set in order - Remove what is not needed
- Remove not needed (or usually not executed) PMs
- Make things visible and easy to be reached
- “A place for everything & everything in its place”
- Labeling and coding of SD work
- Clean, polish and paint - Reveals any out of balance item
- Contamination fighting activities



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2.2 Apply process improvement techniques

Lean Management

5 S Process

A 5 Steps tool focuses on workplace organization and standardized work procedure.



-Typical Applications are:

- Workshop organization
- Store management
- Lubricants store
- PM Program review



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Eliminating Seven Deadly Wastes

Overproduction	• PM intervals / Not needed tasks
Waiting	• Setting idle waiting parts or permits or preparation work
Transportation	• Tools, spares, etc
Processing	• Over reporting, filling forms or useless workflow steps
Inventory	• Normally large not needed stocks - site stores
Motion	• Moving from place to place (see docs -receive permits - break place - from job to job)
Defects	• Low quality work - Rework - Incorrect maintenance procedures



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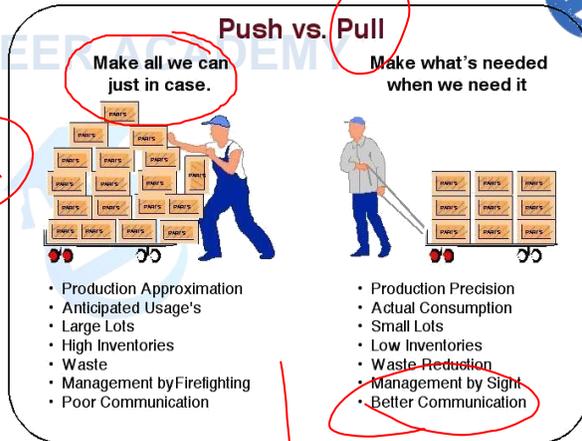
Pull System

Let the customer pull products as-needed

FMEA

Application in Maintenance World:

- Failure Modes pull maintenance strategy.
- Criticality system and job nature pull job priority
- Focus on maintenance tasks that delivers value to organization & stakeholders



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1. Push System (Make-to-Stock / Forecast-Driven)

Explain

Core Concept: Products are manufactured based on forecasted demand or sales estimates, rather than actual orders.

Mechanism: Goods are "pushed" through the supply chain into inventory to anticipate future needs.

Characteristics in Process Reliability:

High Inventory & WIP: No explicit limits on Work in Progress (WIP), often leading to surplus inventory to compensate for variability.

Efficiency Focus: Prioritizes maximizing equipment utilization and minimizing unit costs through large batch sizes.

Risk: Prone to overproduction and waste if forecasts are inaccurate.

Tool: Often associated with Material Requirements Planning (MRP).



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2. Pull System (Demand-Driven / Lean)

Core Concept: Production is triggered only by actual customer demand or orders.

Mechanism: Materials are "pulled" as they are consumed, using signals (like Kanban) to restock only what is needed.

Characteristics in Process Reliability:

WIP Limits: Uses explicit work-in-progress limits to align production with demand, reducing clutter and congestion.

Responsiveness & Flexibility: Highly responsive to changing market patterns.

Waste Reduction: Minimizes overproduction, excess inventory, and associated storage costs.

Tool: Heavily relies on Just-in-Time (JIT) and Kanban.



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Feature	Push system	Pull system
Driver	Forecasts/Estimates	Actual Demand/Orders
Inventory	High (Just-in-Case)	Low (Just-in-Time)
WIP Limits	None/Loose	Explicit/Tight
Goal	Cost efficiency	Responsiveness & Flexibility





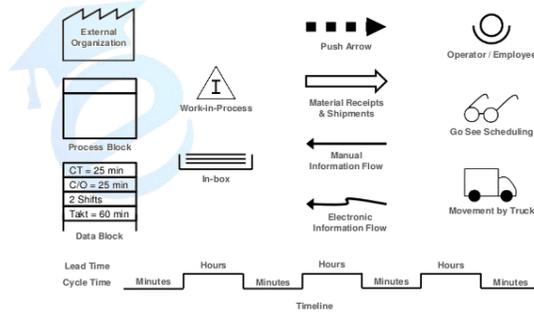
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2.2 Apply process improvement techniques

Value Stream Mapping

Basic Mapping Symbols

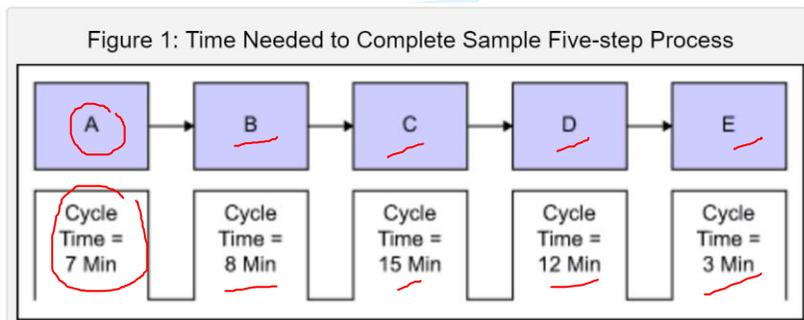
Use of symbols to draw a map of the steps in a process specifying value adding and non-value adding activities



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2.2 Apply process improvement techniques

Value Stream Mapping

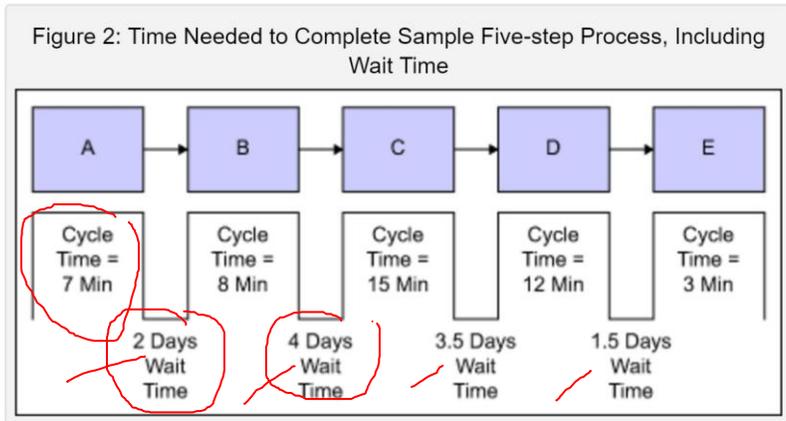




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2.2 Apply process improvement techniques

Value Stream Mapping ENGINEER ACADEMY

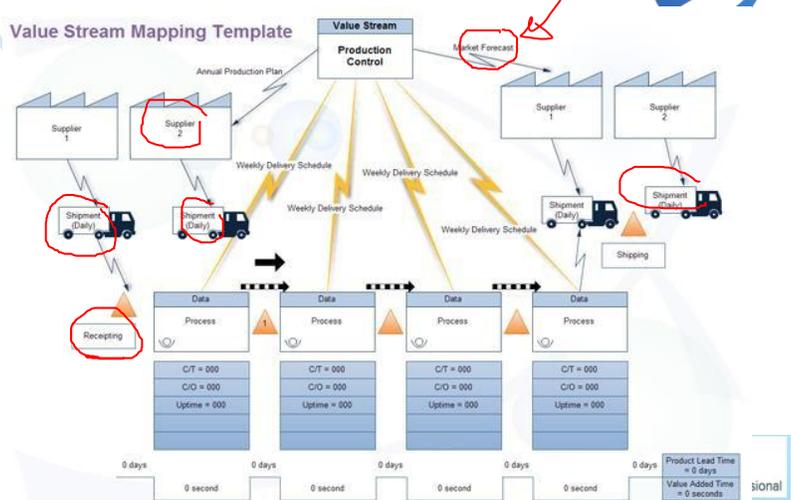


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2.2 Apply process improvement techniques

Value Stream Mapping

Key Words

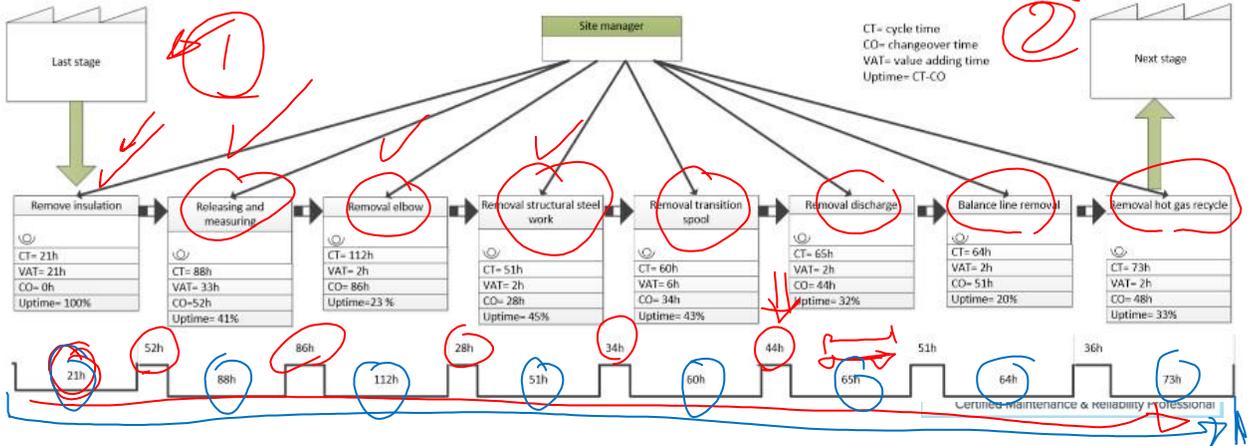




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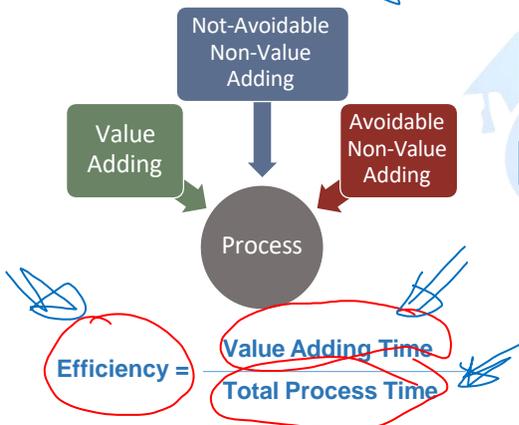
Value Stream Mapping



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2.2 Apply process improvement techniques

Value Stream Mapping



SYMBOL	MEANING	ACTION	EXAMPLES
	OPERATION	ADDS VALUE	CUT, SOLDER, MEASURE, ETC.
	TRANSPORT	MOVE SOME DISTANCE	CONVEY - BY HAND-CARRY, FORKLIFT, ETC.
	INSPECT	CHECK FOR DEFECTS	DIMENSIONAL VISUAL, ETC. INSPECTION
	DELAY	TEMPORARY DELAY OR HOLD	WAIT FOR EQUIP. SHUTDOWN, ETC.
	STORAGE	FORMAL WAREHOUSING	WAREHOUSE, STOREROOM, OTHER STORAGE
	HANDLE	TRANSFER OR SORT	RE-PACKAGE, RETURN TO STORES, ETC.
	DECIDE	MAKE A DECISION	APPROVE/DISAPPROVE, TAKE OFF-LINE, ADJUST OR REPLACE, ETC.

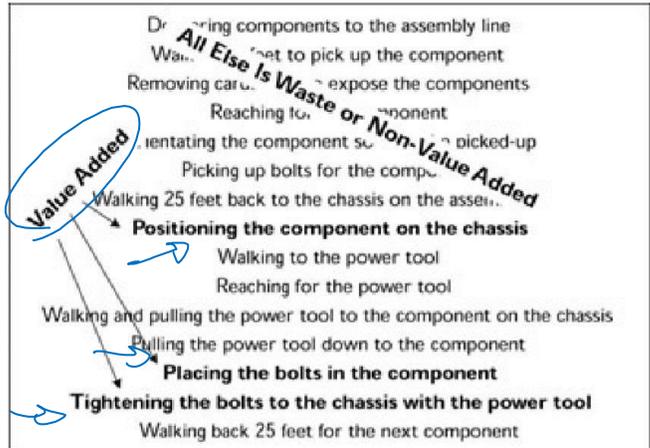
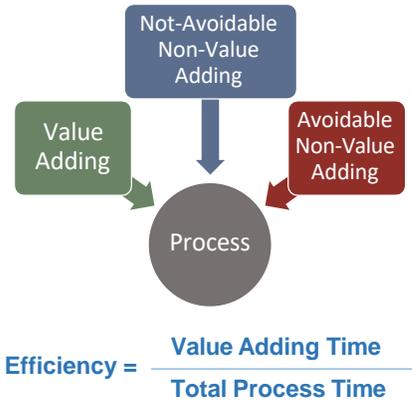




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Value Stream Mapping

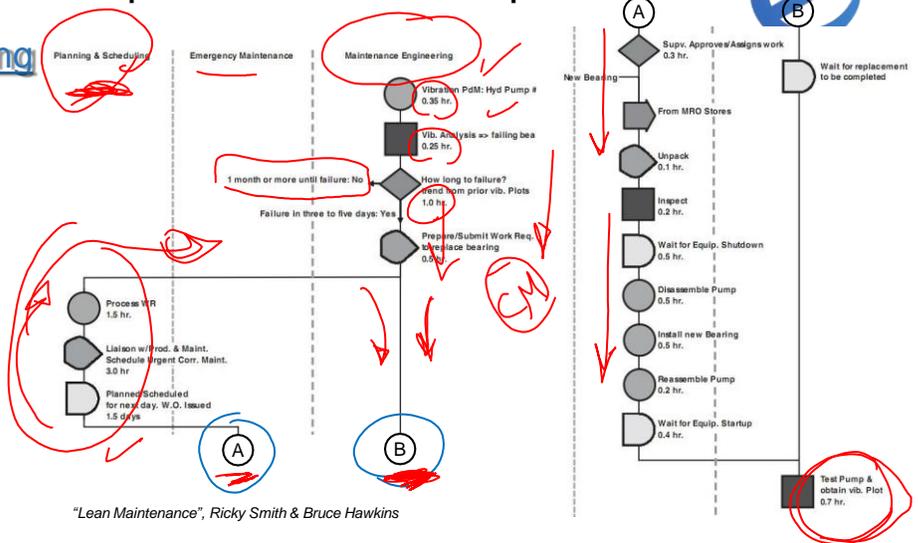


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2.2 Apply process improvement techniques



Value Stream Mapping



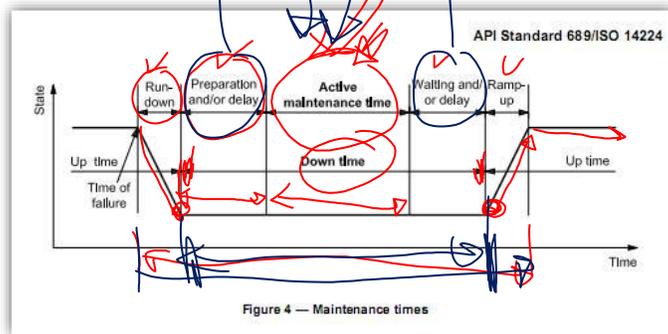
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2.2 Apply process improvement techniques



Value Stream Mapping ENGINEER ACADEMY

For Corrective Maintenance:



$$\text{Efficiency} = \frac{\text{Active Maintenance Time}}{\text{Total Downtime}}$$



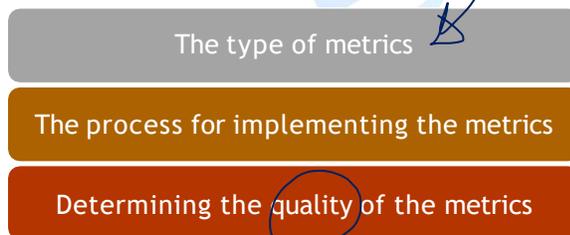
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2.2 Apply process improvement techniques



A crucial step in any process improvement effort is to identify key performance indicators (KPIs) that align with the business goals of the organization.

Some of the considerations an organization must take into account in the development of KPIs:



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2.2 Apply process improvement techniques

Metrics المقاييس must be SMART :

Realistic

Achievable

Be designed around the objectives of the business goals

Specify accomplishments

Identifying the progress of the criteria accomplishments.

Drive continuous improvement



Questions



Which of the following is the primary goal of applying process improvement techniques in manufacturing reliability?

- A. Increase spare parts inventory
- B. Reduce process variation and improve efficiency
- C. Lower operator wages
- D. Eliminate supplier contracts

ANSWER: B





Which tool is most effective for identifying non-value-added steps in a process?

- A. Value stream mapping
- B. Control chart
- C. Pareto analysis
- D. Root cause analysis

ANSWER: A



When applying Kaizen as a process improvement technique, the main focus is on:

- A. Large, one-time capital projects
- B. Continuous, incremental improvements
- C. Eliminating preventive maintenance
- D. Reducing operator training

ANSWER: B





Which of the following best describes the role of Six Sigma in process improvement?

- A. Scheduling preventive maintenance
- B. Reducing process variation and defects
- C. Increasing spare parts inventory
- D. Improving supplier contracts

ANSWER: B



What is the primary benefit of conducting a root cause analysis during process improvement?

- A. Prevents recurrence of failures
- B. Reduces operator wages
- C. Improves supplier contracts
- D. Increases spare parts inventory

ANSWER: A



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2.3 Manage effects of change to processes and equipment

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Establish change protocol

Update documentation Update procedures



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2.3 Manage effects of change to processes and equipment

The success of a maintenance or reliability program can be greatly hampered when changes made to the process or equipment they govern is not properly managed.

Change can occur:

Intentionally, such as a process modification or improvement

By unintentional means, such as component wear or general equipment degradation over time.



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2.3 Manage effects of change to processes and equipment

Unintentional Changes

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A formal change management process is needed to identify any significant changes to:



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2.3 Manage effects of change to processes and equipment

Intentional Changes

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A formal Management of Change process (MOC) is needed

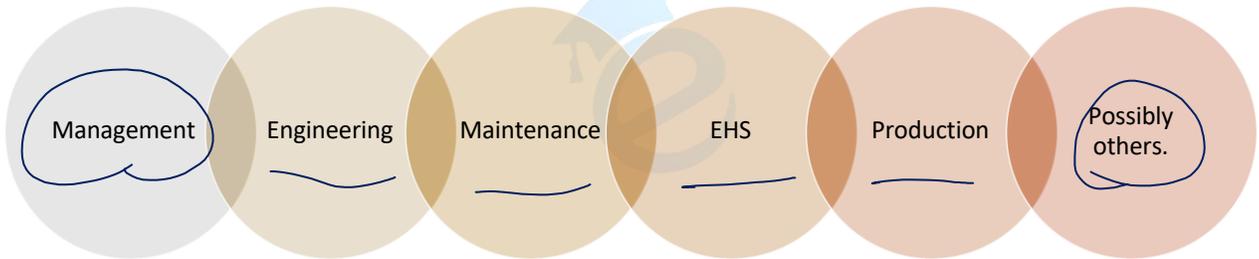
Changes include:



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2.3 Manage effects of change to processes and equipment

After a proper application has been submitted, it is reviewed by all affected parties within the organization. This includes:



The review insures that the effects of the change are properly evaluated and all stakeholders are properly prepared.



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2.3 Manage effects of change to processes and equipment

The change management process also insures that all effected documents are updated. This includes:

- ✓ Drawings such as plant layouts, P&ID's, PFD's, etc.
- ✓ Maintenance documents such as PM's, FMEA's, parts lists and others.
- ✓ Production control documents
- ✓ Safety documents
- ✓ Asset lists
- ✓ Other documents.



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2.3 Manage effects of change to processes and equipment

This includes ensuring that documentation is:



Planner Role in Management of Change?



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2.3 Manage effects of change to processes and equipment

The management-of-change requires :

During Implementation:

- Devices to monitor the progress

Upon completion:

- Devices to insure:
 - Desired effects were achieved
 - All subsequent changes to methods and documentation have been properly addressed.



Questions



When managing changes to processes and equipment, what is the most critical step to ensure reliability is maintained?

- A. Increase spare parts inventory
- B. Communicate changes clearly to all stakeholders
- C. Reduce operator wages
- D. Eliminate preventive maintenance

ANSWER: B



Which of the following best minimizes negative impacts when implementing process or equipment changes?

- A. Ignoring operator feedback
- B. Conducting a risk assessment and training
- C. Reducing supplier contracts
- D. Increasing cycle time

ANSWER: B



Pillar 2 - Manufacturing Process Reliability

2.4 Maintain processes in accordance with applicable standards and regulations

Understand industry standards ✓

Understand regulatory requirements ✓

Ensure compliance ✓

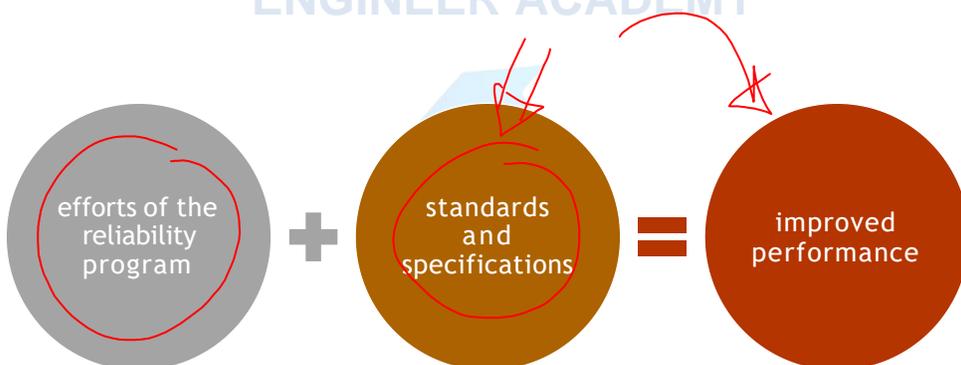


Industry Standards

SMRP **CMRP**
Certified Maintenance & Reliability Professional

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2.4 Maintain processes in accordance with applicable standards and regulations



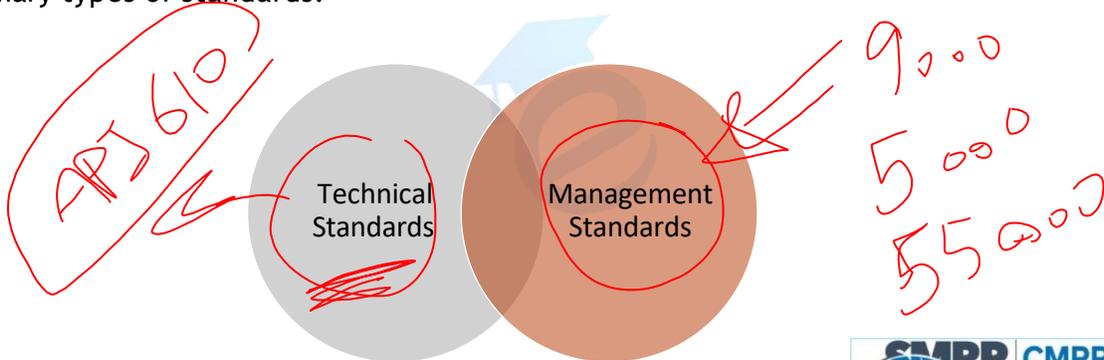
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2.4 Maintain processes in accordance with applicable standards and regulations



Primary types of standards:

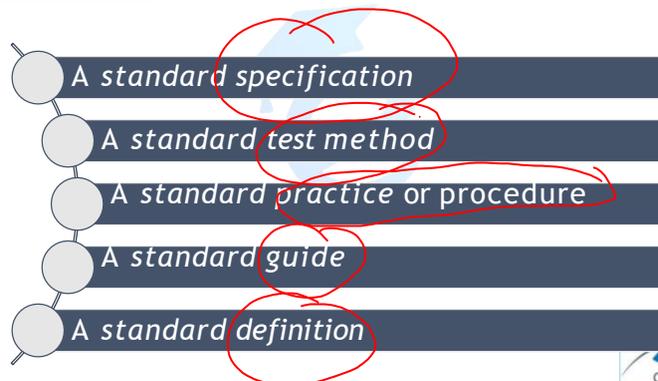


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2.4 Maintain processes in accordance with applicable standards and regulations



Types of technical standards



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2.4 Maintain processes in accordance with applicable standards and regulations

Example Management standards

- ISO 9001 : Quality Management System Standard
- ISO 50001 : Energy Management System Standard
- ISO 31000 : Risk Management System Standard
- ISO 26000: Social responsibility Guide
- ISO 14001: Environment Management System Standard
- ISO 55001: Asset Management - Management System Standard
- ISO 14224: Interchangeability of M&R Data Standard
- OHSAS 18001: Occupational Health and Safety Management



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2.4 Maintain processes in accordance with applicable standards and regulations

Example Technical Standards

API, ANSI, IEEE, ASTM, ..etc

Like:

API 580 : Asset Integrity Management Standard

API 610: Centrifugal Pumps Standard

API 650 : Welded tanks for oil storage



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2.4 Maintain processes in accordance with applicable standards and regulations

Best Practices:

Technique, methods, or processes that are more effective at delivering a desired outcome than any other techniques, methods, or processes. These are usually documented practices used by the most respected, competitive, and profitable organizations.

Benchmark

Process of identifying, sharing, and using knowledge and best practices. It focuses on how to improve any given business process by exploiting top-notch approaches rather than merely measuring the best performance.



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2.4 Maintain processes in accordance with applicable standards and regulations

Gaps in performance resulted from benchmarking of the reliability program must be:



Communication should be to other functions as well, e.g. financial, operational and other service departments.

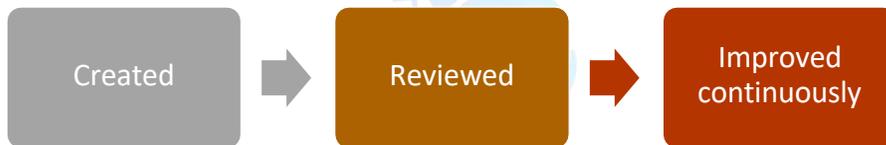


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2.4 Maintain processes in accordance with applicable standards and regulations

As part of a "living program" approach to reliability, action plans to close the gaps to be:



Measurements and action plans are posted in designated areas of the company for all employees to review



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2.4 Maintain processes in accordance with applicable standards and regulations

Benefits of Standard

- Forces us to document the Process.
- Built-in audit process evaluates how are we doing compared to what we said we are going to do.
- Brings uniformity across departments/plants, etc.
- Improves quality and productivity



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2.4 Maintain processes in accordance with applicable standards and regulations

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Benefits of Standard

- Brand & Reputation are important to secure new business opportunities ✓
- Availability of business growth opportunity relates to the ability to demonstrate competence in asset management.
- Being able to deliver return on assets and manage risk are critical competencies.
- Proving compliance to regularities is essential to proceed in success.



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2.4 Maintain processes in accordance with applicable standards and regulations

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Regulations

Specify legal requirements that are mandatory. They include such topics as:

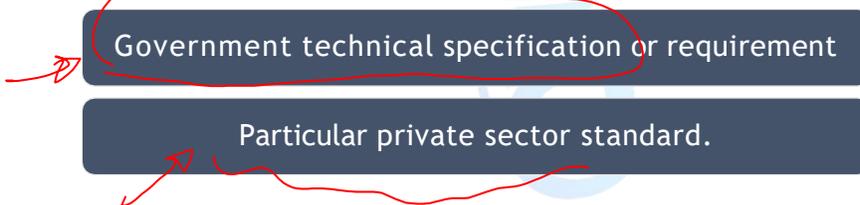


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2.4 Maintain processes in accordance with applicable standards and regulations



A regulation usually consists of :

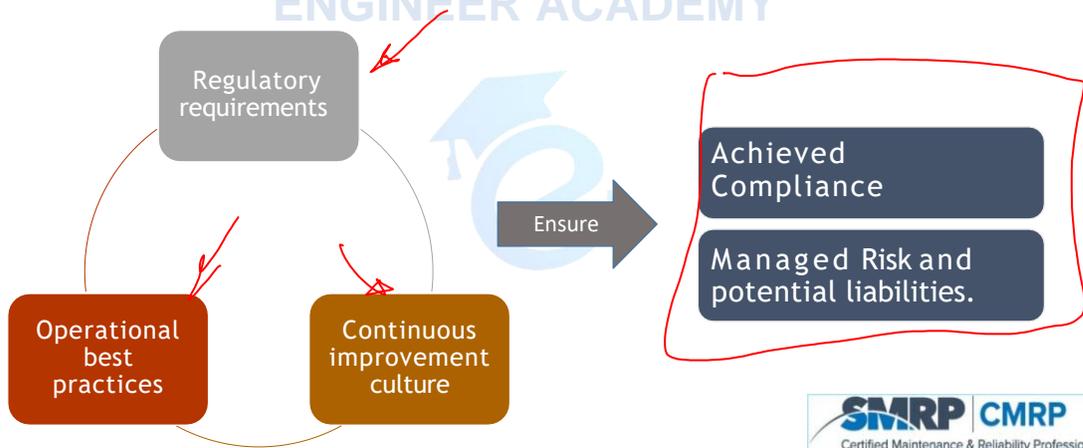


Having a proper understanding of regulations and how they affect a business model may actually save companies money and be more productive.



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2.4 Maintain processes in accordance with applicable standards and regulations



Questions



Which of the following is the primary reason for maintaining processes in accordance with standards and regulations?

- A. To reduce operator wages
- B. To ensure compliance and product safety
- C. To increase spare parts inventory
- D. To eliminate preventive maintenance

ANSWER: B



Which organization typically sets international standards for quality management systems?

- A. ISO
- B. OSHA
- C. EPA
- D. SMRP

ANSWER: A





When maintaining processes to meet regulatory requirements, what is the most critical activity?

- A. Documenting procedures and compliance evidence
- B. Reducing cycle time
- C. Increasing spare parts inventory
- D. Eliminating operator training

ANSWER: A



Which of the following best describes the role of OSHA in process maintenance?

- A. Establishing environmental standards
- B. Setting workplace safety regulations
- C. Defining equipment performance metrics
- D. Managing supplier contracts

ANSWER: B





What is the primary benefit of aligning processes with ISO 9001 standards?

- A. Improved supplier contracts
- B. Consistent quality and customer satisfaction
- C. Reduced operator wages
- D. Increased spare parts inventory

ANSWER: B



Pillar 2 - Manufacturing Process Reliability



Pillar related metrics and KPIs

- Overall Equipment Effectiveness (OEE)
- Total Effective Equipment Performance (TEEP)
- Availability
- Uptime
- Idle Time
- Utilization Time



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Pillar related metrics and KPIs

- Availability

Availability is the percentage of time that the asset is actually operating (uptime) compared to when it is scheduled to operate (gross time). This is also called operational availability.

There are several variations on the definition of availability. This definition is commonly used at the plant level and that is consistent with the term availability when used as a component of other SMRP metrics (e.g., Overall Equipment Effectiveness (OEE) and Total Effective Equipment Performance (TEEP)).



Reference : SMRP Best Practices 4th ED

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Pillar related metrics and KPIs

- Availability

OBJECTIVES :

Availability provides a measure of when the asset is either running or is capable of running. It is a measure of an asset's ability to be operated if required.

$$\text{Availability \%} = \frac{\text{Uptime (hrs)}}{[\text{Total Available Time (hrs)} - \text{Idle Time (hrs)}]} \times 100$$

$$\text{Uptime} = \text{Total Available Time} - (\text{Idle Time} + \text{Downtime})$$

$$\text{Down Time} = \text{Scheduled Downtime} + \text{Unscheduled Downtime}$$



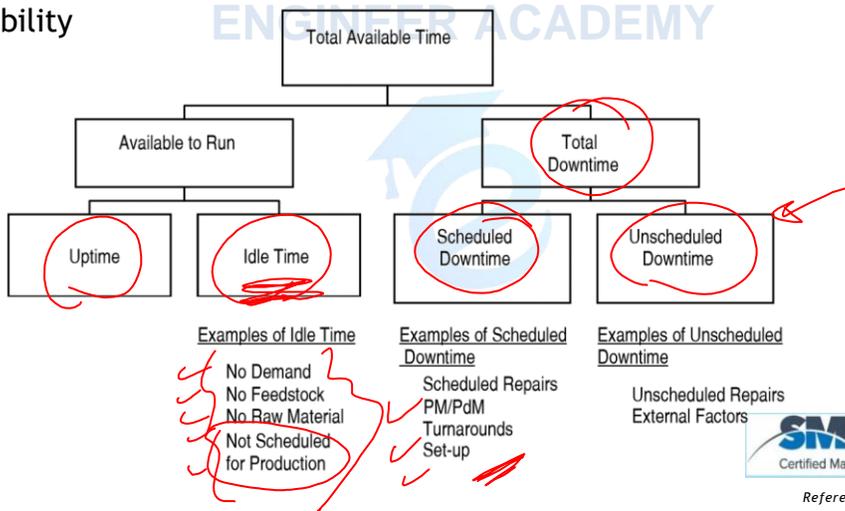
Reference : SMRP Best Practices 4th ED



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Pillar related metrics and KPIs

- Availability



Reference : SMRP Best Practices 4th ED

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Pillar related metrics and KPIs

- Availability

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OTHER DEFINITIONS :

- Inherent Availability
- Achieved Availability
- Operational Availability



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Pillar related metrics and KPIs

- Availability

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Inherent Availability (Ai) :

is a measure of the variables inherent in the design that affect availability.

In the calculation of downtime, it usually includes only active repair time.

No preventive maintenance time and administrative or logistic delays, only corrective maintenance time as downtime.

It is usually calculated during the engineering design of equipment and can be used as a measure of performance between planned shutdowns.



Reference : SMRP Best Practices 4th ED

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Pillar related metrics and KPIs

- Availability

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Inherent Availability (Ai) :

Inherent availability is expressed by the formula:

$$A_i = \frac{MTBF}{(MTBF + MTTR)}$$

Where MTBF = Mean Time Between Failures

MTTR = Mean Time to Repair (corrective maintenance only)

Or

$$A_a = \frac{\text{Uptime}}{\text{Uptime} + \text{Corrective Downtime}}$$



Reference : SMRP Best Practices 4th ED

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Pillar related metrics and KPIs

- Availability

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Achieved Availability (Aa):

Is the probability that an item, when used under design conditions in an ideal support environment, will perform satisfactorily. It includes both active repair time and preventive maintenance time, but excludes administrative and logistic delay times.

It represents the steady-state availability when maintenance downtime, including shutdowns, is considered.



Reference : SMRP Best Practices 4th ED

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Pillar related metrics and KPIs

- Availability

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Achieved Availability (Aa):

Achieved availability is expressed by the formula:

$$Aa = \text{MTBM} / (\text{MTBM} + \text{MDTM})$$

Where: MTBM = Mean Time Between Maintenance

And MDTM = Mean Downtime for Maintenance

Or

$$Aa = \text{Uptime} / (\text{Uptime} + \text{Corrective \& Preventive Downtime})$$



Reference : SMRP Best Practices 4th ED

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Pillar related metrics and KPIs

- Availability

ENGI

An example of the operational availability calculation based on a performance period of one month (720 hours) for a single piece of equipment is shown.

Components	Data	Comments
Total available time	720 hours	24 hours for 30 days
Idle time	240 hours	Power outage 20 hours, no demand 220 hours
Downtime Summary		
Scheduled downtime		
Preventative maintenance ✓	30 hours	30 – 1 hour daily PMs
Scheduled shift breaks ✓	19.8 hours	
Total scheduled downtime	49.8 hours	30 for PMs +19.8 shift breaks
Unscheduled downtime	/	
Waiting for operator /	13.8 hours	
Failures or breakdowns /	9.9 hours	
Setups and changeovers /	16.8 hours	
Tooling or parts changes /	6.9 hours	
Startups and adjustments /	15.0 hours	
No feedstock /	30.0 hours	
Total unscheduled downtime //	92.4 hours	

REFERENCE : SMRP BEST PRACTICES 4TH ED

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Pillar related metrics and KPIs

- Availability

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An example of the operational availability calculation based on a performance period of one month (720 hours) for a single piece of equipment is shown.

Components	Data	Comments
Total available time	720 hours	24 hours for 30 days
Idle time	240 hours	Power outage 20 hours, no demand 220 hours
Total scheduled downtime ✓	49.8 hours	30 for PMs +19.8 shift breaks
Total unscheduled downtime ✓	92.4 hours	
Uptime	337.8	$720 - 240 - 49.8 - 92.4$
Availability: (% of time an asset is operating)	70.38%	$337.8 / (720 - 240) \times 100 = 70.38\%$



Reference : SMRP Best Practices 4th ED

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Pillar related metrics and KPIs

- Overall Equipment Effectiveness (OEE)

OEE is a metric for measuring how well a process is operating by evaluating the three major process components: availability, performance efficiency (rate/speed) and quality. The process can be a single piece of equipment, a manufacturing cell, a production line or a plant.



Reference : SMRP Best Practices 4th ED

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Pillar related metrics and KPIs

- Overall Equipment Effectiveness (OEE)

OEE is a metric for measuring how well a process is operating by evaluating the three major process components: availability, performance efficiency (rate/speed) and quality. The process can be a single piece of equipment, a manufacturing cell, a production line or a plant.

$$\text{OEE} = \text{Availability} \times \text{Performance Efficiency} \times \text{Quality}$$



Reference : SMRP Best Practices 4th ED

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Pillar related metrics and KPIs

- Overall Equipment Effectiveness (OEE)

The purpose of OEE is to :

Identify sources of waste and inefficiencies or process losses that reduce:

- Availability (downtime)
- Performance efficiency (rate/speed)
- Quality (defects)

so that corrective action can be taken to improve the process.



Reference : SMRP Best Practices 4th ED

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Pillar related metrics and KPIs

- Overall Equipment Effectiveness (OEE)

PERFORMANCE EFFICIENCY (Rate/Speed):

The degree to which the equipment operates at historical best speeds, rates and/or cycle times.

BEST PRODUCTION RATE

The rate at which an asset is designed to produce product during a designated time period or the demonstrated best sustained rate, whichever is higher.



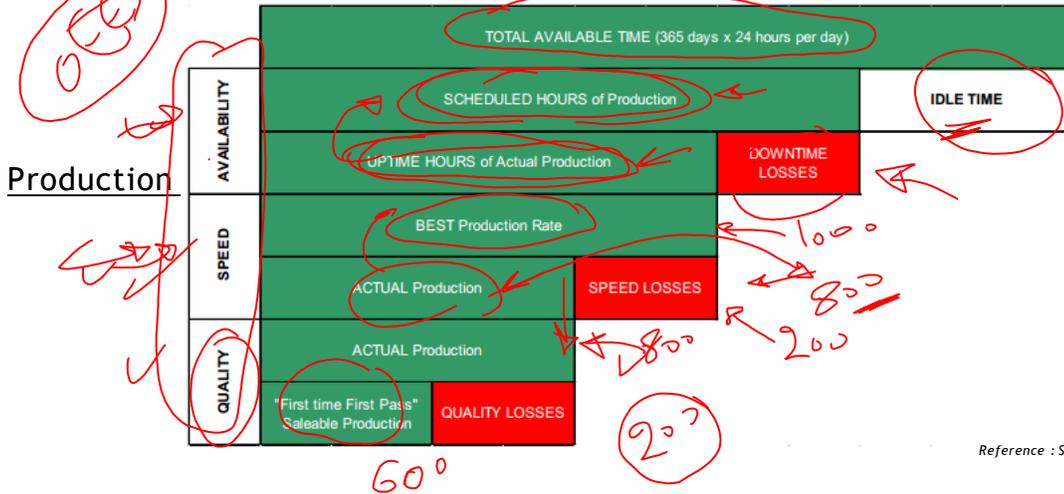
Reference : SMRP Best Practices 4th ED



Pillar 2 - Manufacturing Process Reliability

Pillar related metrics and KPIs

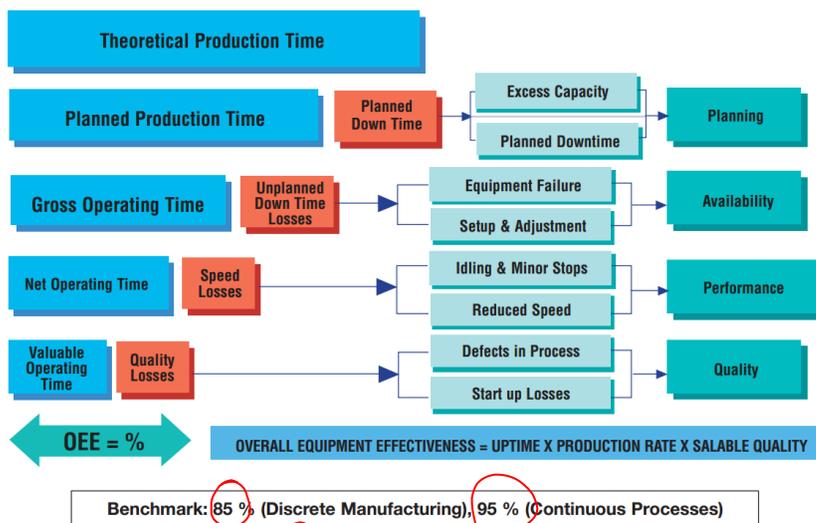
- Overall Equipment Effectiveness (OEE)



Reference : SMRP Best Practices 4th ED

Pillar 2 - Manufacturing Process Reliability

Pillar related metrics and KPIs



Pillar 2 - Manufacturing Process Reliability



Pillar related metrics and KPIs

- Overall Equipment Effectiveness (OEE)

An example of the calculation of OEE percentage based on OEE data for one day (24 hours) for "Machine D" operation are shown in the table below.

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Components	Data	Comments
Total available time	24 hours	24 hours in one day
Idle time	8 hours	Not required eight hours per day
Scheduled downtime		
No production, breaks, shift change, etc.	0.66 hours	Meeting & shift change
Planned maintenance	1.00 hours	Monthly PM
Total scheduled downtime	1.66 hours	
Unscheduled downtime		
Waiting for operator	0.46 hours	Operator distracted, on other tasks
Failure or breakdowns	0.33 hours	Mechanical drive coupling
Set-ups & changeover	0.26 hours	Two size changes
Tooling or part changes	0.23 hours	Screw station bits
Startup & adjustment	0.30 hours	First shift Monday
Input material flow	0.50 hours	Waiting for raw materials
Total unscheduled downtime	2.08 hours	
Total downtime (scheduled + unscheduled)	3.74 hours	1.66 + 2.08 = 3.74 hours
Uptime	12.26 hours	$(24 - 8) - 3.74 = 12.26$ hours
Availability	76.63%	$12.26 / (24 - 8) \times 100 = 76.63\%$

Reference : SMRP Best Practices 5th ED

Pillar 2 - Manufacturing Process Reliability



Pillar related metrics and KPIs

- Overall Equipment Effectiveness (OEE)

An example of the calculation of OEE percentage based on OEE data for one day (24 hours) for "Machine D" operation are shown in the table below.

Performance efficiency losses	(Count)	
Minor stops	10 events	Machine jams
Reduced speed or cycle time	100 / 167 units	Design rate: 12.5 units/hour
Performance efficiency	59.88%	$(100 / 167) \times 100 = 59.88\%$
Quality & yield losses	(Count)	
Scrap product/output	2	Waste, non-salvageable
Defects, rework	1	
Yield/transition	5	Startup & adjustment related
Rejected units produced	8	2 + 1 + 5 = 8
Good units produced	92	100 - 8 = 92 good units
Quality rate	92%	$(92 / 100) \times 100 = 92\%$
Overall equipment effectiveness	42.21%	$76.63 \times 59.88 \times 92.00 = 42.21\%$

OEE (51%) (51%)

Certified Maintenance & Reliability Professional

Reference : SMRP Best Practices 5th ED

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Pillar related metrics and KPIs

- Overall Equipment Effectiveness (OEE)

BEST IN CLASS TARGET VALUE

- 85% to 100% batch type manufacturing
- 90% to 100% continuous discrete manufacturing
- 95% to 100% continuous process

Availability >90%, Quality >99% and Performance >95% equals a 85% to 100% OEE



Reference : SMRP Best Practices 4th ED

Pillar 2 - Manufacturing Process Reliability



Pillar related metrics and KPIs

- Total Effective Equipment Performance (TEEP)

TEEP is a measure of equipment or asset performance based on actual utilization time, availability, performance efficiency and quality of product or output over all the hours in the period. TEEP is expressed as a percentage.

OBJECTIVES

The objective of this metric is to measure how well an organization extracts value from its assets. It provides the basis for setting improvement priorities and root cause analysis.



Reference : SMRP Best Practices 4th ED

Pillar 2 - Manufacturing Process Reliability



Pillar related metrics and KPIs

- Total Effective Equipment Performance (TEEP)

UTILIZATION TIME

Time when the asset is scheduled to run divided by total available time expressed as a percentage.



Reference : SMRP Best Practices 4th ED

Pillar 2 - Manufacturing Process Reliability



Pillar related metrics and KPIs

- Total Effective Equipment Performance (TEEP)

SAMPLE CALCULATION:

TEEP data and calculation for one day (24 hours) of operation of a given asset are shown in the table ressed as a percentage.

Components	Data	Comments and Calculation
Total available time	24 hours	24 hours in one day
Idle time	8 hours	Not required 8 hours per day
Utilization time	66.67%	$(24 - 8) / 24 \times 100 = 66.67\%$
Scheduled downtime		
No production, breaks, shift change, etc.	0.66 hours	Meeting & shift change
Planned maintenance	1.00 hours	Monthly PM
Total scheduled downtime	1.66 hours	
Unscheduled downtime		
Waiting for operator	0.46 hours	
Failure or breakdowns	0.33 hours	Mechanical drive coupling
Set-ups & changeover	0.26 hours	Two size changes
Tooling or part changes	0.23 hours	Screw station bits
Startup & adjustment	0.30 hours	First shift Monday
Input material flow	0.50 hours	Waiting for raw materials
Total unscheduled downtime	2.08 hours	
Total downtime (scheduled + unscheduled)	3.74 hours	$1.66 + 2.08 = 3.74$ hours
Uptime	12.26 hours	$(24 - 8) - 3.74 = 12.26$ hours
Availability	76.63%	$[12.26 / (24-8)] \times 100 = 76.63\%$

Reference : SMRP Best Practices 4th ED

Pillar 2 - Manufacturing Process Reliability



Pillar related metrics and KPIs

- Total Effective Equipment Performance (TEEP)

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SAMPLE CALCULATION:

TEEP data and calculation for one day (24 hours) of operation of a given asset are shown in the table ressed as a percentage.

Performance efficiency losses	(Count)	
Minor stops	10 events	Machine jams
Reduced speed or cycle time	100 v.167 units	Design rate: 12.5 units/hour
Performance efficiency	59.88%	$(100 / 167) \times 100 = 59.88\%$
Quality & yield losses	(Count)	
Scrap, product/output	2	Waste, non-salvageable
Defects, rework	1	
Yield transition	5	Startup & adjustment related
Quality rate	92.00%	$(92 / 100) \times 100 = 92.00\%$
Total Effective Equipment Performance (TEEP)	28.14%	$66.67 \times 76.63 \times 59.88 \times 92.00 = 28.14\%$



Reference : SMRP Best Practices 4th ED

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Pillar related metrics and KPIs

- Total Effective Equipment Performance (TEEP)

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BEST IN CLASS TARGET VALUE:

85% to 100% (Industry Specific)

- Availability >90%
- Quality >99%
- Performance >95%
- Utilization = 100%



Reference : SMRP Best Practices 4th ED

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Pillar practice questions



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