CONGRESO DE MANTENIMIENTO & CONFIABILIDAD COLOMBIA 1ª EDICIÓN

CMC Colombia 2024

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Presentation of a successful experience, case study, or project.

In the Brújula Session, you will learn from the shared experience of a successful implementation that will serve as a guide to initiate or improve your own plans.

Solve problems and improve your reliability through the implementation of new methodologies and technologies, understanding the origin, analysis, action plan, step-by-step process, achievements, setbacks, and lessons learned that culminate in the business case.

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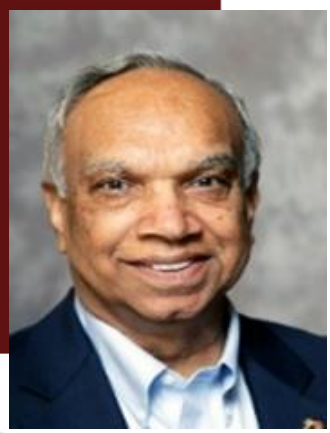
BRÚJULA

CONGRESO DE MANTENIMIENTO & CONFIABILIDAD COLOMBIA 1ª EDICIÓN



Key Performance Indicators (KPIs) and continuous improvement

to Align with organizational objectives

Ramesh Gulati
Reliability Sherpa

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Who am I?

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Ramesh Gulati, *aka Reliability Sherpa*

Asset Management Professional - Change Agent - Thought Leader - Author & Student of Learning

- **Author:** *Maintenance & Reliability Best Practices*; *10 Rights of Asset Management*; *Uptime Elements DICTIONARY;* Maintenance Reliability Best Practices Workbook, etc..



- 60-plus years in the Industry as a "doer–practitioner."
  - Maintenance, Reliability, and Asset Management
  - Change/Culture Management /Operational Excellence
- BSME, MSIE, & EMBA (Owen/Vanderbilt), Certified Professional: PE, CRE, CRL, CAMA, CMRP, CMRT
- **2020 AEDC " Lifetime Achievement Award"**
- **2019 TRC " Lifetime Achievement Award"**
- **2014 CMRP of the Year**
- Taught at Mississippi State University, University of Tennessee, University of Wisconsin, etc.
- Heavily involved with Industry/societies to learn/share, such as SMRP, Reliabilityweb, RMC/UT, etc.
  - **ISO 55000 / TC251 Member- US delegate**

ReliabilityX

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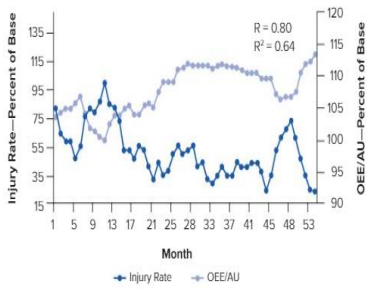
Reliability & Safety Relationship

- Is Safety and Reliability related?



Moore, Ron. Author of "Making Common Sense, Common Practice" MARCON 2011 Seminar/Paper

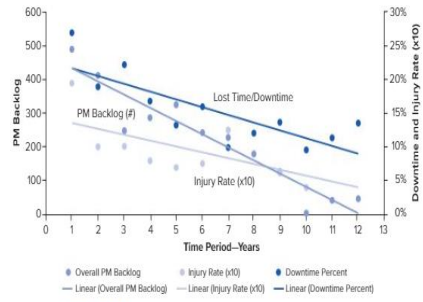


FIGURE 13.4 The PM, Downtime, and Safety Relationship

Ramesh Gulati, Author Maintenance and Reliability Best Practices, 3rd Ed., chapter 13, Fig 13.4

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The reliable plant/site is …

Clean
Organized
Safe
A Culture of Excellence/Reliability
Has rhythm
Produces quality
Profitable

Key Performance Indicators (KPIs) and continuous improvement to Align with organizational objectives

- Performance Indicators
- Continuous Improvements
- Alignment
- Organizational Objectives

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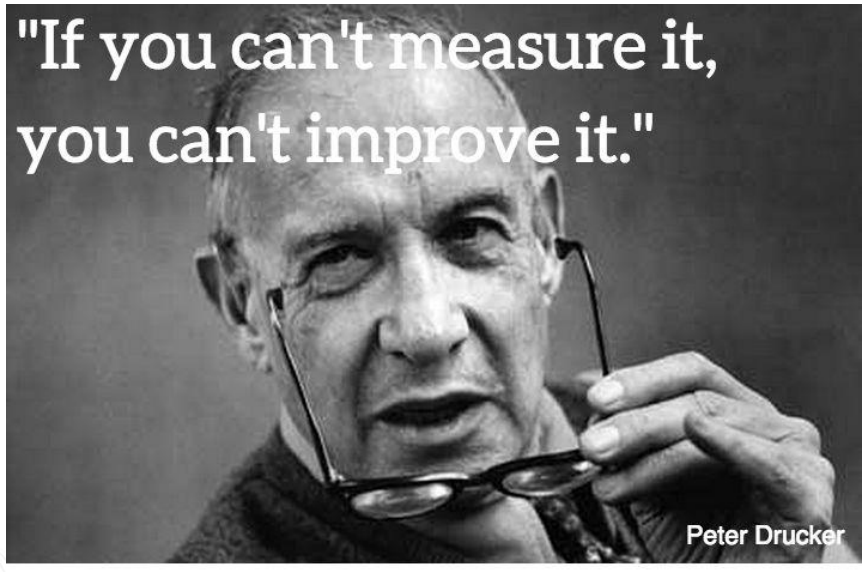
Remember…



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Level of Management – Organizational structure

- Corporate …. “C” Level
- Plant / Site Level
- Functional Department
- Floor- Technician - doers

Puzzle: Find a Word

#BP3ech9FAW1apl24

P	E	R	F	O	R	M	A	N	C	E	M	E	A	S	U	R	E	S	Y	E
B	A	L	A	N	C	E	D	S	C	O	R	E	C	A	R	D	E	L	O	L
T	I	W	H	B	E	S	T	P	R	A	C	T	I	C	E	S	E	C	L	A
R	E	A	L	I	S	T	I	C	E	T	C	D	K	P	D	M	H	D	R	I
N	E	T	W	O	R	K	I	N	G	R	J	S	W	O	I	V	K	R	M	N
U	O	B	J	E	C	T	I	V	E	S	F	Q	V	T	V	V	O	F	E	D
L	B	E	N	C	H	M	A	R	K	V	Q	O	V	B	V	G	H	F	A	I
T	E	U	B	Q	L	E	T	T	W	L	T	P	R	D	R	E	P	N	S	C
C	J	A	Q	Q	N	N	I	L	O	U	O	W	P	M	C	B	B	I	U	A
L	D	Z	D	M	E	A	S	U	R	A	B	L	E	W	A	S	M	A	R	T
A	X	L	W	I	U	E	S	T	L	B	B	M	B	G	W	N	N	V	E	O
G	O	L	E	Q	N	S	I	Q	D	J	E	U	P	T	J	I	C	Y	S	R
G	L	H	J	A	L	G	M	X	C	E	I	S	N	Y	P	H	W	E	M	S
I	M	X	M	A	R	J	W	G	L	V	V	M	T	U	E	Y	R	H	W	I
N	E	V	O	Q	B	N	H	H	A	D	F	F	N	I	U	N	G	S	P	Y
G	T	G	A	R	J	P	I	L	S	Q	F	C	S	Y	N	C	L	K	O	T
L	R	A	O	G	W	Z	O	N	S	C	G	O	S	X	D	C	Q	O	H	M
W	I	L	P	B	P	W	G	Z	G	W	D	N	D	B	E	W	L	M	W	K
J	C	A	W	A	T	T	A	I	N	A	B	L	E	R	R	O	Q	A	G	Z
G	S	J	I	F	S	P	E	C	I	F	I	C	R	O	P	B	C	R	S	D
B	E	N	C	H	M	A	R	K	I	N	G	H	J	K	D	K	N	B	Q	S

Attainable
Balanced Scorecard
Benchmark
Benchmarking
Best in class
Best Practices
Goals
Indicators
KPI
Lagging
Leading
Learning
Measurable
Measures
Metrics
Networking
Objectives
Performance
Performance Measures
Realistic
Smart
Specific
Timely
World Class

Performance Measures

- An organization must measure and analyze its performance.
  - To make the improvements needed to stay in business
  - We live in a very competitive marketplace
- Performance measures must be derived and aligned with the organization's goals and strategies.
  - Centered on critical information and data related to the key business processes and outputs
  - Focused on improving results

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Performance Measures/Indicators

- Performance indicators, also known as **metrics**, are measurable characteristics of products, services, and processes related to the business.
  - Used to track and improve performance
  - Comprehensive set tied to business activities and customers based on long-term and short-term goals
  - Need to be constantly reviewed and aligned with new or updated goals as part of its strategic plan to make lasting improvements to key drivers
- Processes should be designed to collect data – information and also for easy dissemination and analysis.

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Caution!

- The question is not what to measure,
  But what is the root cause of the problem?

  Metrics need context…

- When developing metrics / KPIs, always think **“ End in mind.”**

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Performance Measures- Metrics Development

1. Identify critical work processes and customer or organization - plant/site requirements
2. Identify critical results aligned to requirements
3. Develop measurements for critical processes and requirements
4. Establish performance goals, standards, key metrics
5. Apply the SMART test to ensure the quality of metrics

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Apply SMART principles

Should be clear with basic knowledge of the issues or initiatives, clearly articulated, well-defined and focused	Should be able to determine the degree to which there is completion or attainment. Use quantifiable methodology and information.	It should be realistic, practical, and attainable within operating constraints dependent upon the availability of resources, knowledge, and timeframe.	It should be tied to priorities and objectives and help to contribute to bringing about the desired outcome.	Should be available to take actions in a timely manner

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Types of Performance Indicators - Metrics

- **Leading** indicators are forward-looking, so they help to manage the performance of an asset, system, or process.
- **Lagging** indicators tell how well we did in managing that performance. They are the results
- CAUTION! Indicators can be either leading or lagging, depending on where are in the process

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Leading and Lagging Indicators

Leading indicators

- Input oriented
- Measures process
- Somewhat hard to measure
- Easier to influence than related lagging indicators
- Forward looking …to manage the performance

Lagging indicators

- Output oriented
- Measures results
- Easy to measure
- Harder to improve or influence than related leading indicators
- How well did we manage performance

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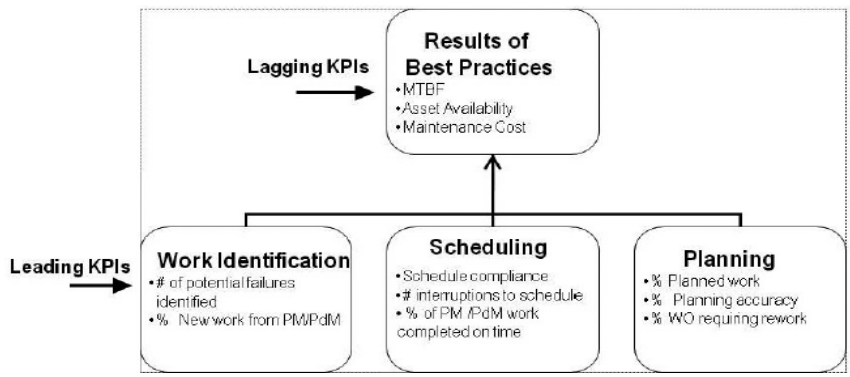
Examples of some Indicators



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Examples of Leading & Lagging

Inventory Accuracy

Availability of Parts

Downtime

Leading → Lagging

Leading → Lagging

PM Compliance → Downtime → Availability

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What Metrics Should a Maintenance -- Capacity Assurance Department have?

- X
- Y
- Z
- A
- Etc..

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Examples of Capacity Assurance Dept metrics…

- PM compliance
- Planned work
- Planning Accuracy
- Schedule Compliance

Capacity Assurance Department's Health Status – Example of Single Metric

Maintenance Department Health — Period Week/Month of xx			
	Result	Weight	Weighted Avg.
PM Compliance	85%	50%	0.425
Planned Work	90%	20%	0.18
Schedule Compliance	95%	20%	0.19
Planning Accuracy	95%	10%	0.095
Weighted Average (This period)			0.89 = 89.0%
Weighted Average (Rolling Last 3/6/12 periods)			90.40%
Goal—Benchmark			94.00%

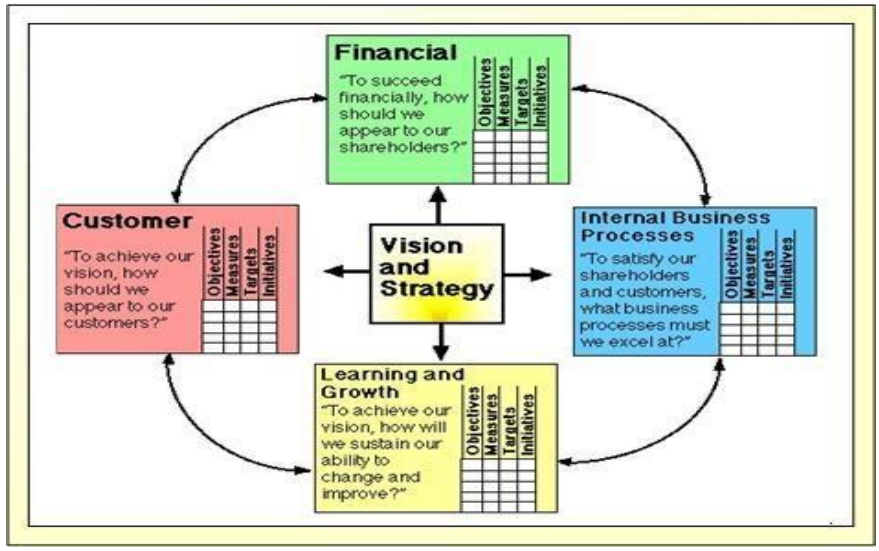
www.smrp.org/Best Practices

No.	Name of Metric	Development Stage	Type
1.0	**BoK - Business & Management**		
1.3	Stores inventory turns	**Web Survey**	Leading
1.4	Stocked MRO per RAV	**Published**	Lagging
1.5	Maintenance Cost per RAV	**Published**	Lagging
2.0	**BoK - Manufacturing Process Reliability**		
2.2	Availability	**Writing**	Lagging
2.3	Uptime	**Validation**	Lagging
2.4	Idle Time	Ready to Re-post	Lagging
3.0	**BoK - Equipment Reliability**		
3.1	OEE	**Web Survey**	Lagging
3.2	Total Downtime	**Published**	Lagging
3.3	Scheduled Downtime	**Published**	Lagging
3.4	Unscheduled Downtime	**Published**	Lagging
3.5.1	MTBF	**Web Survey**	Lagging
3.5.4	MDT	**Web Survey**	Leading
4.0	**BoK - People Skills**		
4.1	Rework	**Published**	Leading
4.2.1	Maintenance Training - $	**Backlog**	Leading
4.2.2	Maintenance Training -MHRs	**Backlog**	Leading
5.0	**BoK - Work Management**		
5.1.2	Actrual Hours to Planning Estimate	**Web Survey**	Leading
5.1.3	Planning Variance Index	**Web Survey**	Leading
5.3	Planner to Craftworker Ratio	**Validation**	Leading
5.4	Wrench Time	**Web Survey**	Leading
5.5	Schedule Compliance	**Web Survey**	Leading
5.7.1	Planned Work	**Web Survey**	Leading
5.8	PM & PdM Compliance	**Validation**	Leading
5.9	PM & PdM Work Order Backlog	Ready to Re-post	Leading
5.11.2	PM & PdM Effectiveness	**Web Survey**	Leading
5.12.3	Planner Effetiveness	**Writing**	Leading
5.14.2	Overtime % of Maintenance Hours	**Validation**	Lagging
5.15.1	Work Order Aging	**Writing**	Leading
5.15.2	Work Order Cycle Time	**Backlog**	Leading

The "Balanced Scorecard"

- The Balanced Scorecard is a strategic management approach developed in the early 1990s by Dr. Robert Kaplan of Harvard Business School, and Dr. David Norton.
  - "The balanced scorecard retains traditional financial measures. However, financial measures tell the story of past events, an adequate story for industrial-age companies for which investments in long-term capabilities and customer relationships were not critical for success.
  - These financial measures are inadequate for guiding and evaluating the journey that organizations must make to create future value through investment in customers, suppliers, employees, processes, technology, and innovation."

Balanced Score Card Model



Reference: Dr Robert Kaplan and David Norton / HBS

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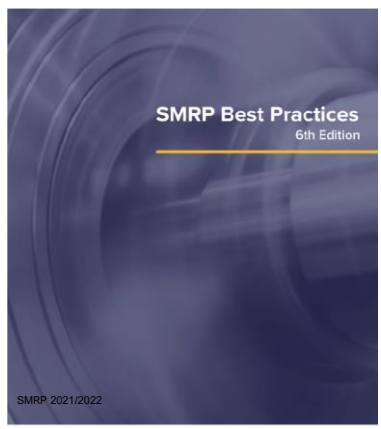
SMRP Best Practices - Metrics



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SOCIETY FOR MAINTENANCE AND RELIABILITY PROFESSIONALS
MAINTENANCE AND RELIABILITY BODY OF KNOWLEDGE

BUSINESS AND MANAGEMENT METRIC

1.5 Total Maintenance Cost As a Percent of Replacement Asset Value (RAV)

A. DEFINITION

The metric is the amount of money spent annually maintaining assets, divided by the Replacement Asset Value (RAV) of the assets being maintained, expressed as a percentage.

B. OBJECTIVES

This metric allows comparisons of the expenditures for maintenance with other plants of varying size and value, as well as to benchmarks. The RAV is used in the denominator to normalize the measurement given that plants vary in size and value.

C. FORMULA

Total Maintenance Cost per RAV (%) =
[Total Maintenance Cost ($) × 100] ÷ Replacement Asset Value ($)

D. COMPONENT DEFINITIONS

Total Maintenance Cost

Total expenditures for maintenance labor (including maintenance performed by operators, e.g., total productive maintenance (TPM), materials, contractors, services, and resources. Include all maintenance expenses for outages, shutdowns or turnarounds, as well as normal operating times. Include capital expenditures directly related to end-of-life machinery replacement This is necessary so that excessive replacement versus proper maintenance is not masked. Do not include capital expenditures for plant expansions or improvements.

Publication Date: April 23, 2009
Revised: September 26, 2012

SMRP OEE Metric 2.1.1 …a

MANUFACTURING PROCESS RELIABILITY METRIC

2.1.1 OVERALL EQUIPMENT EFFECTIVENESS (OEE)

Published on April 16, 2009
Revised on August 3, 2016

DEFINITION

THIS METRIC IS A MEASUREMENT OF EQUIPMENT OR ASSET PERFORMANCE BASED ON ACTUAL AVAILABILITY, PERFORMANCE EFFICIENCY AND QUALITY OF PRODUCT OR OUTPUT WHEN THE ASSET IS SCHEDULED TO OPERATE. OVERALL EQUIPMENT EFFECTIVENESS (OEE) IS TYPICALLY EXPRESSED AS A PERCENTAGE.

The overall equipment effectiveness (OEE) metric is a measurement system for equipment or asset performance based on actual availability, performance efficiency, and quality of product or output when the asset or process is scheduled to operate. Overall equipment effectiveness is typically expressed as a percentage.

OBJECTIVES

This metric identifies and categorizes major losses or reasons for poor asset performance and scheduling. It provides the basis for determining and setting improvement priorities as well as justifying beginning root cause analysis activities. OEE should not be used as a stand-alone program, but as a measurement system defined in a Key Performance Indicator (KPI) line-up. It is considered a Lagging KPI.

OEE frequently is used as a KPI as a tracking measurement for Continuous and Lean improvement programs. OEE is intended for all employees. Correctly applied OEE measures should foster cooperation and collaboration between operations, maintenance, and equipment engineering to identify, reduce, or eliminate the major causes of poor asset performance and scheduling. Maintenance, operations, and equipment engineering teams working alone cannot improve OEE . Traditional OEE methodologies focus on asset in plant use; but nontraditional methodologies can be applied to a broad spectrum of reliability instances where information can be obtained. This would be done by changing the (8 big losses, column) to measurable losses/defects or cause failures. (Ex. Fleet Operations: by Changing "#3" setup to vandalism, and "#7" from startup losses to on-road hazards Etc.) (see graphic below)

MM: What about "equipment, asset or system"
MM: Strike this, it is redundant with the previous paragraph.
"cannot often improve."
TA: Often in this use indicated that one or another can make OEE work. In the reference material it is noted that all parties must participate for a successful implementation; and that OEE failure is more likely if all are not engaged....

Organizational statements

- Corporate objectives are set by the senior management-Leadership
- They are the practical application of the organizational mission statement
  - detailed specific goals
  - Quantifiable
    - Achieve 10% ROI on capital invested in xx year
  - Corporate objectives are long-term in nature

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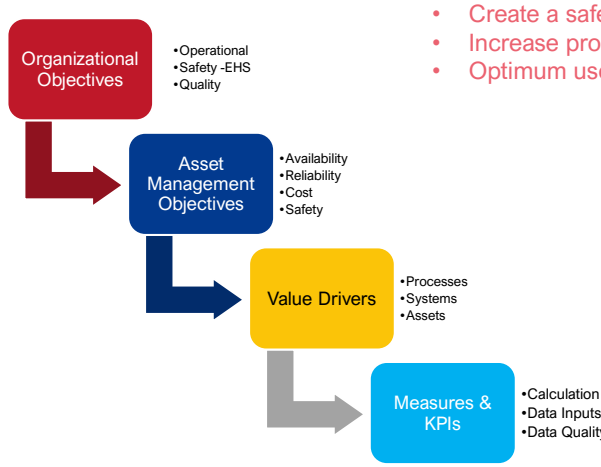
Aligning Indicators with Objectives

- Improve throughput to xx%
- Create a safe environment
- Increase productivity
- Optimum use of resources



- ✓ PM compliance - %
- ✓ # of safety incidents (OSHA)
- ✓ Planned Work - %
- ✓ Improve OEE to 92%

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Plant Performance Indicators!

What information (KPIs) do we need to evaluate a production facility's performance from an asset/maintenance management perspective?

Corporate is interested in buying a company/plant and they have asked you, an O&M expert, what metrics (not more than 5) we need to evaluate to make a decision.

1. _____
2. _____
3. _____
4. _____
5. _____

List 5 KPIs that are indicators of how a plant is performing. Consider the balanced scorecard model.

Plant Performance Indicators! Suggested Plant KPIs to assess the Performance

- X
- X
- X
- X
- x

The List of key metrics… (MRBP page 290 - Fig 9.1 ed.2) (MRBP page 394 - Fig 9.2 ed.3)

- Maintenance cost -- % of RAV
- Return on Asset – Plant profit/Asset value
- Safety – OSHA Recordable injury rate (per 200K hours)
- Trending % Availability, Maintainability & Reliability
- OEE
- % Downtime
- % Planned work
- % Schedule compliance (or PM compliance)
- Work planning accuracy (task time) (Est. to actual)
- % Rework
- % Stock out rate or Service rate
- % PM/CBM/Total work
- Attrition rate
- Employee certified / qualified rate
- Etc..

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"You cannot manage (improve) something you cannot control, and you cannot control something you cannot measure."

– Peter Drucker

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The Value of Metrics

- The value of metrics is in their ability to provide a factual basis in the following areas:
  - Strategic feedback to show the present status of the organization from various perspectives
  - Diagnostic feedback of various processes to guide improvements continuously
  - Trends in performance over time as metrics are tracked
  - Feedback around measurement methods themselves in order to track the correct metrics

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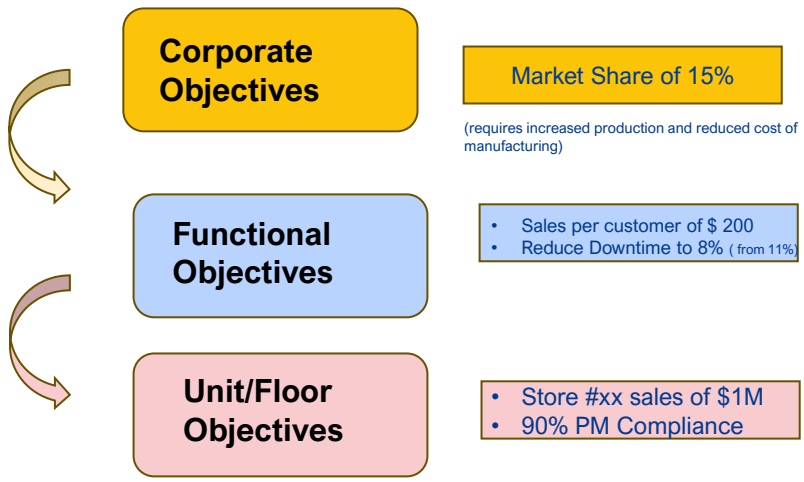
Objective Linkage



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Conclusion

- Performance measurement is a means of quantifiable and unbiased assessment of progress against stated goals and objectives.
  - It brings with it an emphasis on objectivity, consistency, fairness, and responsiveness.
  - It is a reliable indicator of an organization's health and can have an immediate and far-reaching impact.
  - Its impact on an organization can be both immediate and far-reaching.
- Performance indicators are leading or lagging.
  - Leading indicators measure the process and predict changes and future trends.
  - Lagging indicators measure results and confirm long-term trends.
- Successful performance measurement systems:
  - Help to manage and improve processes and document achievements.
  - Support an organization's core values and its relationship with customers, suppliers, and stakeholders.
  - Link/align metrics to the organization's objective

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Thank you!

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