Performance Scorecards for Operations & Maintenance

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Agenda

• Performance Optimization
  – Manufacturing KPIs
  – Gap Analysis
  – Scorecards

• Data Collection
  – How to do it, how not to do it

• Business Intelligence
  – Overview
  – Hierarchies

• O&M Metrics

• Scorecard Tools
Performance Scorecards - History

- **Finance – Budgeting**
  - Finance has been Scorecarding for Years by defining budget targets
  - From the Corporate level down to each cost center, track:
    - Actual
    - Budget
    - Forecast (updated throughout year)

- **Manufacturing – Operations & Maintenance**
  - Only recently has tracking actual vs target performance in such a systematic fashion been applied to other departments in manufacturing
  - Another new trend: scorecards being used by plant personnel, not just executives
  - Enabler for Continuous Improvement initiatives
    - E.g. following DMAIC Model
Measure & Manage Results

• Corporate
  – Asset or capital-based metrics link performance to shareholder value, such as RONA and ROCE

• Production Effectiveness
  – For example, OEE and Cost per Unit Production (Ton, MW, barrel, etc)

• Equipment Reliability and Work Process Effectiveness
  – Measured by MTBF for equipment reliability; ratio of unplanned to planned work; inventory turn rates to measure storehouse effectiveness

• Program Effectiveness
  – For example, defects identified prior to failure indicate effectiveness of programs; track program results through scorecards
Gap Analysis

• Find areas where biggest performance gaps (between current level and industry best practices) – should be first step in improvement program “find lowest hanging fruit”

• Separate Gap Analysis for Areas:
  – Availability
  – Yield
  – Quality
  – Cost

• Example: chemical facility high in Quality and Yield, should focus on improvement in Availability and Cost
Scorecarding Background

- **Scorecard**
  - Collection of visual performance indicators

- **KPI – Key Performance Indicator**
  - Track actual against desired performance targets

- **KPI Tree**
  - Hierarchy of KPIs
Balanced Scorecard Overview

- Continuous Improvement methodology
  - Translate strategy into execution

- Traditional view balances
- performance across
  - Financial
  - Customer
  - Internal Business Processes
  - Learning & Growth

- How does this apply to manufacturers?
  - Need more focused views of performance
  - Break out Operations, Maintenance, Reliability
The Wrong Way to Collect the Data

• Old Approach: Proprietary Integration Nightmare

- EAM
- MES
- ERP

- Periodic & On-line Condition Monitoring Systems
- SCADA, Plant Historians
- Asset Health, Predictive Maintenance
The Right Way to Collect the Data

- Open Standards-based Integration
  - ISA-95 - ERP Integration
  - MIMOSA - EAM Integration
  - OPC - Plant floor integration

Diagram:

- EAM (MIMOSA)
- MES (ISA SP95)
- ERP (ISA SP95)

Connections:
- MIMOSA
- ISA SP95

Systems:
- Periodic & On-line Condition Monitoring Systems
- Control Systems, Plant Historians, HMIs
- Diagnostic/Prognostic CBM & CBO Systems
Data Collection Recommendations

• Data collected from different silos of manufacturing data
  – EAM (Enterprise Asset Management) database
  – SCADA, LIMS, Plant Historians
  – MES, Shop Floor Control
  – Financial, Accounting

• Extract Transform Load (ETL) process should accommodate
  – Cleansing
  – Validation
  – Full Audit Trail, Traceability
  – Notification & Exception-based Alerting
Business Intelligence – Enabler for Scorecarding

• Traditional Database
  – Optimized for structured data storage, retrieval
  – Structured into Tables, Rows

• OLAP Database
  – Optimized for interactive analysis
  – Data is summarized into multi-dimensional views and hierarchies
  – Allows for very intuitive analysis by end users
  – Enables drill-down through pre-defined hierarchies
  – Example Hierarchies
    – Time [Year, Month, Day]
    – Geography [Country, State, City, ZipCode]
    – Plant [Plant, Area, Production Unit, Equipment]
Manufacturing Scorecards – Prior Work

- Reliability Scorecard – John Mitchell
- Maintenance Scorecard – Daryl Mather
- RCM Scorecard – Jack Nicolas
  - Reliability-Centered Maintenance
- Operations Scorecard – Producer Value Model – John Mitchell
  - Goes from corporate manufacturing metrics down to low level equipment and quality metrics
Producer Value Model

- **Producer** - entity for which you can calculate
  - Cost of materials
  - Price of finished goods

- **Example** – each unit in multi-unit power plant, chemical plant, or oil refinery

- **Producer Value Model** — simplified Income Statement
  - Top Tier - EVA (after tax profit – cost of capital), RONA, ROCE
  - Middle Tier – production process including OEE, conversion cost
  - Bottom Tier – O&M metrics, materials, energy
Producer Value Model Diagram

Income from Finished Goods → Cost of Raw Materials → Conversion Costs → Taxes → After Tax Operating Profit → Cost of Capital = EVA

Price of Finished Goods → Production Yield → Quality (actual) → Production Rate (actual) → Availability (actual) → Conversion Cost (objective)

Quality (objective) → Production Rate (objective) → Availability (objective) → Conversion Cost (actual)

Market Conditions → Operations & Maintenance, O & M

Administrative → Operations → Maintenance

Safety, Environmental → Utilities; electric, water → Waste Disposal
Maintenance & Reliability KPIs

• KPIs Frequently used in Maintenance & Reliability
  – Availability
  – Utilization
  – Mean Time Between Failure (MTBF)

• Aggregation Techniques
  – Can be calculated for low level equipment, and rolled all the way up to Plant level
  – Aggregation types include Sum, Average, Weighted Average, Average Over Time, Min, Max, Count
KPI Hierarchy: Strategic to Tactical KPIs

Metric Class
- Strategic
  - Asset / Capital
  - Industry Performance
  - Operating Effectiveness
  - Reliability Management
  - Work Process Efficiency
  - Program Effectiveness
- Operating
  - Effectiveness

Examples
- Strategic
  - RONA, ROCE, ROE
  - Cost as a % of CAV/RAV, EDC,
    Manufacturing Cost per Unit
  - OEE, Asset Utilization, COPQ
  - MTBF, MTTF, MTTR
  - Planned to Total Work,
    Overtime as % Total Hours,
    Storehouse Stock Effectiveness
- Operating
  - Faults Detected Prior to Failure,
    Avoided Cost
Scorecard Tools

- Enable rapid rollout of KPI hierarchies
- Can create separate scorecards for each department
  - Operations
  - Maintenance
  - Reliability
  - Finance

- Integrate with Business Intelligence foundation
  - Enables KPIs to be linked to BI Hierarchies
  - Example Hierarchies
    - Time [Year, Month, Day]
    - Geography [Country, State, City, Zip Code]
    - Plant [Plant, Area, Production Unit, Equipment]
  - Example Rollout:
    - Set Plant availability targets, equipment availability is automatically rolled up to Plant by BI system
    - Can drill down from Plant to analyze problems
Scorecard Tools

• Question: how do we go from a collection of different KPIs into Departmental and Corporate performance indicators?
  – How can “roll up” different KPIs such as OEE, Availability, MTBF?

• Answer: weighted average
  – Scorecard tools enable users to weight individual KPIs according to their relative importance
  – Scores are normalized on a percentage basis
  – KPIs roll up to Departmental Indicators (Operations, Maintenance, Reliability, Finance), and finally up to Corporate indicators
Summary

• What one does not measure, one cannot improve
• Scorecarding is key component of Continuous Improvement
• Visual performance dashboards help keep accountability, provide leading indicators of future performance
• Rigorous tracking of performance targets is no longer just a Budgeting task, also being applied to Operations & Maintenance
• Significant returns can be achieved with focus on identifying performance gaps, greatest opportunities for improvement

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