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وزارة الإنتاج الحربي
Ministry of Military Production

INDUSTRY 4.0 Revolution

ورشه عمل "تطبيقات اللثورة الصناعية الرابعة للصناعة"

التابعة المبادره القومية لاعداد كوادر رقمنة الصناعة

(التدريب على تقنيات الثورة الصناعيه الرابعة – مرحله اولى)

Military production launches the national initiative to prepare the cadres of digitalization of industry

Presented by
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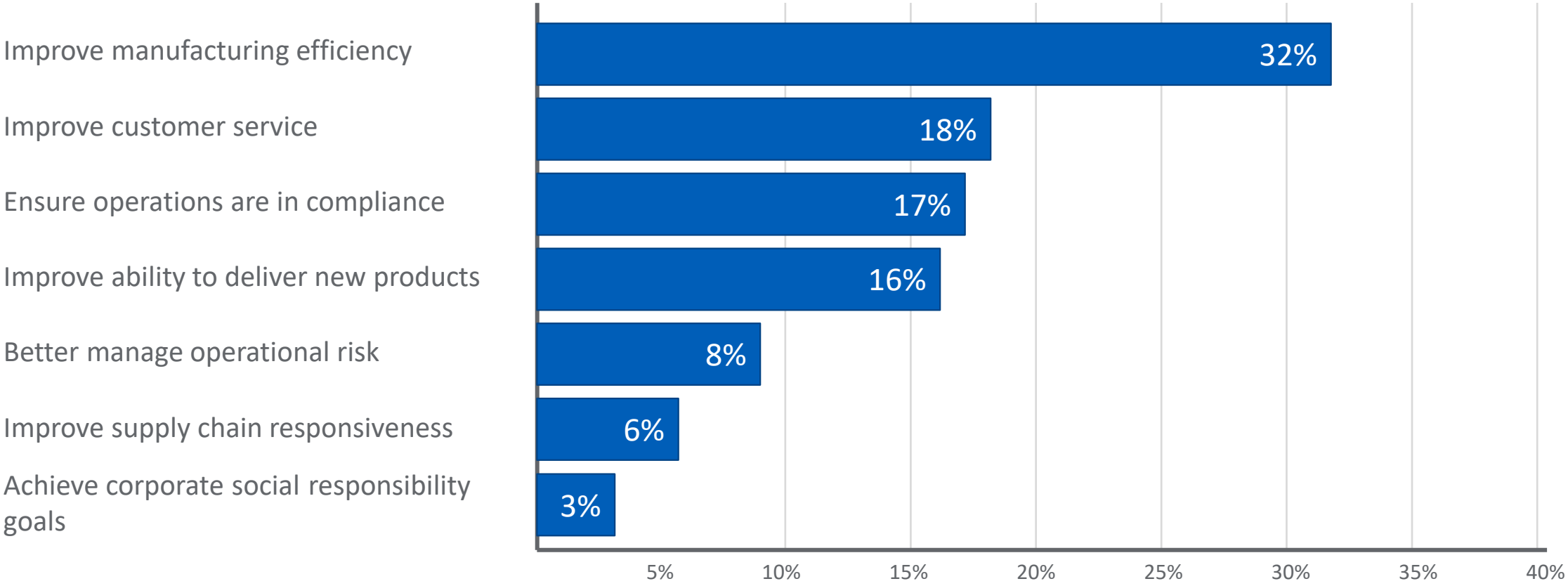
What is the Top Operational Objective of Your Organization?



LNS research

Overall Equipment Effectiveness (OEE)

- Overall equipment effectiveness (OEE) is a measure of how well a manufacturing operation is utilized (facilities, time and material) compared to its full potential, during the periods when it is scheduled to run.
- It identifies the percentage of manufacturing time that is truly productive.
- An OEE of 100% means that only good parts are produced (100% quality), at the maximum speed (100% performance), and without interruption (100% availability).

Availability calculation

- **Availability = operating time / scheduled time**
- ***Example:***
- ***A given Work Center is scheduled to run for an 8-hour (480-minute) shift with a 30-minute scheduled break and during the break the lines stop, and unscheduled downtime is 60 minutes.***
- ***The scheduled time = 480 minutes - 30 minutes = 450 minutes.***
- ***Available Time = 480 Minutes – 30 Minutes Schedule Loss – 60 Minutes Unscheduled Downtime = 390 Minutes***
- ***Availability = 390 min / 450 min = 86.6%***

Productivity Calculation

- **Productivity = (Parts Produced * Ideal Cycle Time) / available time**
- ***Example:***
- ***A given Work Center is scheduled to run for an 8-hour (480-minute) shift with a 30-minute scheduled break and 60 Min unplanned Downtime***
- ***available Time = 450 Min Scheduled – 60 Min Unscheduled Downtime = 390 Minutes***
- ***The Standard Rate for the part being produced is 600 Units/5 hr (300 min).***
- ***Cycle time 0.5 Minutes/Unit.***
- ***Productivity = 600x0.5 / 390 = 76.9%***

Quality Calculation

- **Quality = (Units produced - defective units) / (Units produced)**
- ***Example:***
- **242 Units are produced. 21 are defective.**
- **(242 units produced - 21 defective units) = 221 units**
- **221 good units / 242 total units produced = 91.32%**

OEE Time Chart

82% **Quality** = Fully Operating Time / Net Operating Time

X

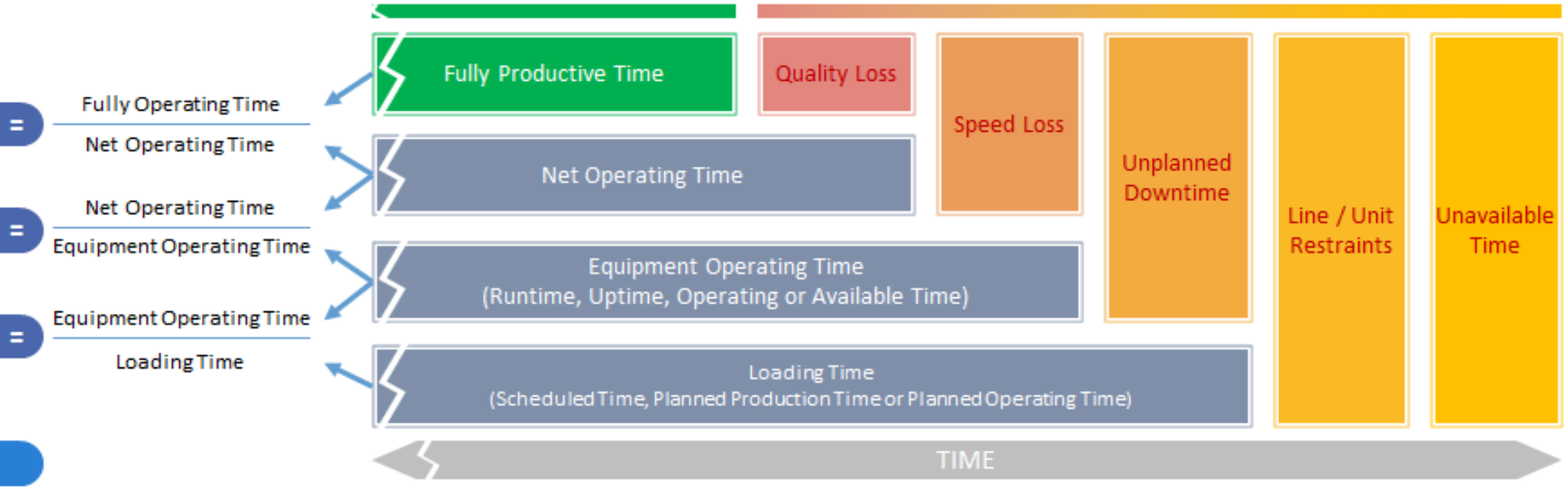
57% **Performance** = Net Operating Time / Equipment Operating Time

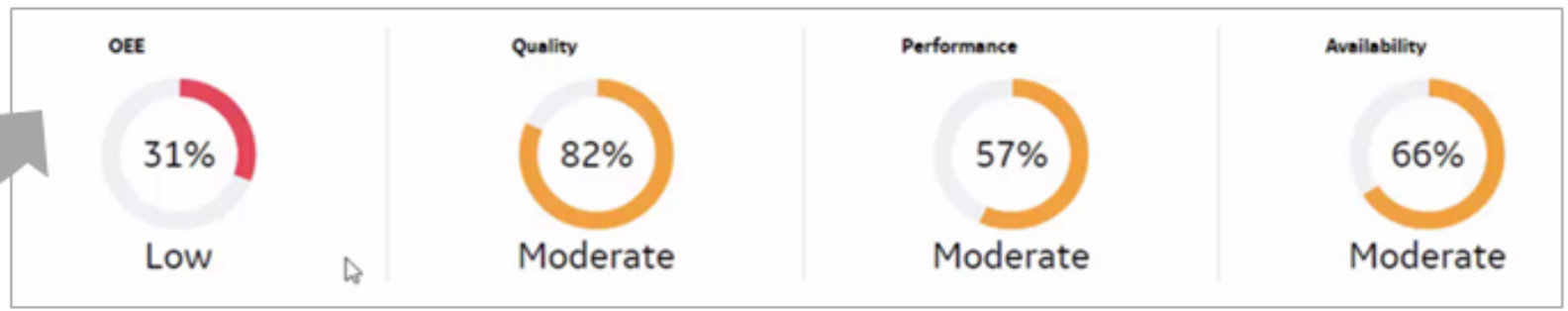
X

66% **Availability** = Equipment Operating Time / Loading Time

=

31% **OEE**





Actual Plant Applications screen

OEE Case Study

- Chemical company producing chemical with maximum capacity of 438,000 Tons/Yr.
- Product Price per Ton is 600 $
- Variable Cost per Ton is 350 $

2012 Financial Information

- Revenue: $ 157,811,400
- Total Cost: $ 146,525,600
- Profit: $ 11,285,800
- Capital Employed: $ 165,781,000
- ROE = 6.81%

Findings

- ~2,000 Hrs. of Breakdown every year
- ~48,000 Tons decrease in annual production capacity due to Process Restrictions
- ~26,000 Tons of off-spec product every year

2012 Technical Information

- Availability = 6,745 / 8,760 = 77%
- Productivity = 289,032 / 337,260 = 86%
- Quality = 263,019 / 289,032 = 91%

- OEE = 77% * 86% * 91% = 60%

Data Analytics Insights

- Maintenance effectiveness calculations showed that Routine Inspection Program for Process Piping Network was not strictly followed.

- Systematic monitoring of Bad Actors (based on both Failure Rate and Maintenance Cost) proofed that Process Pumps are the main contributor for unplanned downtime.

- Continuous Condition Monitoring of Reformer Temperature gave a clue that the process restriction is due to Refractory damage.

Data Driven Decisions

- Commitment to the Preventive Maintenance Plan for Process Piping Network and conducting RCA for Process Pumps Failures improved Breakdown from ~2,000 Hrs. to ~1,500 Hrs. per year

- Scheduled Refractory Replacement based on the Reformer Temperature profile decreased Process Restrictions from ~48,000 Tons to ~30,000 Tons

- Off-spec production maintained at ~26,000 Tons/Yr. with the increase of actual production throughput

2014 Technical Information

- Availability = 7,271 / 8,760 = 83%
- Productivity = 333,366 / 363,540 = 92%
- Quality = 306,697 / 333,366 = 92%

- OEE = 83% * 92% * 92% = 70%

2014 Financial Information

- Revenue: $ 184,018,000
- Total Cost: $ 163,385,000
- Profit: $ 20,633,000
- Capital Employed: $ 168,402,000
- ROE = 12.25%

Financial Impact

	2012	2014
OEE	60 %	70 %
Revenue:	$ 157,811,400	$ 184,018,000
Total Cost:	$ 146,525,600	$ 163,385,000
Profit:	$ 11,285,800	$ 20,633,000
Capital Employed:	$ 165,781,000	$ 168,402,000
ROE	6.81 %	12.25 %

MES Benefits

- **Benefits from successful MES implementation might include:**
  1. **Reduced waste, re-work and scrap, including quicker setup times.**
  2. **More accurate capture of cost-information (e.g. labor, scrap, downtime, and tooling)**
  3. **Increased uptime**
  4. **Incorporate paperless workflow activities**
  5. **Manufacturing operations traceability**
  6. **Decreases downtime and easy fault finding**
  7. **Reduced inventory, through the eradication of just-in-case inventory**

MES Implementation Success Factors

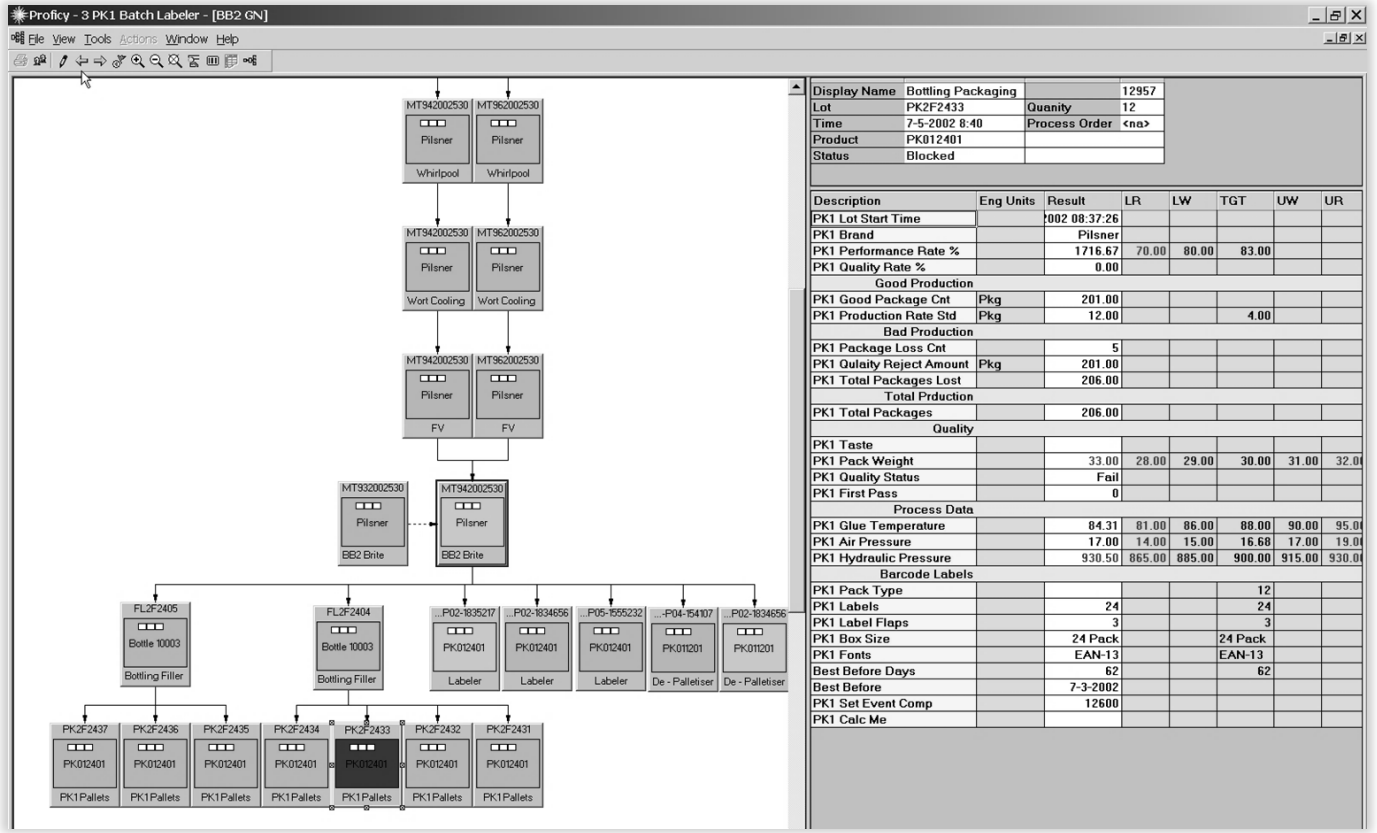
- Determine the KPI to identify the most important influencing factors for the competitiveness, to form the models and to reflect the reality operationally on the models
- information on the entire production process including logistics is available and can be intervened as automated as possible in the process - an integration task that should not be underestimated.
- Only a team of experienced and well-trained engineers from different disciplines can help here, who really know production, logistics and information processes. Without such a dedicated team, operational excellence cannot be fully implemented and, hence, achieved.

MES Management Modules

- Production management
- Quality management
- Batch analysis.
- Efficiency management.

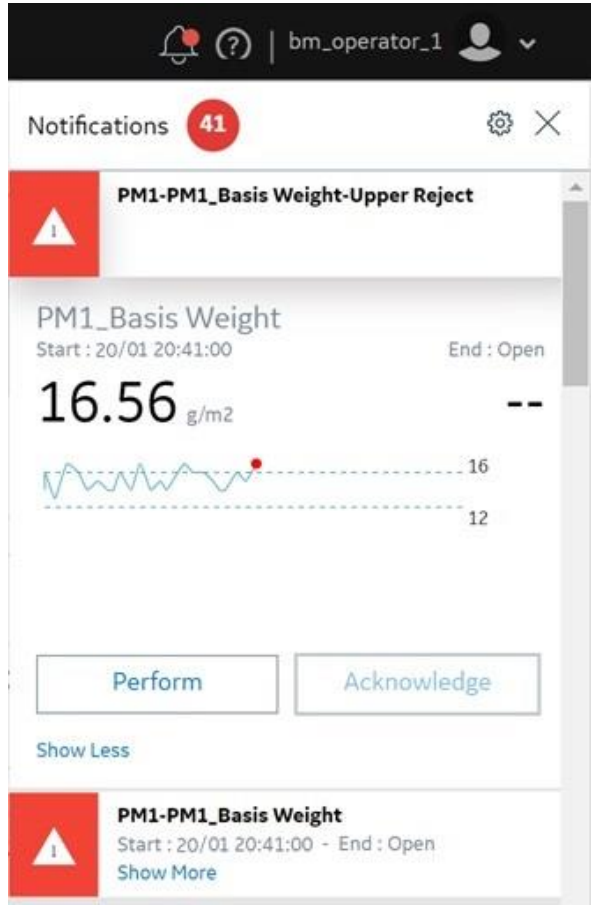
Production management

- Track and trace genealogy of products
- Production schedule execution and tracking
- Order dispatch from schedule
- Monitor consumption of resources



Quality management

- Condition-based quality management with MES
  - Real Time product & process quality analysis & control
  - Alarms based on conformance limits
  - KPIs and dashboards
  - Etc.

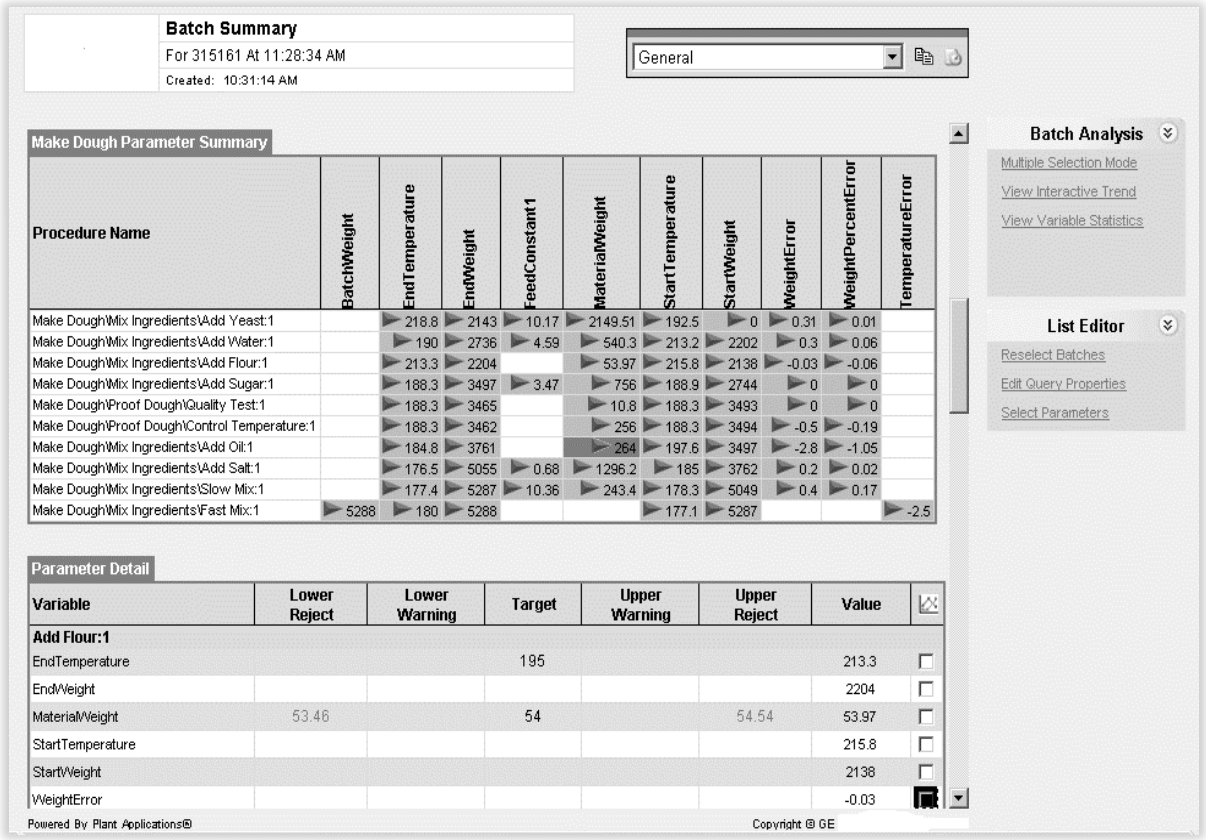


Benefits

- **"Right First Time"**
- Improved product quality
- Lower production waste, scrap & recall cost

Batch analysis

- Batch analysis and reporting according to ISA-88
- Electronic batch records
- Add to both new and existing systems
- Analysis of scheduled and completed batches



Efficiency Management

Track and monitor Production Performance & other KPIs

- OEE & Uptime
- Track downtime, waste and production counts
- Automatically or manually associate events with causes

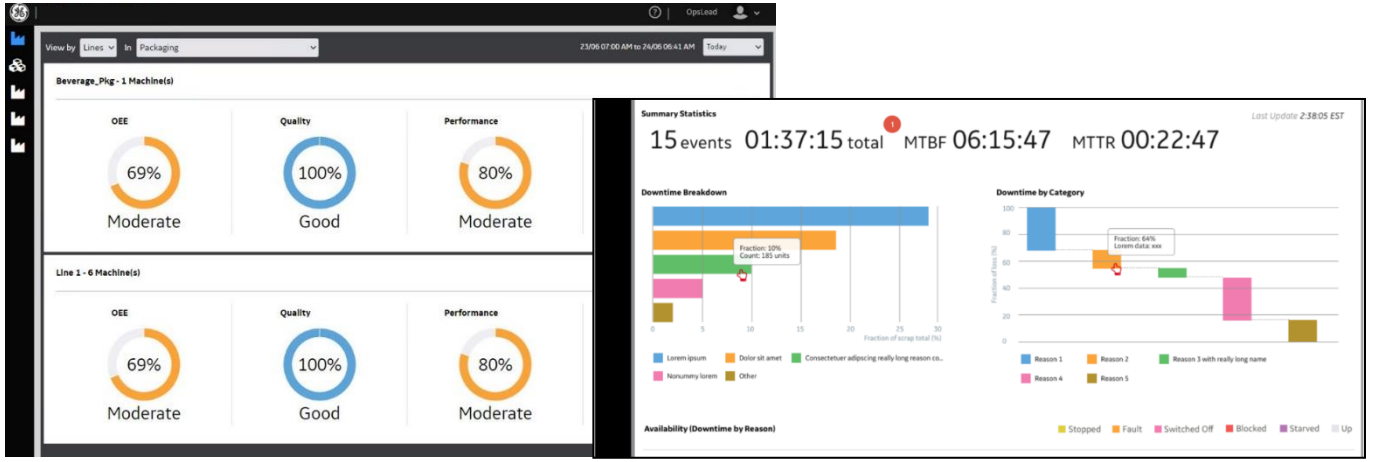
Analyze equipment effective-ness to identify root causes

- Summarize & analyze data by context
- Correlate events and reasons to actual production parameters

Standard & reports, dash-boards for R/T decision-making

- Analysis and visualization
- Detailed Production data for long term analysis

- Reduce unplanned downtime
- Minimize Loss in production
- Improve Labor Efficiency



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Thank You

Digital transformation