APM and MES Applied in Manufacturing

Better Together
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Presenting this session

Steve Garbrecht
Director of Product Marketing, Manufacturing
Key Levers that Drive Enterprise Value objectives in Manufacturing

**INCREASE REVENUE**
- Increase uptime & reliability
- Increased Production Throughput
- Increased Asset Utilization

**REDUCE OPEX**
- Optimize material, services and labor efficiency
- Reduced spare part costs
- Reduced material inventory
- Reduced maintenance costs
- Reduced utility costs

**ROI/TCO**
- Optimize Cap-X
- Negotiate Favorable SLAs
- Extend Equipment Life
- Make Lease or Buy Decisions

**REDUCE OPERATIONAL RISK**
- Improve safety and compliance
- Minimal injuries
- Minimal penalties
- Minimal environmental impact and emissions
## Business Benefits

*APM solutions provide end-to-end value*

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Percentage Range</th>
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<tbody>
<tr>
<td>EH&amp;S Incident Reduction</td>
<td>3-40%</td>
</tr>
<tr>
<td>Increased Availability</td>
<td>2-6%</td>
</tr>
<tr>
<td>Reduction in Reactive Maintenance</td>
<td>10-40%</td>
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<tr>
<td>Inventory Cost Reduction</td>
<td>5-10%</td>
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<tr>
<td>Gain in Employee Productivity</td>
<td>5-25%</td>
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<tr>
<td>Reduction in IT Total Cost of Ownership</td>
<td>5-25%</td>
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### APM Manufacturing Value Points from ARC Research

<table>
<thead>
<tr>
<th>Industry Area</th>
<th>Problem</th>
<th>Result</th>
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<tbody>
<tr>
<td>Packaging</td>
<td>Minimize losses due to breakdown</td>
<td>Productivity up 15-20%, set up times reduced 20%</td>
</tr>
<tr>
<td></td>
<td>Alleviate field service burden</td>
<td>More than 80% of breakdowns diagnosed online with remote monitoring</td>
</tr>
<tr>
<td>F&amp;B Processing</td>
<td>Reduce product giveaway</td>
<td>Checkweigher monitoring reduced product giveaway in six months</td>
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<tr>
<td></td>
<td>Unable to meet target production rate</td>
<td>Real time analytics proved that slowing machine speed by 30% increased resulted in 100% increase in output</td>
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<tr>
<td></td>
<td>Unacceptable material variances</td>
<td>Weight controls have resulted in negative material variance averaging $40K per month</td>
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<tr>
<td>Machinery</td>
<td>Reduce field service calls by OEM</td>
<td>Improved first-time fix rate by 5% with data collection &amp; analysis, also enabled development of MTBF knowledge base</td>
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<tr>
<td></td>
<td>Reduce energy consumption</td>
<td>Remote monitoring of air compressors delivered 15% reduction in energy consumption within 5 months</td>
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<tr>
<td>Pharma Process</td>
<td>Lubrication-enhancement program</td>
<td>Downgrade from 46 lubricants to eight oils &amp; four greases</td>
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<tr>
<td></td>
<td>Integrated compliance management</td>
<td>20-25% reduction in engineering effort</td>
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How do you maintain your assets today?

- You can do maintenance **only when things break**, but when they do, it may **upset production** and profit.
- You can perform **maintenance based on a schedule**, but you may be doing **unneeded work**, which **increases costs**.
- A more **optimal scenario** is where you can **identify failures before they happen** and only **perform the maintenance required to meet the reliability needs** of your specific plant.
GE Digital Portfolio

Asset Performance Management (APM)
Optimize Asset Performance

Automation & MES
Optimize the Process

ServiceMax
Optimize Service Execution

PREDIX
Optimize IT and OT

End to end approach connecting across the asset value stream
Analytics and Cyber Security
Cloud Infrastructure Agnostic
APM Covers the Spectrum: People, Process, and Technology

- Strategy
- Risk
- Analytics + Action
- Operations & Maintenance

- Change Strategy (Interval)
- Optimize Plan
- Drive Work (repair)
- Connect / Collect

- Criticality
- Failure Modes
- Damage Mechanisms

- Re-evaluate Risk

- Sensor Data / Alerts / Events
- Inspection Data / Alerts / History Events
### Current GE APM & OPM Offering

#### Asset Performance Management

**Reliability Management**
- Achieve less unplanned downtime by predicting equipment issues before they occur.
  - Predictive analytics
  - Case and collaboration management
  - Knowledge management
  - Root cause analysis
  - Reliability analysis

**Compliance and Integrity Management**
- Ensure asset integrity and compliance by monitoring changing risk conditions.
  - Hazard analysis
  - Safety lifecycle management
  - Risk based inspection
  - Inspection management
  - Thickness monitoring

**Asset Strategy Optimization**
- Optimize across availability, reliability, risk, and costs through intelligent asset strategies.
  - Reliability centered maintenance
  - Failure mode and effects analysis
  - Strategy management
  - Strategy library
  - Lifecycle cost analysis
  - Financial and risk simulation

#### Operations Performance Management

- Increase revenue and margin by optimizing the efficiency and throughput of your operations.
  - Performance & Financial KPIs
  - Loss Analysis
  - Process troubleshooter
  - Process Optimization
  - Performance benchmarking

### Anytime, anywhere, unified view of your assets’ current state and health.

**Machine and Equipment Health**
- Connectivity
- Data management
- EAM integration
- Condition monitoring
- Data analysis and visualization
- Criticality analysis
- Event management
- Recommendation management
- Reliability Benchmarking
Where should you focus first?

Cost of failure is high

Utilities

Intense regulatory pressure

Capacity constrained

Inspection & calibration challenges
Without knowledge of how your equipment is actually performing, your only choice is to rely on your OEM’s generic specifications.

OEM Specs Bearing Inspection every 500 Run Hours

5 Hours Maintenance at $300/hour (Two Technicians)

6 inspections per year

Based on actual bearing performance, Inspection interval extended to 1,000 hours

Inspection costs cut in half= $4,500 per wrapper per year savings

30 plants with 5 wrappers per plant= $675K per year for just this piece of equipment

How many types of equipment could you apply this to?
## How APM complements your MES

<table>
<thead>
<tr>
<th>Manufacturing Needs</th>
<th>How MES helps – equips operations</th>
<th>How APM Helps – equips maintenance</th>
</tr>
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<tbody>
<tr>
<td>Reduce labor – lights out manufacturing</td>
<td><strong>Send signals</strong> to control systems to dynamically adjust line speed, machine settings and material routing</td>
<td>Provides monitoring tools to <strong>better understand equipment condition. Condition based vs Time based Maintenance.</strong></td>
</tr>
<tr>
<td>Increase efficiency</td>
<td><strong>Provides end to end view of line and equipment efficiency; can alert or change status of product or equipment based on efficiency metrics</strong></td>
<td>Switches maintenance from <strong>break-fix to planned. More easily anticipate best time to bring machine down.</strong></td>
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<tr>
<td>Increase throughput</td>
<td><strong>Releases schedule</strong> to the plant floor for execution at each stage of production to ensure operators can plan and prepare, thus reducing planned downtime like changeover times and setup. Also used to control product flow/routes in real-time.**</td>
<td>For operations that are <strong>capacity constrained,</strong> improved reliability results in <strong>increased throughput</strong></td>
</tr>
<tr>
<td>Control quality</td>
<td>Provides a way to control quality at each stage. <strong>Puts product on hold</strong> due to off spec issues and prevents it from further processing. Can <strong>change the status</strong> of an asset due to quality issues so no further scrap is incurred.</td>
<td>Understanding equipment conditions that led to off spec product can allow you to <strong>identify predictors of bad quality.</strong> APM can detect when equipment is starting to fail where some of these failures <strong>effect quality.</strong></td>
</tr>
<tr>
<td>Ensure Food Safety</td>
<td><strong>Interface for operator checks</strong> and LIMS results as well as process information provides complete <strong>traceability of product</strong> from end to end.</td>
<td>FDA is focusing on preventative measures for food safety control and equipment reliability. <strong>Maintenance procedures enforced and managed for compliance.</strong></td>
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</tbody>
</table>
## Questions answered by MES and APM

<table>
<thead>
<tr>
<th>Sample Questions</th>
<th>Answers from MES</th>
<th>Follow-up Questions</th>
<th>Answers from APM</th>
</tr>
</thead>
<tbody>
<tr>
<td>What’s the top cause of line 2 downtime?</td>
<td>Filler</td>
<td>How can I improve filler reliability?</td>
<td>Adjust maintenance schedule to prevent unplanned faults.</td>
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<td></td>
<td><strong>Asset Strategy Optimization (ASO)</strong></td>
</tr>
<tr>
<td>What are the most common faults on the filler and when do they occur?</td>
<td>Motor protector fault – occurs most when running Product A</td>
<td>Why is this fault occurring?</td>
<td>When motor current &amp; vibration exceed x and rate set-point is y, historically faults occur. <strong>Machine &amp; Equipment Health, Reliability Management (RM)</strong></td>
</tr>
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</tr>
<tr>
<td>Where am I incurring most waste and why?</td>
<td>At filler due to breakage</td>
<td>How can I predict breakage?</td>
<td>Breakage occurs when filler rate exceeds x and capper bearing temp exceeds y. <strong>Machine &amp; Equipment Health</strong></td>
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<tr>
<td>What are my ideal machine settings?</td>
<td>Based on SPC analysis of quality, filler and labeler should be set at x rate when running product A.</td>
<td>What effect do these settings have on filler maintenance requirements?</td>
<td>When running at x rate for product A, filler motor bearings will need lubrication more frequently. <strong>Asset Strategy Optimization (ASO)</strong></td>
</tr>
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GE’s Manufacturing Solution Map

**Operations Performance Management**
- Increase revenue and margin by optimizing the performance and throughput of your plants, product lines and enterprise
  - Real-time business KPIs and predictive alerts
  - Decision support for pricing and configuration
  - Optimized processes and operations

**Automation Solutions**
- Unify visibility and coordination of your current operations state & health
  - SCADA
  - Historian
  - Mobil Solutions
  - Workflow
  - Alarm/Event Management
  - Reporting
  - L1/L2 Process Control

**MES Solutions**
- Improve quality, production and efficiency of any manufacturing process
  - Geneology
  - Conveyor routing control
  - Request material delivery
  - Order Execution Management
  - Downtime Tracking, OEE
  - Traceability / Genealogy
  - Waste Tracking and more

**APM Solutions**
- Increase asset reliability & availability while reducing asset-related cost and risk in operations
  - Current State of Asset Health
  - Achieve less unplanned downtime
  - Ensure Asset Integrity & Compliance
  - Optimize Maintenance Strategies

**Service Solutions**
- Improve mobile service workforce productivity
  - Work Planning and Scheduling
  - Technical Enablement
  - Work order debrief
  - Entitlements & Logistics
How to approach – GE APM Discovery Workshop

**Definition & Process**

**Complimentary collaborative process to assess your company’s business and provide actionable recommendations to achieve outcomes**

**The Process:**

- **Duration:** 2-day in-person workshop
- **Commitment:** Attendance by key business and technical personnel
- **Preparation:** 1-hour prep meeting to discuss goals, capabilities, current initiatives, barriers, people impacted by decisions
- **Discussion topics:** business processes, conditions affecting your business, assets & infrastructure, maintenance history and strategy

**Workshop Outputs**

A comprehensive **Value Discovery Report** that includes:

- Economic justification document
- Outcome map identifying your goals, KPIs, barriers
- Maturity model that defines your current and desired states for your main focus areas
- Value case summary
- Solution Architecture diagram(s)