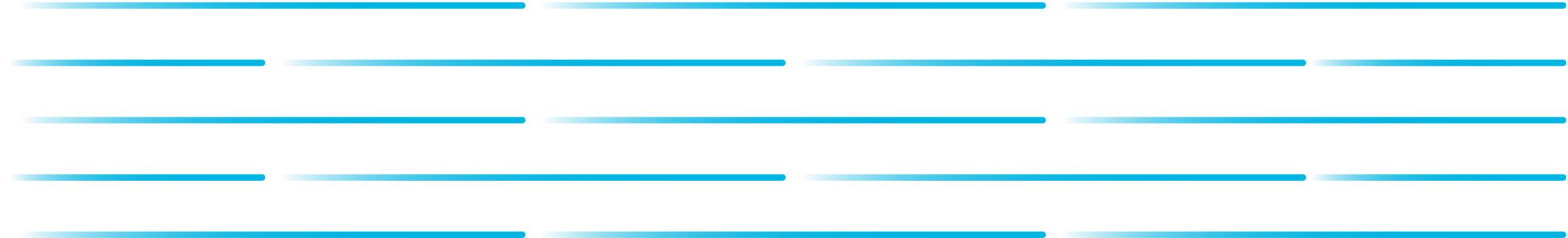




# APM and MES Applied in Manufacturing

Better Together



# Safe Harbor Statements

This document contains "forward-looking statements" within the meaning of the Private Securities Litigation Reform Act of 1995. Forward-looking statements may be identified by words such as "expects", "anticipates", "intends", "plans", "believes", "seeks", "estimates", "will" or words of similar meaning and include, but are not limited to, statements about the expected future business and financial performance of GE. Forward-looking statements are based on management's current expectations and assumptions, which are inherently subject to uncertainties, risks and changes in circumstances that are difficult to predict. Actual outcomes and results may differ materially from these expectations and assumptions due to changes in global political, economic, business, competitive, market, regulatory and other factors. We undertake no obligation to publicly update or review any forward-looking information, whether as a result of new information, future developments or otherwise.

The information presented is intended to be an outline of general product direction and it should not be relied on in making a purchasing decision. The information on the roadmap is for information purposes only, and may not be incorporated into any contract and is not a commitment, promise or legal obligation to deliver any material, code, or functionality. The development, release, and timing of any features or functionality described for our products remains at our sole discretion.



# Presenting this session

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**Steve Garbrecht**

Director of Product Marketing, Manufacturing

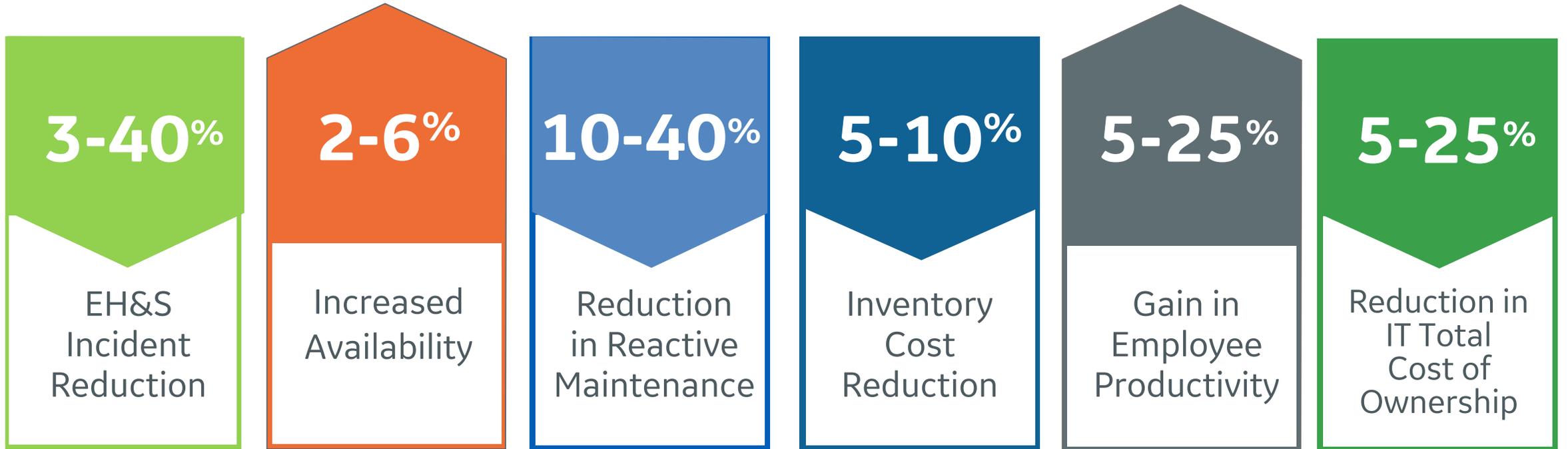


# Key Levers that Drive Enterprise Value objectives in Manufacturing



# Business Benefits

APM solutions provide end-to-end value



# APM Manufacturing Value Points from ARC Research

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



# 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 **unnecessary 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

**Right work at the Right Time**



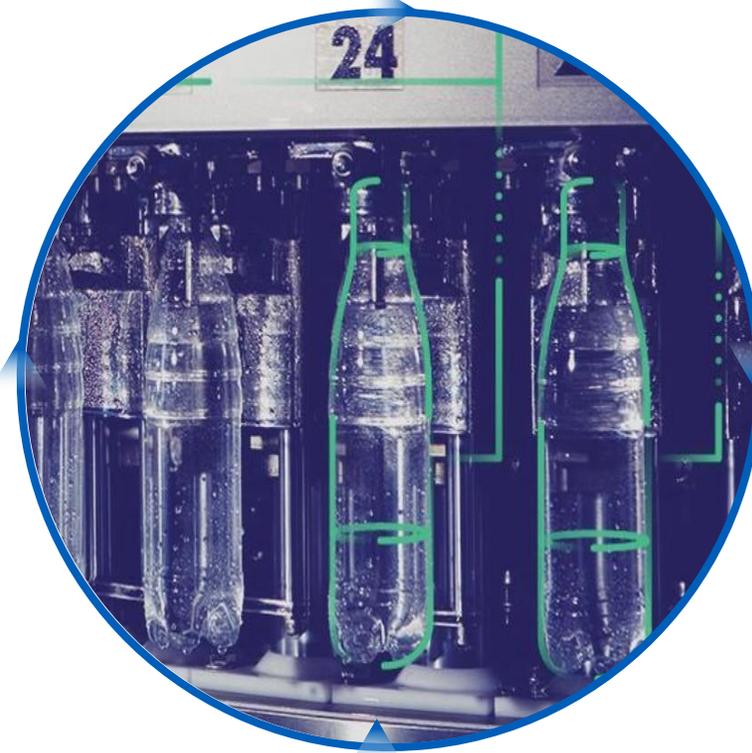
# GE Digital Portfolio

## Asset Performance Management (APM)

Optimize Asset Performance

Automation  
& MES

Optimize the  
Process



Optimize  
Service  
Execution

ServiceMax

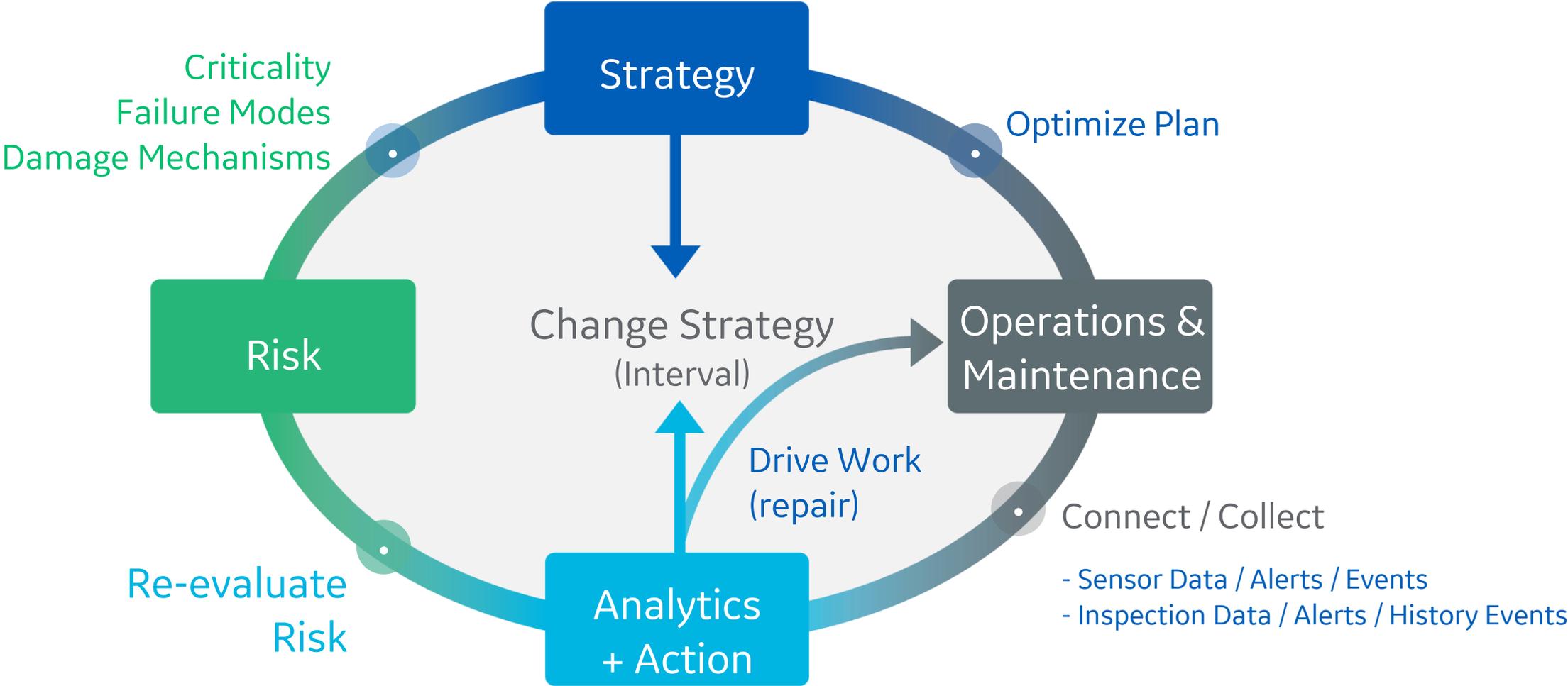
**PREDIX**

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





# 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



### Machine and Equipment Health

**Anytime, anywhere, unified view of your assets' current state and 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**



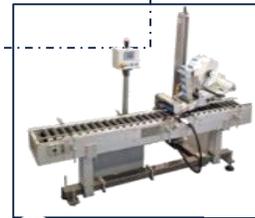
Utilities



**Intense regulatory pressure**



**Capacity constrained**



**Inspection & calibration challenges**



# Improving Planned Maintenance

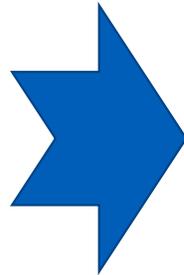
Without knowledge of how your equipment is actually performing, your only choice is to rely on your OEM's generic specifications



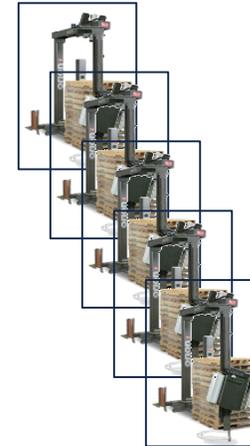
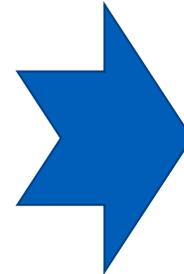
OEM Specs Bearing  
Inspection every  
500 Run Hours

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

6 inspections per  
year



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



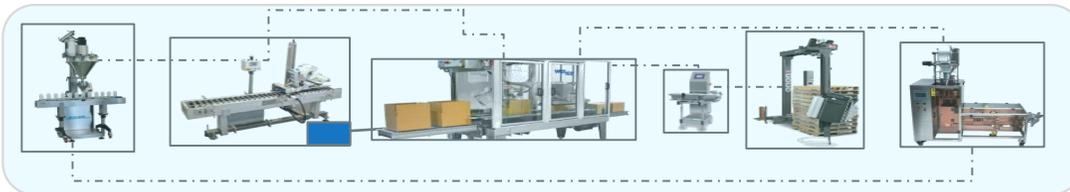
Inspection costs cut  
in half= \$4,500 per  
wrapper per year  
savings

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?



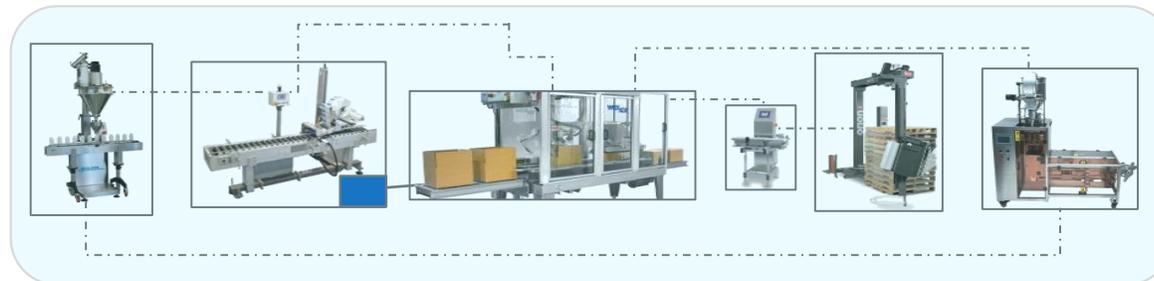
# How APM complements your MES

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



# Questions answered by MES and APM

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



# GE's Manufacturing Solution Map

**PREDIX**

## 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**

- Genealogy
- 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)



