

Automating the Control Plan from the PFMEA

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Gary Capron

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MTS, Control of Manufacturing Manager

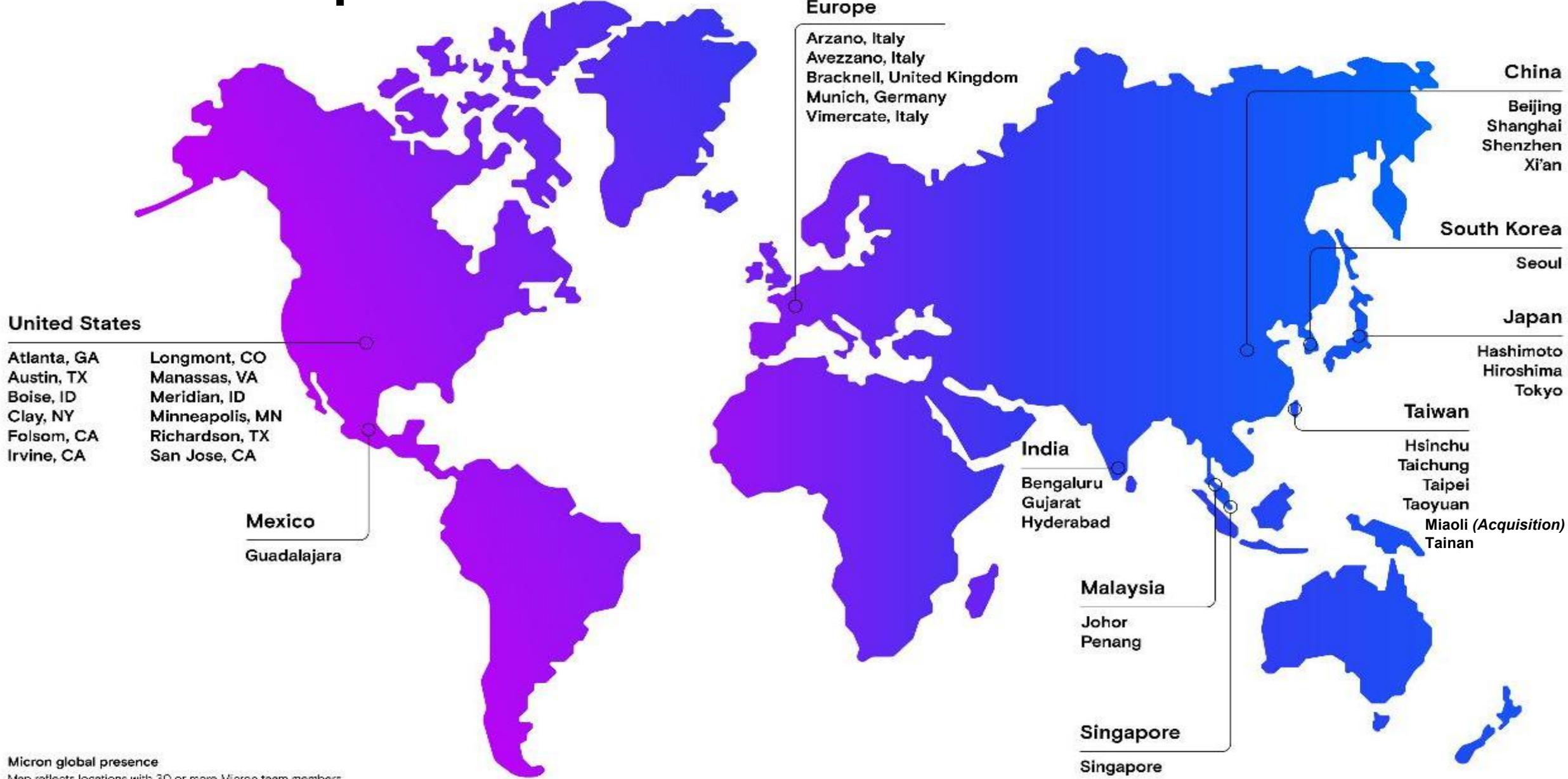
John Vernon

Micron Technology

MTS, Central Quality



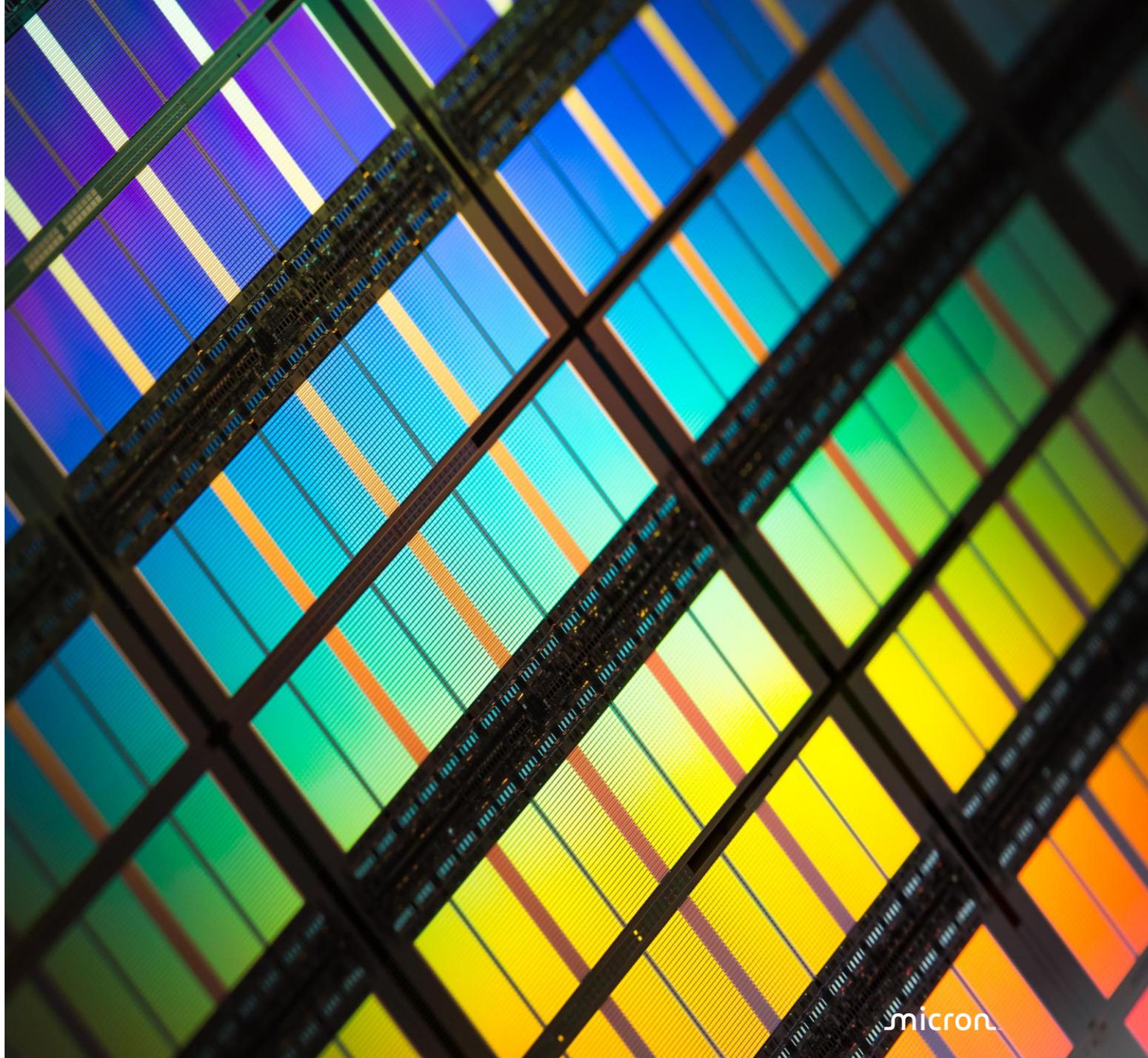
Micron Footprint



Micron global presence
Map reflects locations with 30 or more Micron team members

Topics

- Characteristics of Highly Automated Environments
- Control Plan Roadmap
- Advanced Process Control
- Automated Control Plan
- Artificial Intelligence enhanced FMEA/CP

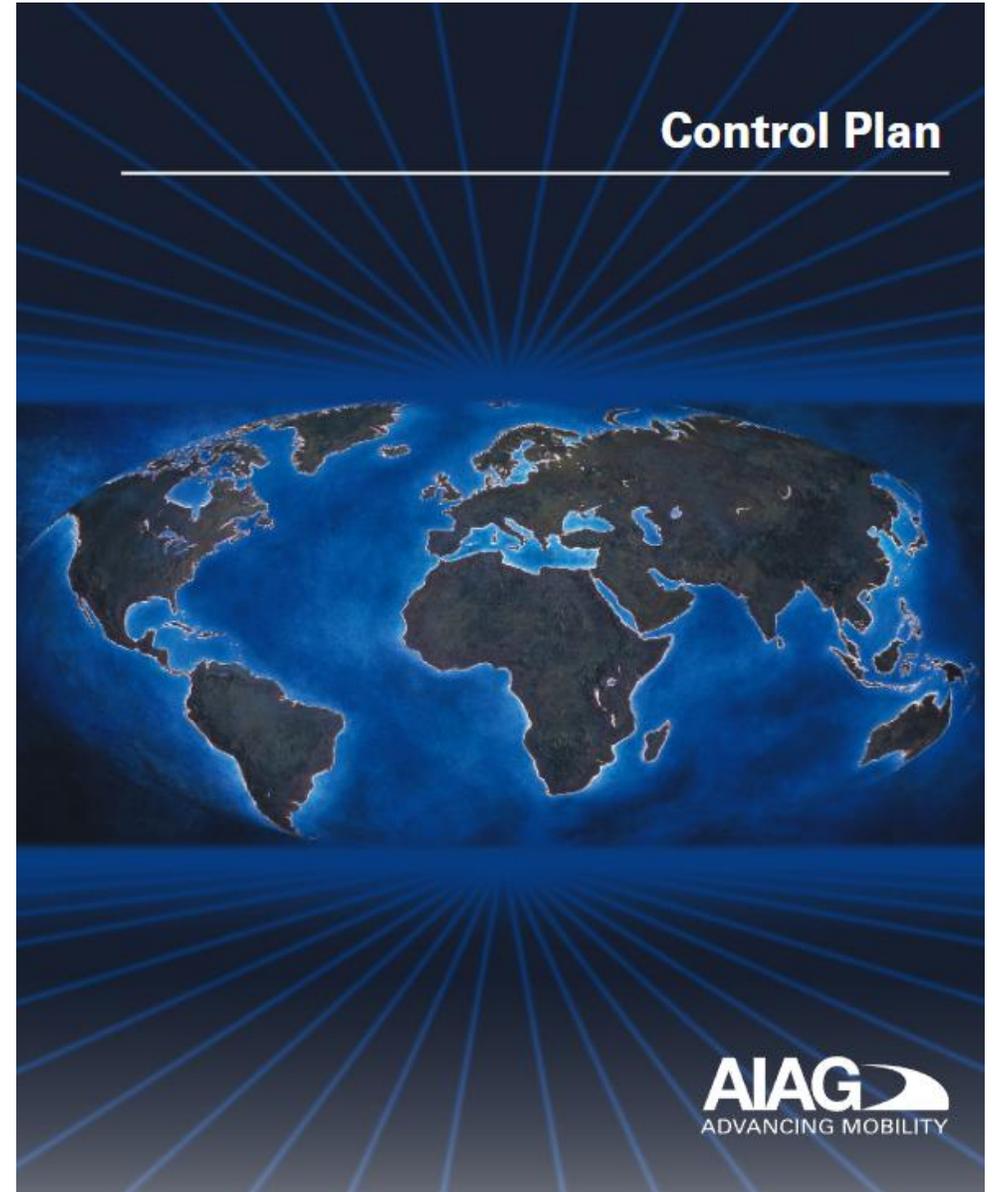


Time for a Poll

- Which statement best describes the Control Plan at your organization?
 - The definitive manufacturing floor guide & process change consulting tool
 - A living document
 - A necessary evil to pass the audit
 - A paper tiger that wastes resources

AIAG – (Automotive Industry Action Group) Control Plan – 1st Edition

- Released March 2024
- Includes a new chapter on “Effective Use of Control Plans”
- Recognizes the use of “Control Plans in Highly Automated Processes”



Characteristics of Highly Automated Processes

such as the Semiconductor Industry

Minimal Human Element

- Manufacturing operations have very little human interaction.

Processes managed by MES (manufacturing execution system)

- Processes will have self adjusting parameters using feedback loops to stay on target.

Automated Handling Systems

- Product is transported between workstations by automated handlers and robots.

Control Systems defined in MES

- Control methods (measurement tool, sample size, frequency, control limits, gage, reaction plans) are defined and housed within the Manufacturing Execution system.

Dynamic Control Plan

- The Control Plan is critical
 - minimize variation in the process
 - ensure every process output is in a state of control
- Control Plan uses Feedback/Feedforward loops
 - variation at any process step can result in non-conforming product
 - continually drive processes to target
- Control Plan is very dynamic
 - A “traditional” control plan cannot accurately portray the details of dynamic control strategy that Micron requires to control our advanced processes



Control Plan Roadmap



Past

Paper Control Plan

Impossible to keep the paper control plan in sync with how the process was running



Today

Control Plan with Linkages to Systems

Control data is stored in the MES system that configures the control.

Control plan says “refer to XXX system”

(Sanctioned Interpretation #24)



Future

Automated Control Plan

Dynamic columns updated real-time from Mfg sites (pinging the actual source of information)

Controls defined in the FMEA and managed in the MES system, control plan is always in-sync

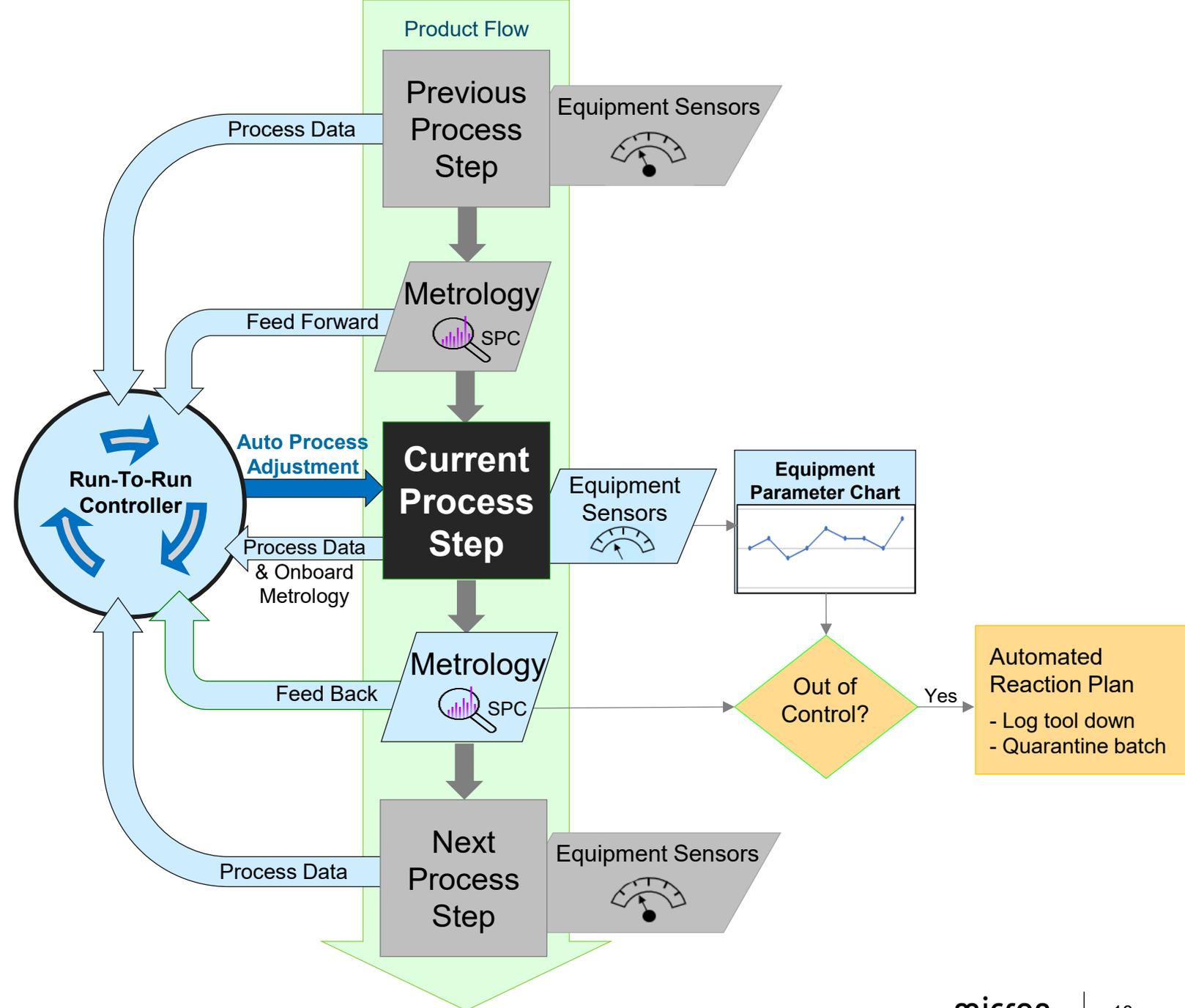
Can produce a compliant view at any time.

AI Enhanced FMEA



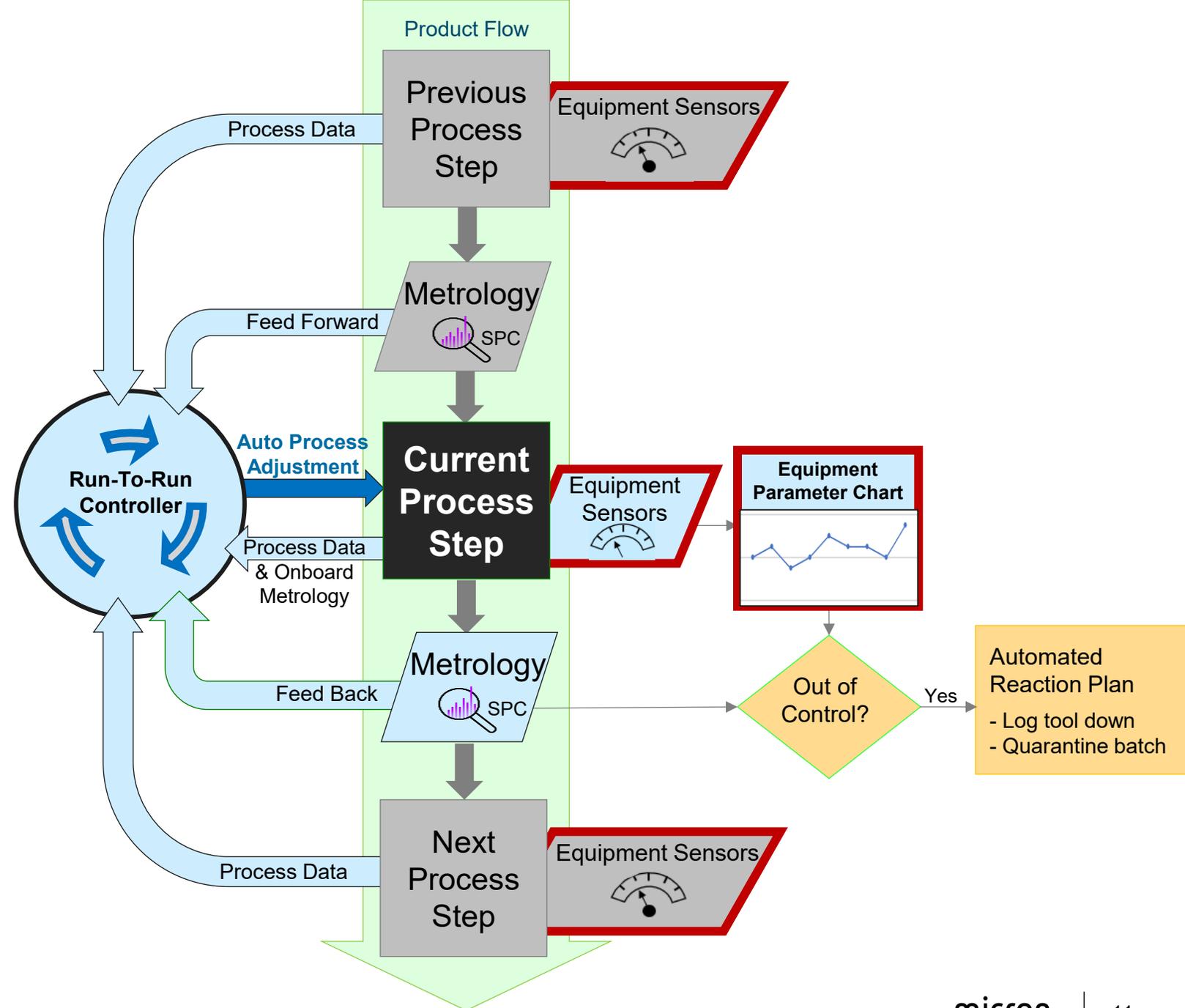
APC – Advanced Process Control

- APC process control strategies are always driving the process to target.
 - Feed Forward and Feed Back loops constantly feed data to the controller to adjust the process.



Equipment Centric Process

- Automated processes may be very sensitive and dependent on the equipment performance.
- Monitoring the equipment performance is, by extension, monitoring the process.



Automated Control Plan

Meta Data	Methods				Reaction Plan	
<ul style="list-style-type: none"> - Part/Process Number - Process Name/Oper. - Mach, Device, Tool - Characteristics <p>Identifying data that can be loaded from the Process Flow Chart or PFMEA</p>	<p>Product / Process / Specification / Tolerance</p> <p>Upper and Lower Control Limits</p> <p>Managed in MES</p>	<p>Evaluations / Measurement Technique</p> <p>Measurement System / Tool</p> <p>Managed in MES</p>	<p>Sample Size Freq</p> <p>Sampling Plan</p> <p>Managed in MES</p>	<p>Control Method</p> <p>Prevention and Detection Controls are defined in the PFMEA.</p>	<p>Action</p> <p>Reaction Mechanism</p> <p>Managed in MES</p>	<p>Owner / Responsible</p> <p>Responsible Role</p> <p>Part of Reaction Mechanism</p>

- Controls are defined in the PFMEA.
- Controls are managed in the MES system.
- Control Plan data is Dynamic, updated real-time from MES system (pinging the actual source of information).
- MES system can deliver an up-to-date control plan in the AIAG Form Sheet format at any time.

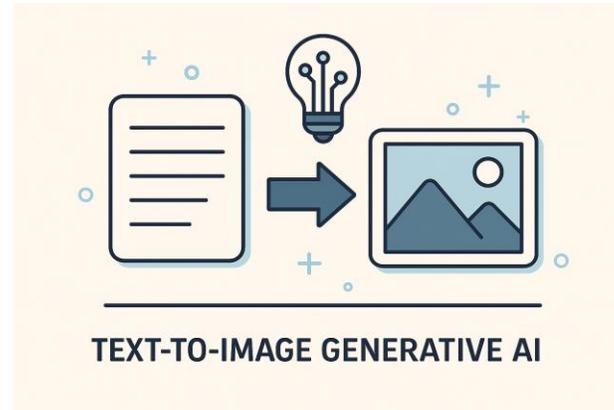
Artificial Intelligence

NLP



- Natural Language Processing
- Understands human language, both written and verbal
- Operates within hard boundaries

Gen AI



- Can convert text to pictures and pictures to text
- Learns patterns from existing data
- Creates new content

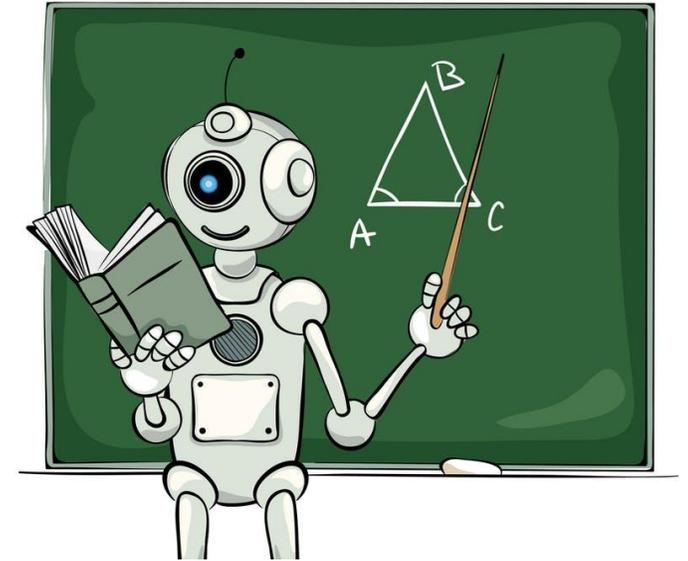
Agentic AI



- Learns
- Remembers
- Acts Autonomously
 - Does not need prompts to act

AI Enhanced FMEA and Control Plan

- Organizations have a huge amount of data.
- AI can link datasets
 - Small scale – using AI on your FMEA dataset to recognize patterns in the FMEA. i.e., severity ratings for similar effects
 - Larger scale – using AI on your manufacturing dataset to recognize patterns on processes. i.e., process X is similar to process Y, what can we learn?



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Q&A



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