



# **Automating the Control Plan in Highly Automated Processes**



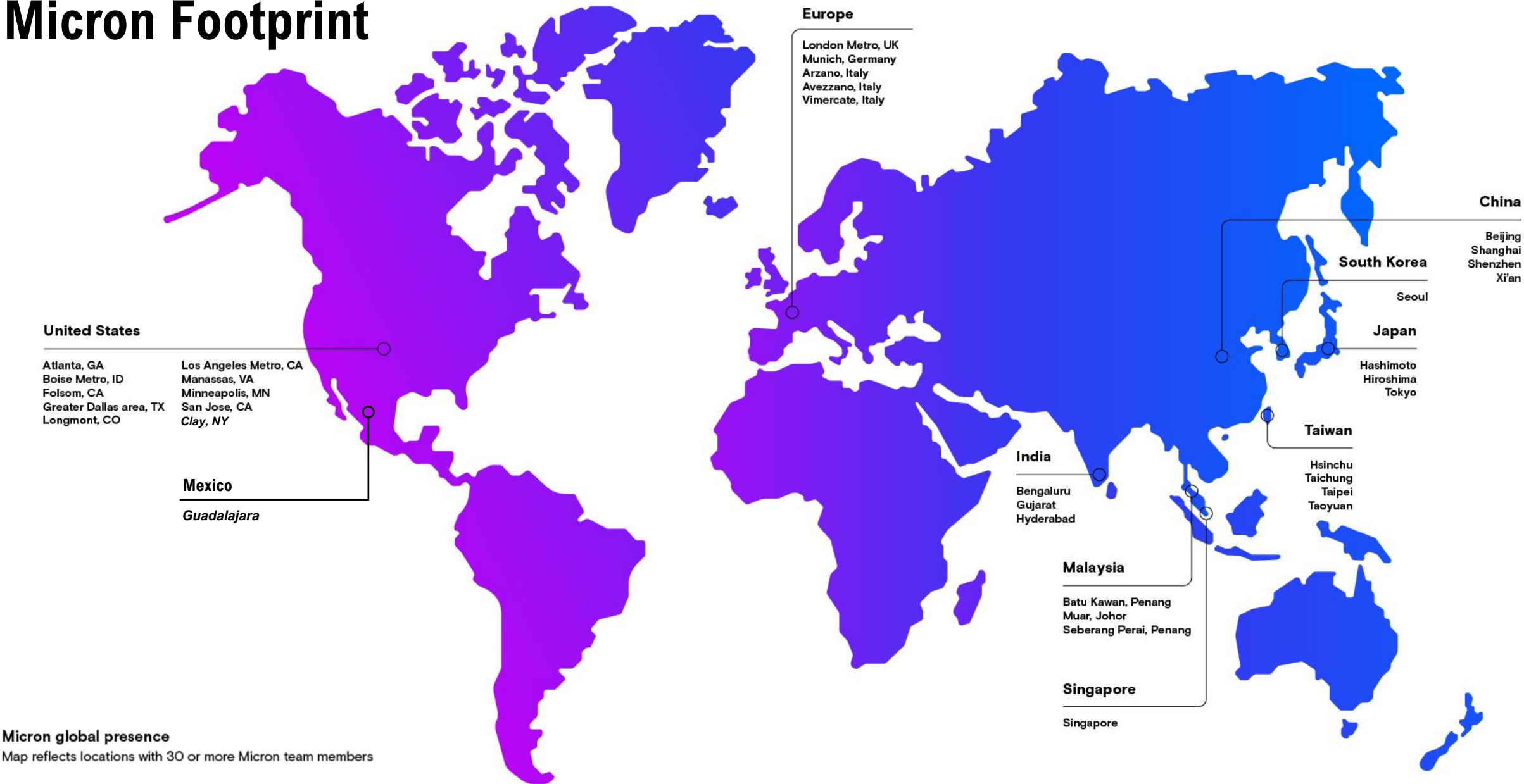
# Gary Capron

Micron Technology

Control of Manufacturing Manager



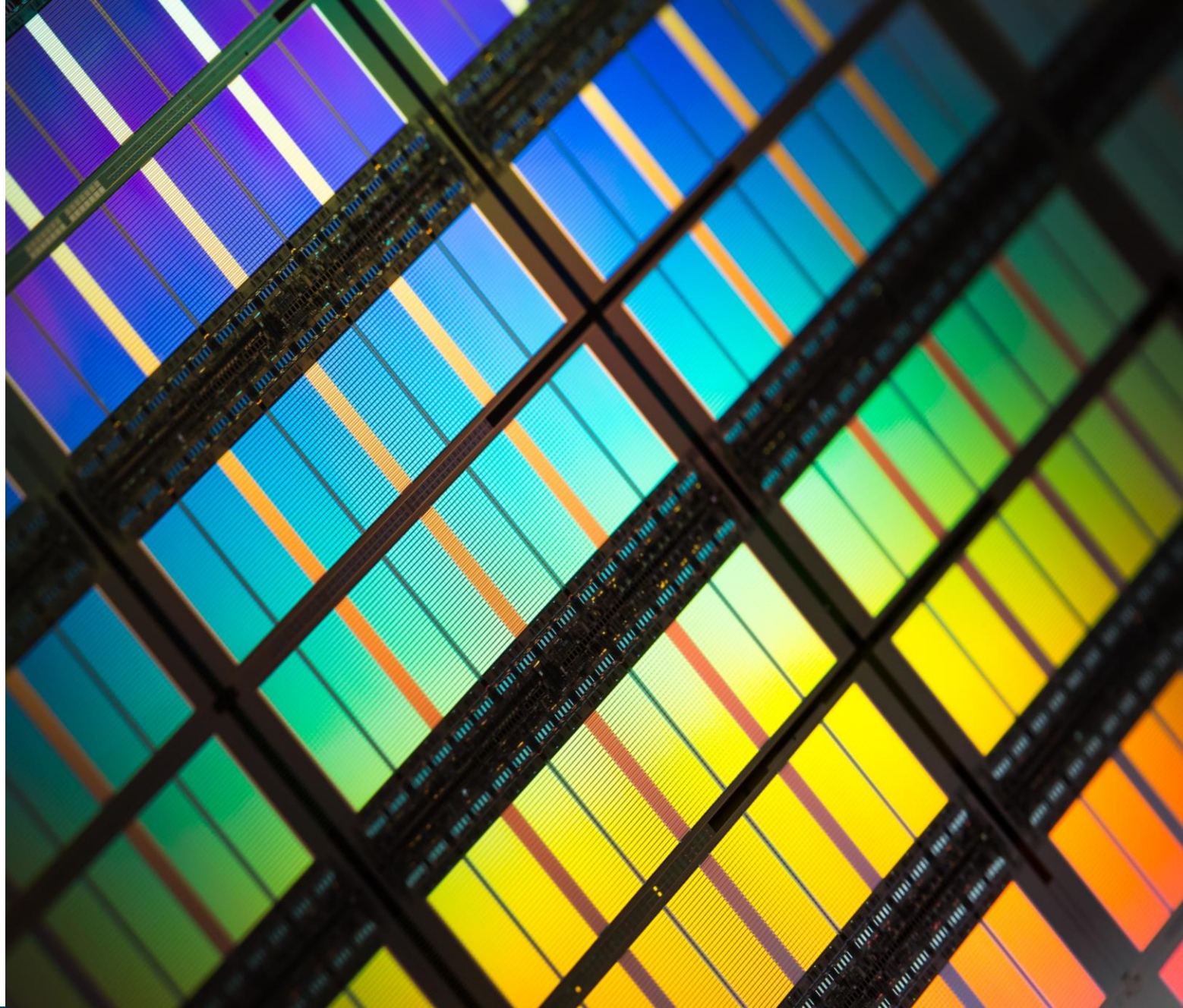
# Micron Footprint



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

# Control Plan – 1<sup>st</sup> 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 controls



# Control Plan Roadmap

9



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

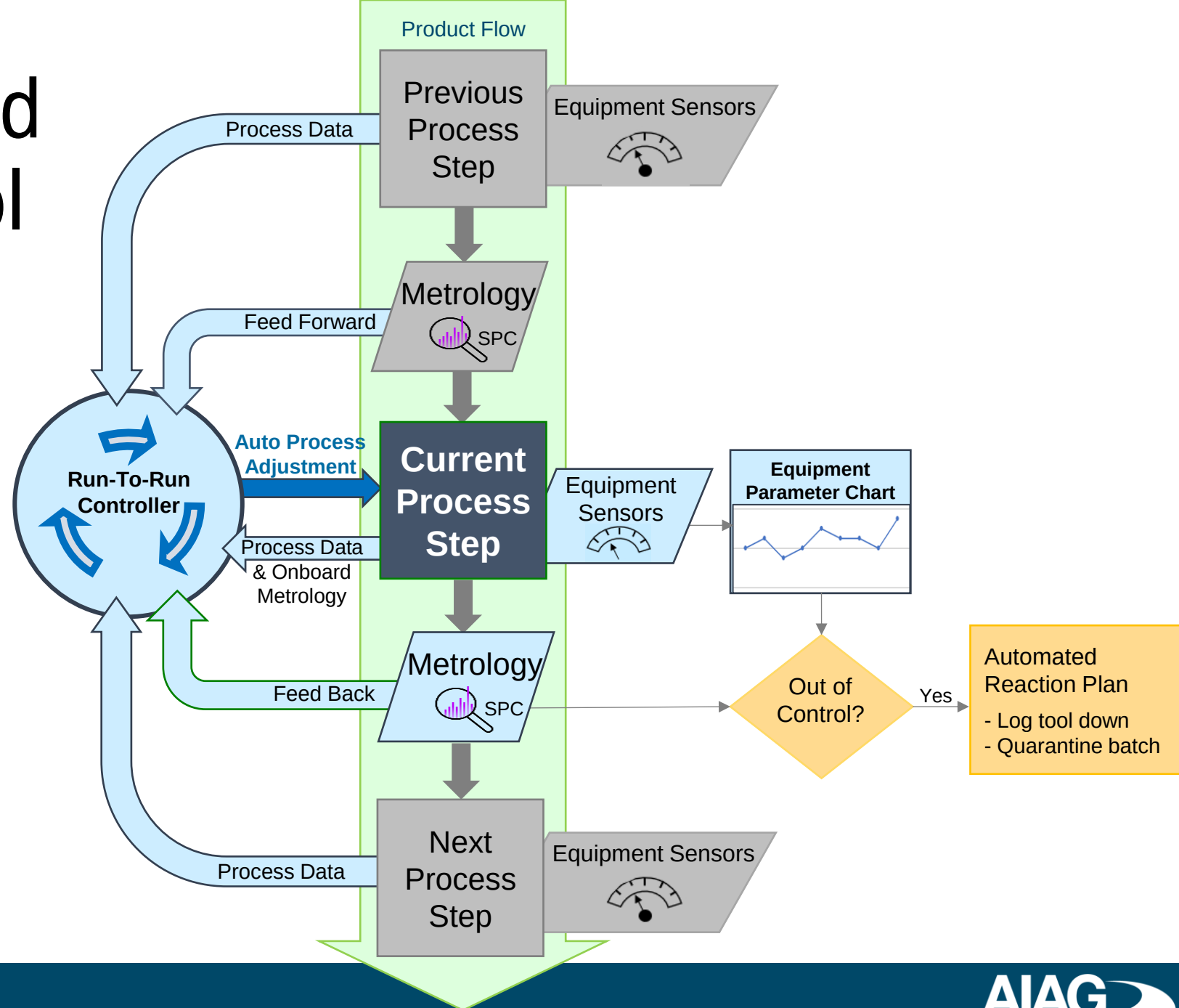
Can produce a compliant view at any time.

AI Enhanced FMEA



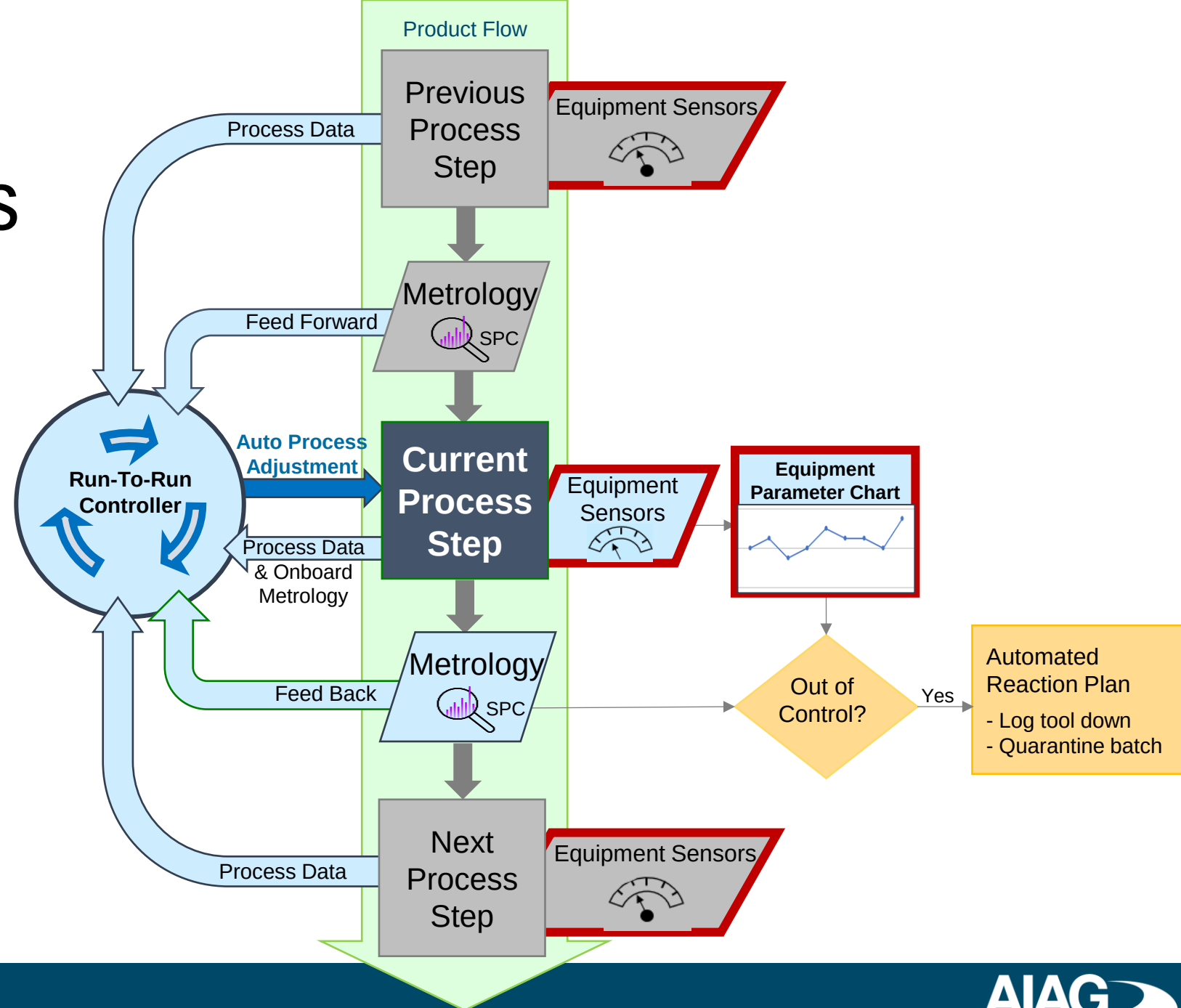
# APC – Advanced Process Control

- 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.



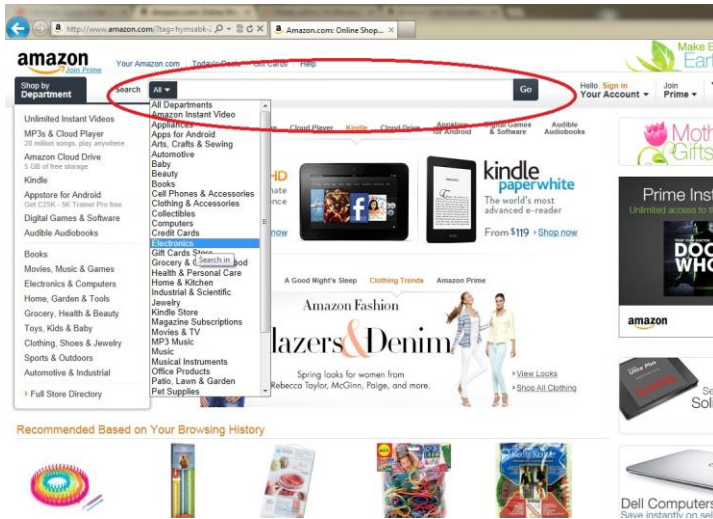
# Automated Control Plan

| Meta Data                                                                                                                                                                                                                                      | Methods                                                                                                          |                                                                                                   |                                                                      |                                                                                                        | Reaction Plan                                                 |                                                                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|--------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"> <li>- Part/Process Number</li> <li>- Process Name/Oper.</li> <li>- Mach, Device, Tool</li> <li>- Characteristics</li> </ul> <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 <b>Controls</b> are defined in the <b>PFMEA.</b></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.

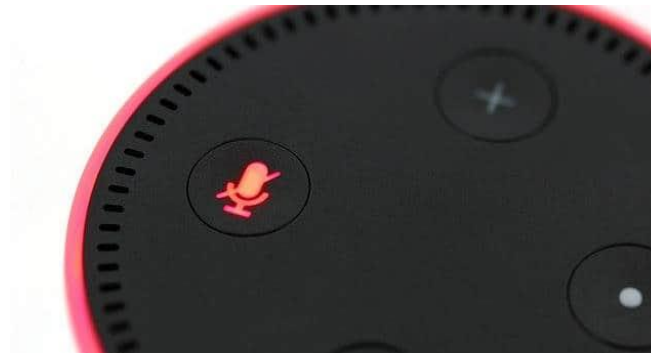
# Artificial Intelligence

## Machine Learning



[This Photo](#) by Unknown Author is licensed under [CC BY-NC-ND](#)

## Natural Language Processing (NLP)



[This Photo](#) by Unknown Author is licensed under [CC BY-NC-ND](#)

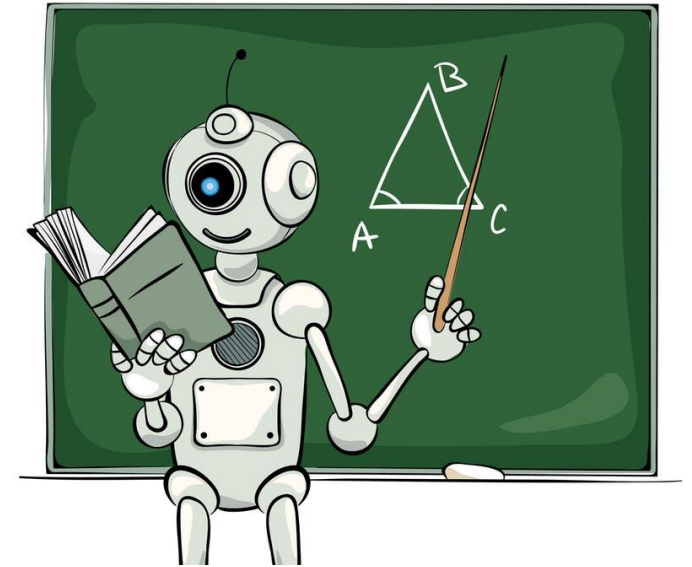
## Graph Analytics



[This Photo](#) by Unknown Author is licensed under [CC BY](#)

# AI Enhanced FMEA

- 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?



[This Photo](#) by Unknown Author is licensed under [CC BY](#)

Q&A

Thank you for your attention!



