
FUJIMI
FUJIMI CORPORATION

FUJIMI CORPORATION

The Future of Materials Quality 'Big Data'

Dr. Andrea C. Oehler
Fujimi Corporation
October 21, 2021

FUJIMI CORPORATION

What is Big Data?

In 2001, Doug Laney summarized the challenges of Big Data management as having three distinct dimensions, introducing the 3V's of Big Data

- Big Data is high-Volume, high-Velocity and/or high-Variety information assets that demand cost effective, innovative forms of information processing that enable enhanced insight, decision making and process automation.

- Veracity, integrity or "truth" of the data or analysis
- Value, big data or its analysis used as an asset

FUJIMI CORPORATION

3V's

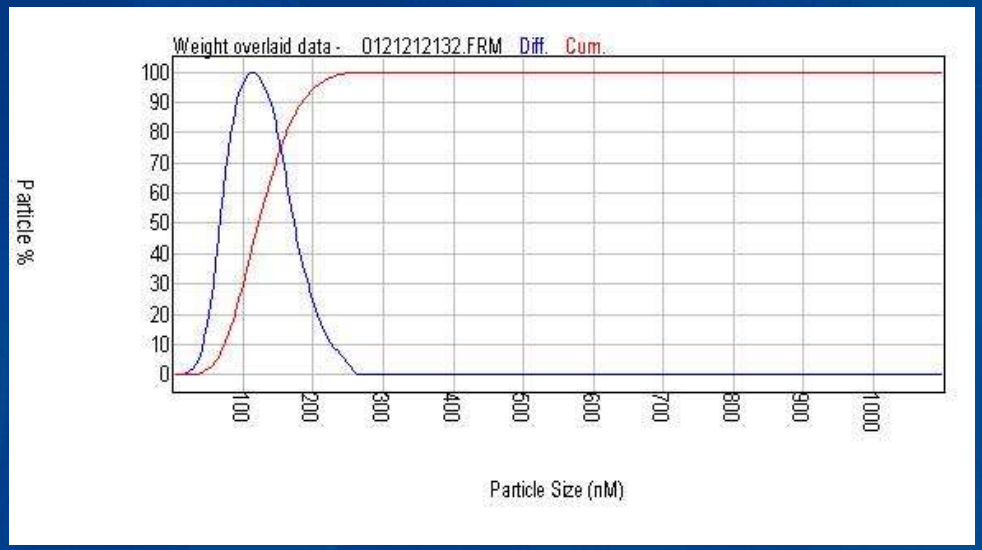
Volume	Variety	Velocity

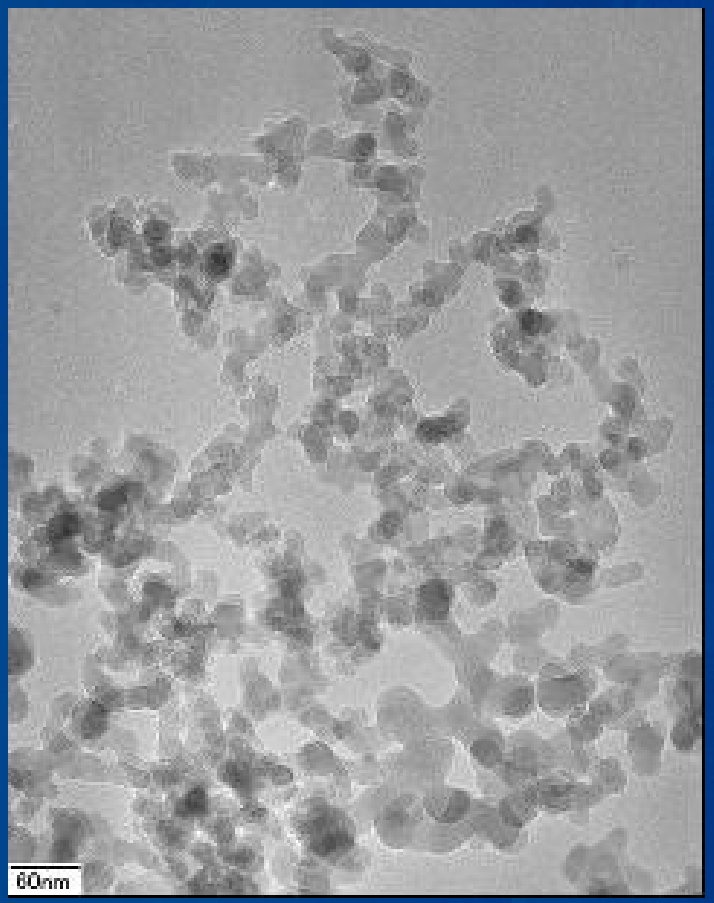
• Internal
  • Manufacturing in process
• External (private)
  • Raw Material
  • Customer performance feedback
  • Local Warehouse
• External (public)
  • Weather
  • Water Quality
	• Structured
	  • Product Analysis
	• Semi-Structured
	  • Raw Material Lots
	  • Customer Qualitative Feedback – Lists of Good/Bad
	• Unstructured
	  • Photos, pictures, sensory characterization
	  • Operator observations, batch notes
		• Very fast
		  • in process censors
		• Fast
		  • Wafer/customer functional performance
		• Slow
		  • Batch Card entries
		• Very slow
		  • Per manufacturing run

CMP Manufacturing Big Data: High-Variety at a range of volume and velocity

FUJIMI CORPORATION

Unstructured Data

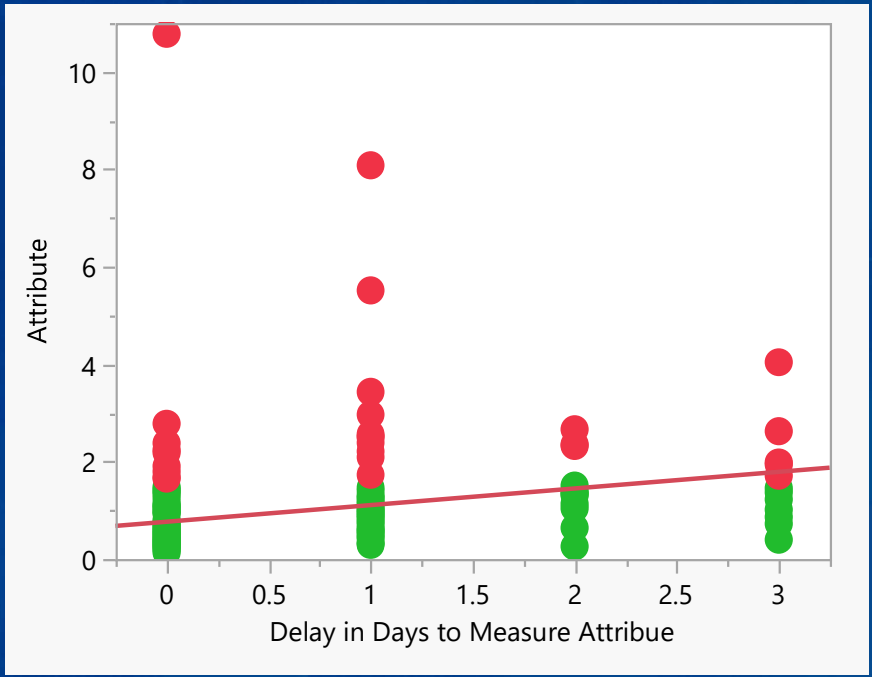


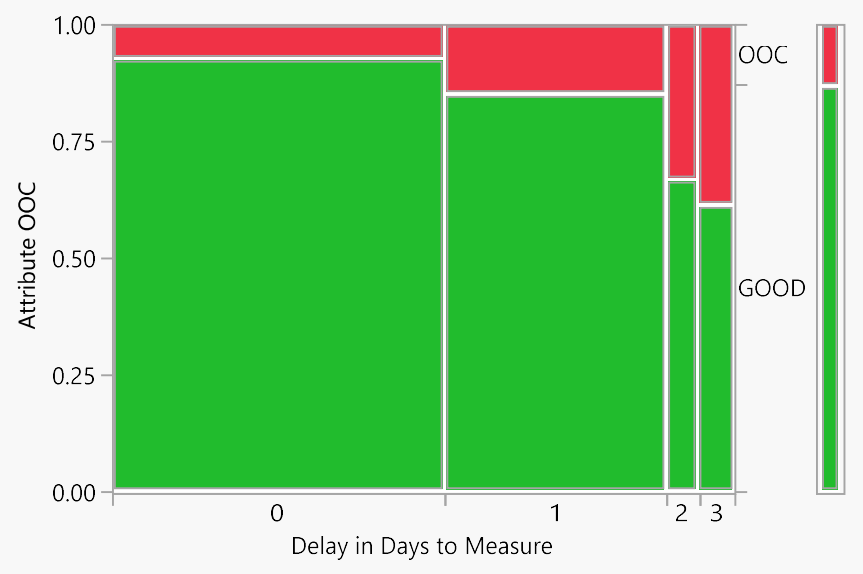


Qualitative Particle Characteristics are Unstructured Data

FUJIMI CORPORATION

Innovative Forms of Information Processing

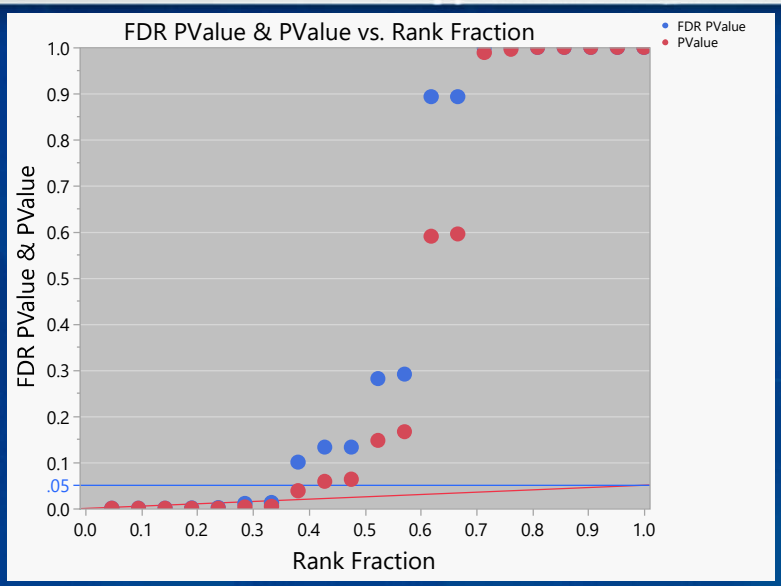


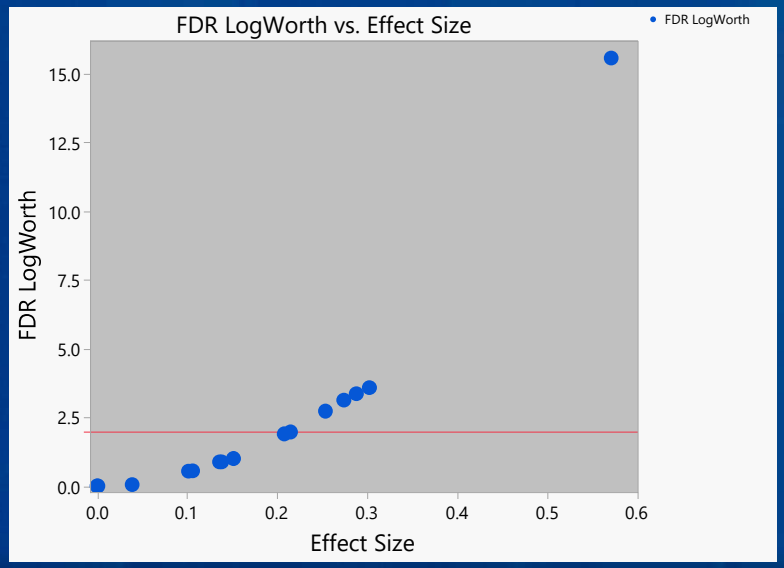


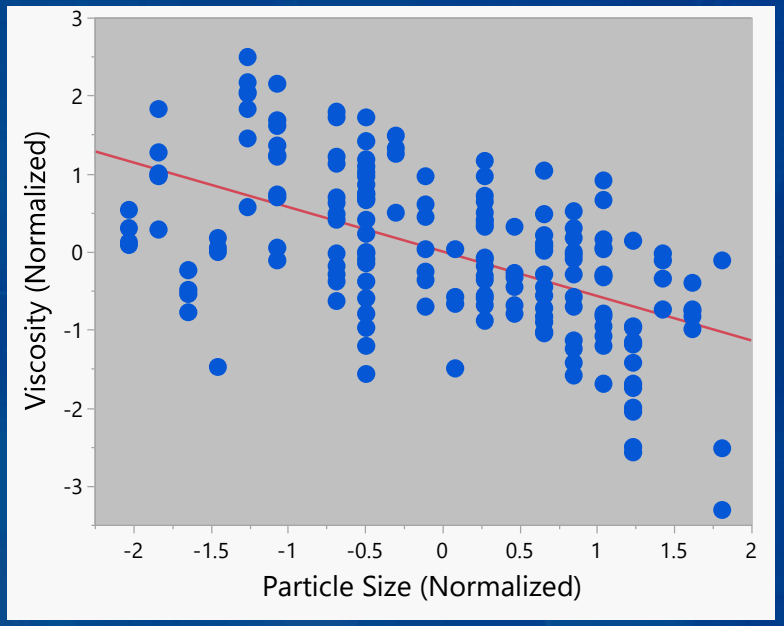
Cell Plot using OOC Characteristics

FUJIMI CORPORATION

Innovative Form of Processing







Response screening is way to look for relationships and avoid p-hacking – identifying false relationships by chance – through FDR p value – False Discovery Rate p-value

Response Screening to Avoid p-Hacking

FUJIMI CORPORATION

Continuous Improvement

PCS - Continuous Improvement through Variation Reduction

- DOE's to identify critical to control parameters
- Metrology variation reduction and improved precision
- Trend Reviews and Investigation

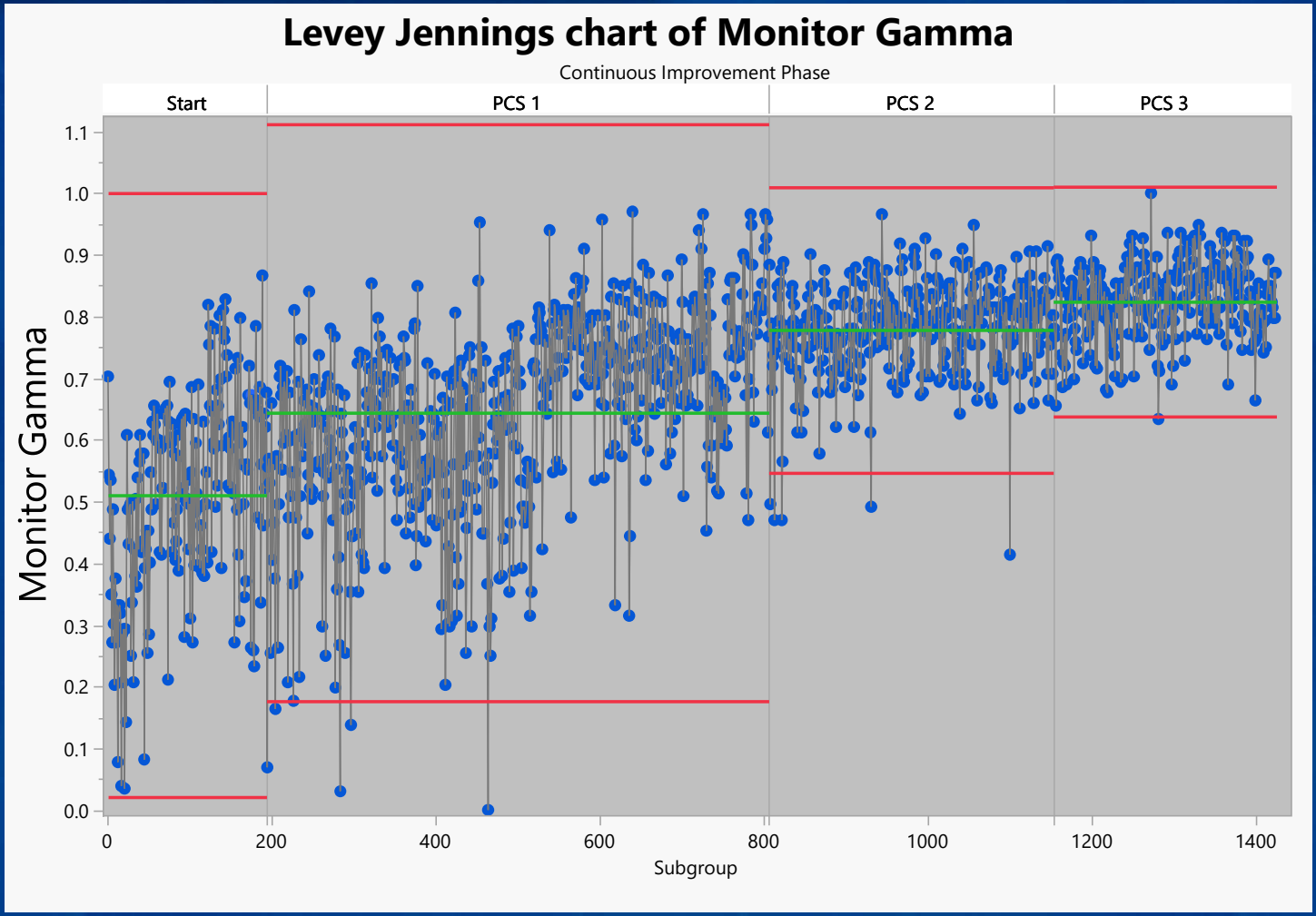
Big Data – Continuous Improvement through Collaboration

- High Variety – Process Settings, Product Monitors, Product Performance
- High Volume – Internal and External sources, Supplier through Customer
- Innovative Forms of Information Processing

Share Big Data to Drive Continuous Improvement

FUJIMI CORPORATION

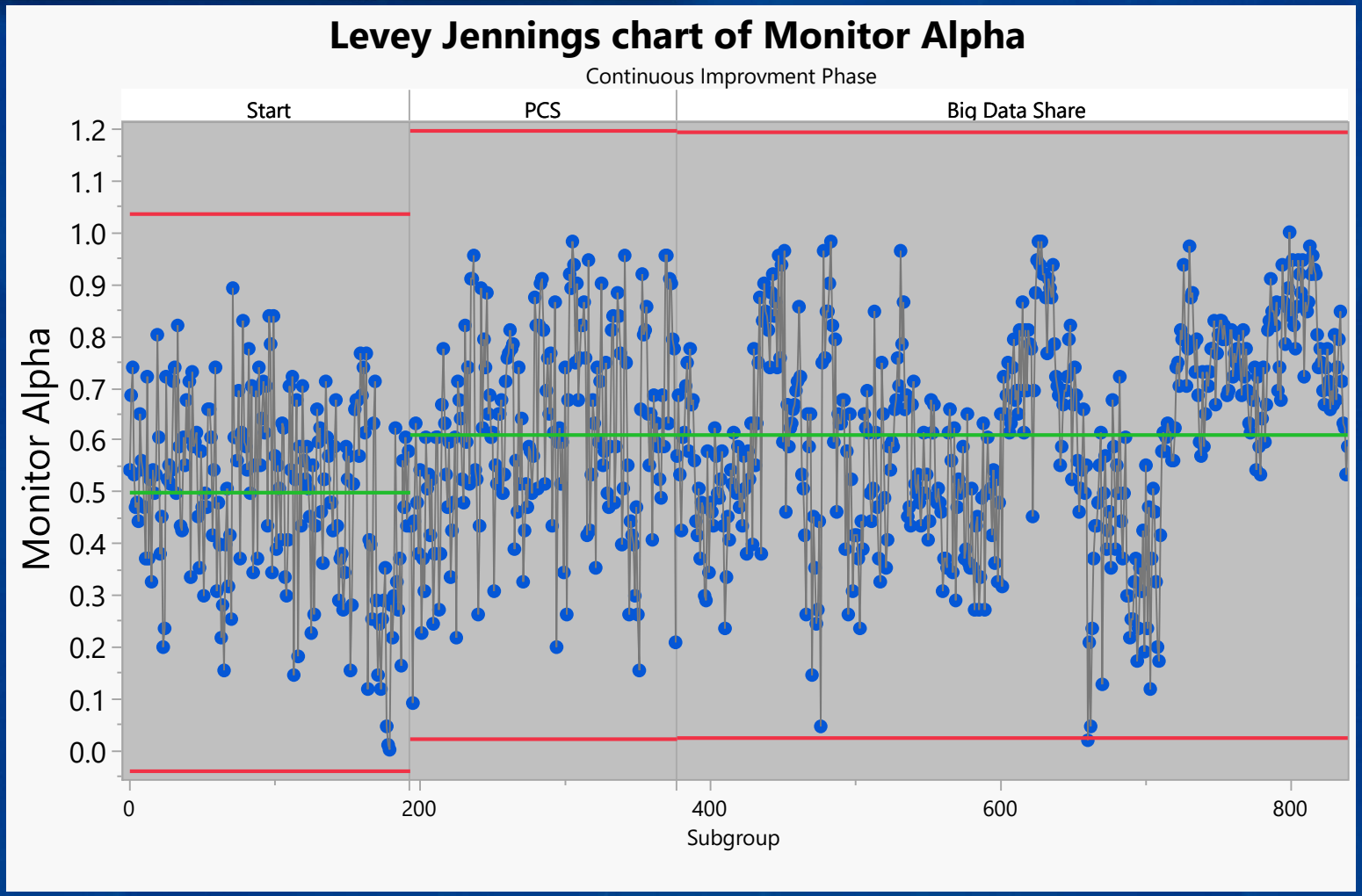
Monitor Gamma



PCS Program Implementation and Continuous Improvement Successful

FUJIMI CORPORATION

Monitor Alpha



Continuous Improvement Not Successful

FUJIMI CORPORATION

Focus on Veracity

Prepare data for Sharing

- Standardizing data $(x-x_{min})/(x_{max}-x_{min})$ or Normalize data $(x-\mu)/\sigma$
- Summarize Data by Lot
- Characterize unstructured data

Remove Noise

- Understand sources of variation such as metrology, applications, environmental conditions
- Identify gaps in data, missing data
- Identify covariates
- Identify inputs versus output

Statistical Techniques

- Scatter Plot Matrix
- Response Screening for False Discovery Rate

"The signal is the truth. The noise is what distracts us from the truth" – Nate Silver

Validate Models

- Apply expertise and experience
- Validate causation versus correlation

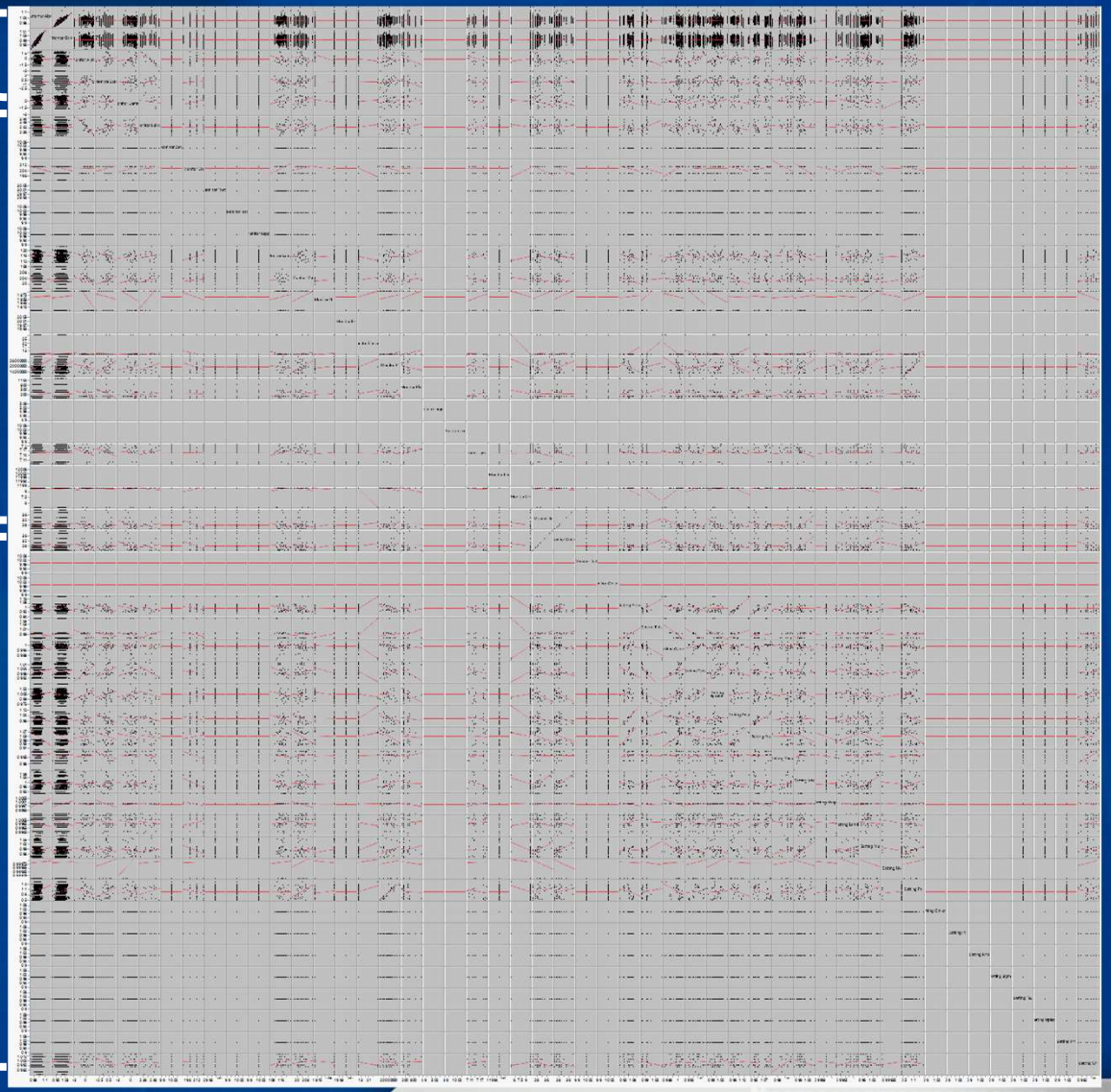
FUJIMI CORPORATION

Scatter Plot Matrix

Customer Response
Including; C_α, C_β

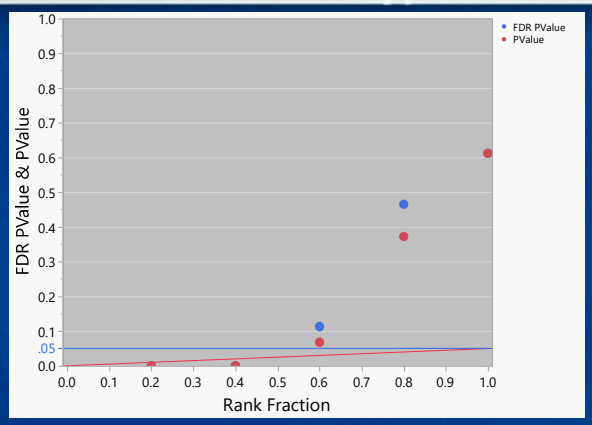
Product Monitors
Including; M_α, M_β, M_γ, M_δ

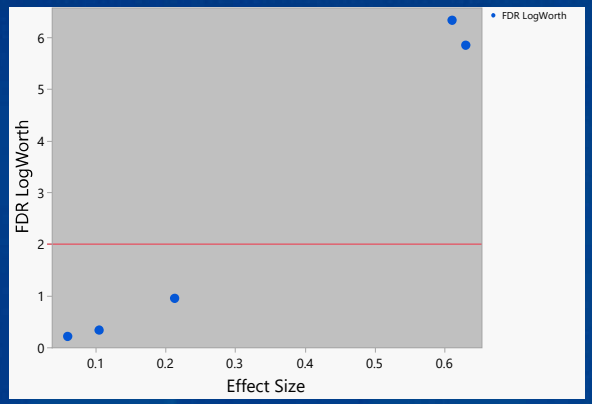
Supplier
Settings and Monitors
Including; S_α, S_β, S_γ, S_δ



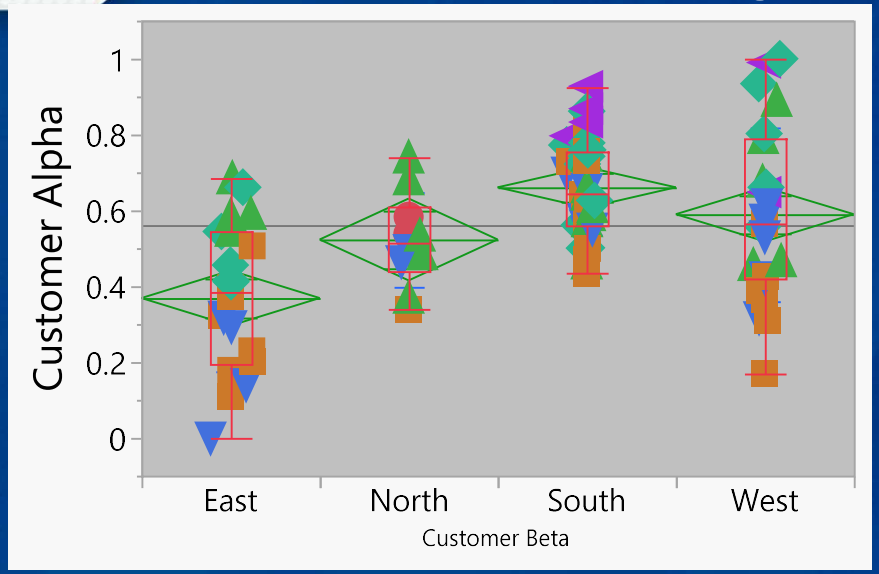
FUJIMI CORPORATION

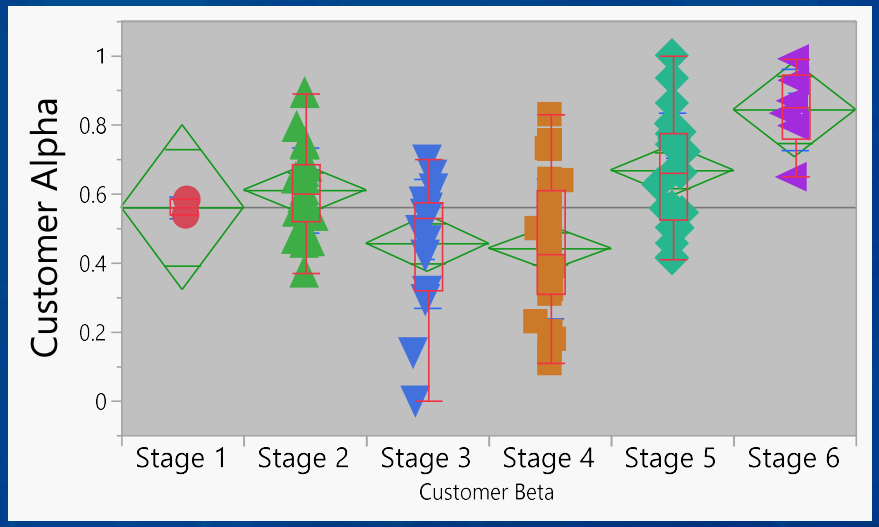
Veracity Check





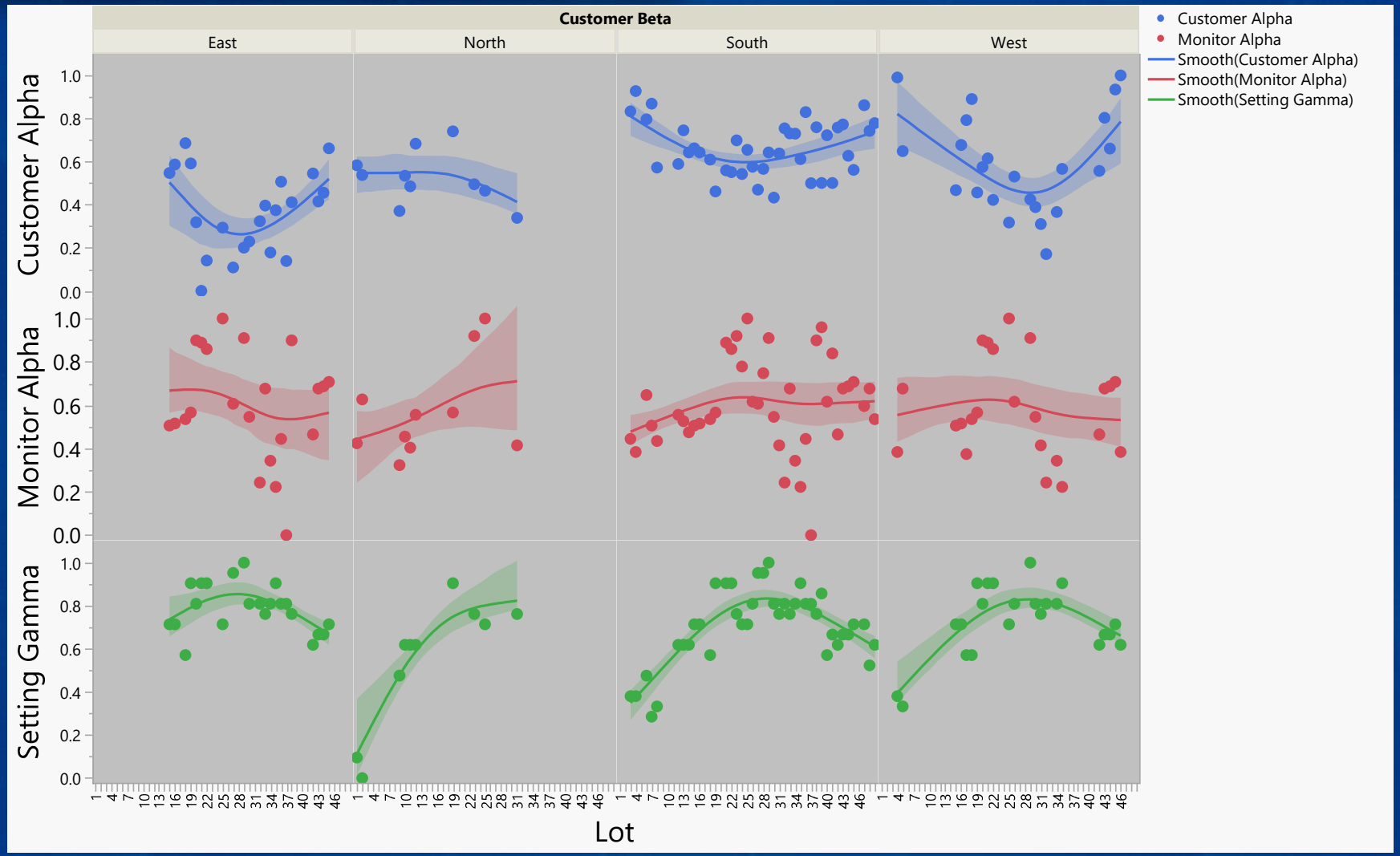
Response Screening
C_α, C_β,
M_α, M_β, M_γ, M_δ





FUJIMI CORPORATION

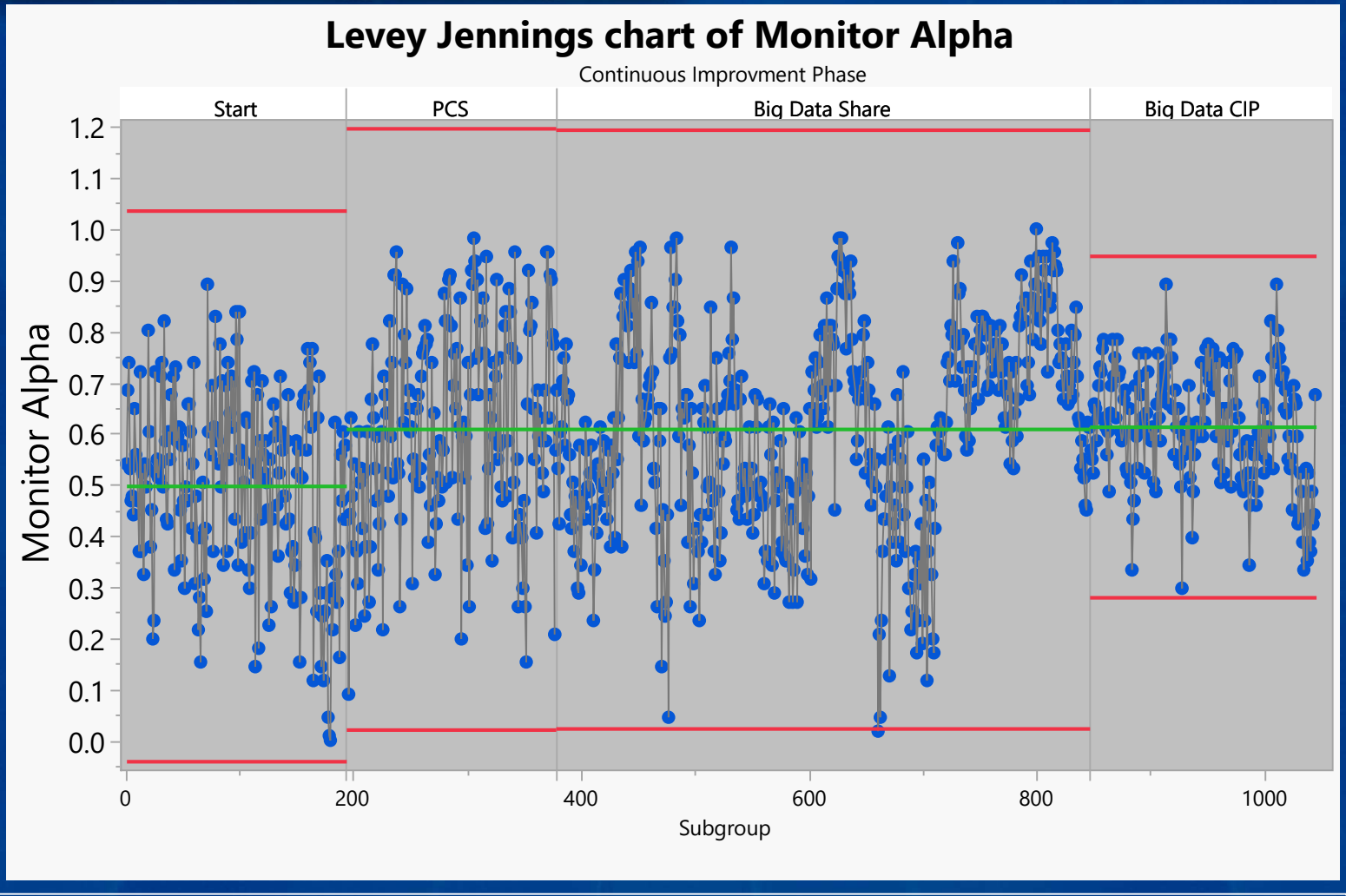
Value – Enhanced Insight



Setting Gamma related to Customer Alpha

FUJIMI CORPORATION

Value - Decision Making



Restricting range of Setting Gamma, reduces variation of Monitor Alpha

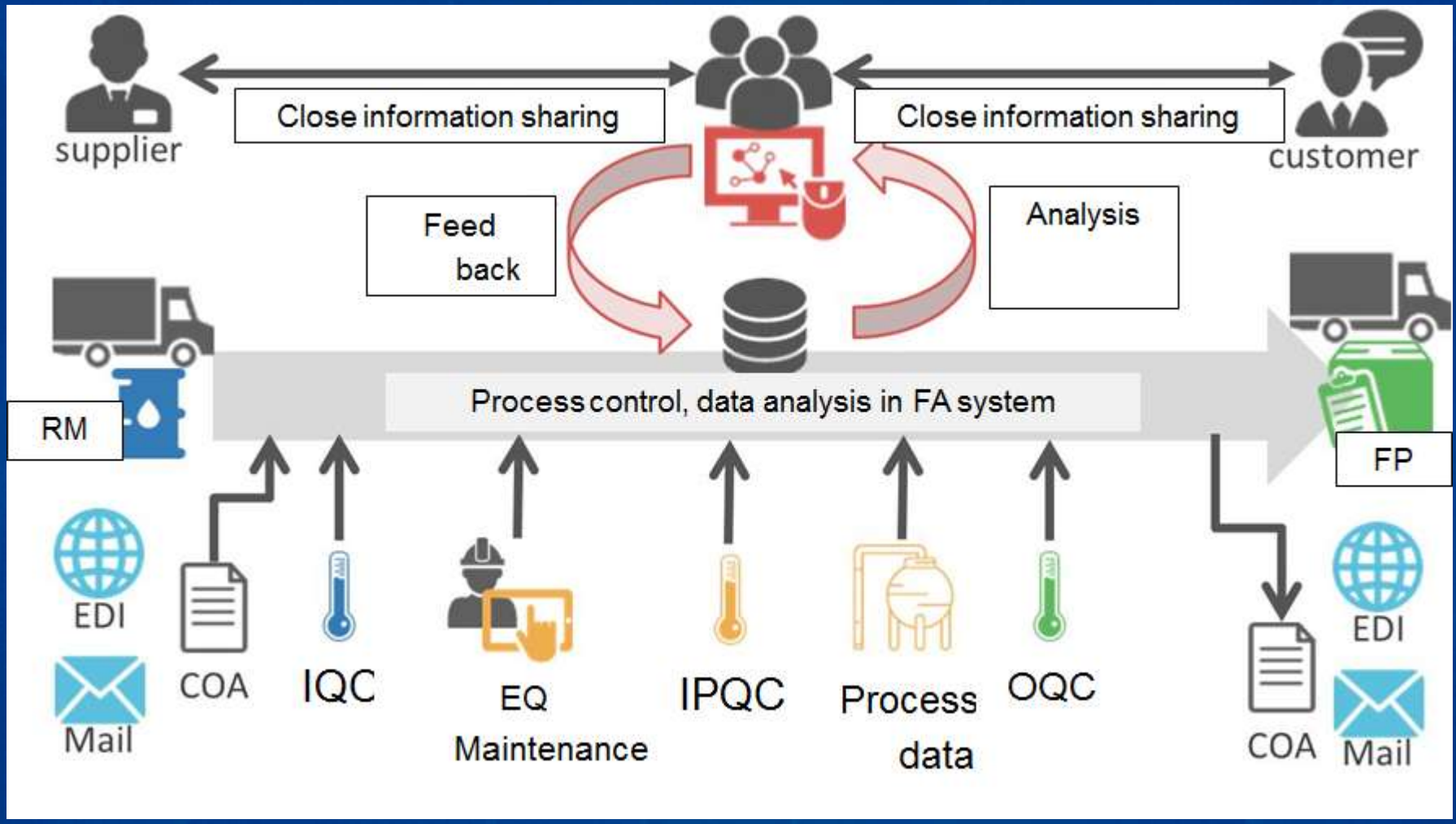
FUJIMI CORPORATION

Is Big Data the Future of Quality

- High-Variety of data
- Innovative forms of information processing
- Expertise to prepare data and develop models for testing
- Collaboration with Supplier, Manufacturing and Customer

FUJIMI CORPORATION

Big Data Vision




FUJIMI
FUJIMI CORPORATION