

# HOW SIEMENS MOTION CONTROL BREAKS THE 5-SIGMA WALL WITH CAUSAL AI

At Siemens Motion Control in Erlangen, a significant leap in quality assurance has been achieved. With a pioneering Causal AI project – an advanced form of data analysis that shifts the focus from mere prediction to true root cause identification – the plant reduced error rates in PCB production to below the demanding 5-sigma threshold.

## From Stable to Six Sigma: A Quality Transformation

The Erlangen plant is a digital flagship site, specializing in the manufacturing of high-precision industrial drives used in automation and motion control systems. At the heart of these drives are complex printed circuit boards (PCBs), whose production is a sophisticated and sensitive process.

Although the production was already considered stable, it wasn't meeting Six Sigma standards – defined as fewer than 3.4 defects per million opportunities. Reaching that level of quality required more than traditional quality assurance – it called for a fundamental change in how production data is used and understood.

Every day, the PCB production line generates more than 500 million data points. While this data contains valuable insights, it had historically been fragmented and difficult to analyze as a whole. Traditional methods required extensive manual effort to combine data sources and establish meaningful correlations – often resulting in incomplete views and missed opportunities for optimization.

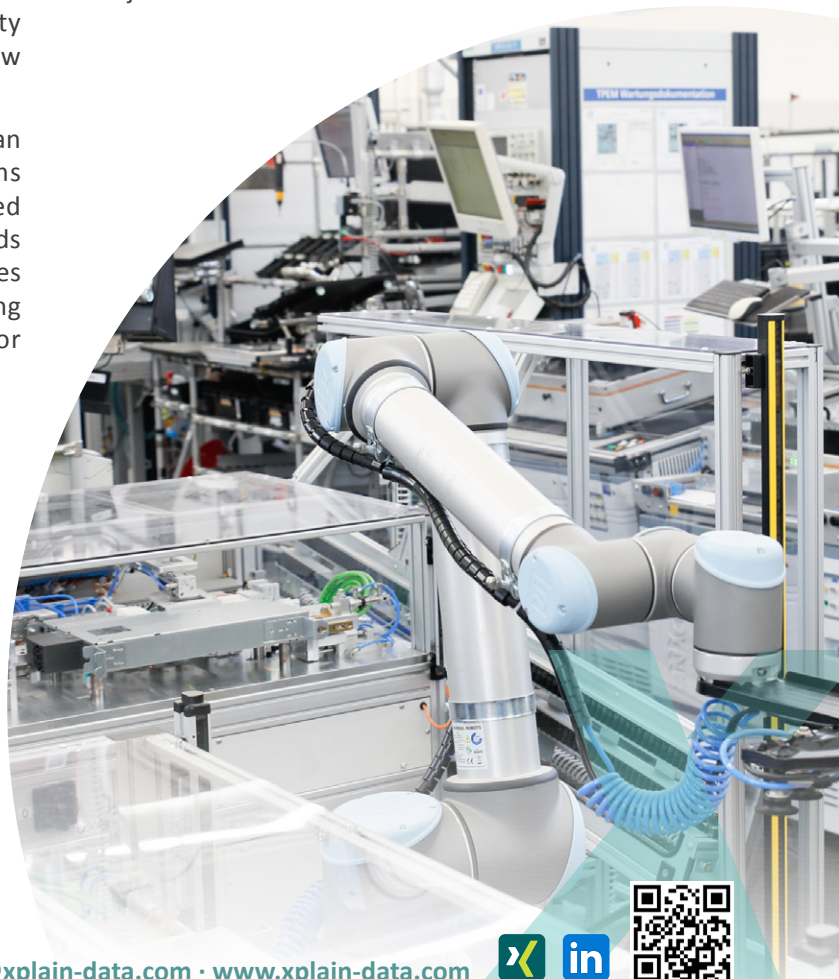
## Making the Shift: From Prediction to Causation

To address this challenge, Siemens made a strategic move by adopting Causal AI technology from Xplain Data. Unlike predictive models that focus on forecasting what might happen, Causal AI identifies the underlying causes of events – answering the critical “why” behind quality deviations.

## ObjectAnalytics: A New Lens on Production Data

Central to this approach is ObjectAnalytics, a patented technology that provides a 360-degree view of each manufactured item. In the case of PCB production, the “object” is the individual board, and every component on it is treated as a sub-object. For each of these 500 components, data is collected across all manufacturing steps: design parameters, soldering results, and inspection outcomes. All this data is merged into a central object model, allowing for precise and holistic analysis of cause-effect relationships.

This object-centric view allows production teams to explore complex data structures visually and intuitively. E.g., certain defects may only appear under very specific combinations of design configurations and material behavior – something traditional tools often miss. With ObjectAnalytics, these patterns become immediately visible, enabling fast and effective root cause analysis with just a few clicks.



## A Scalable Blueprint for AI-Driven Manufacturing

### THE IMPLEMENTATION OF CAUSAL AI AT SIEMENS FOLLOWED THREE MAIN STAGES:

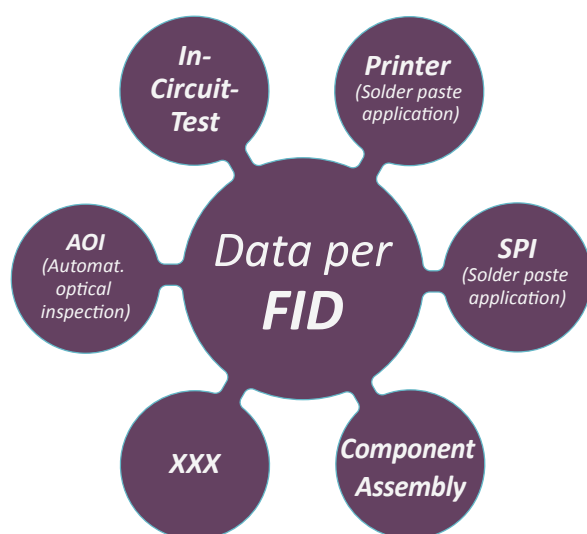
1. Object-centric data consolidation,
2. Causal relationship detection, and
3. Continuous process optimization.

This structured approach enabled Siemens to break through the 5-Sigma barrier. Causal insights from the AOI station revealed previously undetectable design-related defects, allowing early, targeted intervention that significantly boosted the quality and stability of PCB production.

### Looking Ahead: Towards autonomous Quality Control

The journey continues. Upon completion of the project, Siemens is evaluating the broader integration of the solution into routine operations. One key initiative under consideration is the deployment of Xplain Data's autonomous DiscoveryBot, designed to continuously monitor production and identify potential risks in real time. This would facilitate a shift from reactive to proactive quality management and strengthen collaboration between engineering and quality teams.

### PRODUCTION STEPS & DATA GENERATED PER 'FIDUCIAL' (REFERENCE POINT)



Erik Schwulera  
IoT Lead for Manufacturing  
and Six Sigma Director  
Siemens Digital Industries

*"Causal AI is a game changer in electronics production. We can now fully automate quality work, especially root cause analysis," concludes Erik Schwulera.*

*"By implementing the holistic ObjectAnalytics data model, which is based on the entire object tree, we are, for the first time, able to simultaneously analyze the effects of Quality in Process and Quality in Design in a holistic way. For us, this represents a breakthrough in how we can improve production."*

### KEY RESULTS:

- ⊗ HOLISTIC ANALYSIS OF QUALITY ACROSS PROCESS AND DESIGN
- ⊗ FULLY AUTOMATED QUALITY, ESPECIALLY ROOT CAUSE ANALYSIS
- ⊗ DETECTION OF PREVIOUSLY HIDDEN, DESIGN-RELATED FAILURE CAUSES
- ⊗ SURPASSED THE 5-SIGMA THRESHOLD

Lower error rates ⊗ higher quality ⊗ cost savings  
faster processes ⊗ competitive edge

### About Xplain Data

Xplain Data specializes in Causal AI technology, helping manufacturers uncover hidden cause-and-effect relationships within real-world data. By identifying the true drivers of production inefficiencies and quality issues, our algorithms enable proactive interventions to optimize yields, reduce defects, and enhance overall efficiency. Leading enterprises in mechanical engineering and manufacturing rely on our solutions to move beyond correlations and make data-driven improvements with precision.

*Contact us to discuss,  
how to best take advantage  
of Xplain Data's Causal AI solutions  
in your PCB production!*

### More Info:

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