

# Big Data Predictive Analytics & Data Visualization in the Semi-Conductor Industry

## Business:

Big Data, Predictive Analytics & Data Visualization

## Domain:

Semi-Conductor Manufacturing

## Tools:

R, R Shiny, Hadoop, PostgreSQL

## Key Highlights

### Key Success:

- » 20% increase in the efficiency of the process modules resulting in more wafer production per unit time.
- » 3X reduction in repair and maintenance cost and downtime of the process modules.

## Client

The client is one of the world's most advanced semiconductor manufacturing enabler; today, nearly every advanced chip is built using its technology. Its manufacturing centers across the Americas, Europe and Asia develop and supply wafer fabrication equipment & services to every semiconductor manufacturer in the world.

## Overview

The client has set up an IoT infrastructure which collects all-critical data points gathered along the process chain. The recipes and conditions of the process chambers are recorded and stored in real-time by sensors installed in the process module. The client commissioned Indium to develop the analytics layer of its IoT infrastructure which would: measure efficiency of wafer production, monitor wafer production lines, identify outlier process modules, predict defects in process modules and enable predictive maintenance. Although the semiconductor industry is highly complex and domain intensive, Indium Software was able to deliver all the requirement and a few additional value-added features by leveraging its Big Data, Predictive Analytics and Visualisation capabilities.

# 1 Status Quo

The client is a California based value-added services provider for semiconductor manufacturers. They develop and supply wafer fabrication equipment and services to build innovative devices. The process of creating chips involves a chain of individual steps; with each process module producing multiple wafers in defined recipes of temperature, pressure conditions etc.

The application is a data bank of the all-critical data points gathered in the process chain. The recipes or the conditions of the process chambers are recorded and stored in real-time by sensors installed in the process module.

The data produced was continuous, time series in nature and significantly huge in size. This led to an unusual IoT problem. However, the Data was an asset to business which when put to insightful use, facilitates real-time monitoring and defect prediction in the process module.

# 2 Business Requirements

The client wanted a solution to make use of the available data to achieve the following goals:

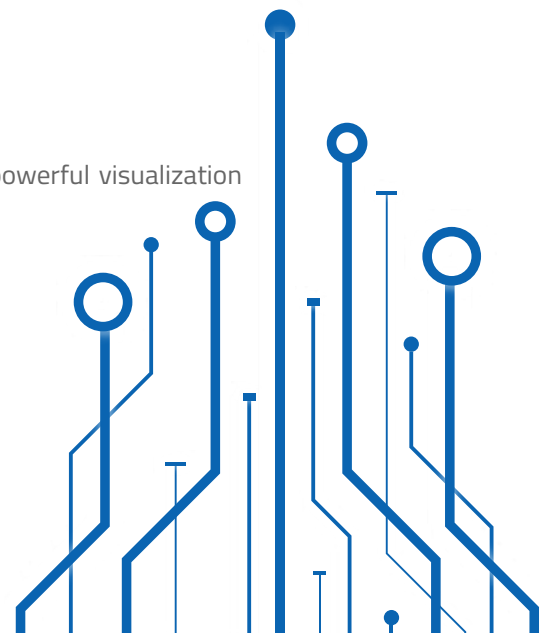
- » Measure efficiency of the wafer productions
- » Monitor production line of wafers
- » Identify outliers process modules
- » Prediction of defects in process modules
- » Predictive maintenance

# 3 Solution

Indium Software analyzed the data collected from the sensors installed on process modules and modelled a solution that treated the data for business use, making it potentially describe, predict and prescribe insights for business efficiencies.

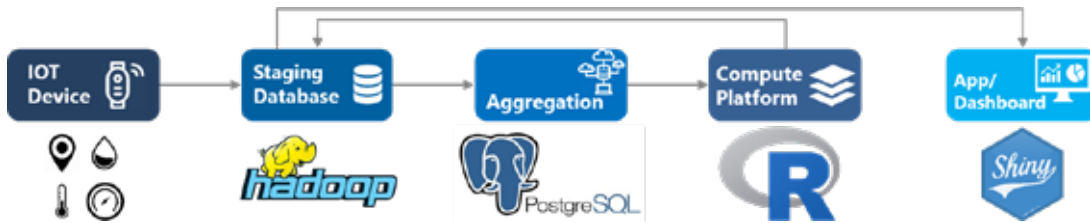
We implemented a Data Science Solution combined with a Visualization layer to aggregate the data volumes from the process chambers and extend it on an actionable interface for key business users.

- » The continuous flux of data from the process required a powerful database to handle raw data as well as the aggregated data (processed). We introduced a Hadoop-based solution for data storage.
- » The data so processed performs the following:
  - » Identifies outliers/ anomaly modules in regular production
    - Reports defects
    - Caters to wafer-level resolutions (lowest possible resolution)
    - Monitors production guidelines
  - » Data insights were realized in interactive and responsive charts using powerful visualization tools.
    - The charts render quick response times.
    - Feature interactions like zoom-in/ brush & deselect/ simulations/ pop ups/ drill-downs.
    - End-to-end analytics from data navigation (selecting Customer, Lab, Process modules of choice) to model building for displaying results and recommendations in a single snapshot.

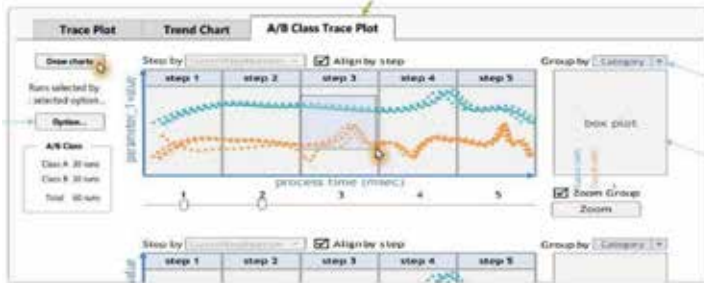
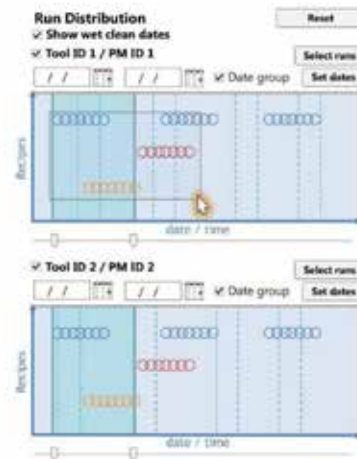
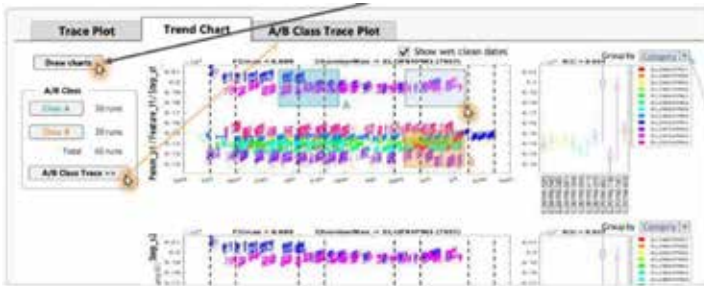


## 4 Business Impact

- » 3X reduction in repair and maintenance cost and downtime of the process modules.
- » 20% increase in the efficiency of the process modules resulting in more wafer production per unit time.
- » Built a product which has become one of the indispensable offerings by our client to their customers.



Data Process Workflow



Visualization Work Samples



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