# Wafer Yield Prediction Model

Department of Industrial and Systems Engineering
IE3100R Systems Design Project AY 10/11

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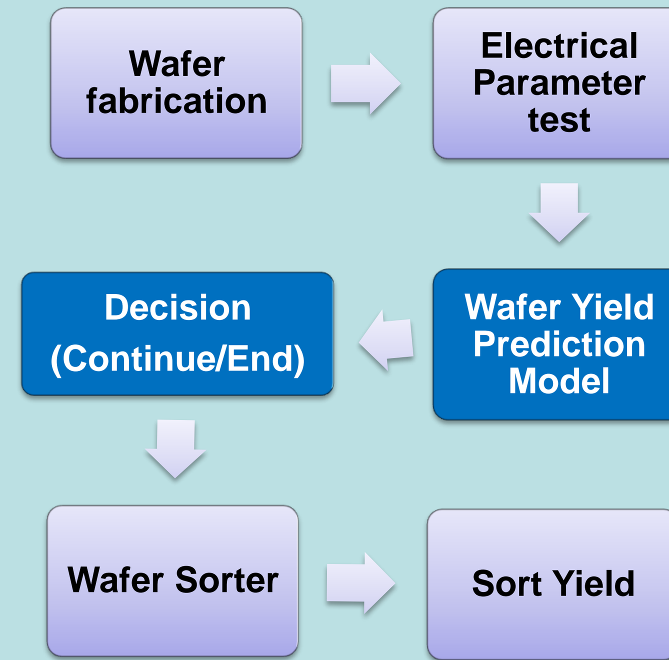
## COMPANY BACKGROUND

GLOBALFOUNDRIES is one of the leading semiconductor foundries in the world. It produces 300mm and 200mm wafers in its plants in Dresden, Germany and in Singapore.

## PROBLEM DESCRIPTION

**Current Process** : Detection of faulty wafer only at sort yield stage.

Proposed flow for early detection: Through a wafer yield prediction model, a decision can be reached on whether to continue to send wafer for sorting.




## OBJECTIVE

•Construct model for Wafer Yield prediction based on electrical parameters

•Evaluate and test different statistical tools for model

## Principle Component Analysis

Convert possibly correlated parameters into a set of uncorrelated variables called **principal components**.

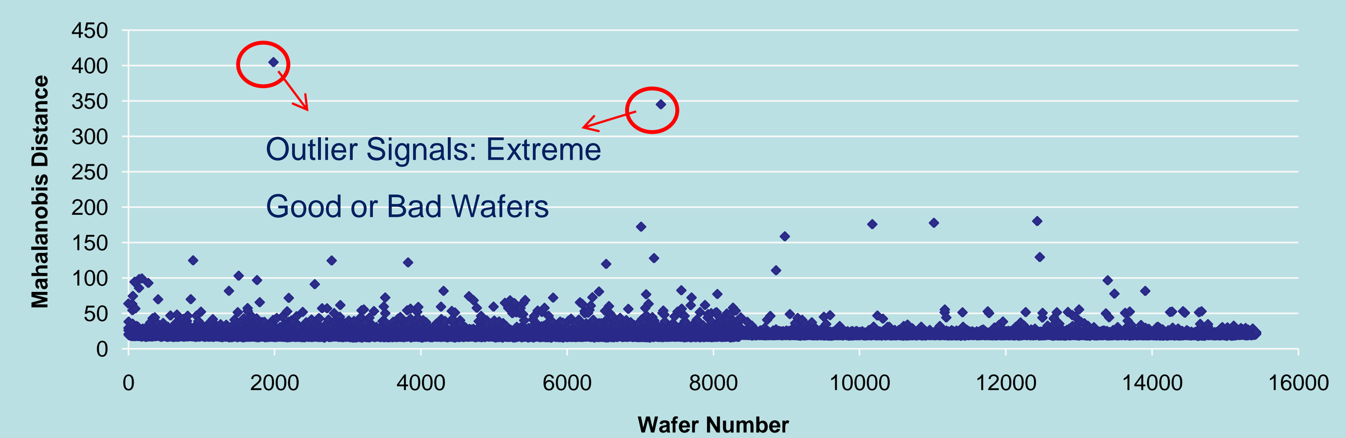
- Reduce number of parameters
- Obtain uncorrelated parameters
- Facilitate software programming

368 electric parameters ➡ 67 principal components

## Mahalanobis Taguchi System

Introduce a scale **(Mahalanobis Distance)** to measure the degree of abnormality

Based on the electric parameters of a wafer, its Mahalanobis Distance is calculated with regards to wafer populations.




High MD indicates abnormality in parameters against the general population, more likely to be defective (or extraordinarily good quality).

## METHODOLOGIES

## REGRESSION

With a large number of parameters, regression analysis needs to handle all the parameters and find the best fit model to predict the yield of future wafers.

**Robust Regression:** Apart from the simple regression, robust regression was applied to see if a model with better predictive power could be constructed.

| Method | Alpha Error | Beta Error |
|---|---|---|
| Simple Regression | 1.04% | 5.2% |
| Robust Regression | 0.063% | 7.9% |

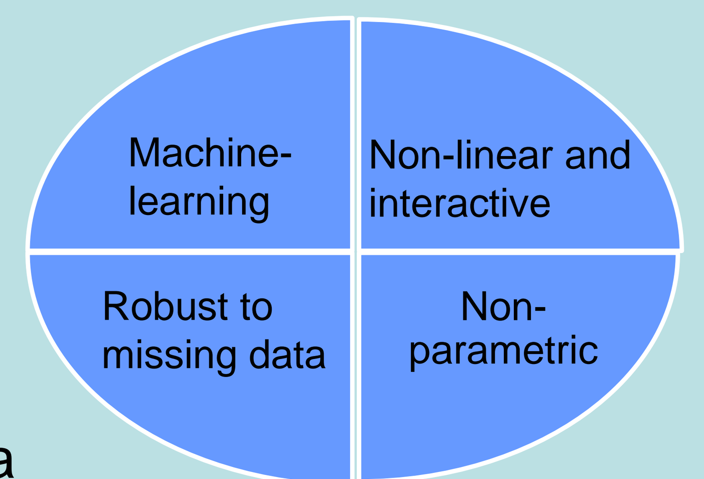
The alpha error produced by regression is relatively small but beta error is substantial. We recommend that regression be used in conjunction with another method such as MARS to validate the prediction yield .

## MARS

**M**ultivariate **A**daptive **R**egression **S**plines

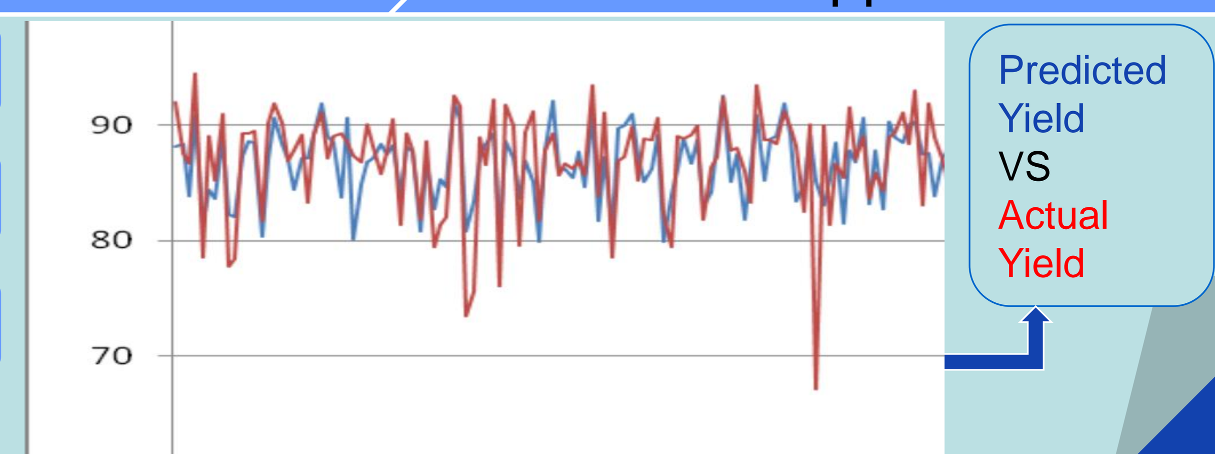
First introduced in 1991 by Jerome Friedman

Quoted by **Stanford University** Statistics Department as "a powerful and flexible method to model relationships that are nearly additive, and produces continuous models with continuous derivatives. In addition, the model can be represented in a form that separately identifies the additive contributions and those associated with different multivariate interactions. "




Model Establishment | Model Application

3.06% MAPE
0.23% α error
0.91% β error




Predicted Yield VS Actual Yield

## CONCLUSION

Wafer yield can be predicted with accuracy before actual sorting at customers' site, which improves the company image of GLOBALFOUNDRIES. At 0.91% β error, the company values the intangible benefits more than the risk of destroying good wafers.