Runsheet Artificial Intelligent for Highly Diversified Products in Pure Foundry Wafer Fab

Kimmy Ang; Lee Tiong Kuan

kimmy.ang@globalfoundries.com; tiongkuan.lee@globalfoundries.com

GLOBALFOUNDRIES

60 Woodlands Industrial Park D Street 2, Singapore 738406

Phone: +65 -66702234

ABSTRACT

A runsheet (process flow) governs the processing steps of LOT from wafer start to shipment. Hence, it is very important that the integration of runsheet strictly adhere to the BKM (Best Known Method). Any failure of flow integration can result in major excursion (LOT scrap), such as tool contamination, customer dissatisfaction, low quality wafers, productivity lost, disruption to wafer/lot in progress, cost incur, employee stress in recovery and low morale (less bonus – poor KPI). It is challenging to ensure 700 runsheets are constantly updated with the latest BKM. This paper introduces Runsheet AI (Artificial Intelligent) Golden Rules to safeguard the flow integration and at the same time retain human knowledge into the system, which is essential due to high attrition rate in this challenging foundry environment.
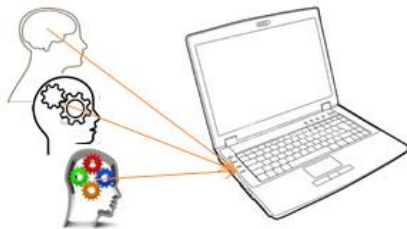
Figure 1: Transfer human knowledge into AI rules

INTRODUCTION

In this highly diversify products/customers, multi-technology & geometry foundry wafer fab, there are many process owners taking care of their own flows and concurrently there are engineers who initiate improvement. Upon approval by change management review board, the process owners or module owners must manually remember to apply the new standard when creating new or uprev (up revision) flow.

To better manage this complex situation, we developed the AI golden rules into the runsheet comparison program, where we use it to compare the difference and highlight the violations.

In Runsheet Comparison Program (Figure 2), we will input a reference flow with active available option and a new flow/uprev with highest version option. AI rules will automatically be applied to check the latest stages and recipes for new/uprev flow just before activation.
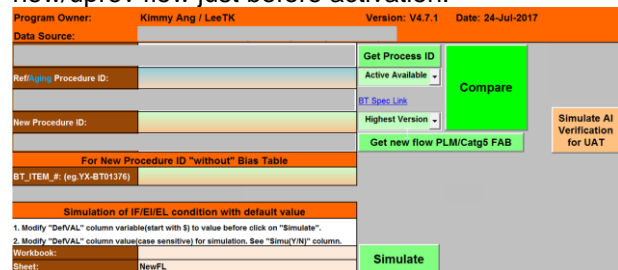

Figure 2: Runsheet Comparison Program

How AI rule works?

The runsheet AI golden rules comprises of common rules, where we need to adhere to when building the flow, and new BKM. We developed AI to augment human brains to ensure consistent implementation of BKM and 100% compliance when a change is made. These "AI" rules can be applied to all or a group of tech type (eg. HV/RF/LOGIC), geometry (eg. 0.18UM/0.30UM), flow type (eg. frontend/ backend/ standard) or by specified process naming convention.

AI rule is able to safeguard the wafer quality prior to lot moving in & out of inventory.

Other area includes the following:

Example 1
AI Rule#1 (Figure 3): Prevent resist wafer into Furnace and ensure correct cleaning for all mask layer. Without this rule, a lot after masking without proper clean will cause Furnace tool to be contaminated with resist, and will cause major lot scrap & excursion.
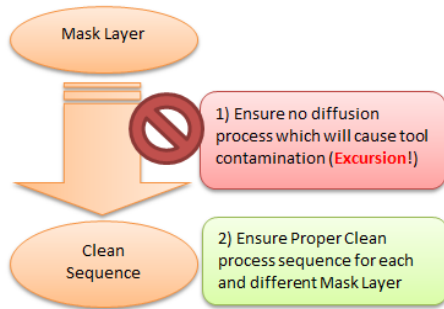
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Figure 3: AI Rule#1

Example 2

AI Rule#8: Lithography Bias Table Checker

Mismatched of litho mask to final print down will result in proto delay and quality concern. This Bias Table Checker (Figure 4) was developed to automatically compare information from Runsheet vs Tape out information from the Bias Table and interlock to proceed if it is not within Litho process achievable margin.

Figure 4: Bias Table Checker

Flexibility in testing AI rule

During user acceptance test, this system is flexible to allow requesters to modify the content of the process flow in order to simulate the different test scenario to ensure the artificial intelligent meets the scope of request.

How AI Monitoring works?

Unlike the runsheet AI checker, which applies "AI" rules on a single flow during creation, the "AI" monitoring (Figure 5 & 6) runs weekly to report with email alert the status of the change for all active flows. This helps the Change Request (CR) owners to track and ensure timely CR closure.
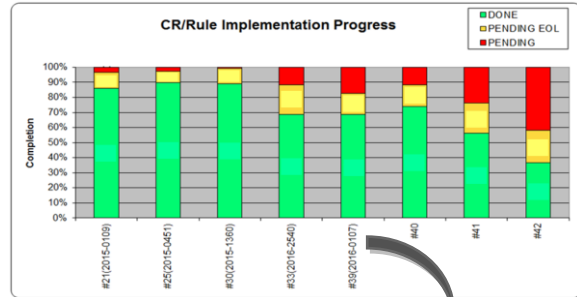

Figure 5: Weekly AI Monitoring Chart

Figure 6: Drill in Details

CONCLUSION

This Runsheet Artificial Intelligent Golden Rule System has provided a solution for highly diversified flows to safeguard the quality / productivity / cost saving. It helps CR owners to track CR closure, and ensure new flow conformed to the golden standard. Since the implementation of this AI rules, we have zero non-conformance. Closed loop system is implemented to ensure sustain highest quality in this challenging environment.