

# Factory Automation for Overall Fab Efficiency

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## Abstract

Factory automation in semiconductor manufacturing can be applied beyond just preventing human errors for wrong recipe to aid process enhancements, improve throughput and OEE, save engineering time and precious consumables, troubleshoot process or equipment problems, and much more. This paper describes how Skyworks has achieved these through various home grown software applications, occasionally in unconventional ways, to improve overall fab efficiency. Compound semiconductor fabs generally don't have advanced tools or big automation budgets like Si fabs. This requires us to be more creative in our factory automation approach.

## PRECIOUS METALS RECLAIM TRACKING

This home grown web based system keeps track of the amount of precious metals consumed in the evaporator chamber and the amount of precious metals deposited on the wafers for the same duration. Based on these two, it calculates the theoretical amount of precious metal to be expected in reclaim.

## INVENTORY MANAGEMENT – PRECIOUS CONSUMABLES

This system keeps track of the inventory at each location, their transfer and consumption at each point. We currently use this system for precious metals, but it can be extended to all precious consumables. There are several reports generated from this database – one report shows how much precious metal we have onsite, and based on last 7 days of average usage, how many days' worth of inventory that is.

## PARTS OUT MANAGER

This system helps our engineers and maintenance techs keep track of all the parts out for repair and their status. It also calculates when a certain part is expected to come back based on cycle time commitments from the vendors. This system also generates a vendor performance report that shows vendors actual turn-around time vs. their commitment.

## SINGLE POINT OF FAILURE TOOLS

This report periodically checks our qualification and capabilities plan against our tool availability in MES and sends notifications of what all are the single point of failure or one of a kind tools at that point in time, so that appropriate actions can be taken to prepare backup tools before the single point of failure tool goes down.

Capability	Qualified Tool	Qualified Level	Qualified Tool Status
XXXX	N_ACID08	QUALIFIED	AVAIL
	N_ACID10	QUALIFIED	AVAIL
	N_ACID15	QUALIFIED_BACKUP	AVAIL
YYYYY	N_YES02	QUALIFIED	AVAIL
	N_YES03	QUALIFIED	AVAIL
ZZZZZ	N_DNS3C1	QUALIFIED	AVAIL
	N_DNS4C1	QUALIFIED	AVAIL
	N_DNS5C1	QUALIFIED	AVAIL
	N_DNS5C2	QUALIFIED	AVAIL
	N_DNS7C1	QUALIFIED	WPEM
	N_DNS7C2	QUALIFIED	PMOUE
	N_TEL1C1	QUALIFIED	RQMAINT
	N_TEL2C1	QUALIFIED	AVAIL
	N_TEL3C1	QUALIFIED	PMMAINT

FIG. I: SINGLE POINT OF FAILURE TOOLS

## OEE IMPROVEMENT AT BOTTLENECK

For one of our bottleneck toolsets, we have provided real-time status updates of the tools (processing, idle, etc) and the expected time the tool is to remain in that state on big screen TVs. Different colors are applied to alert the technicians when a tool has been running a recipe, or in prep mode longer than the standard. This information allows technicians to plan ahead, respond quickly to non-standard conditions, and maximize the throughput on that toolset.

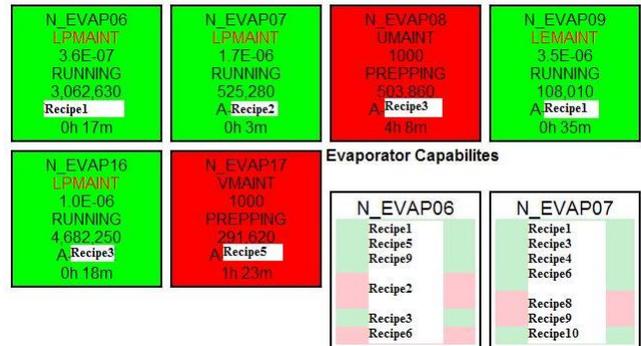


FIG. II: EVAPORATOR STATUS AND DURATION INFO

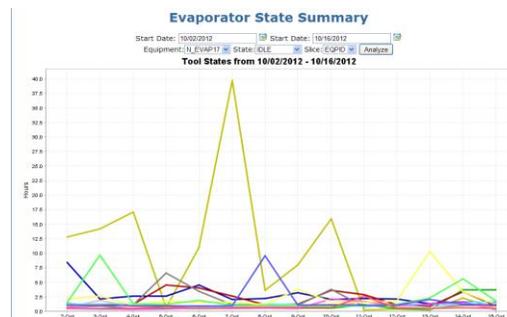


FIG. III: TREND OF EVAPORATOR UTILIZATION

**PRECIOUS METALS CONSUMPTION CONTROL CHARTS**  
 To track consumption of precious metals, we have created control charts on our intranet that show the consumption of precious metals for each run during the last 24 hours, which is reviewed daily.

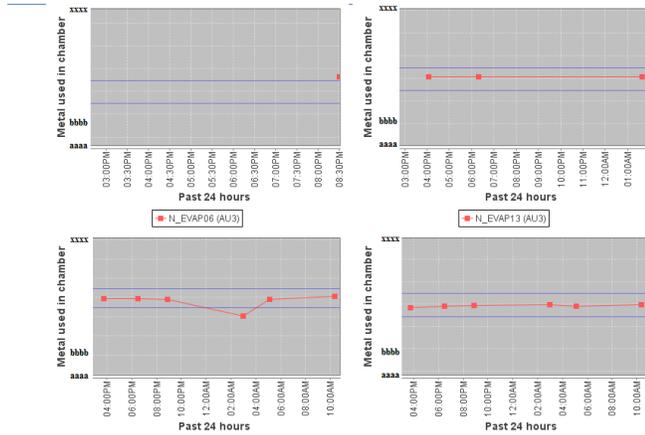


FIG. IV: CONTROL CHARTS OF PRECIOUS METALS CONSUMPTION

**MELT TRACKING ON EVAPORATORS**

To ensure high quality of wafer processing, we track our melts closely for the location, qualification level (such as production, engineering, etc.), weight and age – both in terms of time and number of runs that used a certain melt. This information allows us to correlate quality of the wafer to any of the parameters and be proactive to prevent issues from occurring.

**INVENTORY MANAGEMENT OF SPARE PARTS**

We have created a Web based parts ordering system that allows our technicians and engineers to search for a spare part and order from the warehouse once they find it. This system will then print the order request in the warehouse to let the warehouse person know of the order along with the location of the part, the person and department requesting and the tool that part will be installed on. Based on this information, we could create various financial reports showing the cost by tool, area, too-type, vendor, etc.

**CPK SYSTEM**

We have automated Cpk calculations for our process and created a Web based Cpk System for our engineers to see Cp and Cpk values as well as the raw data that is used in the Cpk calculation.

**ESD TRACKING SYSTEM**

Our ESD tracking system has two components – Measurement and Reporting. The measurement component runs on a hand-held device such as the one shown in Fig V. It allows the technician to scan the barcode of the location and enter the reading from the ESD tester. This information

is saved in our database. The reporting component provides graphical representation of the success rate as well as history by location.



FIG. V: ESD MONITORING SYSTEM

**INVENTORY MONITORING**

Our Inventory monitoring system shows inventory by technology and location. There are various ways to slice the data. Different color stacks represent inventory of different processes, tool-type or production area depending on which way the user is slicing the data.

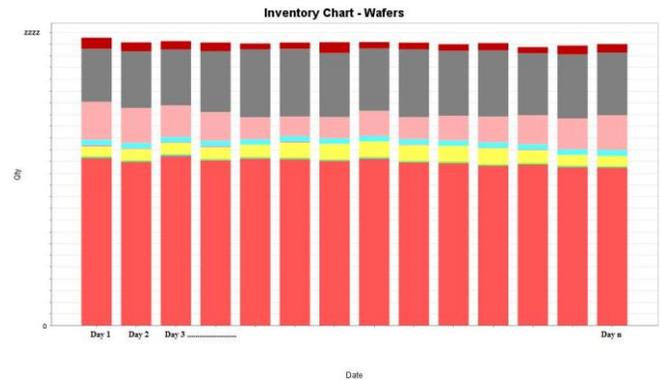


FIG. VI: INVENTORY MONITORING

**CONCLUSIONS**

Used creatively, Factory Automation helps improve overall fab efficiency, not just the yields by preventing wrong recipes. With some creativity, and inputs from manufacturing and engineers, we have created systems to save time, improve yield, and help improve processes. We will discuss additional details of several of these systems during our Man Tech presentation.