FabTime Cycle Time Management Newsletter

Information

Mission: To discuss issues relating to proactive wafer fab cycle time management

Publisher: FabTime Inc. FabTime sells cycle time management software for wafer fab managers. New features in development for FabTime include E10 Age filters on the Tool WIP and State List chart, multi-threading functionality for the short-interval scheduler, and enhancements to chart and data table sorting capabilities.

Editor: Jennifer Robinson

Contributors: Kelvin Lim (Innovative Global Solutions and Services Pte Ltd (IGSS)); David Jimenez (WWK); John Taylor (TR Control Solutions Ltd.)

Keywords: OEE, Cluster Tools, Metrics and Goals; Material Management

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Welcome

Welcome to Volume 17, Number 1 of the FabTime Cycle Time Management Newsletter! We hope that 2016 is off to a productive start for all of you. In this issue we have an announcement about a promotion for FabTime's Teresa Fallwell, and about FabTime's participation in next week's FOA Collaborative Forum. Our software tip of the month is about sorting moves trend and pareto charts by delta from goal (to identify objects that are furthest from meeting their goals). In our subscriber discussion forum we have several responses to last issue's main article about cluster tool OEE, including a couple of minor corrections.

In our main article this month we share a guest article by John Taylor of TR Control Solutions. In this article, John outlines a sometimes hidden source of cycle time problems in wafer fabs: managing gases and chemicals. Expirations and stockouts of gases and chemicals can result in downtime and / or yield problems, both of which, as we well know, can contribute to wafer fab cycle time. TR Control Solutions offers a commercial product to help manage gas and chemical usage and expiration data. We imagine that many of you have your own solutions, and we welcome your feedback as we discuss this new-to-us fab performance management challenge.

Thanks for reading – Jennifer

FabTime

Community News/Announcements

Promotion for Teresa Fallwell

FabTime is pleased to announce the promotion of Teresa Fallwell to Customer Relationship Manager. Teresa has been with FabTime for 6 years and will continue her accounting and office management responsibilities, but will also be managing the business aspects of our customer relationships (use of support hours, requests for extra projects, etc.). She will continue to report to Jennifer Robinson, FabTime Co-Founder and Chief Operating Officer. We are grateful for Teresa's willingness to expand her role with FabTime, and believe that this change will help us to keep our customers happier in the coming year.

FabTime / Microchip Presentation at the Fab Owners Association Collaborative Forum

FabTime's Frank Chance and Microchip's Steven Novella will be presenting at the Fab Owners Association Collaborative Forum next week on work that FabTime has been doing with Microchip Technology in the area of Short-Interval Scheduling. The scheduling functionality is an enhancement to FabTime's dispatch module. We plan to describe this work in more detail in a future newsletter issue.

The FOA's 4th Annual Collaborative Forum is being held at the Sofitel San Francisco on February 10-11, 2016. The event theme is "Manufacturing Challenges — Supply Chain Solutions" and will feature case studies that highlight collaborative successes that are presented jointly by Device Makers and Associate Members. The program will also include Industry Analysts and other invited industry experts. More details, including a draft agenda, can be found here.

FabTime welcomes the opportunity to publish community announcements, including conference notices and calls for papers. Send them to newsletter@FabTime.com.
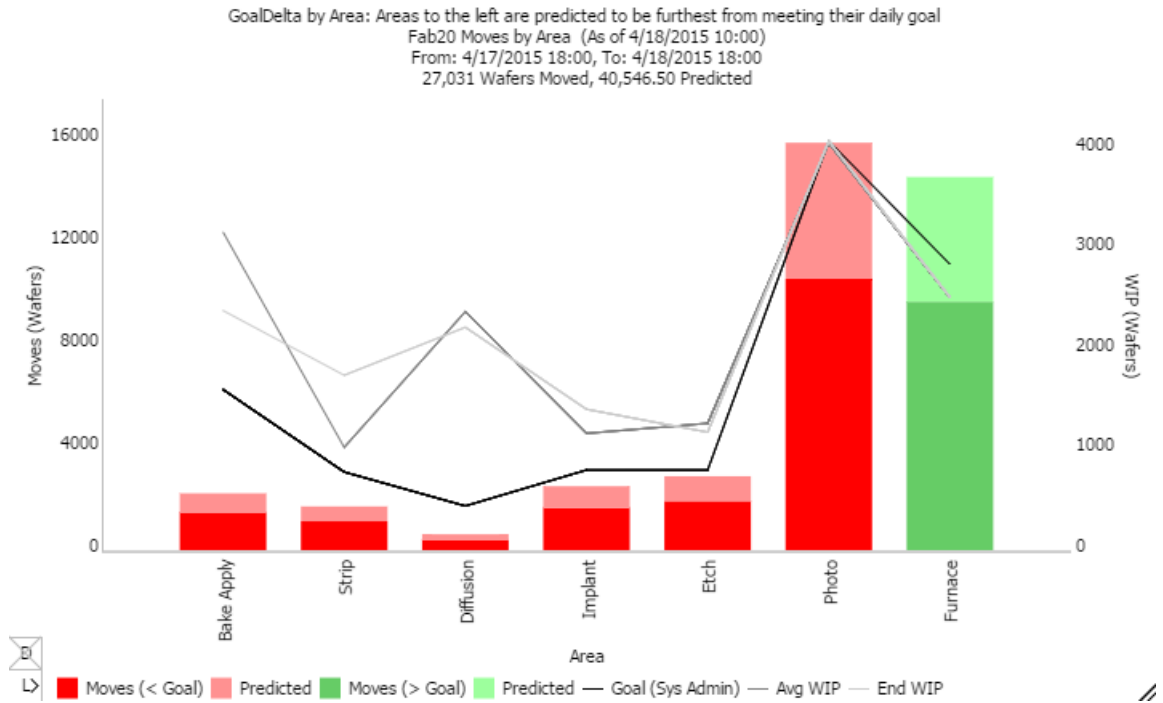
FabTime User Tip of the Month

Use New GoalDelta Sort to Find Objects Furthest from Goal

A new feature in Patch 107 of FabTime is the ability to sort the Moves Trend and Pareto charts by the delta between the goal and the actual or predicted performance. Simply select GoalDelta from the first Sort: drop-down. GoalDelta is Predicted Moves (in wafers) - Goal Moves (in wafers). This means that for objects that have not yet met (or are not predicted to meet) their goal, GoalDelta will be negative. Sorting in ascending order brings the objects with the largest negative value of GoalDelta (the objects furthest from meeting their goal) to the left-hand side of the chart, or top of the data table. These are the objects that are furthest from meeting their goal. An example is shown on the next page.

This new capability can be used to identify tools, areas, or individual operations or other objects that are not on target to meet goals in the current shift, or did not meet them in prior shifts.

If you have questions about this item, or any other FabTime software questions, just use the Feedback form inside FabTime's software. Subscribe to the separate Tip of the Month email list (with additional discussion for customers only). Thanks!

GoalDelta by Area: Areas to the left are predicted to be furthest from meeting their daily goal
Fab20 Moves by Area (As of 4/18/2015 10:00)
From: 4/17/2015 18:00, To: 4/18/2015 18:00
27,031 Wafers Moved, 40,546.50 Predicted

Subscriber Discussion Forum

Corrections from Previous Main Article on Cluster Tool OEE

Our thanks to **David Jimenez from WWK** and **Kelvin Lim from Innovative Global Solutions and Services Pte Ltd** (IGSS) for pointing out two typos in the previous issue, both of which could have affected comprehension.

In the last sentence of the opening paragraph of the main article, we wrote:

"We believe that these issues (for example, a lack of stored data on productive vs. standby time within process **models**) are likely common to many fabs, whether or not they use FabTime for reporting, and so we have chosen to share our experiences and solutions in this article."

David pointed out that this should have read "a lack of stored data on productive vs. standby time within process **modules**"

Also, in the numeric example for the main article, we listed the production time for the three sample models as:

Production Time: PM1 = 6, PM2 = 8, PM3 = 24

Later, when we calculated aggregate production time, we had:

Production Time = 6 + 8 + 14 = 28 hours (Production time for an MPCT is the sum of the SEMI E10 Production Times of all process modules.)

As Kelvin astutely observed, the production time of PM3 should have been listed as 14, not 24, hours, because we used 14 for our calculations.

If anyone would like a revised copy of the newsletter PDF, simply email newsletter@fabtime.com. Our apologies for any inconvenience or confusion.

Availability Calculations for Cluster Tools

Kelvin Lim also sent us some notes about how his company has handled cluster tool availability calculations.

"I was reading with interest in Cluster Tool OEE calculation as I am currently working with my client to change their way of reporting the Availability of one of their Cluster Tools.

This tool has 4 Chambers and 2 Load Locks in one system.

The process flows are as follows:

■ PM1 & 2: Run similar process (Process A)

■ PM3: Run another process (Process B)

■ PM4: All processes need to run through this chamber as the last step

Example:

Process A needs to run in PM1 or PM2 followed by PM4

Process B needs to run in PM3 followed by PM4

As for the LoadLock, if one LoadLock is down it can only support 1 Process at a time so we factor in a 50% loss.

Our client's current way of reporting cluster availability is wrong:

Example:

Cluster Availability will report 67% when 1 chamber is down but in actual fact if PM3 is down Process B's availability is Zero and Process A's availability is 100%.

In order to accurately calculate the availability, we decided to separate the cluster availability tracking by process (i.e. PM1 & 2 as one and PM3 as another) and add-in the factor of System availability and LoadLock availability factors. We modified the current Matrix Table used by our client into 2 Matrix Tables, one for Process A and the other for Process B.

Just sharing our approach."

FabTime Response: Kelvin's example reinforces the complexity of estimating availability for multi-path cluster tools. We welcome feedback from other subscribers.

FabTime welcomes the opportunity to publish subscriber discussion questions and responses. Simply send your contributions to Jennifer.Robinson@FabTime.com.

A Hidden Source of Cycle Time in Wafer Fabs: Gas and Chemical Changes

by John Taylor of TR Control Solutions

In this article, we bring to your attention a hidden source of cycle time problems in wafer fabs, one that may not be well understood by the manufacturing organization. Creating electronic circuits on wafers requires multiple process steps performed by highly sophisticated machines. These machines are operated by highly skilled personnel using specialty gases and chemicals. This all takes place in a closely controlled, extremely clean environment. Semiconductor fabrication is a highly challenging technological feat with many opportunities for defects to occur.

The specialty gases and chemicals used in the silicon wafer manufacturing process are ultra-pure and subject to stringent specifications. Because many of these materials deteriorate over time they are supplied with an expiration date beyond which they should not be used. If they are used, however, and they have deteriorated below the required specification, they may cause process excursions and result in tool downtime and/or scrapped wafers. Ultimately, use of expired gases and chemicals can affect both the throughput and the cycle time of the facility.

Given the already highly complex challenges involved in silicon wafer manufacturing, it would seem obvious that avoiding the (unapproved) use of expired material and thus potentially introducing manufacturing issues, is a no brainer. This is easier said than done. Semiconductor fabs are often very large facilities and the gases and chemicals may be supplied from hundreds of use points around the fab. These materials are often very hazardous so they need to be handled carefully. A continuous supply is necessary to avoid any interruptions to production, so gas and chemical management is usually a multi-shift 24/7/365 operation.

Three important things are required, to avoid the unplanned use of expired material: 1) clear visibility of material on-site and in-use; 2) accurate predictions of the rate of material usage in relation to expiration dates; and 3) early and repeated notifications of shelf life expiration events.

Avoiding supply interruptions

While using expired material is obviously to be avoided (for the reasons described above), another management issue is the unexpected downtime that may be caused when cylinders of gas or containers of chemicals have to be replaced (because the shelf life has been reached). This changeover time can also be detrimental to fab productivity.

While it may not be possible to completely eliminate the downtime needed to accommodate these forced replenishments, their occurrence may be minimized with sufficient visibility of usage and expiration dates and repeated notifications of impending expiration.

Avoiding material stock-outs

Some of the specialty gases and chemicals used in fabs have long lead times (sometimes because of a worldwide shortage in supply), some are very expensive and most have shelf life limitations. Unless very close monitoring of usage rates, material availability, and expiration dates is performed, stock-outs can occur which can result in an interruption to supply, downtime and reduced production throughput. This, of course, given the objective of maximum output, is highly undesirable.

Visibility and early notifications are also required to minimize the occurrence of stock-outs. Specialty gases in particular are often dispensed from multiple use points in a fab. A picture of the total (across all

use points) mass usage per day, week & month, derived from cylinder pressure or weigh scale readings, provides an important metric to help avoid stock-outs. Notifications of unexpected variations in usage provide the visibility required to ensure that replenishment stock is available when required. Couple this mass usage data with metrics on production activity and procurement budgets (e.g. wafer turns and material forecasts) and further metrics can be used to help avoid highly disruptive stock-outs.

Solutions

It is not unusual to find hard pressed managers and technicians in multi-billion dollar silicon wafer fabs struggling to manage a continuous supply of specialty gases and chemicals, using spreadsheets, emails and 'a wing and a prayer.' In terms of IT sophistication, gas and chemical management is often a 'Cinderella' operation. This seems surprising when one considers the potential for problems to occur and the efforts made elsewhere to avoid disruptions to the output of the fab.

At TR Control Solutions, we believe there is value in an off-the-shelf solution for tracking usage of and preventing disruptions from specialty gases and chemicals. We have developed two products, fab|Smart® & fab|Smarter™ to address this need. These products are in use and are having a positive impact on the performance of this key area in semiconductor manufacturing.

Conclusions from FabTime

Gas and chemical management can be a hidden source of cycle time problems in wafer fabs. The unintended use of expired materials can result in downtime and/or yield problems. Changing over canisters (because of imminent expiration or running out of the gas or chemical) causes equipment downtime. Unplanned stock-outs (when a gas or chemical runs out unexpectedly) can result in longer and more variable incidents of unplanned downtime. All of these things, of course, contribute to high cycle times.

It seems to us that access to better data can help fabs to plan ahead, and avoid or mitigate these issues. We view TR Control Solutions' fab|Smart® products as somewhat parallel to FabTime's web-based dashboard, taking in some of the reams of data available in the fab, and turning it into useful information.

Questions for FabTime Subscribers

Do you have a data-driven system for managing your gases and chemicals, or do you do something more ad-hoc? Do you use a commercial product, or something designed in-house? Have you seen examples where problems in managing gases and chemicals have led to cycle time issues?

Reference

This article was originally published on the TR Control Solutions website, and was adapted for the FabTime newsletter by Jennifer Robinson. The original article, with links to more information, can be found here.

Subscriber List

Total number of subscribers: 2796

Top 20 subscribing companies:
- Infineon Technologies (144)
- Micron Technology, Inc. (139)
- Intel Corporation (137)
- Maxim Integrated Products, Inc. (121)
- ON Semiconductor (108)
- GLOBALFOUNDRIES (101)
- Fairchild Semiconductor (72)
- Carsem M Sdn Bhd (71)
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- Freescale Semiconductor (53)
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- Analog Devices (49)
- Skyworks Solutions, Inc. (49)
- Microchip Technology (48)
- Seagate Technology (46)
- Atmel Corporation (42)
- NXP Semiconductors (35)
- Cypress Semiconductor (32)
- TDK-Epcos (32)

Top 4 subscribing universities:
- Ecole des Mines de Saint-Etienne (EMSE) (18)
- Arizona State University (8)
- Nanyang Technological University (7)
- Virginia Tech (7)

New companies and universities this month:
- Linde Group
- Zymergen

Sampler Set of Other Subscribing Companies and Universities:
- ams AG (5)
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- Automatiseringsteknik (1)
- Celerant Consulting (1)
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- Veeco Instruments (2)

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FabTime's Web-Based Dashboard is Fully Applicable for Assembly & Test Facilities

- Do your customers (internal or external) want more visibility into your factory?
- Is it difficult to look at trends in equipment performance, or tie equipment performance to throughput and cycle time?
- Does your factory lack real-time reporting?

FabTime can help. FabTime saves your management team time daily by turning MES data into information, via a real-time web-based dashboard that includes lot dispatching. FabTime saves your IT staff time by breaking the cycle of custom-developed reports. Most importantly, FabTime can help your company to increase revenue by reducing cycle times up to 20% for regular lots, and even more for high-priority lots.

Although FabTime was originally designed for front-end manufacturing, you can use FabTime for your assembly or test facility. You simply need to have a transaction-based manufacturing execution system. FabTime can link to all commercial systems commonly used in the industry (e.g. WorkStream, Promis, Eyelit, Mesa, FactoryWorks) or can link to internally developed systems. FabTime can pull data from multiple databases if needed (e.g. WIP transactions from the MES, tool transactions from another system). FabTime is currently being implemented in two assembly and test facilities, with no major technical hurdles.

FabTime Applicability for Back-End Factories

- FabTime handles lot merging and splitting, with full tracking of overall cycle times.
- All chart quantities (moves, WIP, etc.) can be displayed as die, with data tables formatted for readability of large quantity values.
- Custom assembly and test parameters (applicable to WIP or tool state transactions) can be mapped.
- Custom site-specific reports for wire bond area have been developed for customers (die and component placements, etc.).
- Custom dispatch factors allow for incorporation of back-end-specific data used in dispatch decisions (e.g. availability of boards, and minimization of sequence-dependent setups).